# Total Maximum Daily Load Report for the Southern Whitewater River Watershed

**DRAFT**

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Prepared by

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# 1.0 EXECUTIVE SUMMARY

The Southern Whitewater River watershed (HUC: 0508000305, 0508000306, 0508000308) is located in southeastern Indiana along the Ohio state border. The watershed has a surface area of 412 square miles and drains a total of 1,370 square miles. The Salt Creek watershed (0508000305) is located farthest west and originates near Buena Vista, Indiana before flowing east until the confluence with Whitewater River. The Whitewater River continues flowing east through Pipe Creek watershed (0508000306) before the confluence with East Fork Whitewater River from the north. Whitewater River then flows southeast as it travels through Whitewater River watershed (0508000308), entering Ohio near West Harrison, Indiana and ultimately entering the Ohio River through the Great Miami River west of Cincinnati. The mainstem Whitewater River is classified as a State Outstanding Resource and while few impairments exist currently, it is crucial to protect the condition of this aquatic resource to prevent future degradation. While this document covers the Southern Whitewater River watershed in its entirety, Salt Creek, Pipe Creek and Whitewater River watersheds will be discussed separately throughout the document.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (USEPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) impaired waters list. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual wasteload allocations (WLAs) for regulated sources and load allocations (LAs) for sources that are not directly regulated. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

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

This TMDL has been developed for nutrients and sediment impaired biological communities and *E. coli* in the Southern Whitewater River watershed.

After IDEM identifies a waterbody as having an impairment and places the waterbody on Indiana's Section 303(d) list of impaired waters, IDEM implements a sampling plan to determine the extent and the magnitude of the impairment. The next task is to reassess the waterbodies using new sampling data and to examine the watershed as a whole. The reassessment data helps IDEM identify the area of concern for TMDL development. As a result of the reassessment for the Southern Whitewater River watershed, the pollutants and the impaired segments for which TMDLs were developed differ from the pollutants and impaired segments appearing on the Draft 2014 Section 303(d) list for the following reasons:

- Sampling performed by the Indiana Department of Environmental Management in 2013 and 2014 generated new water quality data that were not available at the time the Draft 2012 Section 303(d) list was developed.

Data used for the TMDL analysis were collected from 33 stream sites (T1-T33) by IDEM between November 2013 and October 2014. Twelve additional sites (P1-P12) were sampled between April 2014 and October 2014 as part of the IDEM probabilistic monitoring program. This data, although not specifically targeted through the TMDL monitoring design, was also used in reassessing the watershed. All available IDEM historical data was also used in supporting the results described in the TMDL document.

Potential sources of *E. coli*, nutrients and sediment in the watershed include regulated point sources such as waste water treatment plants (WWTPs), leaking or failing septic systems, industrial facilities and construction activities. Point sources are regulated through the National Pollutant Discharge Elimination System (NPDES). Potential nonpoint sources of *E. coli*, nutrients and sediment in the watershed include unregulated urban storm water, agricultural runoff, forested runoff and confined feeding operations (CFOs). Determining the specific reasons for high levels of *E. coli*, nutrients and sediment within any waterbody is challenging. There are many potential sources and the pollutants are inherently variable. Specific sources of each impaired waterbody should be further evaluated during follow-up implementation activities.

Determining the specific reasons for high *E. coli* counts in any given waterbody is challenging. There are many potential sources and *E. coli* counts are inherently variable. Within the Southern Whitewater River watershed, subwatersheds with agricultural land uses, confined feeding operations, and narrow riparian buffers surrounding streams also have the highest average *E. coli* counts. It is therefore possible that these characteristics are contributing to the elevated *E. coli* counts. However, other factors could also explain this correlation, such as steep terrain surrounding many of the streams causing runoff to enter the streams much faster carrying with it potential sources. Many of the subwatersheds are headwater streams and those subwatersheds also tend to experience smaller flows and thus have less dilution. Specific sources of *E. coli* to each impaired waterbody should be further evaluated during follow-up implementation activities.

Within the Southern Whitewater River watershed, subwatersheds with agricultural lands and wastewater treatment plants also have the highest total phosphorus loads. It is therefore possible that there are point sources, as well as, nonpoint sources contributing to elevated phosphorus loads. However, other factors could also explain this correlation, such as nutrient management practices, precipitation events and lake eutrophication contributing to downstream surface water. Specific sources of total phosphorus to each impaired waterbody should be further evaluated during follow-up implementation activities.

Within the Southern Whitewater River watershed, subwatersheds with narrow riparian buffers and steep terrain also have the highest total suspended solid (TSS) loads. It is therefore likely that high TSS loads coincide with rainfall events in these subwatersheds. However, other factors could also explain elevated levels of TSS, such as unknown illicit dischargers, permit violations or cattle access to streams.

Various subwatersheds in the Southern Whitewater River watershed have impaired biotic communities (IBC). Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) list, suggests that one or more of the aquatic biological communities are unhealthy as determined by IDEM's monitoring data. IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Southern Whitewater River watershed, nutrients (total nitrogen (TN) and total phosphorus (TP)) and total suspended solids (TSS) have been identified as pollutants for TMDL development.

An important step in the TMDL process is the allocation of the allowable loads to individual point sources as well as sources that are not directly regulated. The Southern Whitewater River watershed TMDL includes these allocations, which are presented for each of the XX Assessment Unit IDs (AUIDs) located in the twenty 12-digit hydrologic unit code (HUC) subwatersheds.

There are five permitted WWTPs and four permitted industrial facilities located in the Southern Whitewater River watershed. Of these facilities, 2 have been found to be in violation of their permit limits for *E. coli*, nutrients and sediment. Although 2 NPDES facilities have been found to be in violation of

their permit limits for *E. coli*, nutrients and sediment, the majority of the time discharge effluent from these facilities meets water quality standards.

There are several types of nonpoint sources located in the Southern Whitewater River watershed, including land use runoff, animal feeding operations, livestock with direct access to the stream, and wildlife. Although Indiana does not have a permitting program for nonpoint sources, many nonpoint sources are addressed through voluntary programs intended to reduce pollutant loads, minimize flow, and improve water quality.

This TMDL report identifies which locations could most benefit from focus on implementation activities. These areas throughout the Southern Whitewater River watershed are referred to as potential priority implementation areas (PPIAs). It also provides recommendations on the types of implementation activities, including best management practices (BMPs) that key implementation partners in the Southern Whitewater River watershed can consider to achieve the pollutant load reductions calculated for each subwatershed. PPIAs can help watershed stakeholders identify critical areas and select BMPs in the Southern Whitewater River watershed through a watershed management planning process. **Error! Reference source not found.** presents the PPIAs and associated BMP recommendations identified having a high likely degree of effectiveness to achieve the *E. coli*, nutrients and sediment load reductions allocated to sources in each subwatershed. These subwatershed rankings are based on the results of the Recovery Potential Tool (RPT), while the implementation activities are recommended based on potential point and nonpoint sources of pollution in the subwatershed.

**Table 1. PPIAs and Recommended BMPs in the Salt Creek Watershed to Achieve Pollutant Load Reductions by Subwatershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Fremont Branch (050800030505) | 1 | Outreach and education and training |
| | | Filter Strips |
| | | Grazing land management |
| Bull Fork (050800030503) | 2 | Filter Strips |
| | | Riparian forested/herbaceous buffers |
| | | Grazing land management |
| Little Salt Creek (050800030504) | 3 | Cover crops |
| | | Riparian forested/herbaceous buffers |
| | | Grazing land management |
| Righthand Fork Salt Creek (050800030502) | 4 | Comprehensive Nutrient Management Plan |
| | | Conservation tillage/residue management |
| | | Heavy Use Area Pad |
| Headwaters Salt Creek (050800030501) | 5 | Comprehensive Nutrient Management Plan |
| | | Conservation tillage/residue management |
| | | Heavy Use Area Pad |

**Table 2. PPIAs and Recommended BMPs in the Pipe Creek Watershed to Achieve Pollutant Load Reductions by Subwatershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Yellow Bank Creek (050800030605) | 1 | Outreach and education and training |
| | | System replacement |
| | | Nutrient Management Plan |
| Walnut Fork (050800030604) | 2 | Outreach and education and training |
| | | Filter strips |

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| | | Nutrient Management Plan |
| Clear Fork (050800030602) | 3 | Outreach and education and training |
| | | Conservation tillage/residue management |
| | | System replacement |
| Headwaters Pipe Creek (050800030601) | 4 | Outreach and education and training |
| | | Conservation tillage/residue management |
| | | System replacement |
| Duck Creek (050800030603) | 5 | Outreach and education and training |
| | | Nutrient Management Plan |
| | | Filter strips |

**Table 3. PPIAs and Recommended BMPs in the Whitewater River Watershed to Achieve Pollutant Load Reductions by Subwatershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Jameson Creek (050800030810) | 1 | Not enough information to prioritize |
| Johnson Fork (050800030806) | 2 | Outreach and education and training |
| | | Riparian forested/herbaceous buffers |
| | | Constructed Wetland |
| Blackburn Creek (050800030805) | 3 | Outreach and education and training |
| | | Riparian forested/herbaceous buffers |
| | | Constructed Wetland |
| Little Cedar Creek (050800030804) | 4 | Riparian forested/herbaceous buffers |
| | | Outreach and education and training |
| | | Grazing land management |
| Wolf Creek (050800030802) | 5 | Riparian forested/herbaceous buffers |
| | | Outreach and education and training |
| | | Grazing land management |
| Big Cedar Creek (050800030803) | 6 | Outreach and education and training |
| | | Nutrient Management Plan |
| | | Filter strips |
| Headwaters Blue Creek (050800030801) | 7 | Manure handling, storage, treatment, and disposal |
| | | Outreach and education and training |
| | | Filter strips |
| Howard Creek (050800030808) | 8 | Manure handling, storage, treatment, and disposal |
| | | Nutrient Management Plan |
| | | Filter strips |
| Headwaters Dry Fork Whitewater River (050800030807) | 9 | Manure handling, storage, treatment, and disposal |
| | | Nutrient Management Plan |
| | | Filter strips |
| Lee Creek | 10 | Not enough information to prioritize |

Public participation is an important and required component of the TMDL development process. The following public meetings and public comment periods have been held to further develop this project:

- Two TMDL public kickoff meetings were held on October 29, 2013. The first meeting was held at 2:00 PM (EST) at the Franklin County Government Center, 1010 Franklin Avenue, Brookville, IN 47012. The second kickoff meeting was held at 6:00 PM (EST) at the Batesville Middle School, 201 N. Mulberry Street, Batesville, IN 47006. IDEM described the TMDL program and provided a summary of the available data and the proposed sampling approach at both meetings.
- A Southern Whitewater River Monitoring Field Day was held on June 16, 2014 from 10:00 AM – 12:00 PM (EST). This event was held at the Brookville City Park along the East Fork Whitewater River. At this event, participants learned more about sampling methods from conducted by IDEM and Hoosier Riverwatch staff in the watershed. Field procedures for fish & macroinvertebrate collection, habitat assessment and water chemistry were demonstrated. Live wells and voucher specimens were on hand for observation.
- A Draft TMDL meeting was held at the Franklin County Government Center- Commissioners Room; 1010 Franklin Ave. Brookville, IN at 2:00 PM and Batesville Middle School- Commons; 201 Mulberry St. Batesville IN 6:00 PM on August 6, 2015 during which IDEM describes the TMDL program and provided an overview of the draft TMDL results. A representative from the Whitewater River Watershed Project will also provide information on current and future activities.

## 2.0 INTRODUCTION

This section of the Total Maximum Daily Load (TMDL) provides an overview of the Southern Whitewater River watershed location and the regulatory requirements that have led to the development of this TMDL to address impairments in the Southern Whitewater River watershed.

The Southern Whitewater River watershed (0508000305, 0508000306, 0508000308), shown in Figure 1, is located in southeastern Indiana along the Ohio state border. The watershed has a surface area of 412 square miles and drains a total of 1,370 square miles. The Salt Creek watershed (0508000305) is located farthest west and originates near Buena Vista, Indiana before flowing east until the confluence with Whitewater River. The Whitewater River continues flowing east through Pipe Creek watershed (0508000306) before the confluence with East Fork Whitewater River from the north. Whitewater River then flows southeast as it travels through Whitewater River watershed (0508000308), entering Ohio near West Harrison, Indiana and ultimately entering the Ohio River through the Great Miami River west of Cincinnati. Land use throughout the watershed is predominantly forested land. The Southern Whitewater River Watershed is primarily in Franklin County with Fayette, Rush, Decatur, Ripley and Dearborn Counties also having smaller portions of the watershed. The Righthand Fork Salt Creek subwatershed is also a source of drinking water for the community surrounding Lake Santee.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (USEPA) regulations require that states develop TMDLs for waters on the Section 303(d) lists. USEPA defines a TMDL as the sum of the individual wasteload allocations (WLA) for point sources and load allocations (LA) for nonpoint sources, and a margin of safety (MOS) such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded.

The overall goals and objectives of the TMDL study for the Southern Whitewater River watershed are:

- Assess the water quality of the impaired waterbodies and identify key issues associated with the impairments and potential pollutant sources.
- Determine current loads of pollutants to the impaired waterbodies.
- Use the best available science and available data to determine the total maximum daily load the waterbodies can receive while fully supporting the impaired designated use(s).
- If current loads exceed the maximum allowable loads, determine the load reduction that is needed.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Identify potential priority implementation areas (PPIAs) that watershed stakeholders can use to identify critical areas
- Recommend activities for purposes of TMDL implementation.
- Submit a final TMDL report to the U.S. Environmental Protection Agency (USEPA) for review and approval.

Watershed stakeholders and partners can use the final approved TMDL report to craft a watershed management plan (WMP) that meets both USEPA's nine minimum elements under the CWA Section 319 Nonpoint Source Program, as well as the additional requirements under IDEM's 2009 WMP Checklist.

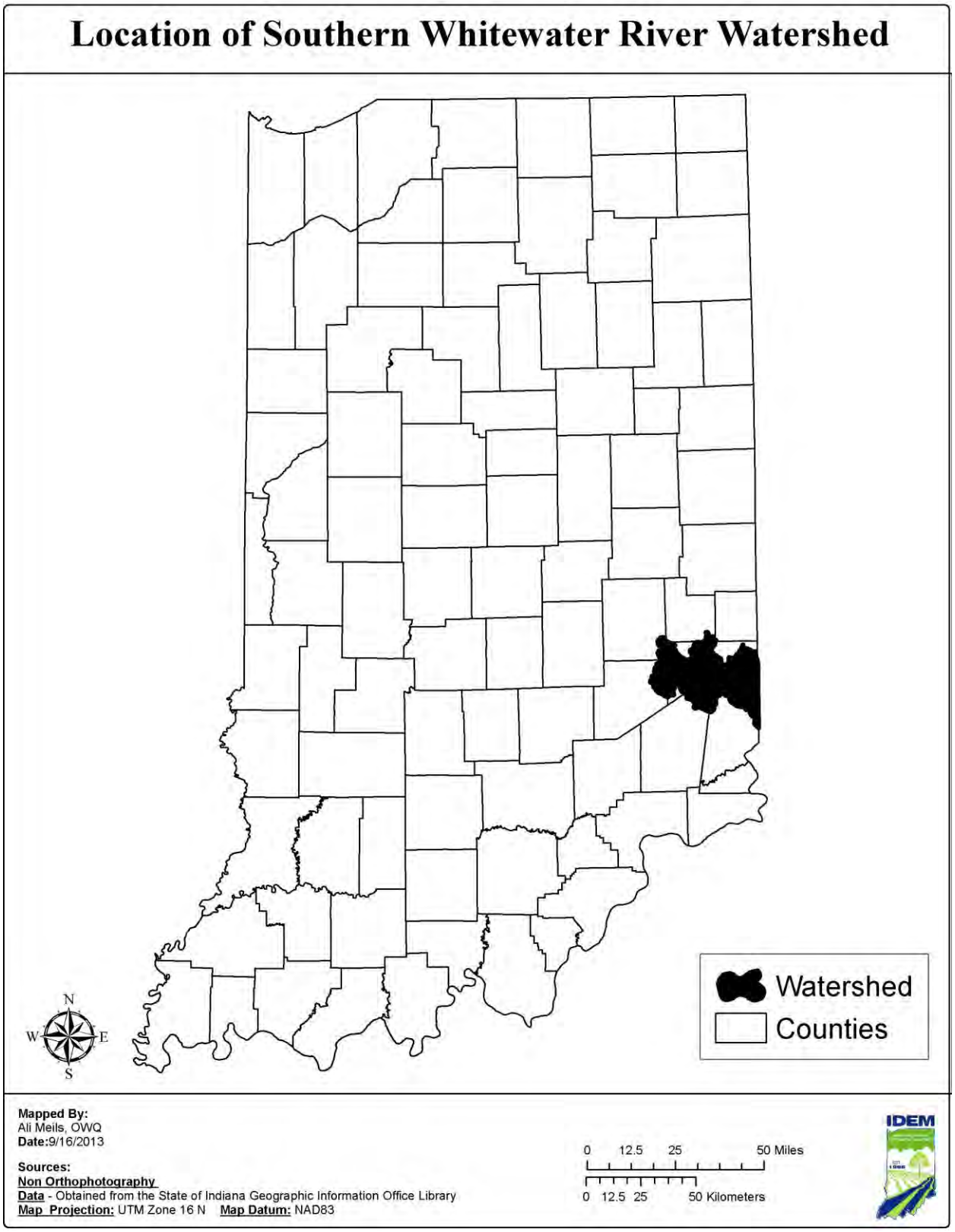


**Figure 1. Location of the Southern Whitewater River Watershed**

## 2.1 Water Quality Standards

Under the Clean Water Act (CWA), every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the CWA's goal of "swimmable/fishable" waters. Water quality standards consist of three different components:

- **Designated uses** reflect how the water can potentially be used by humans and how well it supports a biological community. Examples of designated uses include aquatic life support, drinking water supply, and full body contact recreation. Every waterbody in Indiana has a designated use or uses; however, not all uses apply to all waters. The Southern Whitewater River Watershed TMDLs focus on protecting the designated aquatic life support, drinking water supply, and full body contact recreational uses of the waterbodies.
- Criteria express the condition of the water that is necessary to support the designated uses. **Numeric criteria** represent the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. **Narrative criteria** are the general water quality criteria that apply to all surface waters. Numeric criteria for *E. coli*, nutrients and sediment were used as the basis of the Southern Whitewater River Watershed TMDLs.
- Antidegradation policies protect existing uses and provide extra protection for high-quality or unique waters.

The water quality standards in Indiana pertaining to *E. coli*, nutrients and sediment are described below.

*E. coli* is an indicator of the possible presence of pathogenic organisms (e.g., enterococcal *E. coli*, viruses, and protozoa) which may cause human illness. The direct monitoring of these pathogens is difficult; therefore, *E. coli* is used as an indicator of potential fecal contamination. *E. coli* is a sub-group of fecal coliform, the presence of *E. coli* in a water sample indicates recent fecal contamination is likely. Concentrations are typically reported as the count of organisms in 100 milliliters of water (count/100 mL) and may vary at a particular site depending on the baseline *E. coli* level already in the river, inputs from other sources, dilution due to precipitation events, and die-off or multiplication of the organism within the river water and sediments.

The numeric *E. coli* criteria associated with protecting the recreational use are described below.

> *"The criteria in this subsection are to be used to evaluate waters for full body contact recreational uses, to establish wastewater treatment requirements, and to establish effluent limits during the recreational season, which is defined as the months of April through October, inclusive. E. coli bacteria, 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. . . However, a single sample shall be used for making beach notification and closure decisions."* [Source: Indiana Administrative Code Title 327 Water Pollution Control Board. Article 2. Section 1-6(a).]

The term nutrients refers to the various forms of nitrogen and phosphorus found in a waterbody. Both nitrogen and phosphorus are necessary for aquatic life, and both elements are needed at some level in a waterbody to sustain life. The natural amount of nutrients in a waterbody varies depending on the type of system. A pristine mountain spring might have little to almost no nutrients, whereas a lowland, mature stream flowing through wetland areas might have naturally high nutrient concentrations. Streams draining larger areas are also expected to have higher nutrient concentrations.

Nutrients generally do not pose a direct threat to the designated uses of a waterbody. However, excess nutrients can cause an undesirable abundance of plant and algae growth, a process is called eutrophication. Eutrophication can have many effects on a stream. One possible effect is low dissolved oxygen concentrations caused by excessive plant respiration and/or decay. Ammonia, which is toxic to fish at high concentrations, can be released from decaying organic matter when eutrophication occurs. For these reasons, excessive nutrients can result in the non-attainment of biocriteria and impairment of the designated use.

Like most states, Indiana has not yet adopted numeric water quality criteria for nutrients. The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

> *"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)] …*
>
> *(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]*
>
> *(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]*

IDEM has not yet adopted numeric water quality criteria for total suspended solids (TSS). The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

> *"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)] …*
>
> *(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]*
>
> *(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]*

In addition, the narrative biological criterion [327 IAC 2-1-3(2)] states the following:

> *"All waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community."*

The water quality regulatory definition of a "well-balanced aquatic community" is "*an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species*" [327 IAC 2-1-9(49)].

**Error! Reference source not found.** presents the criteria associated with the fish community Warm Water Index of Biotic Integrity (IBI) and benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) that indicates whether a watershed is fully supporting or not supporting the aquatic life use.

**Table 4. Aquatic Life Use Support Criteria for Biological Communities**

| Biotic Index | | Integrity Class | Corresponding Integrity Class | Attributes |
|---|---|---|---|---|
| Fish community Warm Water Index of Biotic Integrity (IBI) Scores (Range of possible scores is 0-60) | Fully Supporting IBI ≥ 36 | Excellent | 53-60 | Comparable to "least impacted" conditions, exceptional assemblage of species |
| | | Good | 45-52 | Decreased species richness (intolerant species in particular), sensitive species present |
| | | Fair | 36-44 | Intolerant and sensitive species absent, skewed trophic structure |
| | Not Supporting IBI < 36 | Poor | 23-35 | Many expected species absent or rare, tolerant species dominant |
| | | Very Poor | 12-22 | Few species and individuals present, tolerant species dominant |
| | | No Organisms | 12 | No fish captured during sampling. |
| Benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) Scores Multihabitat MHAB methods (Range of possible scores is 12-60) | Fully Supporting mIBI ≥ 36 | Excellent | 53-60 | Comparable to "least impacted" conditions, exceptional assemblage of species |
| | | Good | 45-52 | Decreased species richness (intolerant species in particular), sensitive species present |
| | | Fair | 36-44 | Intolerant and sensitive species absent, skewed trophic structure |
| | Not Supporting mIBI < 36 | Poor | 23-35 | Many expected species absent or rare, tolerant species dominant |
| | | Very Poor | 12-22 | Few species and individuals present, tolerant species dominant |
| | | No Organisms | 12 | No macroinvertebrates captured during sampling. |

## 2.2 TMDL Target Values

Target values are needed for the development of TMDLs because of the need to calculate allowable daily loads. For parameters that have numeric criteria, such as *E. coli*, the target equals the numeric criteria. For parameters that do not have numeric criteria, target values must be identified from some other source. The target values used to develop the Southern Whitewater River Watershed TMDL are presented below.

### 2.2.1 *E. coli*

The target value used for the Southern Whitewater River Watershed TMDL was based on the 125 counts/100 mL geometric mean component of the standard (i.e., daily loading capacities were calculated by multiplying flows by 125 counts/100 mL). This approach ensures that both components of the standard will be met since a daily loading capacity based on 125 counts/100 mL will, by definition, meet the 235 counts/100 mL component of the standard. The use of the geometric mean component of the standard results in an added MOS (see Section 12.1 for more details).

### 2.2.2 IBC TMDLs

The following sections describe the TMDL target values used for nutrients and TSS when developing an IBC TMDL.

#### 2.2.2.1 Nutrients

Although Indiana has not yet adopted numeric water quality criteria for nutrients, IDEM has identified the following nutrient benchmarks that are used to assess potential nutrient impairments:

- Total phosphorus should not exceed 0.30 mg/L (USEPA's nationwide 1986 Quality Criteria for Waters also known as the *Gold Book*).
- Total nitrogen should not exceed 10.0 mg/L (Indiana Drinking Water Standard).

The total phosphorus (0.30 mg/L) and total nitrogen (10.0 mg/L) values were used as TMDL targets during the development of the Southern Whitewater River Watershed TMDL. IDEM has determined that meeting these targets will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community.

#### 2.2.2.2 Total Suspended Solids (TSS)

Although Indiana has not yet adopted numeric water quality criteria for TSS, IDEM has identified target values based on the U.S. EPA recommendation for excellent fisheries. A target of 25.0 mg/L for total suspended solids has been identified as a protective concentration for fisheries (Waters, T.F., 1995). A target value of 25.0 mg/L TSS was therefore used as the TSS TMDL target value to ensure protection of biological communities and the supporting habitat in the Whitewater River and its tributaries to protect the State Outstanding Resource Waters. IDEM has determined that meeting the TSS target will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community.

Various subwatersheds in the Southern Whitewater River watershed have impaired biological communities (IBC). Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) list, means IDEM's monitoring data shows one

or both of the aquatic communities are not as healthy as they should be. IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Southern Whitewater River watershed, TSS and TP have been identified as pollutants for TMDL development.

Several subwatersheds in the Southern Whitewater River watershed have dissolved oxygen impairments. Dissolved oxygen is not a source of impairment but a symptom of other sources. To address these impairments in the Southern Whitewater River watershed, phosphorus and TSS, where applicable, have been identified as a pollutant for TMDL development.

## 2.3 Listing Information

The Southern Whitewater River watershed and a number of tributaries are listed as impaired for *E. coli*, and IBC's (nutrients and sediment) on Indiana's Impaired Waters List, as shown in **Error! Reference source not found.**. IDEM identifies the Southern Whitewater River watershed and its tributaries using a watershed numbering system developed by USGS, NRCS, and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (i.e., those with shorter HUCs) to smallest (i.e., those with longer HUCs). (For more information on HUCs, go to http://www.in.gov/idem/nps/2422.htm.) **Error! Reference source not found.** shows the 12-digit HUCs located in the Southern Whitewater River watershed.

A total of 85 AUIDs within the Southern Whitewater River watershed will be cited as impaired for *E. coli*, nutrients, biological communities, dissolved oxygen, PCBs or mercury on the Indiana 2016 303(d) list. These impaired segments account for approximately 584 miles of *E. coli* impairments, 35 miles of nutrient impairments, 99 miles of IBC impairments, 87 miles of DO impairments, 62 miles of PCB impairments, and 34 miles of mercury impairments. The listings and causes of impairment have been adjusted as a result of reassessment data.

Table 6 presents listing information for the Southern Whitewater River watershed, including a comparison of the updated listings with the 2012 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Southern Whitewater River watershed are available in Appendix B.

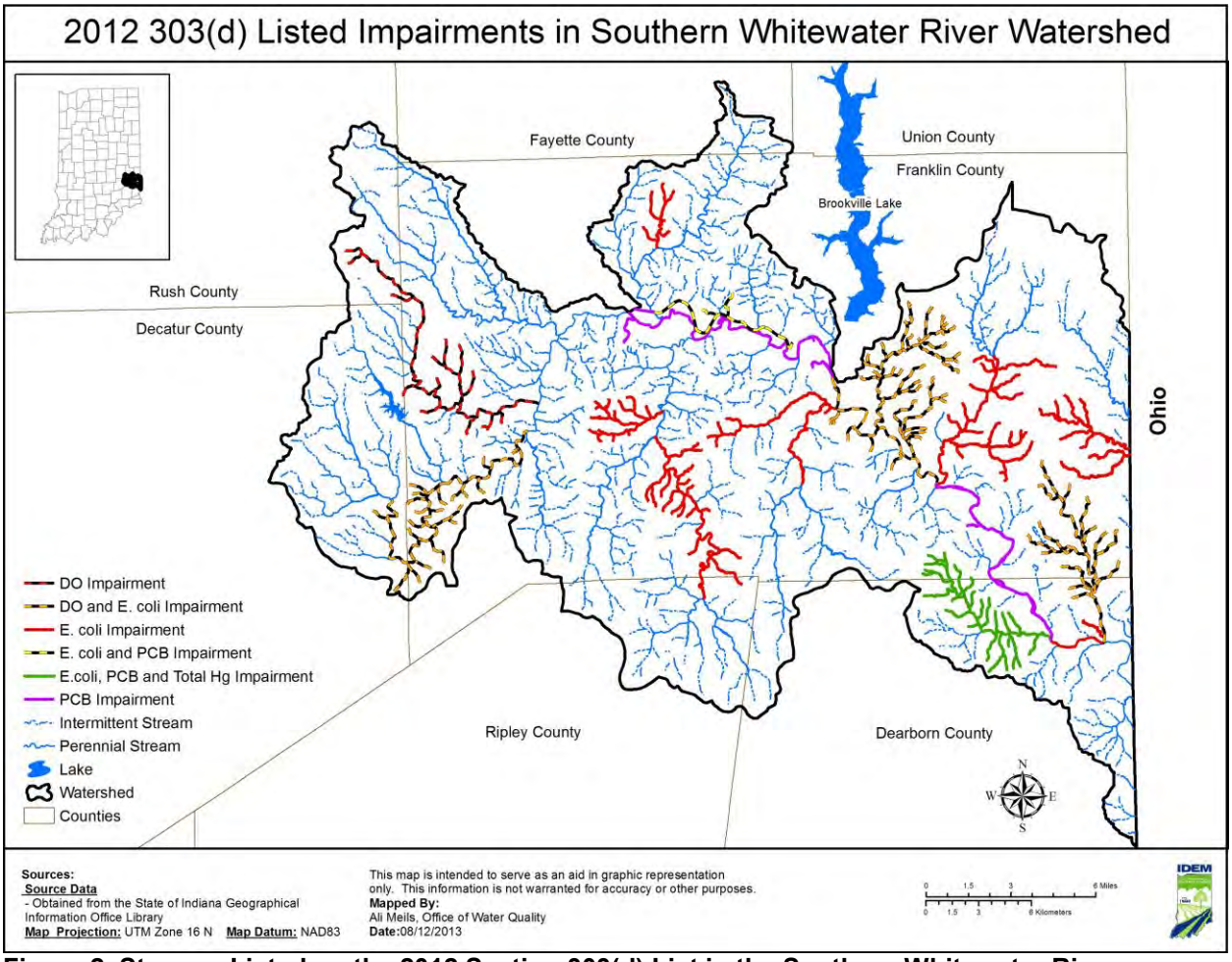


**Figure 2. Streams Listed on the 2012 Section 303(d) List in the Southern Whitewater River Watershed**

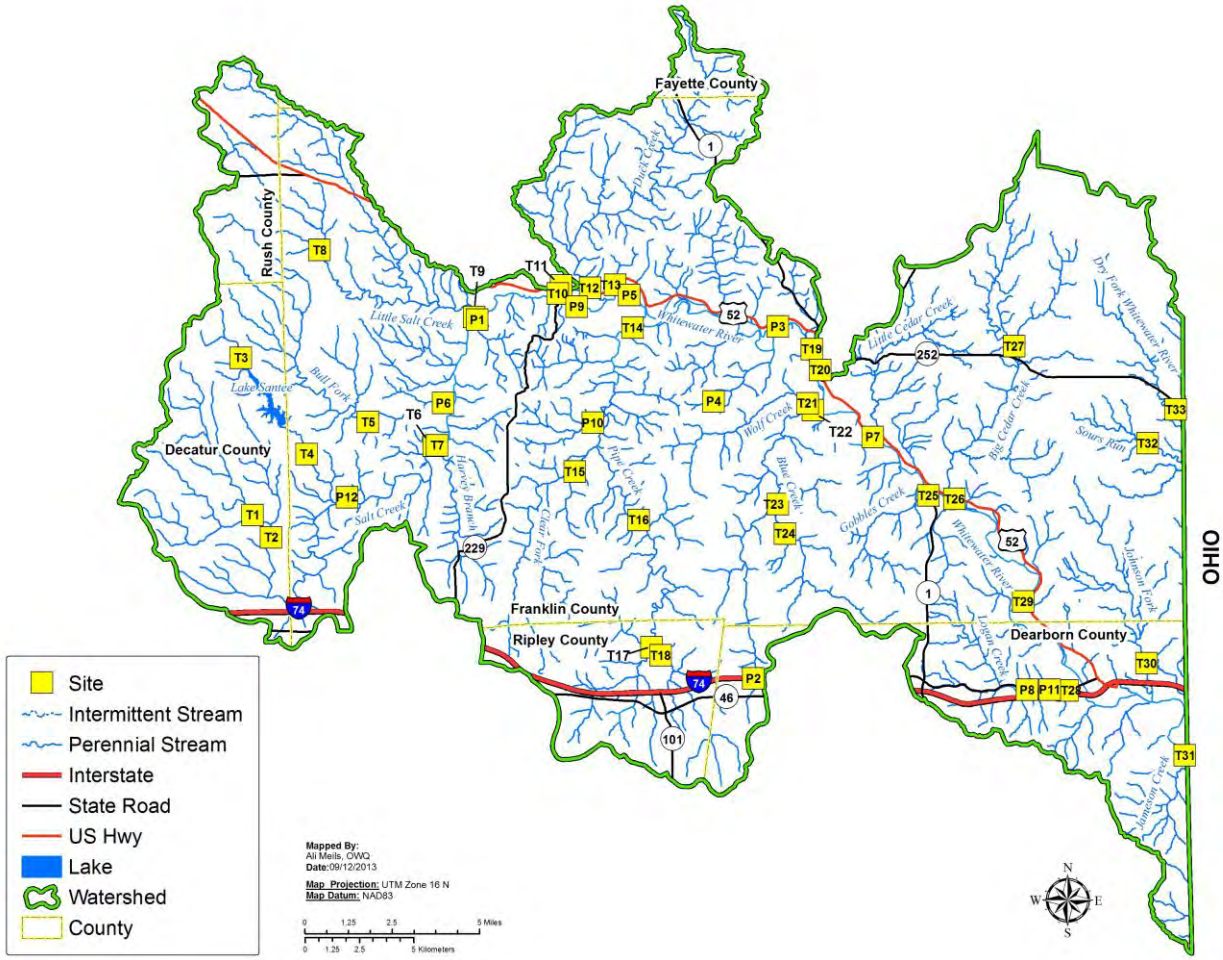


**Figure 3 Sampling Locations in 2013 Southern Whitewater River Watershed TMDL**

**Table 5 Southern Whitewater River Sampling Site Information**

| Site # | L-Site # | Stream Name | Road Name | AUID 2012 |
|---|---|---|---|---|
| T1 | GMW050-0023 | Tributary of Salt Creek | CR 150 N | ING0351_T1002 |
| T2 | GMW-05-0006 | Salt Creek | CR 50 N | ING352_01 |
| T3 | GMW-05-0014 | Righthand Fork Salt Creek | E CR 550 N | ING0352_T1003 |
| T4 | GMW-05-0011 | Righthand Fork Salt Creek | Hamburg Rd | ING0352_T1006 |
| T5 | GMW-05-0009 | Bull Fork | Bullfork Rd | ING353_02 |
| T6 | GMW-05-0007 | Salt Creek | Rail Fence Rd | ING352_01 |
| T7 | GMW-05-0012 | Harvey Branch | Rail Fence Rd | ING0355_T1002 |
| T8 | GMW-05-0015 | South Fork Little Salt Creek | Chapel Rd | ING0354_T1003 |
| T9 | GMW-05-0008 | Little Salt Creek | Stipps Hill Rd | ING0354_02 |
| T10 | GMW-05-0010 | Salt Creek | SR 229 | ING0355_01 |
| T11 | GMW-04-0018 | Whitewater River | US 52 | ING0348_03 |
| T12 | GMW-06-0019 | Duck Creek | US 52 | ING0363_02 |
| T13 | GMW-06-0022 | Whitewater Canal | Unnamed Rd | ING0362_01 |
| T14 | GMW-06-0015 | Pipe Creek | Silver Creek Rd | ING0364_02 |
| T15 | GMW-06-0013 | Clear Fork | Schwegman Rd | ING0362_02 |
| T16 | GMW-06-0020 | Pipe Creek | St. Marys Rd | ING0364_01 |
| T17 | GMW-06-0014 | Tributary of Pipe Creek | St Marys Rd | ING0361_T1005 |
| T18 | GMW060-0027 | Pipe Creek | Pipe Creek Rd | ING0361_02 |
| T19 | GMW-06-0012 | Whitewater River | Saint Mary Rd | ING0365_01 |
| T20 | GMW-07-0026 | East Fork Whitewater River | US 52 | ING037H_01 |
| T21 | GMW-08-0026 | Wolf Creek | Blue Creek Rd | ING0382_02 |
| T22 | GMW080-0003 | Blue Creek | Highland Center Rd | ING0382_01 |
| T23 | GMW-08-0014 | Blue Creek | Blue Creek Rd | ING0382_01 |
| T24 | GMW-08-0022 | East Fork Blue Creek | Blue Creek Rd | ING0381_02 |
| T25 | GMW-08-0015 | Whitewater River | SR 1 | ING0384_01 |
| T26 | GMW-08-0016 | Big Cedar Creek | US 52 | ING0383_02 |
| T27 | GMW-08-0024 | Big Cedar Creek | Big Cedar Rd | ING0380_01 |
| T28 | GMW-08-0019 | Logan Creek | SR 46 | ING0386_T1001 |
| T29 | GMW-08-0030 | Whitewater River | St. Peters Rd | ING0385_01 |
| T30 | GMW-08-0018 | Johnson Fork | Johnson Fork Rd | ING0386_02 |
| T31 | GMW-08-0021 | Whitewater River | Jamison Rd | ING038A_01 |
| T32 | GMW-08-0027 | Sours Run | Drewersburg Rd | ING0388_01 |
| T33 | GMW-08-0020 | Dry Fork Whitewater | Dickson Rd | ING0387_02 |

| | | | | |
|---|---|---|---|---|
| | | River | | |
| P1 | GMW-05-0001 | Little Salt Creek | Stipps Hill Rd | ING0354_02 |
| P2 | GMW-08-0001 | Blue Creek | County Line Rd | ING0364_01 |
| P3 | GMW-06-0002 | Whitewater River | St. Mary Rd | ING0365_01 |
| P4 | GMW-06-0003 | McCartys Run | St. Mary Rd | ING0365_T1003 |
| P5 | GMW-06-0004 | Whitewater River | Silver Creek Rd | ING0365_01 |
| P6 | GMW-05-0002 | Bull Fork | Bullfork Rd | ING0353_02 |
| P7 | GMW-08-0013 | Whitewater River | River Rd | ING0384_01 |
| P8 | GMW-08-0003 | Logan Creek | Covered Bridge Rd | ING0386_T1001 |
| P9 | GMW-06-0005 | Whitewater River | Pennington Rd | ING0365_01 |
| P10 | GMW-06-0006 | Walnut Fork | Walnut Fork Rd | ING0364_T1003 |
| P11 | GMW-08-0005 | Logan Creek | Higher Ground Lane | ING0386_T1001 |
| P12 | GMW-05-0003 | Salt Creek | Giesting Rd | ING0352_01 |

***Understanding Table 2:***

- *Column 1: Site #.* Lists the site number that corresponds to the site location in Figure 3.
- *Column 2: L-Site #* .Provides the site number from the IDEM AIMS database.
- *Column 3: Stream Name*. Identifies the stream name that the site is located on.
- *Column 4: Road Name.* Identifies the road name at which the site is located or the nearest road crossing.
- *Column 5: AUID 2012.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the Section 303(d) listing assessment process.

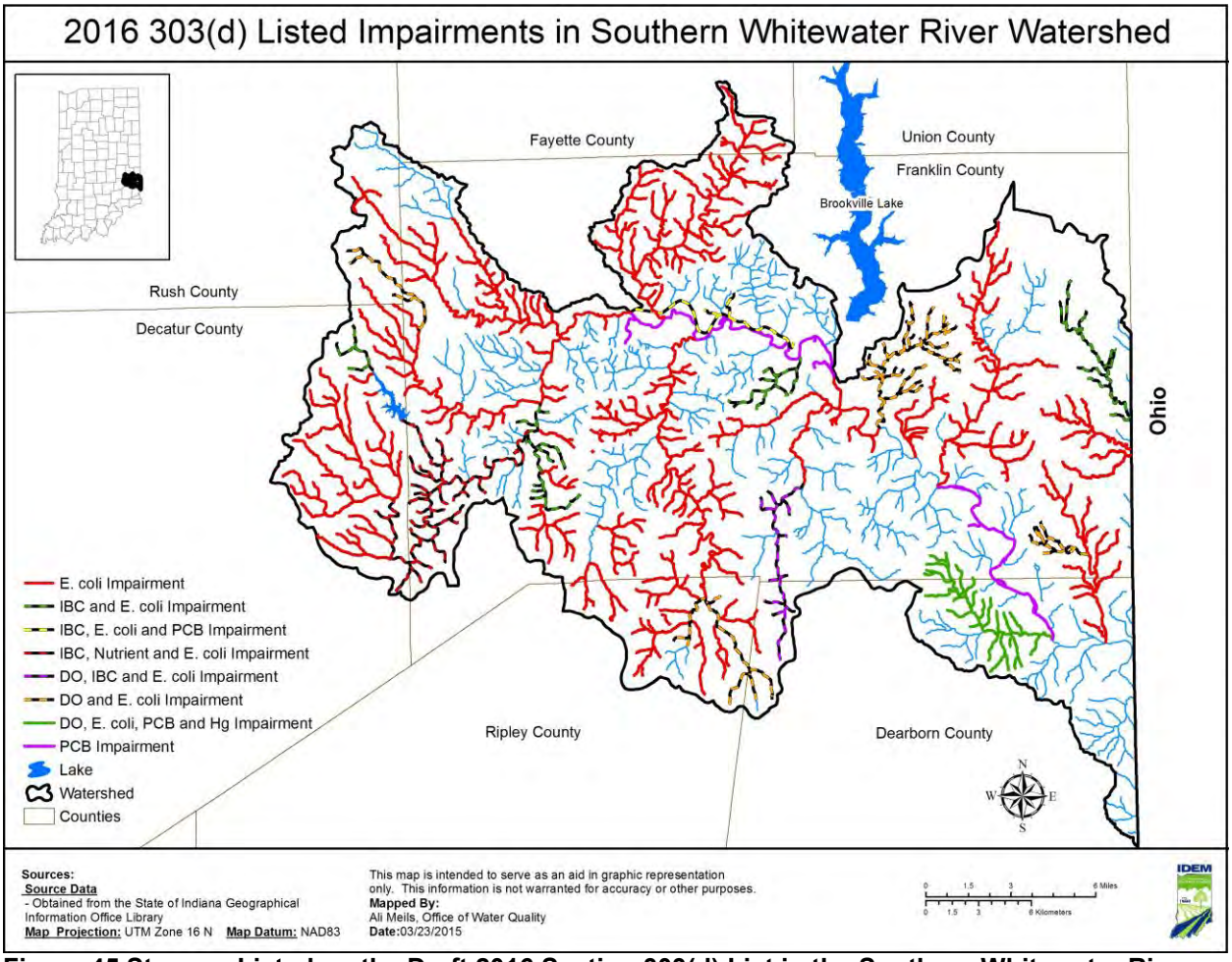


**Figure 45 Streams Listed on the Draft 2016 Section 303(d) List in the Southern Whitewater River Watershed**

**Table 6. Section 303(d) List Information for the Southern Whitewater River Watershed for 2012 and 2016.**

| Watershed (10-digit HUC) | Subwatershed (12-digit HUC) | Previous AUID | Draft 2012 Section 303(d) Listed Impairment | New AUID | Updated Impairments to be Listed in on 4A in 2016 | Number of TMDLs in 2015 |
|---|---|---|---|---|---|---|
| Salt Creek (0508000305) | Headwaters Salt Creek (050800030501) | ING0351_00 | | ING0351_01 | E. coli | E. coli-1 |
| | | | | ING0351_T1001 | E. coli | E. coli-1 |
| | | New | | ING0351_T1002 | E. coli | E. coli-1 |
| | | New | | ING0351_T1003 | E. coli | E. coli-1 |
| | Righthand Fork (050800030502) | ING0353_00 | DO, *E. coli* | ING0352_01 | E. coli, IBC, Nutrients | E. coli-1 |
| | | ING0352_00 | DO, *E. coli* | | | |
| | | New | | ING0352_01A | | |
| | | ING0353_P1024 | | ING0352_P1001 | | |
| | | New | | ING0352_T1001 | E. coli | E. coli-1 |
| | | New | | ING0352_T1002 | E. coli | E. coli-1 |
| | | New | | ING0352_T1003 | E. coli, IBC | E. coli-1 |
| | | New | | ING0352_T1004 | E. coli | E. coli-1 |
| | | New | | ING0352_T1005 | E. coli | E. coli-1 |
| | | ING0353_00 | | ING0352_T1006 | E. coli, IBC, Nutrients | E. coli-1<br>TP-1<br>TN-1 |
| | | New | | ING0352_T1007 | | |
| | | New | | ING0352_T1008 | | |
| | | New | | ING0352_T1009 | | |
| | | New | | ING0352_T1010 | | |
| | | New | | ING0352_T1011 | | |
| | Bull Fork (050800030503) | ING0355_00 | DO | ING0353_01 | E. coli, DO | E. coli-1 |
| | | | | ING0353_02 | E. coli | E. coli-1 |
| | | New | | ING0353_02A | | |
| | | New | | ING0353_T1001 | E. coli | E. coli-1 |
| | | New | | ING0353_T1002 | E. coli | E. coli-1 |
| | | New | | ING0353_T1003 | E. coli | E. coli-1 |
| | | New | | ING0353_T1004 | E. coli | E. coli-1 |
| | | New | | ING0353_T1005 | E. coli | E. coli-1 |
| | | ING0355_00 | DO | ING0353_T1006 | | |
| | | New | | ING0353_T1007 | E. coli | E. coli-1 |
| | | New | | ING0353_T1008 | | |
| | Little Salt Creek (050800030504) | ING0357_00 | | ING0354_01 | | |
| | | | | ING0354_02 | E. coli | E. coli-1 |
| | | New | | ING0354_T1001 | | |
| | | ING0357_T1001 | | ING0354_T1002 | E. coli | E. coli-1 |
| | | | | ING0354_T1003 | E. coli | E. coli-1 |
| | | New | | ING0354_T1004 | E. coli | E. coli-1 |
| | | New | | ING0354_T1005 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Fremont Branch (050800030505)** | ING0358_00<br>ING0356_00 | | ING0355_01 | E. coli | E. coli-1, TSS-1 |
| | | ING0354_00 | | ING0355_T1001 | E. coli | E. coli-1 |
| | | | | ING0355_T1002 | E. coli, IBC | E. coli-1 |
| | | New | | ING0355_T1003 | E. coli | E. coli-1 |
| | | New | | ING0355_T1004 | E. coli | E. coli-1 |
| | | New | | ING0355_T1005 | | |
| | | ING0356_00 | | ING0355_T1006 | | |
| | | New | | ING0355_T1007 | | |
| | | ING0356_00 | | ING0355_T1008 | | |
| | | New | | ING0355_T1009 | | |
| | | New | | ING0355_T1010 | | |
| **Pipe Creek (0508000306)** | **Headwaters Pipe Creek (050800030601)** | ING0363_00 | | ING0361_02 | E. coli, DO (4C) | E. coli-1 |
| | | ING0363_P1026 | | ING0361_P1001 | | |
| | | ING0363_P1025 | | ING0361_P1002 | | |
| | | New | | ING0361_T1003 | E. coli | E. coli-1 |
| | | New | | ING0361_T1004 | E. coli | E. coli-1 |
| | | ING0363_00 | | ING0361_T1005 | E. coli, DO | E. coli-1 |
| | | New | | ING0361_T1005A | | |
| | | New | | ING0361_T1005B | | |
| | | New | | ING0361_T1005 C | | |
| | | New | | ING0361_T1006 | E. coli | E. coli-1 |
| | | New | | ING0361_T1006A | E. coli | E. coli-1 |
| | | New | | ING0361_T1007 | E. coli | E. coli-1 |
| | | New | | ING0361_T1008 | E. coli | E. coli-1 |
| | | New | | ING0361_T1009 | E. coli | E. coli-1 |
| | **Clear Fork (050800030602)** | ING0365_00 | | ING0362_02 | | |
| | | New | | ING0362_02A | E. coli | E. coli-1 |
| | | New | | ING0362_T1002 | E. coli | E. coli-1 |
| | | New | | ING0362_T1003 | E. coli | E. coli-1 |
| | | New | | ING0362_T1004 | E. coli | E. coli-1 |
| | | New | | ING0362_T1005 | | |
| | | New | | ING0362_T1006 | | |
| | **Duck Creek (050800030603)** | ING0361_00 | | ING0363_01 | E. coli | E. coli-1 |
| | | ING0361_01<br>ING0362_T1001 | | ING0363_02 | E. coli | E. coli-1 |
| | | New | | ING0363_T1001 | E. coli | E. coli-1 |
| | | New | | ING0363_T1002 | E. coli | E. coli-1 |
| | | New | | ING0363_T1003 | E. coli | E. coli-1 |
| | | New | | ING0363_T1004 | E. coli | E. coli-1 |
| | | New | | ING0363_T1005 | E. coli | E. coli-1 |
| | | New | | ING0363_T1006 | E. coli | E. coli-1 |
| | | New | | ING0363_T1007 | E. coli | E. coli-1 |
| | | ING0361_T1001 | | ING0363_T1008 | E. coli | E. coli-1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | New | | ING0363_T1009 | E. coli | E. coli-1 |
| | | ING0361_T1002 | | ING0363_T1010 | E. coli | E. coli-1 |
| | **Walnut Fork (050800030604)** | ING0364_00 | *E. coli* | ING0364_01 | E. coli | E. coli-1 |
| | | ING0366_00 | | ING0364_02 | E. coli | E. coli-1 |
| | | New | | ING0364_T1001 | E. coli | E. coli-1 |
| | | New | | ING0364_T1002 | E. coli | E. coli-1 |
| | | ING0366_T1002 | *E. coli* | ING0364_T1003 | E. coli | E. coli-1 |
| | | New | | ING0364_T1004 | | |
| | | New | | ING0364_T1005 | | |
| | | ING0366_T1001 | | ING0364_T1006 | | |
| | | New | | ING0364_T1007 | | |
| | | New | | ING0364_T1008 | | |
| | **Yellow Bank Creek (050800030605)** | ING0362_00<br>ING0367_00<br>ING0368_00 | PCBs | ING0365_01 | PCBs | TSS-1 |
| | | ING0362_01<br>ING0367_00<br>ING0368_00 | *E. coli*, PCBs | ING0365_02<br>ING0362_01 | E. coli, IBC, PCBs (ING0362_01 only) | E. coli-1 |
| | | New | | ING0365_T1001 | | |
| | | ING0368_00 | | ING0365_T1002 | | |
| | | ING0368_00 | | ING0365_T1003 | E. coli, IBC | E. coli-1 |
| | | ING0368_00 | | ING0365_T1004 | | |
| | | New | | ING0365_T1005 | | |
| | | New | | ING0365_T1006 | | |
| | | New | | ING0365_T1007 | | |
| | | ING0367_00 | | ING0365_T1008 | | |
| | | New | | ING0365_T1009 | | |
| **Whitewater River (0508000308)** | **Headwaters Blue Creek (050800030801)** | ING0381_00 | | ING0381_01 | E. coli, DO, IBC | E. coli-1 |
| | | ING0382_00 | | ING0381_02 | | |
| | | New | | ING0381_T1001 | | |
| | | New | | ING0381_T1002 | | |
| | | New | | ING0381_T1003 | | |
| | | New | | ING0381_T1004 | | |
| | **Wolf Creek-Blue Creek (050800030802)** | ING0382_01<br>ING0383_00 | *E. coli* | ING0382_01 | E. coli, IBC | E. coli-1 |
| | | ING0384_T1001 | *E. coli* | ING0382_02 | E. coli | E. coli-1 |
| | | New | | ING0382_T1001 | | |
| | | New | | ING0382_T1002 | | |
| | | New | | ING0382_T1003 | | |
| | | New | | ING0382_T1004 | | |
| | | New | | ING0382_T1005 | | |
| | | New | | ING0382_T1006 | | |
| | | New | | ING0382_T1007 | | |
| | | New | | ING0382_T1008 | | |
| | | New | | ING0382_T1009 | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Big Cedar Creek (050800030803)** | ING0387_00<br>ING0387_T1001<br>ING0387_T1002<br>ING0387_T1003 | | ING0383_01 | E. coli | E. coli-1 |
| | | ING0388_00 | *E. coli* | ING0383_02 | E. coli | E. coli-1 |
| | | ING0387_T1004 | | ING0383_T1001 | | |
| | | ING0387_01 | | ING0383_T1002 | | |
| | | ING0388_T1001 | *E. coli* | ING0383_T1003 | E. coli | E. coli-1 |
| | | ING0388_T1002 | *E. coli* | ING0383_T1004 | E. coli | E. coli-1 |
| | | ING0388_T1003 | *E. coli* | ING0383_T1005 | E. coli | E. coli-1 |
| | | ING0388_T1004 | | ING0383_T1006 | | |
| | **Little Cedar Creek (050800030804)** | ING0384_00<br>ING0385_00<br>ING0386_00 | DO, *E. coli* | ING0384_01 | E. coli | E. coli-1<br>TSS-1 |
| | | ING0385_00 | DO, *E. coli* | ING0384_T1001 | E. coli, DO | E. coli-1 |
| | | ING0386_00 | | ING0384_T1002 | | |
| | | ING0386_T1043<br>ING0386_00 | DO, *E. coli* | ING0384_T1003 | E. coli | E. coli-1 |
| | | ING0386_00 | | ING0384_T1004 | | |
| | **Blackburn Creek (050800030805)** | ING0389_T1019<br>ING0389_T1020 | PCBs | ING0385_01 | PCBs | TSS-1 |
| | | ING0389_T1009 | | ING0385_01A | | |
| | | ING0389_T1002<br>ING0389_T1003 | | ING0385_T1001 | | |
| | | ING0389_T1001 | | ING0385_T1002 | | |
| | | New | | ING0385_T1003 | | |
| | | ING0389_T1005 | | ING0385_T1004 | | |
| | | ING0389_T1006 | | ING0385_T1005 | | |
| | | ING0389_T1007 | | ING0385_T1006 | | |
| | | ING0389_T1008 | | ING0385_T1007 | | |
| | | New | | ING0385_T1008 | | |
| | | New | | ING0385_T1009 | | |
| | | ING0389_T1010 | | ING0385_T1010 | | |
| | **Johnson Fork (050800030806)** | ING038B_T1021<br>ING038A_T1041 | *E. coli* | ING0386_01 | | TSS-1 |
| | | ING038B_00 | DO, *E. coli* | ING0386_02 | E. coli | E. coli-1 |
| | | ING038A_00<br>ING038A_T1001<br>ING038A_T1002<br>ING038A_T1003<br>ING038A_T1004<br>ING038A_T1006<br>ING038A_T1007<br>ING038A_T1008 | *E. coli,*<br>PCBs, Hg | ING0386_T1001 | E. coli, DO,<br>IBC, PCBs, Hg | E. coli-1 |
| | | ING038A_T1005 | | ING0386_T1002 | E. coli | E. coli-1 |
| | | ING038A_T1009 | | ING0386_T1003 | | |
| | | ING038C_00 | | ING0386_T1004 | | |
| | | New | | ING0386_T1005 | | |
| | | ING038B_00 | DO, *E. coli* | ING0386_T1006 | E. coli, DO (4C) | E. coli-1 |
| | | New | | ING0386_T1006A | E. coli, DO (4C) | E. coli-1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ING038B_00 | DO, *E. coli* | ING0386_T1007 | E. coli | E. coli-1 |
| | | ING038B_00 | *E. coli* | ING0386_T1008 | E. coli | E. coli-1 |
| | **Headwaters Dry Fork Whitewater River (050800030807)** | ING038D_00 | | ING0387_02 | E. coli, IBC | E. coli-1 |
| | | | | ING0387_03 | | |
| | **Howard Creek (050800030808)** | ING038E_00 | *E. coli* | ING0388_01 | E. coli | E. coli-1 |
| | | New | | ING0388_P1001 | | |
| | | ING038E_00 | *E. coli* | ING0388_T1005 | E. coli | E. coli-1 |
| | | New | | ING0388_T1006 | | |
| | | ING038E_00 | *E. coli* | ING0388_T1007 | E. coli | E. coli-1 |
| | | ING038F_00 | | ING0388_T1008 | | |
| | **Lee Creek (050800030809)** | ING038G_00 | | ING0389_01 | | |
| | **Jameson Creek (050800030810)** | ING038C_T1022 | | ING038A_01 | | TSS-1 |
| | | New | | ING038A_01A | | |
| | | New | | ING038A_P1001 | | |
| | | ING038C_00 | | ING038A_T1010 | | |
| | | | | ING038A_T1011 | | |
| | | ING038H_00 | | ING038A_T1012 | | |

***Understanding***

Table 6***:***

- *Column 1: Watershed (10-digit HUC).* Lists the subwatersheds at the 10-digit HUC scale that were part of the initial assessment for the Southern Whitewater River watershed.
- *Column 2: Subwatershed (12-digit HUC).* Shows the name of the subwatershed at the 12-digit HUC scale. The subwatershed found in this second column is the appropriate scale for what the IDEM's WMP Checklist defines as a subwatershed for the purposes of watershed management planning.

- *Column 3: Previous AUID.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2008 Section 303(d) listing assessment process.
- *Column 4: 2012 Section 303(d) Listed Impairment.* Identifies the cause of impairment associated with the 2012 Section 303(d) listing.
- *Column 5: New AUID.* Provides the updated AUIDs associated with each 12-digit HUC subwatershed. Look for these AUIDs used throughout this report to present detailed analysis of sources, load allocations, and recommended implementation activities in PPIAs.
- *Column 6: Updated Impairment to be Listed on 4A in 2016.* Provides the updated causes of impairment if new data and information are available.

## 2.4 Priority Ranking Discussion

The Southern Whitewater River Watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, IDEM's interest in conducting baseline water quality monitoring for local planning, and a competitive Section 319 application from the local partners to develop a watershed management plan, and implementation management measures, including BMPs.

# 3.0 DESCRIPTION OF THE SALT CREEK WATERSHED

This section of the TMDL report contains a brief characterization of the Salt Creek watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to *E.coli* and nutrient impairments. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

The Salt Creek watershed (0508000305), shown in **Error! Reference source not found.**, is located farthest west in the Southern Whitewater River watershed. The watershed comprises 117 square miles and also drains a total of 117 square miles. The tributaries of Salt Creek watershed originate in Rush and Decatur counties and flow east into Franklin County. Salt Creek then flows north before its confluence with Whitewater River. Land use throughout the watershed is predominantly forested land. The Salt Creek Watershed is also a source of drinking water for the community surrounding Lake Santee.

There are a number of existing impairments in the Salt Creek watershed from the Draft 2012 303(d) List of Impaired Waters (Figure 5). In the Salt Creek watershed there are approximately 53 stream miles on the Draft 2012 303(d) List of Impaired Waters. The listings and causes of impairment have been adjusted as a result of reassessment data collected at 13 sampling locations in the watershed (Figures 3). Within the Salt Creek watershed a total of 28 assessment unit IDs (AUIDs) are cited as impaired for *E. coli* (193 stream miles), nutrients (35 stream miles), or biological communities (51 stream miles) on the Indiana's Draft 2016 303(d) list (Figure 7). These impaired segments account for approximately 193 stream miles. Table 3 presents listing information for the Salt Creek watershed, including a comparison of the updated listings with the 2012 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Salt Creek watershed are available in Appendix B.

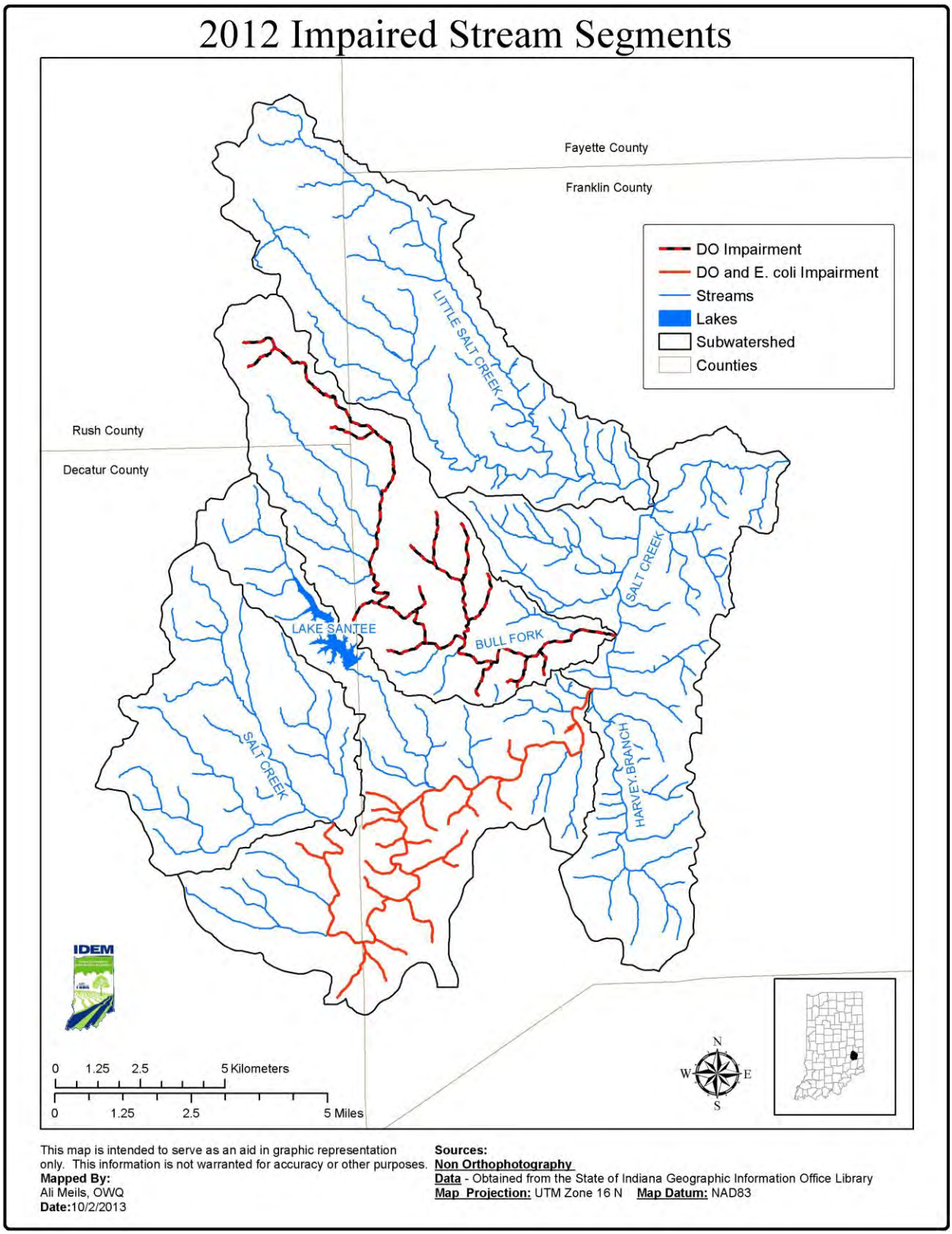


Figure 6 Streams Listed on the Draft 2012 Section 303(d) List in the Salt Creek Watershed

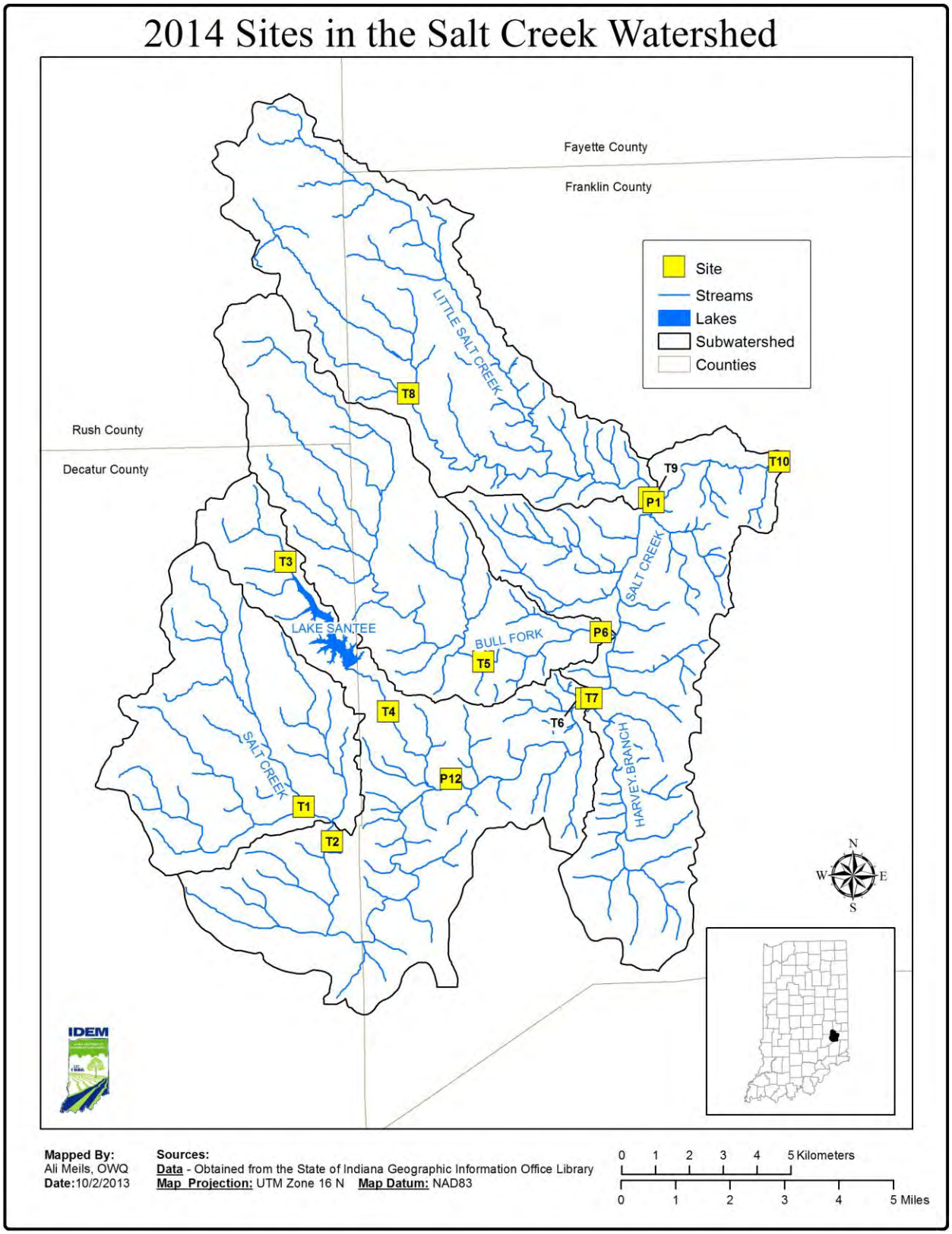


Figure 7 Sampling Locations in 2014 Salt Creek Watershed

**Table 7 Salt Creek Sampling Site Information**

| Site # | Station # | Stream Name | Road Name | AUID 2012 |
|---|---|---|---|---|
| T1 | GMW050-0023 | Tributary of Salt Creek | CR 150 N | ING0351_T1002 |
| T2 | GMW-05-0006 | Salt Creek | CR 50 N | ING0352_01 |
| T3 | GMW-05-0014 | Righthand Fork Salt Creek | E CR 550 N | ING0352_T1003 |
| T4 | GMW-05-0011 | Righthand Fork Salt Creek | Hamburg Road | ING0352_T1006 |
| T5 | GMW-05-0009 | Bull Fork | Bullfork Road | ING0353_02 |
| T6 | GMW-05-0007 | Salt Creek | Rail Fence Road | ING0352_01 |
| T7 | GMW-05-0012 | Harvey Branch | Rail Fence Road | ING0355_T1002 |
| T8 | GMW-05-0015 | South Fork Little Salt Creek | Chapel Road | ING0354_T1003 |
| T9 | GMW-05-0008 | Little Salt Creek | Stipps Hill Road | ING0354_02 |
| T10 | GMW-05-0010 | Salt Creek | SR 229 | ING0355_01 |
| P1 | GMW-05-0001 | Little Salt Creek | Stipps Hill Rd | ING0354_02 |
| P6 | GMW-05-0002 | Bull Fork | Bullfork Rd | ING0353_02 |
| P12 | GMW-05-0003 | Salt Creek | Giesting Rd | ING0352_01 |

***Understanding Table 7:***

- *Column 1: Site #.* Lists the site number that corresponds to the site location in Figure 3.
- *Column 2: Station #* .Provides the IDEM site identification number for the location.
- *Column 3: Stream Name*. Identifies the Stream Name where the site is located.
- *Column 4: Road Name.* Identifies the Road Name where the site is located.
- *Column 5: AUID 2012.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2016 Section 303(d) listing assessment process.

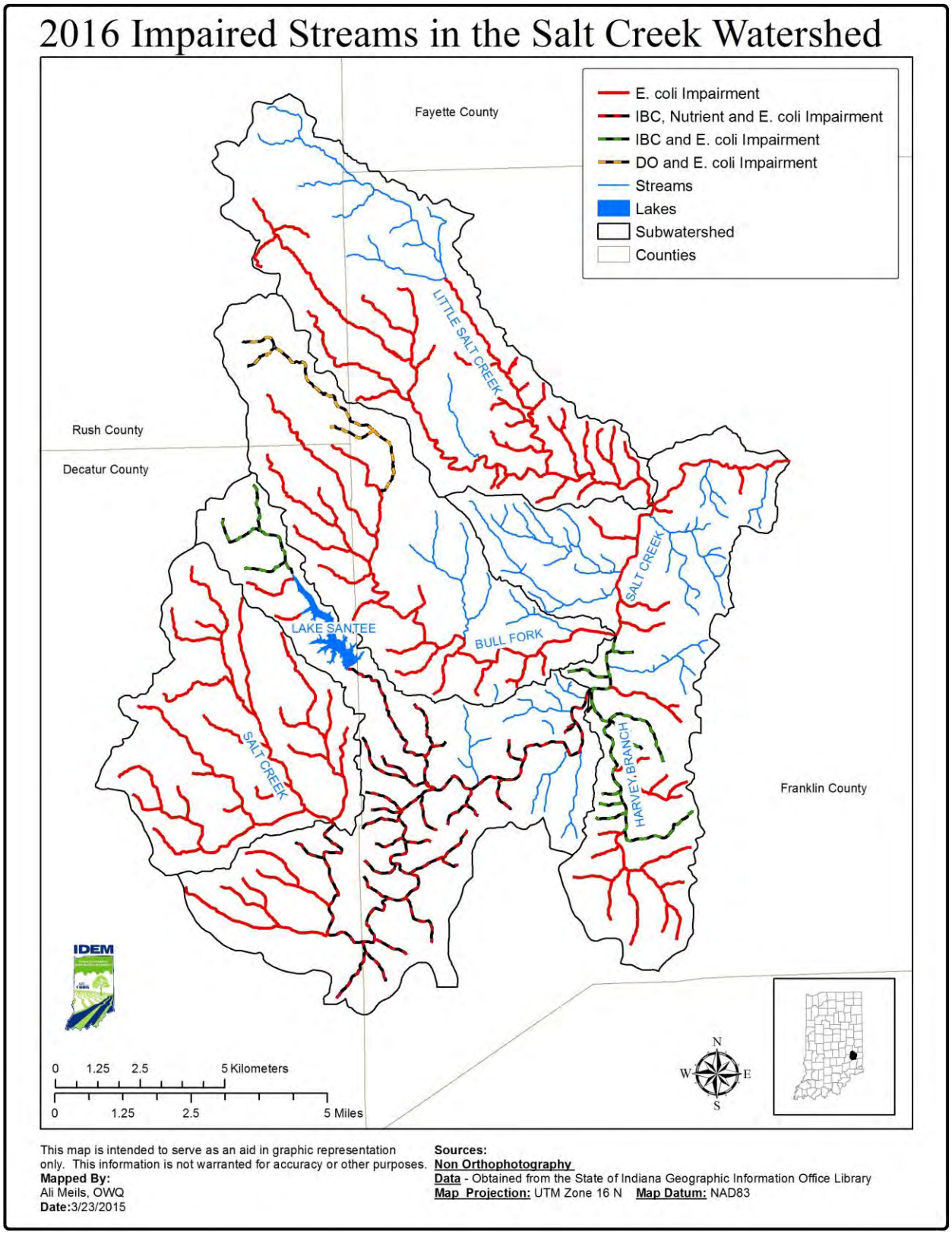


**Figure 8 Streams Listed on the Draft 2016 Section 303(d) List in the Salt Creek Watershed**

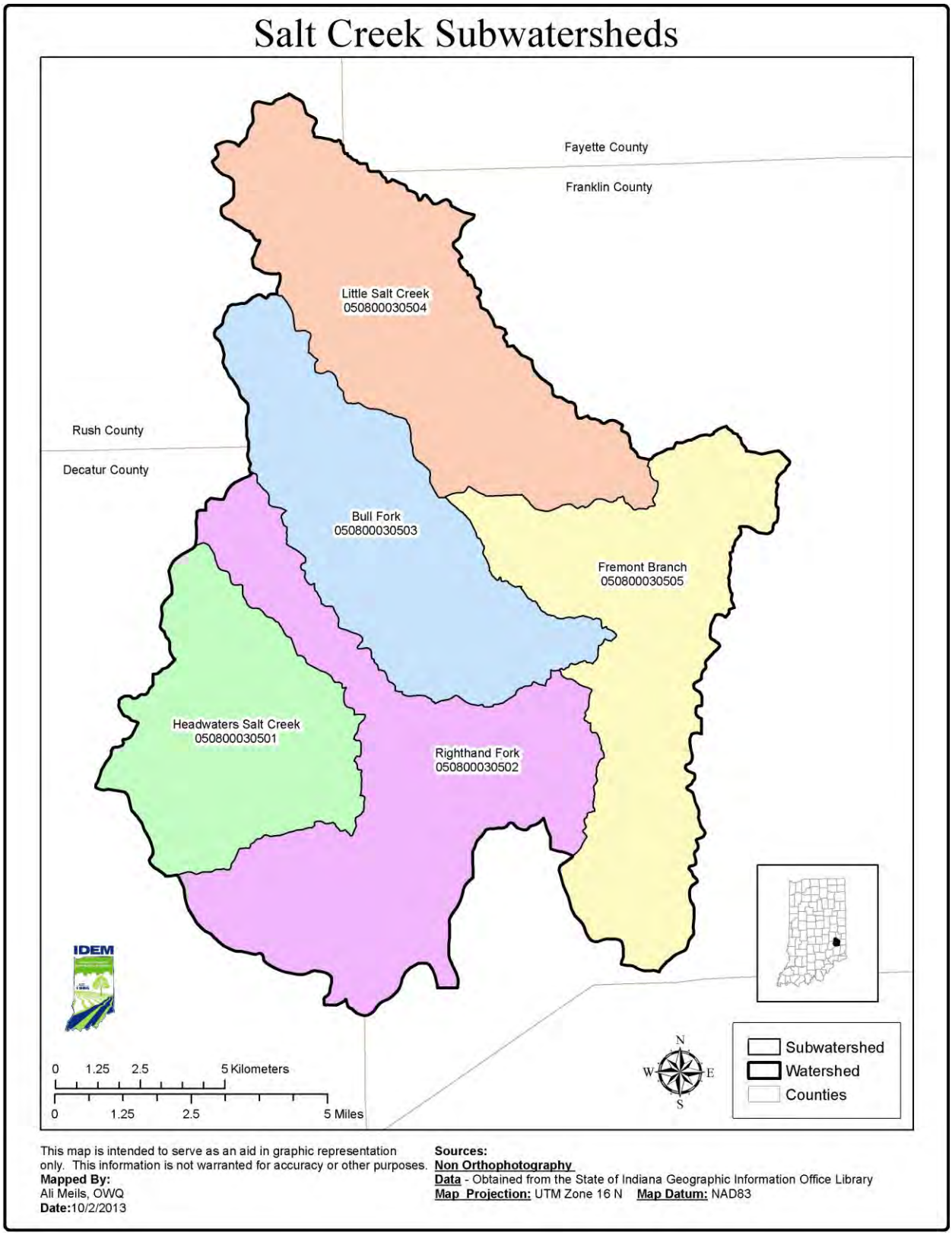


**Figure 9 Subwatersheds (12-Digit HUCs) in the Salt Creek Watershed**

## 3.1 Land Use

Land use patterns provide important clues to the potential sources of *E. coli*, nutrients and sediment in a watershed. Land use information for the Salt Creek watershed is available from the USDA, National Agriculture Statistics Service (NASS), and 2012 Indiana Cropland Data Layer. The Cropland Data Layer (CDL) categorizes the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2012. Figure 10 displays the spatial distribution of the land uses and the data are summarized in Table 88.

Land use in the Salt Creek watershed is primarily forested, comprising 50 percent of the Salt Creek watershed. Undeveloped forested land is ideal for riparian areas around waterbodies. The topography of the watershed may play a greater role in pollutants reaching the stream than the forested land use areas. Approximately 30 percent of the land is agriculture and 5 percent is developed. Agricultural lands can be significant sources of TSS, nutrients and *E. coli* if they are fertilized with manure and other inorganic fertilizers. The remaining land categories represent less than 15 percent of the total land area.

The Salt Creek watershed has a diverse network of streams. Tributaries include Little Salt Creek, Bull Fork, Righthand Fork Salt Creek, Fremont Branch and Harvey Branch among others. Many of these tributaries are shown in **Error! Reference source not found.**5 and **Error! Reference source not found.**. The Salt Creek watershed is comprised of fast flowing headwater streams, surrounded by forested riparian areas. The smaller headwater streams along the northern and western edge are impacted by agricultural practices, however the majority of the watershed has little silt with a cobble and gravel substrate. They are fast flowing streams based on the topography of the land. The variegate darter (*Etheostoma variatum*) is an Indiana State Endangered fish species that is found in Whitewater River along the mainstem. Salt Creek is the only known tributary to Whitewater River where the variegate darters are also found. The variegate darter is restricted to the Ohio River drainage and are only found in the Whitewater River watershed in Indiana. They are an indicator of good water quality and are abundant in high quality streams. They are found in medium to large streams and rivers with swift flowing riffles with gravel, cobble or boulders on the stream bottom. Additional information on state endangered, threatened and rare species can be found on the DNR website (http://www.in.gov/dnr/naturepreserve/4666.htm). No variegate darters were collected in the Salt Creek watershed during IDEMs sampling in 2014. A reduction in the TSS target was implemented in the area where the variegate darters have been found a more detailed discussion of this is found in Section 13 of this document

**Table 8. Land Use of Salt Creek Watershed**

| Land Use | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Agricultural Lands | 22,088.70 | 34.51 | 29.40 |
| Developed Land | 3,651.28 | 5.71 | 4.87 |
| Forested Land | 37,886.96 | 59.20 | 50.44 |
| Pasture/Hay | 10,173.23 | 15.90 | 13.55 |
| Shrub/Scrub | 869.79 | 1.36 | 1.16 |
| Wetlands | 2.45 | 0.01 | 0.01 |
| Open Water | 426.55 | 0.67 | 0.57 |
| TOTAL | **75,098.96** | **117.36** | **100** |

***Understanding Table 8:*** The predominant land use types in the Salt Creek watershed can indicate potential sources of *E. coli*, nutrient and sediment loadings. Different types of land uses are characterized

by different types of hydrology. For example, developed lands are characterized by impervious surfaces that increase the potential of storm water events during high flow periods delivering *E. coli*, nutrients and sediment to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water to running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute *E. coli*, nutrients and sediment to the watershed. Understanding types of land uses will help identify the type of implementation approaches that watershed stakeholders can use to achieve *E. coli*, nutrient and sediment load reductions.

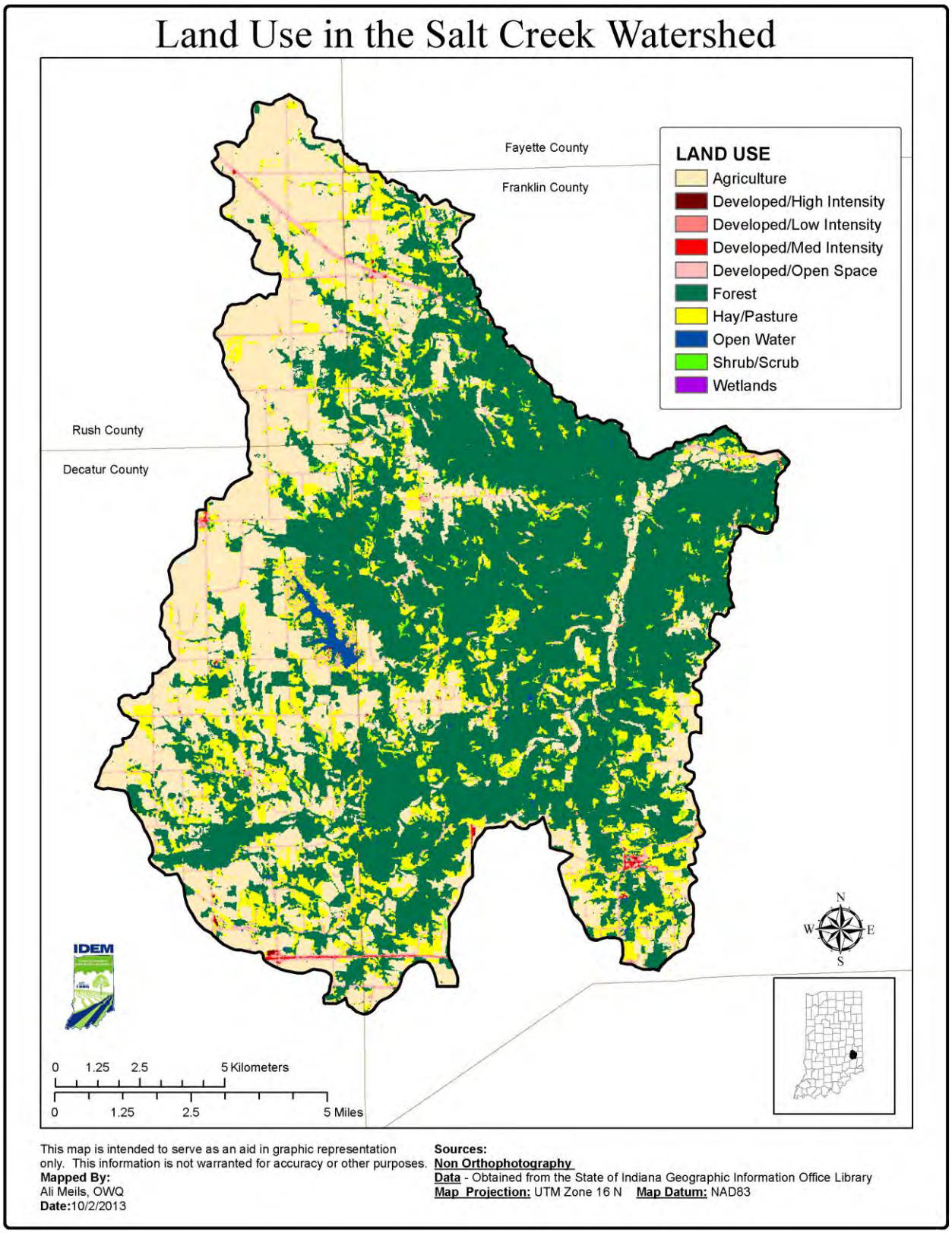


**Figure 10. Land Use in the Salt Creek Watershed**

## 3.2 Cropland

Land use patterns provide important clues to the potential sources of *E. coli*, nutrients and sediment in a watershed. Land use information for the Salt Creek watershed is available from the USDA, National Agriculture Statistics Service (NASS), and Indiana Cropland Data Layer. These data categorize the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from 2012. Figure 10 displays the spatial distribution of the cropland and the data are summarized in Table 8.

Land use in the Salt Creek watershed is primarily forested, comprising approximately 50 percent of the Salt Creek watershed. However there is a significant portion of the watershed that is agricultural (30 percent). Corn and soybean crops are not typically associated with high *E. coli*, nutrient and sediment, loads, unless they have been fertilized with manure. Approximately 94 percent of the cropland is corn or soybean.

**Table 9 Crop Land of Salt Creek Watershed**

| Crop Data | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Corn | 11635.03 | 18.18 | 50.87 |
| Soybean | 9916.14 | 15.49 | 43.35 |
| Alfalfa and other Hay | 989.43 | 1.55 | 4.32 |
| Double Crop Winter Wheat/corn or Soybeans | 328.69 | 0.51 | 1.44 |
| Double Crop Soybeans/Oats | 1.33 | <0.01 | <0.01 |
| Pop or Orn Corn | 0.67 | <0.01 | <0.01 |
| Tomatoes | 0.44 | <0.01 | <0.01 |
| Rye | 0.44 | <0.01 | <0.01 |
| TOTAL | 22,872.17 | 35.73 | 100 |

***Understanding Table 9:*** The predominant cropland types in the Salt Creek watershed can indicate potential sources of *E. coli*, nutrient and sediment loadings. Cropland use in the Salt Creek watershed is primarily corn and soybean. Understanding types of cropland will help identify the type of implementation approaches that watershed stakeholders use to achieve *E. coli*, nutrient and sediment load reductions.

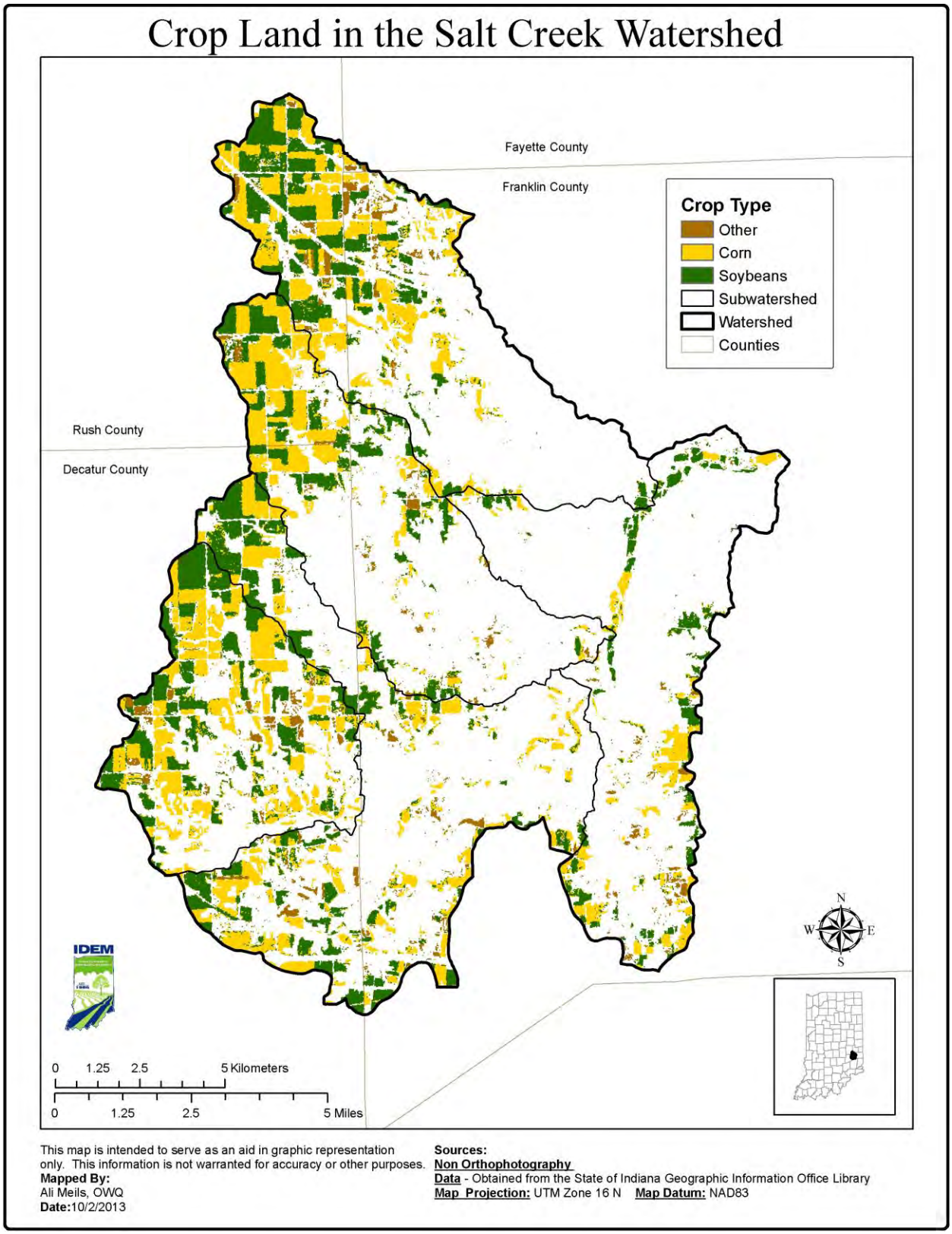


**Figure 11 Crop Land of Salt Creek Watershed**

## 3.3 Human Population

Counties with land located in the Salt Creek watershed include Rush, Fayette, Decatur and Franklin counties. Major cities and towns with jurisdiction at least partially within the Salt Creek watershed include Oldenburg and Batesville. Unincorporated towns in the watershed include Andersonville, Clarksburg, and Buena Vista. U.S. Census data for each county during the past three decades are provided in **Error! Reference source not found.**. Cities and towns are labeled in Figure 12.

**Table 10 Population Data for Counties in the Salt Creek Watershed**

| County | 1990 | 2000 | 2010 |
|---|---|---|---|
| Rush | 18,159 | 18,261 | 17,392 |
| Fayette | 26,065 | 25,588 | 24,277 |
| Decatur | 23,673 | 24,555 | 25,740 |
| Franklin | 19,580 | 22,151 | 23,087 |
| TOTAL | ***87,477*** | ***90,555*** | ***90,496*** |

Source: U.S. Census Bureau.

***Understanding* Error! Reference source not found.*:*** Water quality is linked to population growth because a growing population often leads to more development, translating into more houses, roads, and infrastructure to support more people. **Error! Reference source not found.** provides information that shows how population has changed in each of the counties located in the Salt Creek watershed over time. In addition, understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action now could help prevent further water quality degradation.

Estimates of population within Salt Creek watershed are based on US Census data (2010) and the percentage of the total county and urban area that is within the watershed (Table 11). Based on this analysis, the estimated population of the watershed is 8,700 with approximately 93 percent of the population classified as rural residents and seven percent classified as urban residents. Figure 13 indicates population density within the Salt Creek watershed.

**Table 11. Estimated Population in the Salt Creek Watershed**

| County | 2010 Population | Total Estimated Watershed Population | Percent of Total Watershed Population | Non-urban Population | Urban Population |
|---|---|---|---|---|---|
| Rush | 17,392 | 473 | 5.43 | 473 | 0 |
| Fayette | 24,277 | 35 | 0.40 | 35 | 0 |
| Decatur | 25,740 | 2,223 | 25.49 | 2,203 | 20 |
| Franklin | 23,087 | 5,990 | 68.68 | 5,401 | 589 |
| **TOTAL** | ***90,496*** | **8,721** | **100** | **8,112** | **609** |

***Understanding Table 11:*** Problems associated with impervious surfaces, riparian habitat, storm water flows, and wastewater inputs are where the greatest population is concentrated. Non-urban populations are more likely to suffer from failing septic systems, agricultural runoff, and poor riparian habitat. Comparing information in **Error! Reference source not found.** with Table 11 can provide an understanding of how population might change and which counties are experiencing the most growth and shifts in urban and non-urban population.

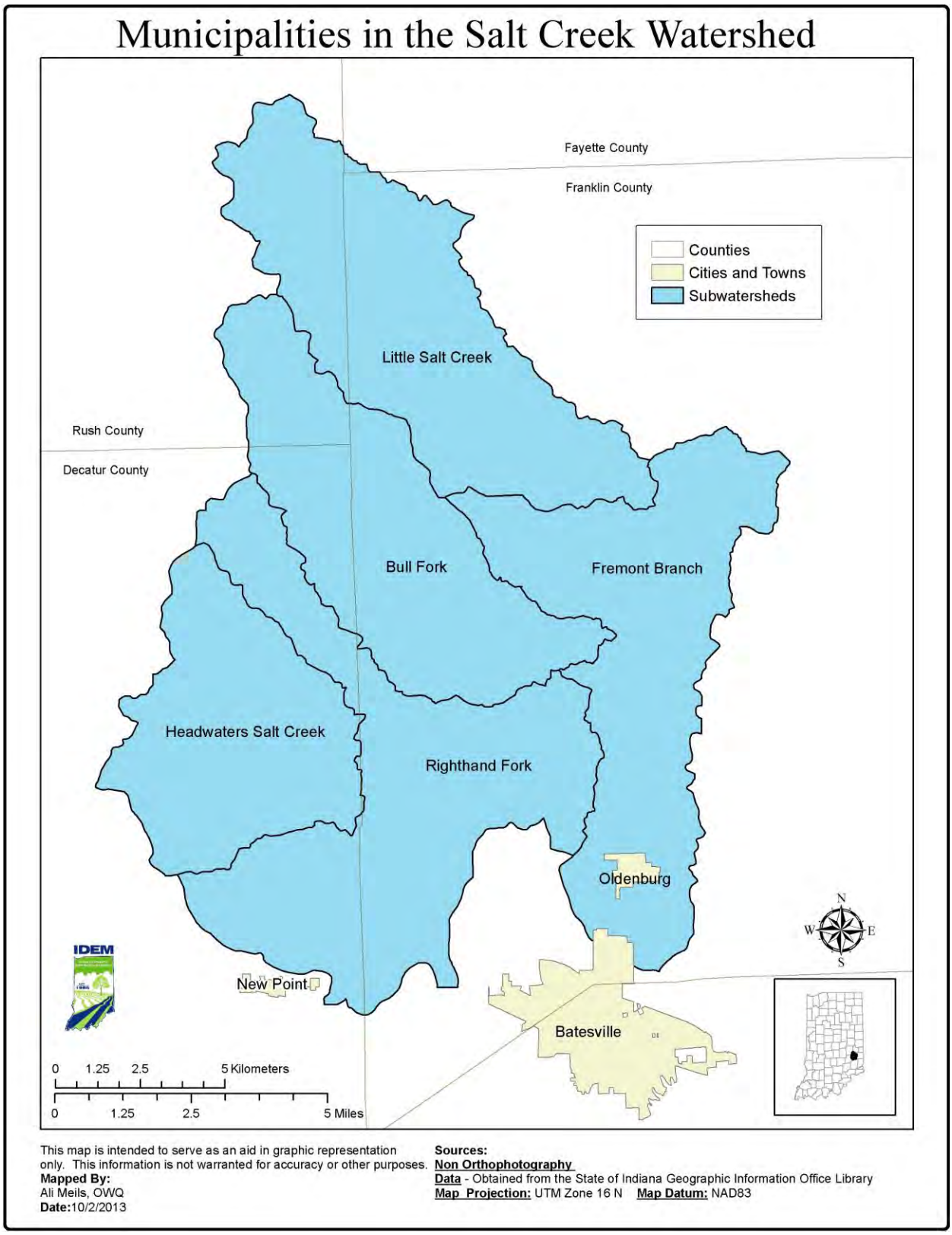


**Figure 12. Municipalities in the Salt Creek Watershed**

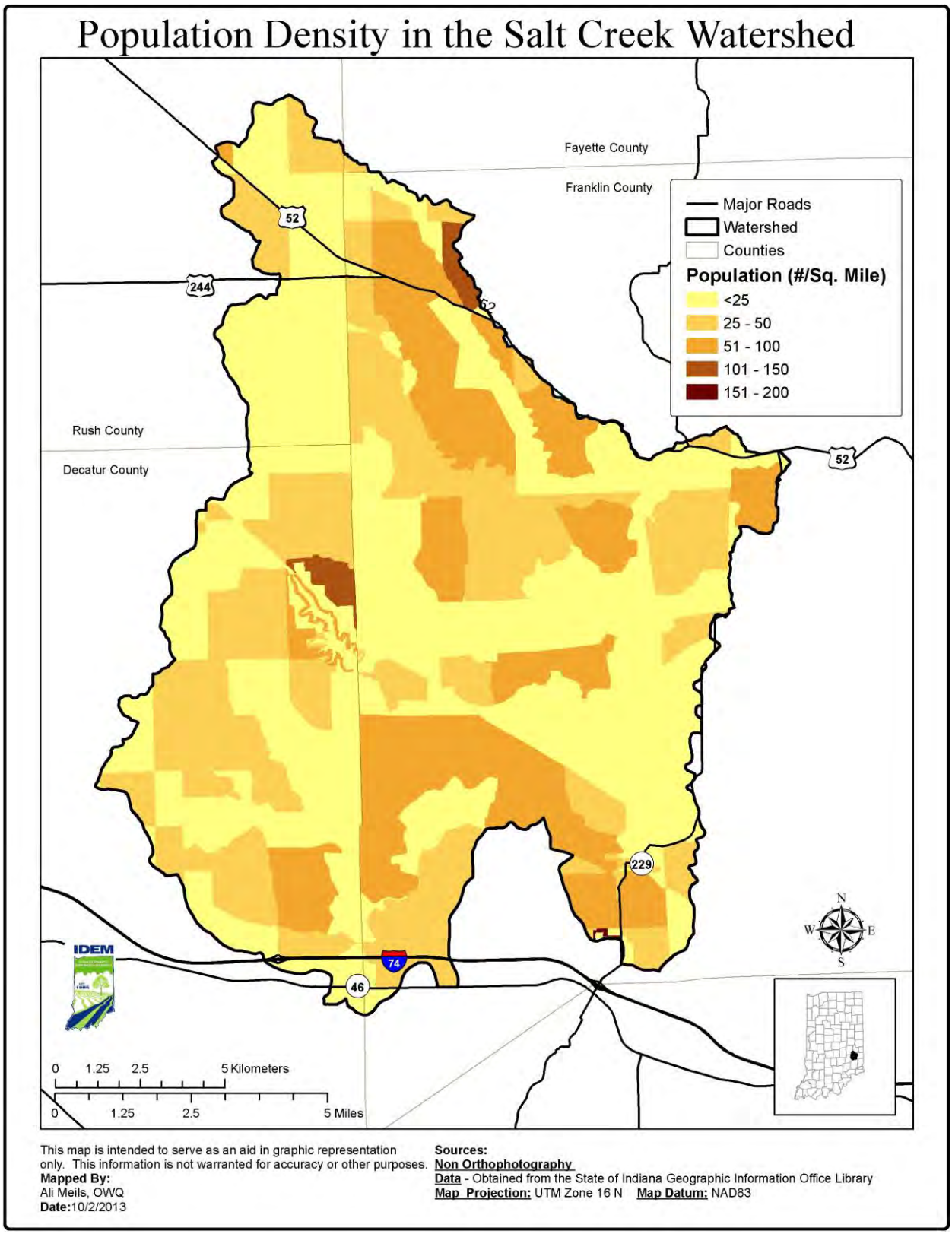


**Figure 13. Population Density in the Salt Creek Watershed**

## 3.4 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Information concerning the topography and geology within the Salt Creek watershed is available from the Indiana Geologic Survey (IGS). The majority of Salt Creek watershed is located in the Eastern Corn Belt Plain (ECBP) ecoregion with the eastern part of the watershed located in the Interior Plateau (IP) ecoregion. The ECBP is characterized by extensive cropland agriculture with some natural forest cover and gently rolling glacial till plains dissected by moraines, kames and outwash plains. The IP ecoregion includes a till plain of low topographic relief formed from Illinoian glacial drift materials, rolling to modestly or deeply dissected basin terrain. Layers of sandstone, siltstone, shale and limestone underlie much of the Interior Plateau. Limestone outcrops are common, as are areas pitted with limestone sinks. Elevations in the watershed range from 670 feet to 1090 feet. The landscape changes from gentle slopes in the north and western portions of the watershed to steeper slopes as you move east through the watershed. Figure 14 shows the topography of the Salt Creek watershed. National Elevation Data (NED) is available from the USGS National Map seamless server (http://seamless.usgs.gov/website/seamless/viewer.htm). The steep slopes within the watershed produce rapid flows of water which often causes heavy erosion along the banks and more opportunity for pollutants to enter the streams through runoff.

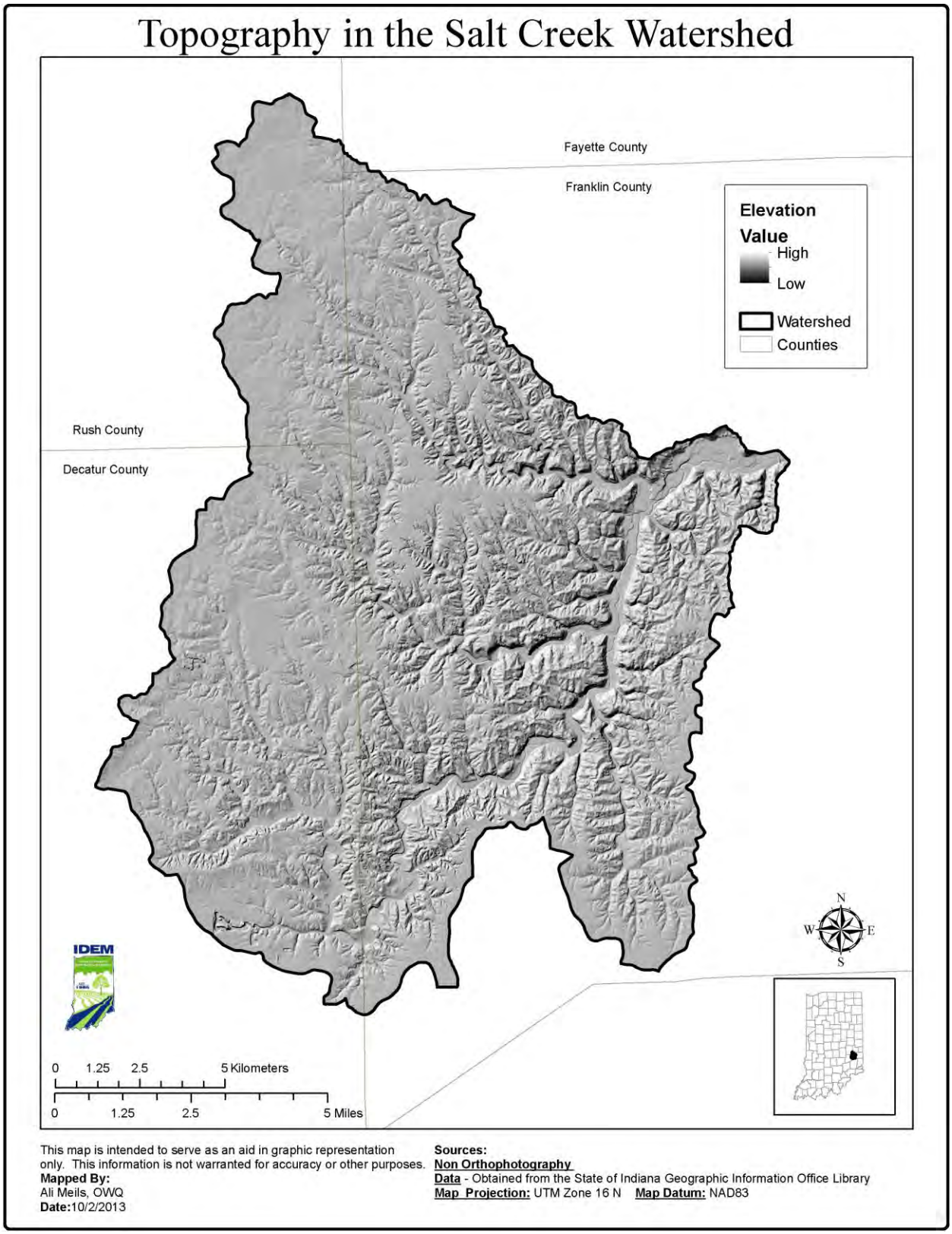


**Figure 14. Topography of the Salt Creek Watershed**

The entire bedrock surface of Indiana consists of sedimentary rocks. The major kinds of sedimentary rock in Indiana include limestone, dolomite, shale, sandstone, and siltstone. The northern two-thirds of Indiana are composed of glacial deposits containing groundwater. These glacial aquifers exist where sand and gravel bodies are present within clay-rich glacial till (sediment deposited by ice) or in alluvial, coastal, and glacial outwash deposits. Groundwater availability is much different in the southern unglaciated part of Indiana. There are few unconsolidated deposits above the bedrock surface, and the voids in bedrock (other than karst dissolution features) are seldom sufficiently interconnected to yield useful amounts of groundwater. Water supplies in southern Indiana usually come from reservoirs, such as Lake Santee, in lieu of water wells.

Based on information gathered in the Atlas of Hydrogeologic Terrains and Settings of Indiana, the Salt Creek watershed is sensitive to ground water pollution through surface water. Hydrogeologic settings help to interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to the surface and subsurface environment. Generally the Salt Creek watershed is located in the bottomlands of southern Indiana, which are often associated with large bedrock valleys and significant quantities of late glacial till outwash. These outwash deposits are the major ground water resources for the entire southern part of the state. They are characterized by shallow water table conditions and are consequently zones of significant interaction between surface water and ground water.

Specifically, the outwash in the Southern Whitewater River valley constitutes the primary source of ground water in this part of the state, as suitable aquifers are generally sparse in the adjoining uplands. Most of the valley bottom is in floodplain, so water table depths are typically between 5 and 15 feet. A considerable amount of ground water is transmitted down-valley within the outwash and interacts with the river at frequent meanders that cut across the aquifer. The valley as a whole is generally a ground water discharge area, although it is unlikely that there is an appreciable volume of actual discharge to this segment of the valley in view of the poor water-transmitting properties of the surrounding bedrock and till. Overall characteristics indicate that ground water beneath the valley floor is likely to be relatively sensitive to contamination, and that finding replacement water sources would be difficult should contamination affect a part of the aquifer. This should be of special concern since there is currently one surface drinking water source known in the Salt Creek watershed. All other drinking water sources are ground water sources.

While the topography and geology of the watershed can have an effect on hydrology, it is also likely that soil characteristics will play a role in affecting hydrologic processes.

## 3.5 Soils

There are different soil characteristics that can affect the health of the watershed. These characteristics include soil drainage, septic tank suitability, soil saturation, and soil erodibility.

### 3.5.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and runoff characteristics during periods of prolonged wetting. The Natural Resources Conservation Service (NRCS) has defined four hydrologic groups for soils, described in Table 12 (NRCS, 2001). Data for the Salt Creek watershed were obtained from the Soil Survey Geographic (SSURGO) database. Downloaded data were summarized based on the major hydrologic group in the surface layers of the map unit and are displayed in Figure 15.

The majority of the watershed is covered by group C soils (76%) and group B soils (23%). Group A and D make up the remaining 1% of the watershed.

**Table 12. Hydrologic Soil Groups**

| Hydrologic Soils Group | Description |
|---|---|
| A | Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little runoff. |
| B | Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils. |
| C | Soils with slow infiltration rates. Soils with finer textures and slow water movement. |
| D | Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff. |

***Understanding Table 12:*** Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect *E. coli*, nutrients and sediment loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high *E. coli*, nutrients and sediment loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of *E. coli*, nutrients and sediment to streams.

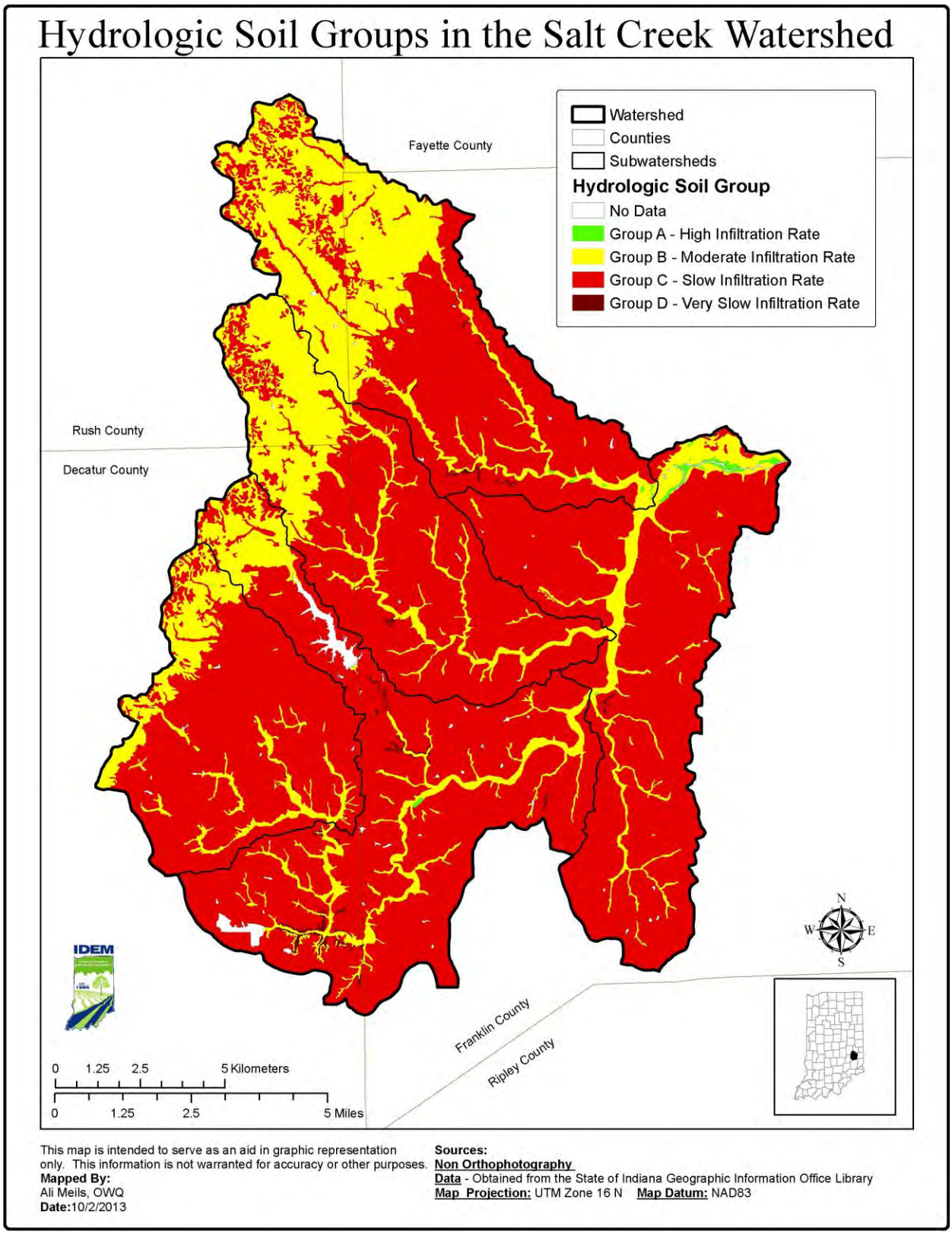


**Figure 15. Hydrologic Soil Groups in the Salt Creek Watershed**

### 3.5.2 Septic Tank Suitability

Septic systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design can often overcome these limitations (i.e., perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system.

Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems.

The septic system is considered failing when the system exhibits one or more of the following:

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures

2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters

3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Salt Creek watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 99 percent of the Salt Creek watershed is considered “very limited” in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation or expensive installation designs. Approximately one percent of the soils within the Salt Creek watershed have “somewhat limited” septic suitability or are “not rated,” meaning these soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. There are no soils in the Salt Creek watershed that are designated “not limited,” meaning that the soil type is suitable for septic systems.

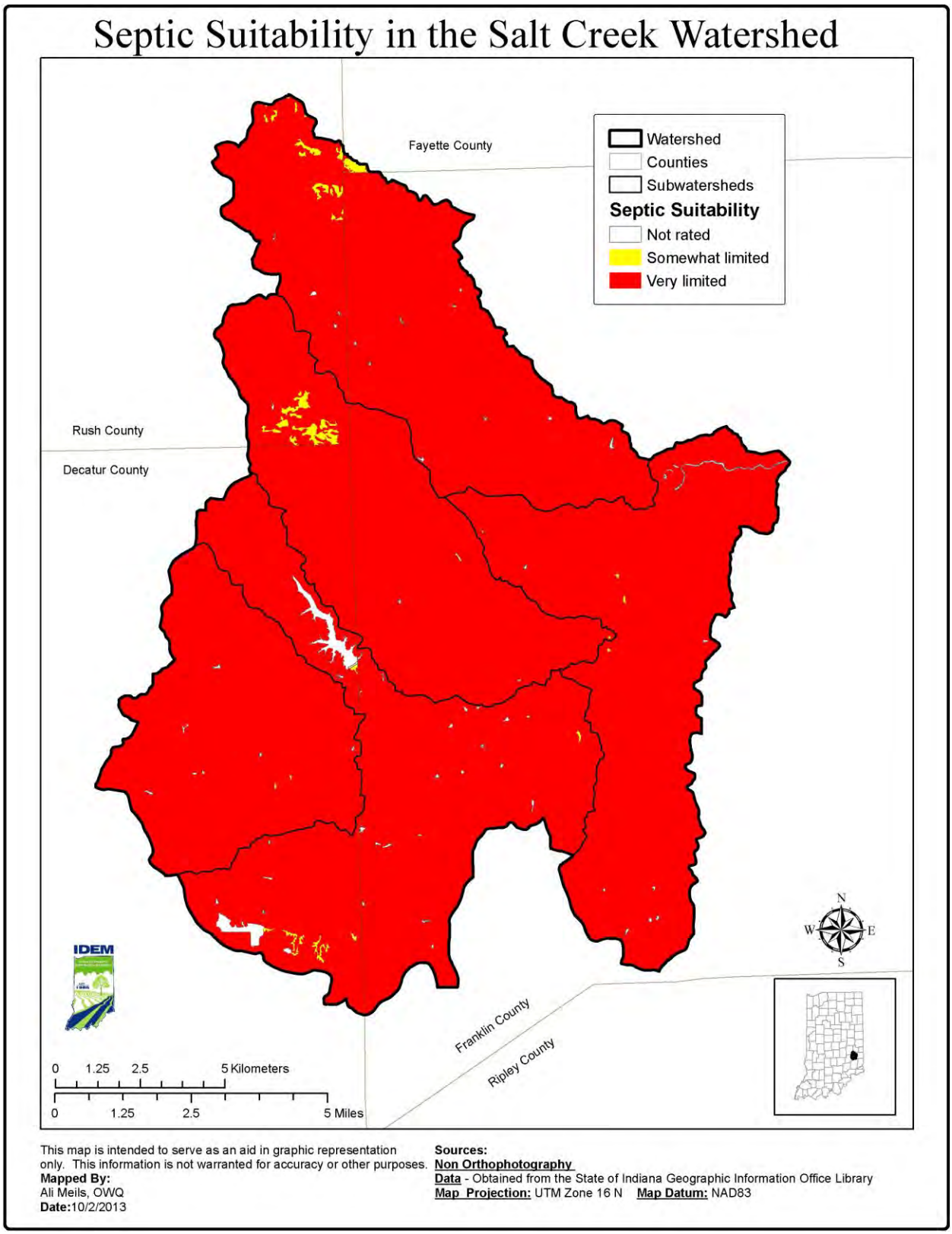


**Figure 16. Suitability of Soils for Septic Systems in the Salt Creek Watershed**

### 3.5.3 Soil Saturation

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Hydric soils have been identified in the Salt Creek watershed and are important in consideration of wetland restoration activities. Approximately 4,063 acres or 5 percent of the Salt Creek watershed area contains soils that are considered hydric, as shown in Table 13. However, a large majority of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils, as shown in Figure 17, can be used to consider possible locations of wetland creation or enhancement. There are many components in addition to soil type that must be considered before moving forward with wetland design and creation. In the Salt Creek watershed, Franklin County has the most acreage of hydric soils. Areas within these counties might contain opportunities for wetland restoration activities that could help address water quality impairments. Additional information on wetlands can be found on the IDEM website (http://www.in.gov/idem/wetlands).

**Table 13. Hydric Soils by County in the Salt Creek Watershed**

| County | Symbol | Hydric Soil Type | Acres | Total Percent |
|---|---|---|---|---|
| Decatur | Cm | Clermont silt loam | 991.96 | 68.74 |
| | Cy | Cyclone silt loam | 421.97 | 29.24 |
| | Mr | Milford silty clay | 4.74 | 0.33 |
| | So | Sloan silt loam | 24.34 | 1.69 |
| | | **Total** | **1,443.01** | **100** |
| Fayette | | **Total** | **0** | **0** |
| Franklin | Cm | Cobbsfork silt loam | 1,451.51 | 94.28 |
| | Cy | Cyclone silt loam | 57.38 | 3.73 |
| | Mr | Milford silty clay loam | 30.61 | 1.99 |
| | | **Total** | **1,539.50** | **100** |
| Rush | Cy | Cyclone silty clay loam | 1,080.75 | 100 |
| | | **Total** | **1,080.75** | **100** |

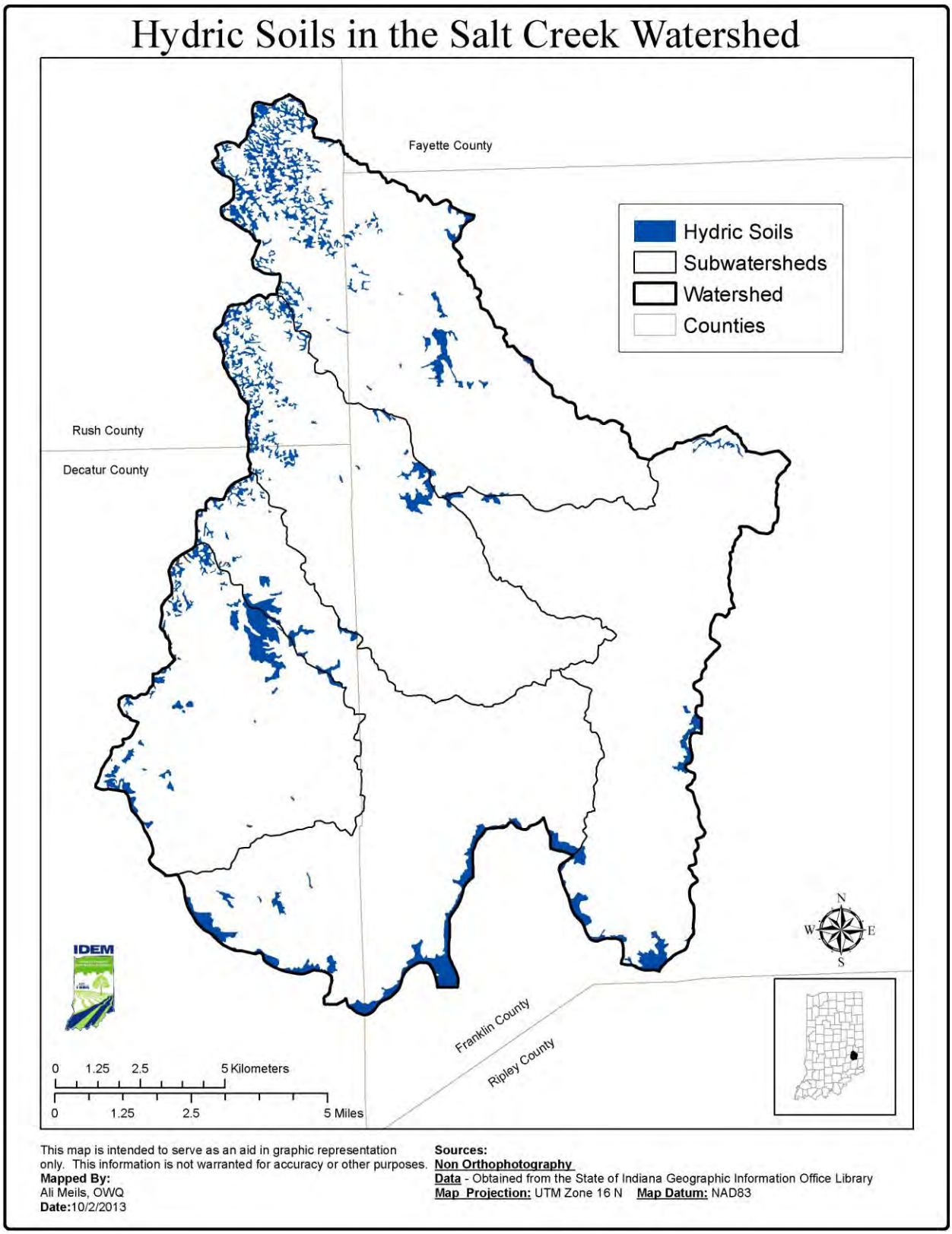


**Figure 17. Hydric Soils in the Salt Creek Watershed**

Data on hydric soils by county is available from NRCS at http://soils.usda.gov/use/hydric/. Agencies such as the USGS and U.S. Fish and Wildlife Service (USFWS) estimate that Indiana has lost approximately 85 percent of the state's original wetlands. (See http://www.in.gov/dnr/fishwild/files/partner.pdf and http://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html) Currently, the Salt Creek watershed contains approximately 970 acres of wetlands or 1.3 percent of the total surface area (USFWS,

2003).

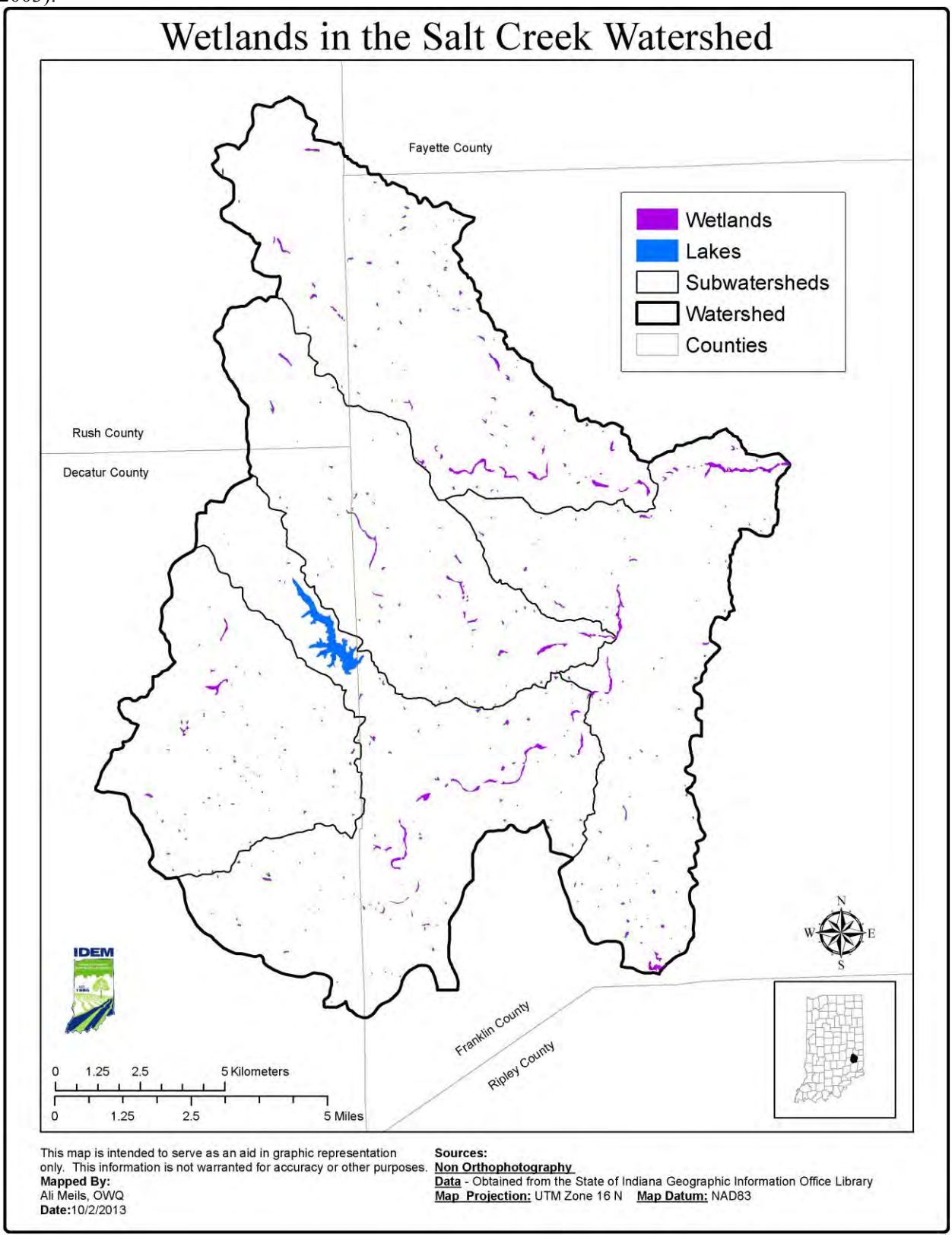


Figure 18 shows estimated locations of wetlands as defined by the USFWS's National Wetland Inventory (NWI). Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at <

http://www.fws.gov/wetlands/Data/Web-Map-Services.html>. Aerial photograph interpretation techniques were used to compile the NWI. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground surveys, and boundaries are generalized in most cases. The wetland information used in Section 3.1 was from the MRLCC dataset and is based on soil types, whereas, aerial photography interpretation techniques were used to compile the NWI. Therefore the estimate of the current extent of wetlands in the Salt Creek watershed from the NWI may not agree with those listed in Section 3.1, which are based upon the MRLCC dataset. Wetland areas act to buffer wide variations in flow conditions that result from storm events. They also allow water to infiltrate slowly thus reducing the risks of contaminated water runoff into waterbodies.

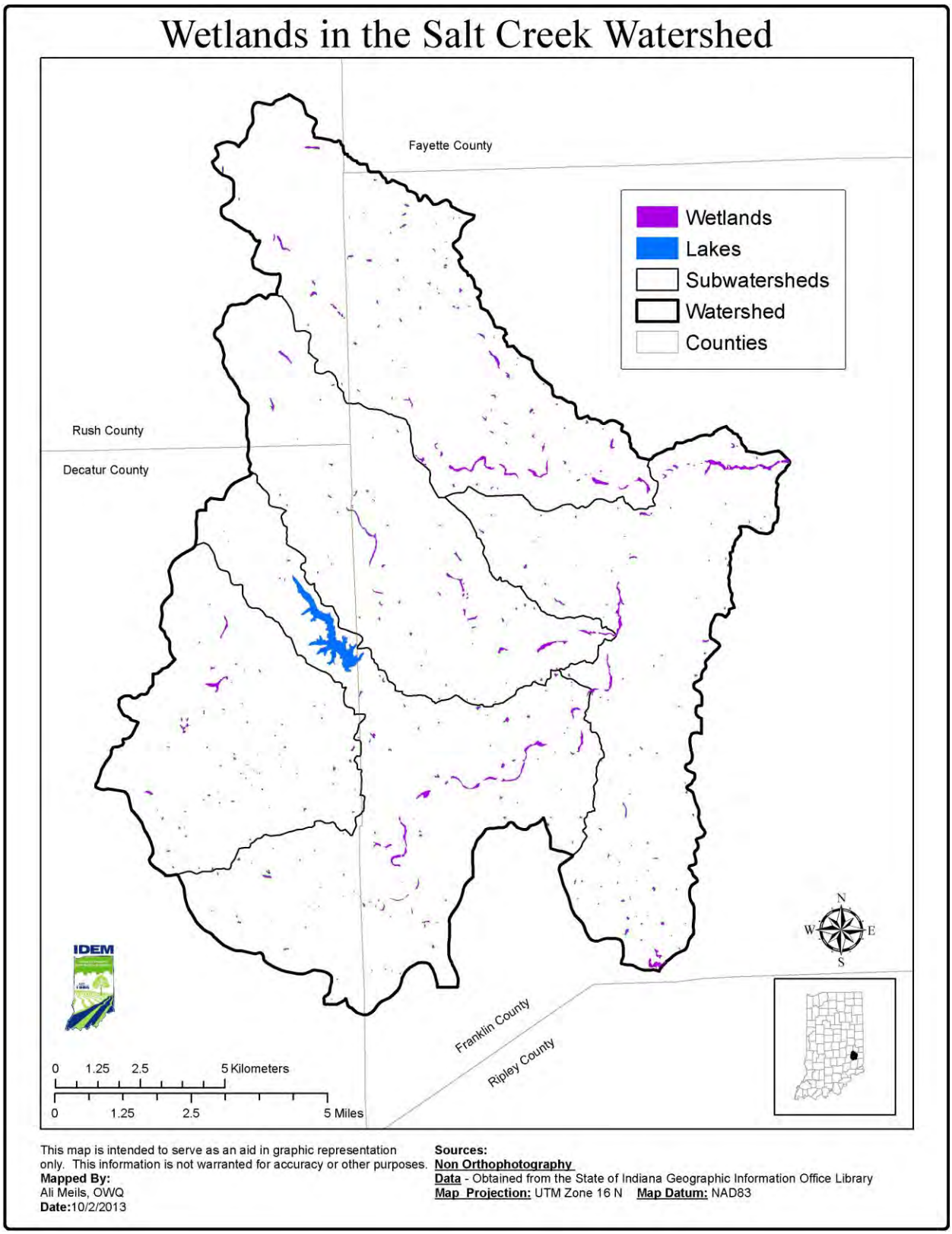


**Figure 18. Locations of Wetlands in Salt Creek Watershed**

Changes to the natural drainage patterns of a watershed are referred to as hydromodification. Historically, drain tiles have been used throughout Indiana to drain marsh or wetlands and make it either habitable or tillable for agricultural purposes. While tile drainage is understood to be pervasive – estimated at thousands of miles in Indiana – it is extremely challenging to quantify on a watershed basis because these tiles were established by varying authorities including County Courts, County Commissioners, or County Drainage Boards (see http://boonecounty.in.gov/Default.aspx?tabid=167). Records were not kept by private landowners as to the location and quantity of these tiles.

In addition to tile drainage, regulated drains are another form of hydromodification. A regulated drain is a drain which was established through either a Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated drains can be an open ditch, a tile drain, or a combination of both. The County Drainage Board can construct, maintain, reconstruct or vacate a regulated drain. In the Salt Creek watershed, there are approximately 1 mile of tile drains and 1 mile of open ditches under the jurisdiction of the Rush County Drainage Board all other county information is unavailable.

### 3.5.4 Soil Erodibility

Although erosion is a natural process within stream ecosystems, excessive erosion negatively impacts the health of watersheds. Erosion increases sedimentation of the streambeds, which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as runoff, it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms.

The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land. HELs are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another. The classification for HELs is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, which is the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. The soil types and acreages in the Salt Creek watershed are

listed by county in Table 14. HELs and potential HELs in the Salt Creek watershed are mapped in

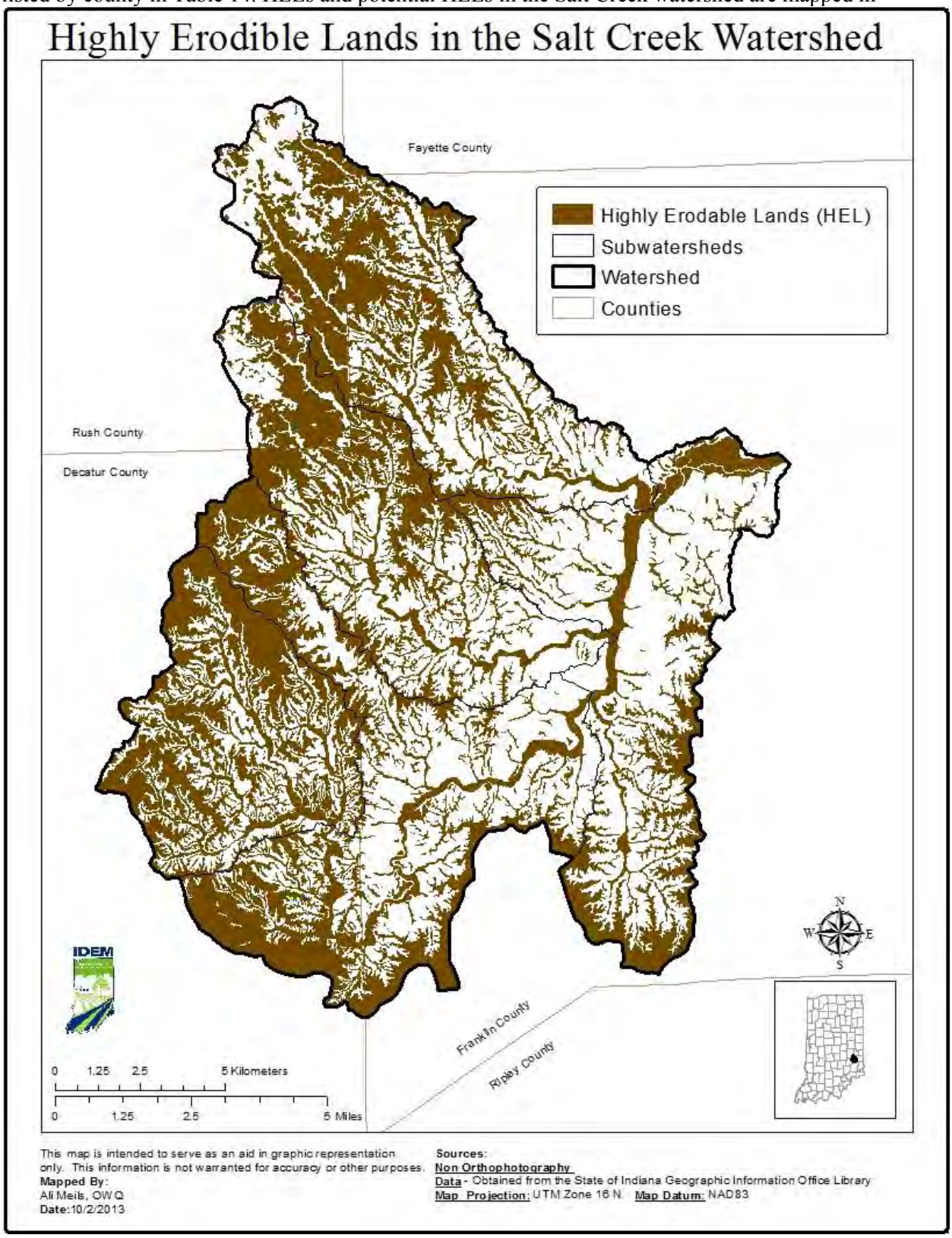

Figure 19. The data used to create

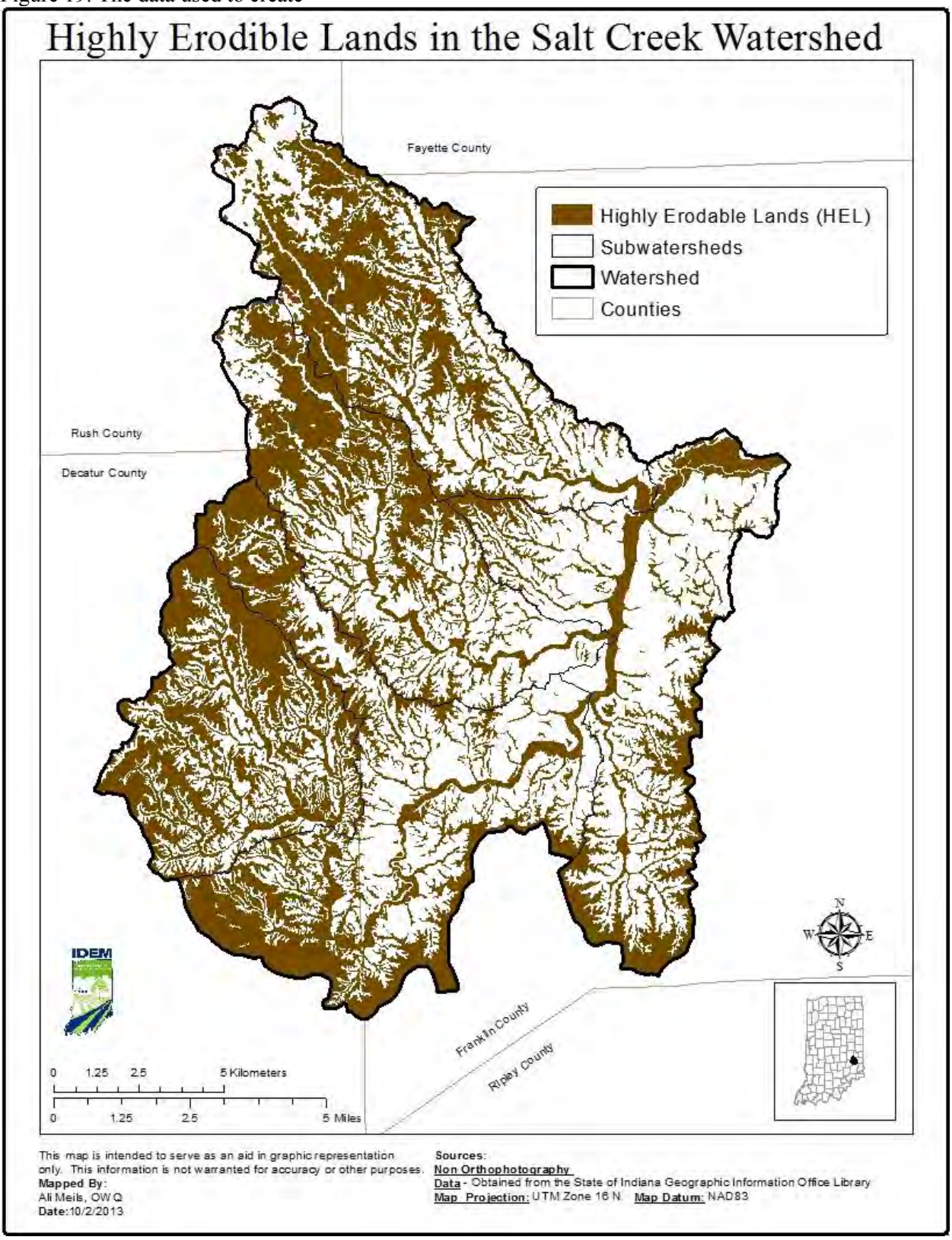


Figure 19 was collected from the NRCS offices of Decatur, Franklin, Fayette and Rush Counties. A total of 36,545 acres or 49 percent of the Salt Creek watershed is considered highly erodible or potentially

highly erodible. Rainfall within the Salt Creek watershed is moderately heavy with an annual average of 43 inches. This rainfall and climate data specific to the watershed is available from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html). Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases. When comparing the HEL map to the landuse map it seems much of the HEL is agricultural land. Best management practices, such as cover crops, should be used to prevent bare soil from being exposed to the elements furthering the loss of sediments. On the other hand, when comparing the HEL map to the topography map, it appears these areas are also the flattest areas in the watershed which is helping prevent sediment erosion.

**Table 14. HEL/Potential HEL Total Acres in the Counties in the Salt Creek Watershed**

| County | Symbol | HEL/Potential HEL Soil Types | Acres | Total Percent |
|---|---|---|---|---|
| Decatur | AvA, AvB | Avonburg silt loam | 3,367.65 | 24.70 |
| | Cg | Chagrin loam | 454.68 | 3.33 |
| | Ch | Chagrin variant silt loam | 52.90 | 0.39 |
| | CkB2 | Cincinnati silt loam | 361.74 | 2.65 |
| | Cm | Clermont silt loam | 991.96 | 7.27 |
| | CnG | Corydon-Rock outcrop complex | 144.92 | 1.06 |
| | Cy | Cyclone silt loam | 421.97 | 3.09 |
| | FcA, FcB | Fincastle silt loam | 721.47 | 5.29 |
| | GrC2 | Grayford-Ryker silt loam | 60.75 | 0.45 |
| | Lb | Lobdell silt loam | 685.09 | 5.02 |
| | MeA, MeB2 | Martinsville loam | 27.87 | 0.20 |
| | MmB2 | Miami silt loam | 101.53 | 0.74 |
| | Mr | Milford silty clay | 4.74 | 0.03 |
| | Or | Orrville silt loam | 1,145.29 | 8.40 |
| | RsB2 | Rossmoyne silt loam | 3,053.57 | 22.40 |
| | RuB | Russell silt loam | 761.94 | 5.59 |
| | So | Sloan silt loam | 24.34 | 0.18 |
| | Ud | Udorthents-Pits complex | 133.37 | 0.98 |
| | WmB | Williamstown silt loam | 159.94 | 1.17 |
| | XnA, XnB | Xenia silt loam | 962.23 | 7.06 |
| | | **Total** | **13,637.95** | **100** |
| Fayette | RsB1, RsC2 | Russell silt loam | 36.21 | 67.49 |
| | RtB3, RtC3, RtD3 | Russell soils | 14.22 | 26.51 |
| | XeB1 | Xenia silt loam | 3.22 | 6.0 |
| | | **Total** | **53.65** | **100** |
| Franklin | AlA, AlB | Alvin sandy loam | 351.21 | 1.91 |
| | AvA | Avonburg silt loam | 3,566.46 | 19.40 |
| | CkB2 | Cincinnati silt loam | 3,328.98 | 18.11 |
| | Cm | Cobbsfork silt loam | 1,451.51 | 7.89 |
| | Cy | Cyclone silt loam | 57.38 | 0.31 |
| | Db | Dearborn loam | 601.22 | 3.27 |

| County | Symbol | HEL/Potential HEL Soil Types | Acres | Total Percent |
|---|---|---|---|---|
| | ElB | Eldean loam | 6.75 | 0.04 |
| | FcB | Fincastle silt loam | 132.99 | 0.72 |
| | GD, GE | Gessie loam | 1,164.96 | 6.34 |
| | Ht | Holton silt loam | 724.84 | 3.94 |
| | MmB2 | Miami silt loam | 363.39 | 1.98 |
| | Mr | Milford silty clay loam | 30.61 | 0.17 |
| | Mt, Mx | Moundhaven sandy loam | 138.44 | 0.75 |
| | OcA, OcB2 | Ockley loam | 166.40 | 0.91 |
| | Og | Oldenburg silt loam | 764.47 | 4.16 |
| | PrC | Princeton fine sandy loam | 45.91 | 0.25 |
| | Rm | Ross silt loam | 12.60 | 0.07 |
| | RsA, RsB2 | Rossmoyne silt loam | 2,995.98 | 16.30 |
| | RuB2 | Russell silt loam | 428.45 | 2.33 |
| | UaB | Uniontown silt loam | 45.08 | 0.25 |
| | WeB2 | Weisburg silt loam | 132.41 | 0.72 |
| | WmB | Williamstown silt loam | 21.98 | 0.12 |
| | Wn | Wirt loam | 1,277.65 | 6.95 |
| | WoB | Woolper silty clay loam | 57.78 | 0.31 |
| | XnA, XnB2 | Xenia silt loam | 518.32 | 2.82 |
| | | **Total** | **18,385.77** | **100** |
| Rush | MoC3, MoD3 | Miami clay loam | 1,080.75 | 24.19 |
| | MmD, MmB2 | Miami silt loam | 1,363.22 | 30.51 |
| | RuB | Russell silt loam | 293.32 | 6.56 |
| | WwB2 | Williamstown silt loam | 260.41 | 5.83 |
| | XeB | Xenia silt loam | 1,470.33 | 32.91 |
| | | **Total** | **4,468.03** | **100** |

***Understanding Table 14:*** In the Salt Creek watershed, Franklin County has the most acreage of HEL/potential HEL soils. Areas within these counties might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.

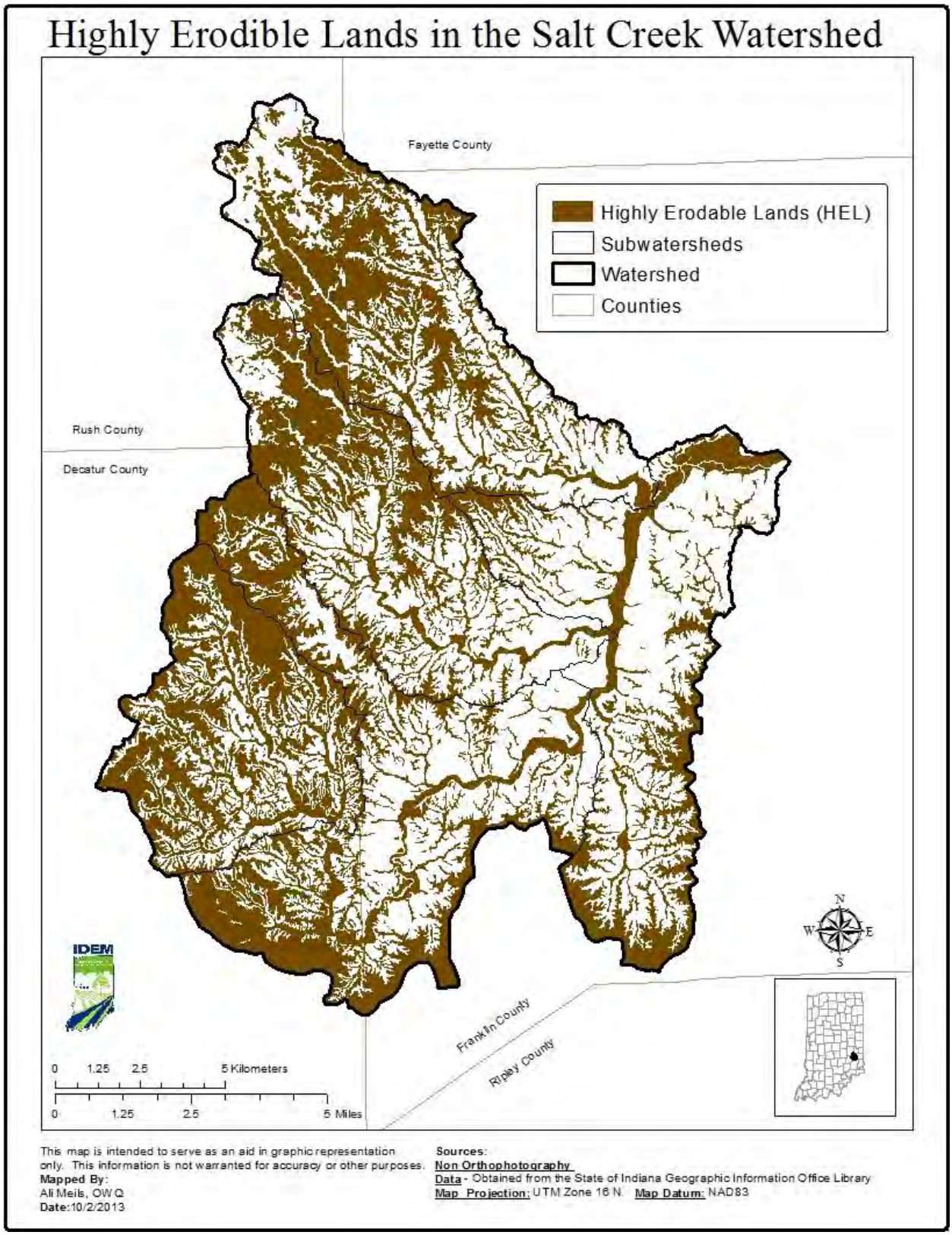


**Figure 19. HEL/Potential HEL Soils in the Salt Creek Watershed**

The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect help determine adoption of conservation practices and estimate the average annual soil loss from Indiana's agricultural lands. The latest figures for the counties in the Salt Creek watershed are shown in Table 15. Tillage practices captured in ISDA's tillage transect include No-Till, Mulch-Till, Reduced-Till and conventional tillage practices. ISDA defines No-Till as any direct seeding system including site preparation, with minimal soil disturbance. Mulch-Till is any tillage system leaving greater than 30 percent residue cover after planting, excluding no-till. Reduced-Till is a tillage system leaving 16 percent to 30 percent residue cover after planting. Conventional-Till is any tillage system leaving less than 30 percent residue cover after planting.

**Table 15. County Tillage Transect Data from 2009 to 2013 in the Salt Creek Watershed**

| Crop | Tillage Practice | Decatur | | | Fayette | | | Franklin | | | Rush | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 |
| Corn | % No-Till | 33 | 24 | 27 | 22 | 39 | 40 | 19 | 23 | 21 | 19 | 33 | 19 |
| | % Mulch-Till | 18 | 18 | 16 | 7 | 21 | 11 | 15 | 15 | 14 | 19 | 37 | 40 |
| | % Reduced-Till | 14 | 18 | 28 | 18 | 31 | 19 | 33 | 43 | 54 | 36 | 20 | 35 |
| | % Conventional-Till | 36 | 39 | 29 | 53 | 9 | 30 | 33 | 19 | 11 | 26 | 10 | 6 |
| Soybeans | % No-Till | 71 | 61 | 64 | 69 | 53 | 46 | 70 | 50 | 62 | 65 | 82 | 63 |
| | % Mulch-Till | 15 | 18 | 18 | 15 | 39 | 32 | 11 | 32 | 22 | 15 | 13 | 26 |
| | % Reduced-Till | 6 | 10 | 13 | 10 | 6 | 16 | 7 | 14 | 14 | 14 | 3 | 10 |
| | % Conventional-Till | 7 | 10 | 6 | 5 | 2 | 6 | 13 | 3 | 2 | 6 | 2 | 1 |

***Understanding Table 15:*** According to Table 15, No-Till practices for soybeans are predominant in all counties in the Salt Creek watershed. There has been a reduction in conventional tillage practices for corn in both Franklin and Rush counties since 2009.

## 3.6 Climate and Precipitation

Climate varies in Indiana depending on latitude, topography, soil types, and lakes. Information on Indiana's climate is available through sources including the Indiana State Climate Office at Purdue University (http://climate.agry.purdue.edu/climate/narrative.asp).

Climate data from Station 121030 located in Brookville were used for climate analysis of the Salt Creek watershed. Monthly data from 1948 - 2013 were available at the time of analysis. In general, the climate of the region has hot, humid summers and cold winters. From 1948 to 2013, the average winter temperature in Brookville was 32°F and the average summer temperature was 85°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 183 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of runoff on water quality. From 1948 to 2013, the annual average precipitation in Brookville at Station 121030 was approximately 43 inches, including approximately 15.5 inches of snowfall.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of storm water on the Salt Creek watershed. Using data from 121030 during 1948 to 2013, 52 percent of the measureable precipitation events were very low intensity (i.e., less than 0.2 inches), while 8 percent of the measurable precipitation events were greater than one inch.

Knowing when precipitation events occur helps in the linkage analysis, which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Salt Creek watershed occurs between the months of April and May. Precipitation/ Rainfall graphs can be found for all sampling sites in Appendix B.

## 3.7 Summary

The information presented helps to provide a better comprehensive understanding of the conditions and characteristics in the Salt Creek watershed that, when coupled with the sources, affect both water quality and water quantity. In summary, the predominant land uses in the Salt Creek watershed of forested and agricultural lands serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the Salt Creek watershed. Human population, which is greatest in Franklin and Decatur counties in the Salt Creek watershed, indicates where more infrastructure related pressures on water quality might exist. The subsections on topography and geology, as well as soils, provide information on the natural features that affect hydrology in the Salt Creek watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Salt Creek watershed. Lastly, the subsection on climate and precipitation provides information on water quantity and the factors that influence flow, which ultimately affects the influence of storm water on the watershed. Collectively, this information plays an important role in understanding the sources that contribute to water quality impairment during TMDL development and crafting the linkage analysis that connects the observed water quality impairment to what has caused that impairment.

# 4.0 SOURCE ASSESSMENT

This section presents information concerning IDEM's segmentation process as it applies to the Salt Creek watershed in order to present a source assessment specific to the Salt Creek watershed as well as summaries of significant sources of *E. coli*, nutrients and sediment for each subwatershed within the Salt Creek watershed.

## 4.1 Understanding Subwatersheds and Assessment Units

As briefly discussed in Section 2.3, the Salt Creek watershed contains five 12-digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include (**Error! Reference source not found.**):

- Headwaters Salt Creek (050800030501)
- Righthand Fork Salt Creek (050800030502)
- Bull Fork (050800030503)
- Little Salt Creek (050800030504)
- Fremont Branch (050800030505)

Within each 12-digit HUC subwatershed, IDEM has identified several Assessment Unit (AUIDs), which represent individual stream segments. Through the process of segmenting subwatersheds into AUIDs, IDEM identifies streams reaches and stream networks that are representative for the purposes of assessment. In practice, this process leads to grouping tributary streams into smaller catchment basins of similar hydrology, land use, and other characteristics such that all tributaries within the catchment basin can be expected to have similar potential water quality impacts. Catchment basins, as defined by the aforementioned factors and are typically very small, which significantly reduces the variability in the water quality expected from one stream or stream reach to another. Given this, all tributaries within a catchment basin are assigned a single AUID. Grouping tributary systems into smaller catchment basins also allows for better characterization of the larger watershed and more localized recommendations for implementation activities. Variability within the larger watershed will be accounted for by the differing AUIDs assigned to the different catchment basins.

Table 16 contains the AUIDs in the subwatersheds of the Salt Creek watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.

**Table 16. Assessment Units in Salt Creek Watershed**

| Name of Subwatershed | Surface Area (sq. miles) | Percent Surface Area | Current AUID (2014) | Length (mi) | Drainage area (sq. miles) |
|---|---|---|---|---|---|
| Headwaters Salt Creek (050800030501) | 17.35 | 14.76 | ING0351_01 | 8.10 | 17.32 |
| | | | ING0351_T1001 | 4.33 | |
| | | | ING0351_T1002 | 14.04 | |
| | | | ING0351_T1003 | 7.88 | |
| Righthand Fork (050800030502) | 28.45 | 24.25 | ING0352_01 | 28.15 | 45.76 |
| | | | ING0352_01A | 0.38 | |
| | | | ING0352_P1001 | 2.46 | |
| | | | ING0352_T1001 | 2.86 | |
| | | | ING0352_T1002 | 5.15 | |

| Name of Subwatershed | Surface Area (sq. miles) | Percent Surface Area | Current AUID (2014) | Length (mi) | Drainage area (sq. miles) |
|---|---|---|---|---|---|
| | | | ING0352_T1003 | 4.05 | |
| | | | ING0352_T1004 | 1.17 | |
| | | | ING0352_T1005 | 0.53 | |
| | | | ING0352_T1006 | 7.17 | |
| | | | ING0352_T1007 | 2.37 | |
| | | | ING0352_T1008 | 2.23 | |
| | | | ING0352_T1009 | 2.13 | |
| | | | ING0352_T1010 | 2.35 | |
| | | | ING0352_T1011 | 1.08 | |
| Bull Fork (050800030503) | 21.57 | 18.38 | ING0353_01 | 6.56 | 21.56 |
| | | | ING0353_02 | 13.01 | |
| | | | ING0353_02A | 0.36 | |
| | | | ING0353_T1001 | 1.56 | |
| | | | ING0353_T1002 | 3.70 | |
| | | | ING0353_T1003 | 5.25 | |
| | | | ING0353_T1004 | 1.18 | |
| | | | ING0353_T1005 | 1.07 | |
| | | | ING0353_T1006 | 5.74 | |
| | | | ING0353_T1007 | 1.08 | |
| | | | ING0353_T1008 | 2.18 | |
| Little Salt Creek (050800030504) | 25.14 | 21.42 | ING0354_01 | 10.92 | 25.13 |
| | | | ING0354_02 | 20.43 | |
| | | | ING0354_T1001 | 2.57 | |
| | | | ING0354_T1002 | 9.48 | |
| | | | ING0354_T1003 | 6.81 | |
| | | | ING0354_T1004 | 4.07 | |
| | | | ING0354_T1005 | 1.92 | |
| Fremont Branch (050800030505) | 24.87 | 21.19 | ING0355_01 | 10.16 | 117.36 |
| | | | ING0355_T1001 | 9.26 | |
| | | | ING0355_T1002 | 11.49 | |
| | | | ING0355_T1003 | 3.08 | |
| | | | ING0355_T1004 | 1.84 | |
| | | | ING0355_T1005 | 3.71 | |
| | | | ING0355_T1006 | 5.50 | |
| | | | ING0355_T1007 | 8.37 | |
| | | | ING0355_T1008 | 7.43 | |
| | | | ING0355_T1009 | 2.35 | |
| | | | ING0355_T1010 | 1.71 | |

***Understanding Table 16:*** Land area helps IDEM to define the pollutant load reductions needed for each AUID in each 12-digit HUC subwatershed that comprises the Salt Creek watershed. Information in each column is as follows:

- *Column 1: Name of Subwatershed.* Lists the name of the subwatersheds.

- *Column 2: Surface Area.* Indicates the total surface area for each subwatershed.
- *Column 3: Percent Surface Area.* Indicates the percent of the total surface area, providing a relative understanding of the portion of each subwatershed in the Salt Creek watershed.
- *Column 4: Current AUID*. Provides the updated AUIDs associated with each subwatershed.
- *Column 5: Length.* Quantifies the length of each AUID stream segment.
- *Column 6: Drainage Area.* Quantifies the area the subwatershed drains.

IDEM bases percent load reductions on the drainage area for each AUID in the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations found in this report. This table will help watershed stakeholders look at the smaller segments within the Salt Creek watershed and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

## 4.2 Source Assessment by Subwatershed

This section summarizes the available information on significant point and nonpoint sources of *E. coli*, nutrients and sediment in the five subwatersheds of the Salt Creek watershed.

The term “point source” refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel or conduit, by which pollutants are transported to a waterbody. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term “point source” also includes: concentrated animal feeding operations (CAFO) which are places where animals are confined and fed; storm water runoff from Municipal Separate Storm Sewer Systems (MS4s), construction site of one acre or more of land disturbance, and specific categories of industrial activities that convey storm water; and illicitly connected “straight pipe” discharges of household waste. Permitted point sources are regulated through the NPDES.

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, runoff from lawn fertilizer applications, pet waste, storm water runoff (outside of MS4 communities), and other sources. In rural areas, nonpoint sources can include runoff from cropland, pastures and animal feeding operations and inputs from streambank erosion, leaking or failing septic systems, and wildlife.

### 4.2.1 Salt Creek Subwatershed Summary

This section of the report presents the available information on the sources of *E. coli*, nutrients and sediment in the Salt Creek subwatersheds.

**Table 17. Land Use in the Headwaters Salt Creek Subwatersheds**

| Subwatershed | Area | Land Use | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Developed | Forest | Hay/ Pasture | Shrub | Open Water | Wetlands | |
| Headwaters Salt Creek | Acres | 5258 | 538 | 3387 | 1807 | 76 | 24 | <1 | 11,090 |
| | Sq. Mi. | 8 | 1 | 5 | 3 | <1 | <1 | <1 | 17 |
| | Percent | 47 | 5 | 31 | 16 | 1 | <1 | <1 | 100 |
| Righthand Fork Salt Creek | Acres | 5,118 | 1,144 | 8,674 | 2,781 | 187 | 305 | 1 | 18,210 |
| | Sq. Mi. | 8 | 2 | 14 | 4 | <1 | <1 | <1 | 28 |
| | Percent | 28 | 6 | 48 | 15 | 1 | 2 | <1 | 100 |
| Bull Fork | Acres | 3923 | 470 | 7,553 | 1,625 | 216 | 17 | 0 | 13,804 |
| | Sq. Mi. | 6 | 1 | 12 | 3 | <1 | <1 | 0 | 22 |
| | Percent | 28 | 3 | 55 | 12 | 2 | <1 | 0 | 100 |
| Little Salt Creek | Acres | 5,694 | 828 | 7,542 | 1,777 | 36 | 206 | 1 | 16,084 |
| | Sq. Mi. | 9 | 1 | 12 | 3 | <1 | <1 | <1 | 25 |
| | Percent | 36 | 5 | 48 | 11 | <1 | 1 | <1 | 100 |
| Fremont Branch | Acres | 2,133 | 649 | 10,730 | 2,169 | 185 | 45 | 0 | 15,911 |
| | Sq. Mi. | 3 | 1 | 17 | 3 | <1 | <1 | 0 | 24 |
| | Percent | 14 | 4 | 67 | 14 | 1 | <1 | 0 | 100 |

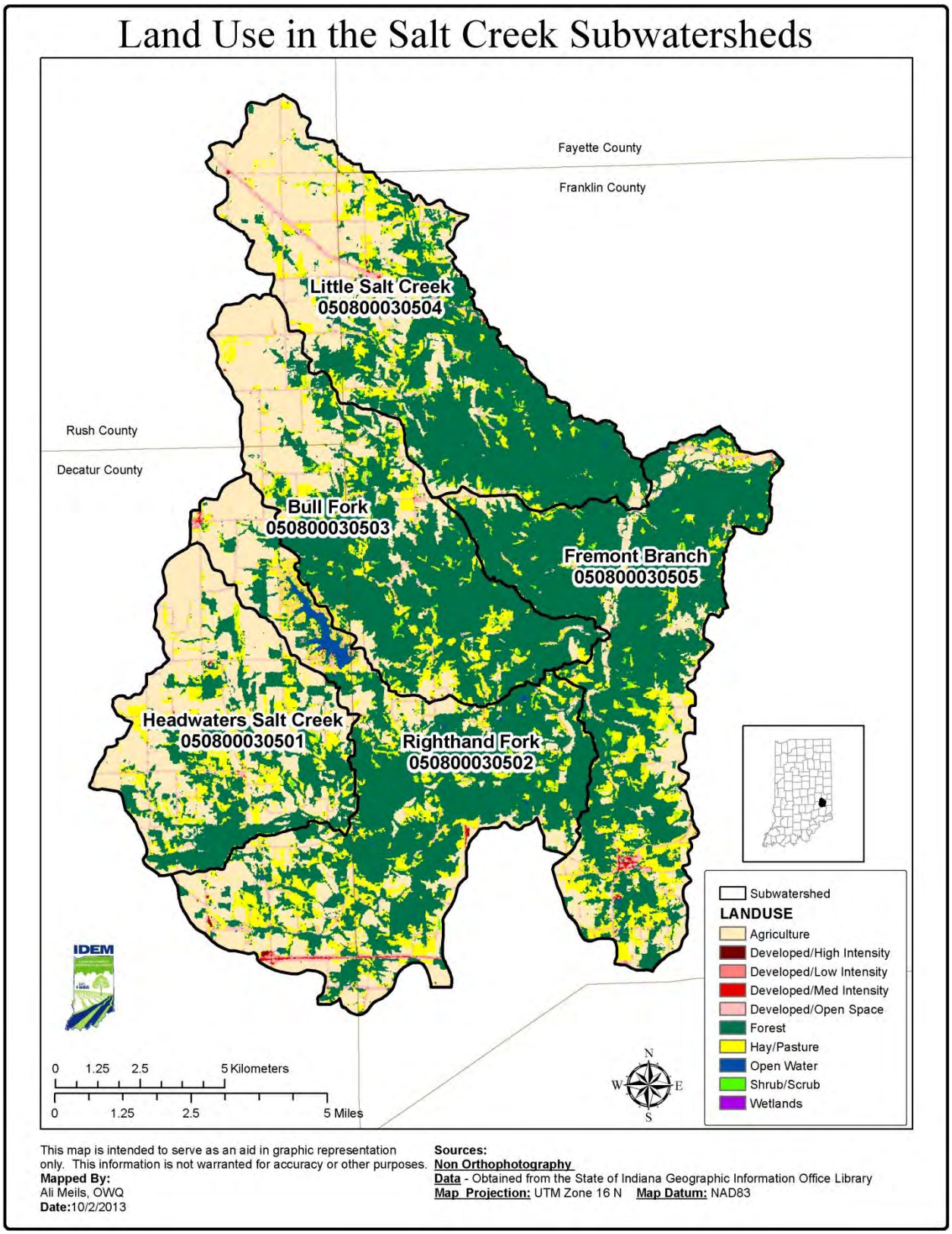


**Figure 20. Land Use in the Salt Creek Subwatersheds**

#### 4.2.1.1 Point Sources

The State of Indiana regulates the direct discharge of pollutants to waters of the State through the National Pollutant Discharge Elimination System (NPDES) Permit Program. The permits issued place limits on the amount of pollutants that may be discharged to surface waters by each facility. These limits are set at levels protective of both aquatic life in the waters which receive the discharge and protective of human health. This section summarizes the potential point sources of *E. coli*, nutrients and sediment in the Salt Creek watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

***Municipal Facilities***

A municipal facility, or wastewater treatment plant (WWTP), is designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes. Some of the functions of a WWTP include agricultural wastewater treatment, sewage treatment and industrial wastewater treatment. WWTPs are critical for maintaining public sanitation and a healthy environment.

Municipal facilities in Indiana are required to disinfect their effluent during the recreational season (April 1 to October 31). **Error! Reference source not found.** contains the maximum design flow for the active facilities.

Treated municipal sewage is a point source of nutrients. WWTPs may release water with elevated concentrations of nutrients into streams. As discussed in Section 2.2, the target value for total phosphorus is 0.30 mg/L and the target value for total nitrogen is 10 mg/L. These target values are used to establish potential permit limits. Phosphorus is interpreted as an average in the NPDES permits. All monitoring data shows that when in compliance with the current permit limit of 1.0 mg/L, the in-stream TMDL target is met.

Flows used to calculate nutrient loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Nutrient concentrations used to calculate nutrient loads from each treatment plant are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels).

The TMDL target value for TSS is set at the WWTP's permit effluent limit for TSS. Therefore, a target of 30 mg/L for total suspended solids TSS has been identified as a permit limit for NPDES facilities.

There are two WWTP dischargers that discharge wastewater containing *E. coli*, nutrients and sediment within the Salt Creek watershed (Figure 20). These facilities are as follows: Lake Santee Regional Waste and Water District WWTP and Oldenburg WWTP. Summaries of the WWTP permits within the Salt Creek watershed are described below.

**Table 18. NPDES Permitted Wastewater Treatment Plants Discharging within the Salt Creek Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA | NA |
| Righthand Fork Salt Creek | Lake Santee Regional Waste and Water District Wastewater Treatment Plant | IN0060704 | ING0352_T1006 | Righthand Fork | 0.1 |
| Bull Fork | NA | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA | NA |
| Fremont Branch | Oldenburg WWTP | IN0023973 | ING0355_T1001 | Harvey Branch | 0.15 |

The Lake Santee Regional Waste and Water District WWTP operates a Class I extended aeration treatment facility consisting of nitrification, two final clarifiers, an aerobic digester, ultraviolet light disinfection, post aeration and influent and effluent flow meters. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points. Final solids are land applied under Land Application Permit INLA000663. Effluent from the plant impacts a small portion of Righthand Fork Salt Creek downstream of Lake Santee, approximately three miles upstream of the confluence with Salt Creek.

The Town of Oldenburg WWTP operates a Class I extended aeration treatment facility consisting of a flow meter, an oxidation ditch, two secondary clarifiers (although only one in use), and effluent chlorination/dechlorination. Liquid sludge is stored in one of the two aerobic digesters and then dewatered by a sludge dewatering bagger system. Bags of sludge are then hauled to a landfill by a private contractor. The collection system is comprised of 100% separate sanitary sewers by design with one sanitary sewer overflow (SSO). Oldenburg WWTP was granted a construction permit in 2011 to update the facility. The plans indicate the construction of a flow equalization pump station and a flow equalization tank to collect excess wet weather flow when the influent flows exceed the capacity of the raw sewage pump station. This 500,000 gallon tank should reduce or eliminate SSO events. An additional secondary clarifier and digester upgrades are included in the construction plans. Effluent from the plant impacts the headwaters of Harvey Branch, approximately three miles upstream of the confluence with Salt Creek. A notice on noncompliance was issued to the facility in January 2014 for an ammonia nitrogen violation and as of September of 2014 the facility remains in violation according to the EPA.

**Error! Reference source not found.** presents a summary of permit compliance for WWTP NPDES facilities in the Salt Creek watershed for the five year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). The table also presents the total number of violations in the five year period for the NPDES permitted parameters. According to **Error! Reference source not found.**, there have been seven NPDES facility inspections resulting in potential problems or violations in the five year period. Overall, there are a total of ten permit violations for the NPDES permitted parameters in the Salt Creek watershed.

**Table 19. Summary of WWTP Inspections and Permit Compliance in the Salt Creek Subwatersheds for the Five Year Period Ending September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Month | Year | Parameter | Type | # Violations |
| Headwaters Salt Creek | NA | NA | NA | NA | NA | | | | |
| Righthand Fork Salt Creek | Lake Santee Regional Waste and Water District Wastewater Treatment Plant | IN0060704 | ING0352_T1006 | 07/13/2009: Potential problems observed<br>07/06/2011: No violations observed<br>02/13/2013: Potential problems observed<br>10/29/2013: No Violations observed | Dec<br>April | 2010<br>2013 | TSS<br>TSS | Max Wk Avg<br>Max Wk Avg | 1<br>1 |
| Bull Fork | NA | NA | NA | NA | NA | | | | |
| Little Salt Creek | NA | NA | NA | NA | NA | | | | |
| Fremont Branch | Oldenburg WWTP | IN0023973 | ING0355_T1001 | 01/06/2010: Potential problems observed<br>09/27/2011: Potential problems observed<br>03/08/2012: Potential problems observed<br>02/19/2013: Potential problems observed<br>01/08/2014: Violations observed | April<br>May<br>April<br>April<br>April<br>Dec<br>April<br>Jan | 2010<br>2010<br>2011<br>2011<br>2011<br>2011<br>2012<br>2104 | *E. coli*<br>*E. coli*<br>BOD<br>*E. coli*<br>TSS<br>Ammonia<br>Ammonia<br>Ammonia | Daily Max<br>Daily Max<br>Max Wk Avg<br>Daily Max<br>Max Wk Avg<br>Max Wk Avg<br>Max Wk Avg<br>Max Wk Avg | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 |

### *Sanitary Sewer Overflows*

Sanitary sewer overflows (SSOs) are unintentional and illegal discharges of raw sewage from municipal sanitary sewers. SSOs discharge *E. coli* to waterbodies and may occur due to:

- Severe weather resulting in of excessive runoff of storm water into sewer lines
- Vandalism
- Improper operation and maintenance
- Malfunction of lift stations
- Electrical power failures

Overflows in the sanitary sewer system or in a sanitary portion of a combined sewer system are expressly prohibited from discharging at any time. Should any release from the sanitary sewer system occur, the permitee is required to notify the Enforcement Section of the Office of Water Quality orally within 24 hours and in writing within five days of the event in accordance with the requirements in Part II.C.2.b of the permit. The correspondence shall include the duration and cause of discharge as well as the remediation action taken to eliminate it.

One permitted facility with one SSO location was identified in the Salt Creek watershed. (Table 20). The Town of Oldenburg WWTP operates a Class I extended aeration treatment facility. The collection system is comprised of 100% separate sanitary sewers by design with one sanitary sewer overflow (SSO).

**Figure 21** Sanitary Sewer Overflows in the Salt Creek Subwatersheds

| Subwatershed | Facility Name | Permit # | Type | AUID |
|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA |
| Righthand Fork Salt Creek | NA | NA | NA | NA |
| Bull Fork | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA |
| Fremont Branch | Oldenburg WWTP | IN0023973 | SSO – Influent Structure NA | ING0355_T1001 |

### *Industrial Facilities*

Industrial facilities with NPDES permits produce wastewater generated through producing a product. Wastewater discharges from industrial sources may contain pollutants at levels that could affect the quality of receiving waters. The NPDES permit program establishes specific requirements for dischargers from industrial sources. If the industrial facility discharges wastewater directly to a surface water then it requires an individual or general NPDES permit. A general permit, or permit-by-rule, is a “one size fits all” type of activity-specific permit. The general permit rule (327 IAC 15-1 through 15-4) covers the following activities: coal mining, coal processing, and reclamation activities, noncontact cooling water, petroleum products terminals, groundwater petroleum remediation systems, hydrostatic testing of commercial pipelines, and sand, gravel and stone operations. In contrast, individual permits are tailored to the specific activities of the facility and may regulate a number of additional pollutants other than those described under the general permits.

There is one industrial facility with a general NPDES permit within the Salt Creek watershed. Based on the industrial activities and the regulated parameters within the specific permits there is only one active industrial facility that discharges wastewater within the Salt Creek watershed (**Error! Reference source not found.** and **Error! Reference source not found.**). This facility is the New Point Quarry. Summaries of the industrial permits within the Salt Creek watershed are described below.

**Figure 22** NPDES Permitted Industrial Facilities in the Salt Creek Subwatersheds

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA | NA |
| Righthand Fork Salt Creek | New Point Quarry | ING490006 | ING0352_T1002 | Salt Creek | NA |
| Bull Fork | NA | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA | NA |
| Fremont Branch | NA | NA | NA | NA | NA |

New Point Quarry is engaged in sand, gravel, dimension stone or crushed stone operations. They have been granted a general permit allowing processed wastewater from sand and gravel operations to be discharged to an unnamed tributary of Salt Creek. The effluent consists of ground and rain water necessary to dewater the quarry.

**Error! Reference source not found.** presents a summary of permit compliance for industrial NPDES facilities in the Salt Creek watershed for the three year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). The table also presents the total number of violations in the five year period for all parameters. According to **Error! Reference source not found.**, there have been two NPDES industrial facility inspection in the five year period. Overall, there are no permit violations in the Salt Creek watershed.

**Table 20. Summary of Inspections and Permit Compliance for Industrial Facilities in the Salt Creek Subwatersheds for the Five Year Period Ending in September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 |
|---|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA | NA |
| Righthand Fork Salt Creek | New Point Quarry | ING490006 | ING0352_T1002 | 12/17/2009: No violations observed 01/10/2012: No violations observed | NA |
| Bull Fork | NA | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA | NA |
| Fremont Branch | NA | NA | NA | NA | NA |

### *Industrial Storm Water*

Depending on the type of industrial facility operated more than one NPDES program may apply. Some industrial facilities require an additional permit under the storm water program which will be discussed in this section.

Industrial storm water permits are required for facilities where activities of the industrial operation are exposed to storm water and run-off is discharged though a point source to waters of the state. The general permit 327 IAC 15-6 (Rule 6) applies to specific categories of industrial activities that must obtain permit coverage. Determination of applicable industrial activities is based on a facility's Standard Industrial Classification (SIC) Code(s) or facility activities included in the listed narrative descriptions within the rule. Under certain circumstances, a facility may require an individual storm water permit. This permit is typically required only if a regulated industrial activity category has established effluent limitations or IDEM determines the storm water discharge will significantly lower water quality. There are two Industrial storm water permits within Salt Creek watershed Batesville Aviation Service LLC and Roman Nobb Incorporated. Industrial storm water permits in the Salt Creek watershed are shown in Figure 22.

These facility must develop and implement a Storm Water Pollution Prevention Plan (SWP3), and submit a completed SWP3 Checklist Form certifying to IDEM that such a plan is in place. The SWP3 is used to identify potential and actual storm water pollutant sources, and to determine best management practices and measures that will minimize the pollutants transported in storm water run-off. The SWP3 itself must be retained at the facility, and made available for review during any on-site inspection. Periodically, the plan must be reviewed, and revised if changes at the facility alter conditions that could affect run-off.

**Figure 21. NPDES Industrial Storm Water Permits in the Salt Creek Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Estimated Acreage |
|---|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA | NA |
| Righthand Fork Salt Creek | Batesville Aviation Services LLC | INR800261 | ING0352_01 | Salt Creek | 0.023 |
| Bull Fork | NA | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA | NA |
| Fremont Branch | Roman Nobbe Incorporated | INR210213<br>INR00R065 | ING0355_T1001 | Harvey Branch | 0.056 |

### *Construction Storm Water*

Storm water run-off associated with construction activity is regulated under 327 IAC 15-5 which is commonly known as Rule 5. Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities.

The requirements of Rule 5 now apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land disturbing activity results in the disturbance of less than one (1) acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to storm water permitting.

In Indiana most construction projects subject to Rule 5 are administered through a general permit. A general permit is a permit by rule, and as such it is not "issued" in the same manner as an individual NPDES permit would be issued. Rather, Rule 5 was "conditionally issued" to all future "project site owners" at the time that the rule was adopted by the Indiana Water Pollution Control Board. The permit conditions within Rule 5 apply universally to all "project site owners" who are eligible to operate under the rule.

Rule 5 requires the development of a Construction Plan and an integral part of the Construction Plan is a SWP3. The SWP3 addresses several issues. First, the plan outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. Second, the plan addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. Finally, the plan should also address pollutants that will be associated with the post construction land use. It is the responsibility of the project site owner to implement the storm water pollution prevention plan. In addition, it is critical that the site is monitored during the construction process and in field modifications are made to address the discharge of sediment and other pollutants from the project site. This may require modification of the plan and field changes on the project site, as necessary, to prevent pollutants, including sediment, from leaving the project site.

If an adverse environmental impact from a project site is evident, a Rule 5 permit or, in more significant situations, an individual storm water permit may be required. An individual storm water permit is typically required only if IDEM determines the discharge will significantly lower water quality. If an individual storm water permit is required, notice will be given to the project site owner. The acreage numbers in Table 23 were calculated by using an area weighted approach with using the past five years of permitted construction sites in Rush, Decatur, Franklin and Fayette counties.

**Table 22. Permitted Construction Acreage in the Salt Creek Subwatersheds**

| Subwatershed | Estimated Construction Acreage |
|---|---|
| Headwaters Salt Creek | 1.72 |
| Righthand Fork Salt Creek | 2.09 |
| Bull Fork | 1.55 |
| Little Salt Creek | 1.71 |

| | |
|---|---|
| Fremont Branch | 1.35 |

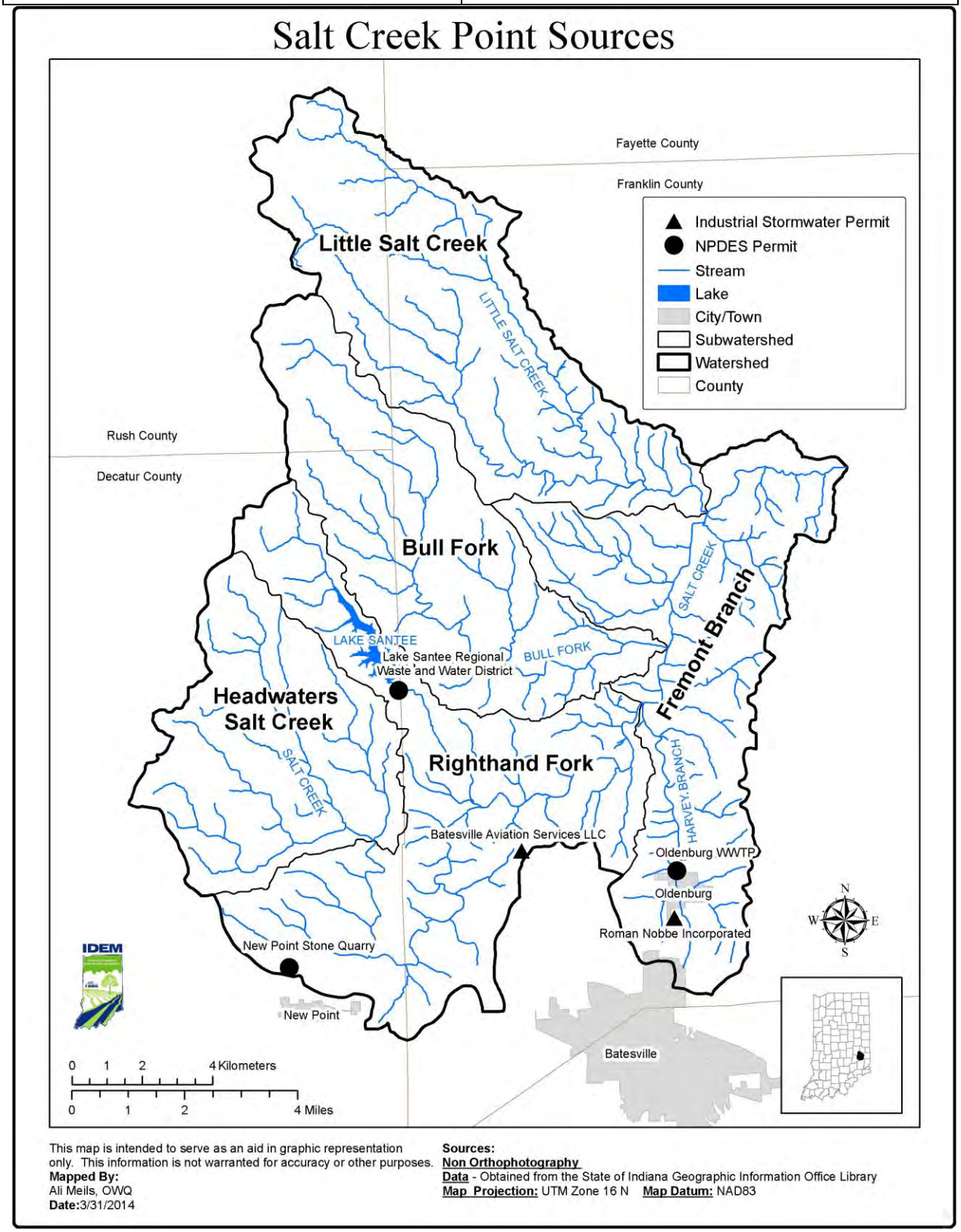


**Figure 23. Point Sources in the Salt Creek Watershed**

#### *Illicitly Connected "Straight Pipe" Systems*

Some household wastes within Indiana and potentially within the Salt Creek watershed directly discharge to a stream or are illegally connected directly to tile-drainage pipes in rural areas, providing a direct source of pollutants such as *E. coli*, nutrients, and TSS to the stream (these systems are sometimes referred to as "straight pipe" discharges).

### Nonpoint Sources

This section summarizes the potential nonpoint sources of *E. coli*, nutrients and sediment in the Salt Creek watershed that are not regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

#### *Cropland*

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from decomposition of residual crop material, fertilization with chemical (e.g., anyhdrous ammonia) and manure fertilizers, inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal and industrial wastewater treatment facilities. The majority of nutrient loading from cropland occurs from fertilization with commercial and manure fertilizers (USEPA, 2003). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (USEPA, 2003).

Watershed specific data are not available for field specific crops. However, county-wide data available from the National Agricultural Statistic Service (NASS) were downloaded and area weighted to estimate crop acreage in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total acreage of crops in the county based on the NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of cropland with the watershed. The 2012 NASS statistics was used in the analysis as shown in Table 24.

**Table 23. Major Cash Crop Acreage in the Salt Creek watershed**

| Crop | Total Acreage in County | | | |
|---|---|---|---|---|
| | Decatur | Fayette | Franklin | Rush |
| Corn | 85,300 | 38,100 | 39,600 | 110,000 |
| Soybean | 75,100 | 35,700 | 35,800 | 103,000 |
| Winter Wheat | 4,600 | 1,600 | 1,800 | 3,700 |

| Subwatershed Area (mi²) | Crop | Total Acreage | Percentage of Subwatershed Crop Acreage |
|---|---|---|---|
| Headwaters Salt Creek (17.32 mi²) | Corn | 2,861.05 | 55.39 |
| | Soybean | 2,264.60 | 43.85 |
| | Winter Wheat | 39.36 | 0.76 |
| | **Total** | **5,165.01** | **100** |
| Righthand Fork Salt Creek (28.44 mi²) | Corn | 3,483.07 | 51.42 |
| | Soybean | 3,123.25 | 46.11 |

| | | | |
|---|---|---|---|
| | Winter Wheat | 167.50 | 2.47 |
| | **Total** | **6,773.82** | **100** |
| **Bull Fork (21.56 mi²)** | Corn | 3,440.78 | 51.21 |
| | Soybean | 3,128.36 | 46.56 |
| | Winter Wheat | 149.76 | 2.23 |
| | **Total** | **6,718.90** | **100** |
| **Little Salt Creek (25.13 mi²)** | Corn | 3,803.05 | 51.01 |
| | Soybean | 3,503.45 | 46.99 |
| | Winter Wheat | 149.14 | 2.00 |
| | **Total** | **7,455.64** | **100** |
| **Fremont Branch (24.86 mi²)** | Corn | 2,514.6 | 51.30 |
| | Soybean | 2,273.3 | 46.37 |
| | Winter Wheat | 114.30 | 2.33 |
| | **Total** | **4,902.2** | **100** |

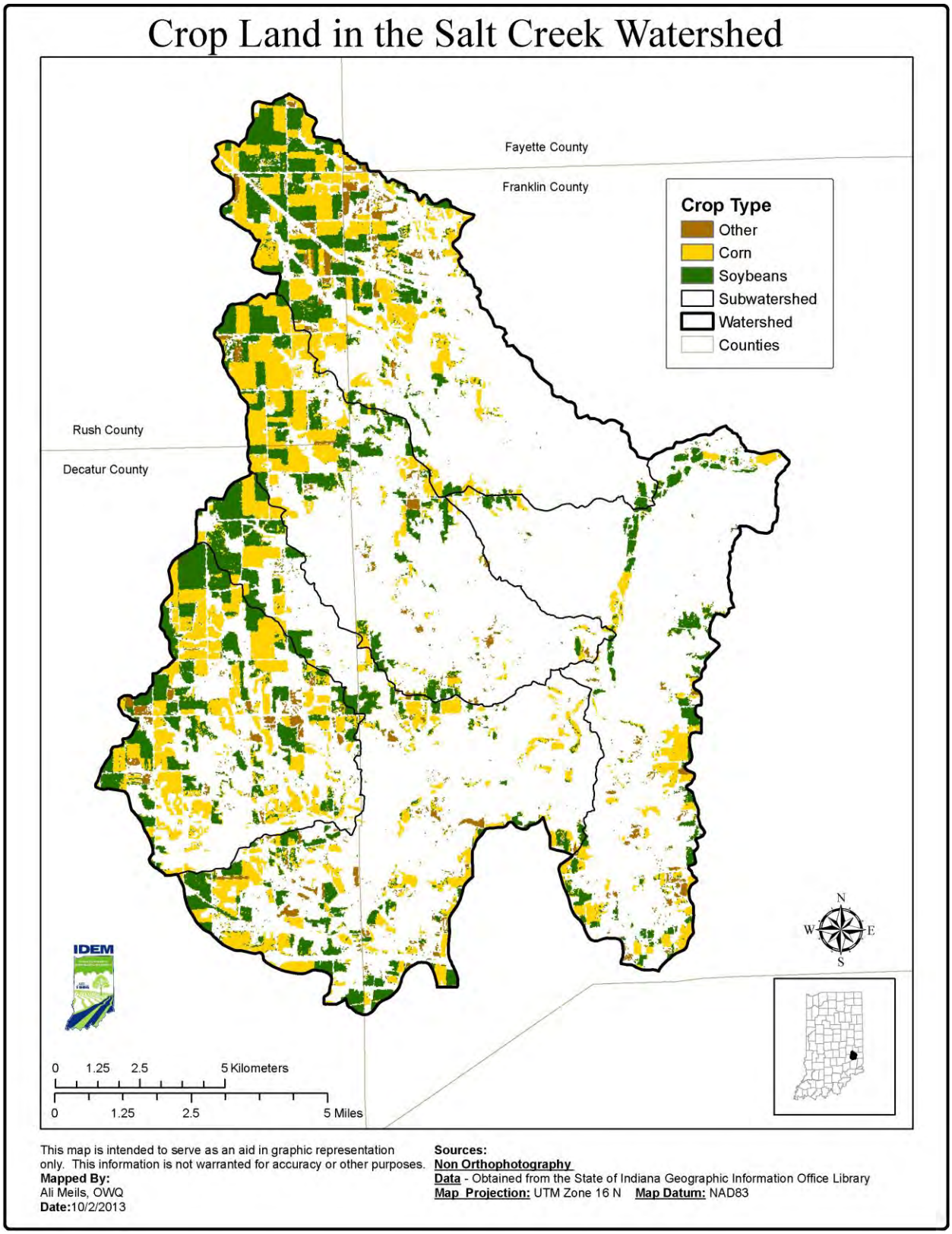


**Figure 24 Major Cash Crop Agriculture in the Salt Creek Subwatersheds**

### *Pastures and Livestock Operations*

Runoff from pastures and livestock operations can be potential agricultural sources of *E. coli*, nutrients, and sediment. For example, animals grazing in pasturelands deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated runoff during a storm event.

Livestock are potential source of *E. coli*, sediment and nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county-wide data available from the National Agricultural Statistic Service were downloaded and area weighted to estimate animal population in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total number of animals in the county based on the NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of animals with the subwatersheds. There are an estimated 11,823 animal units in the Salt Creek watershed and the animal unit density is 100 animal units per square mile as shown in Table 49.

**Table 24. Animal Unit Density in the Salt Creek Subwatersheds**

| | **Hogs and Pigs** | **Cattle and Calves** | **Sheep and Goats** | **Horses and Ponies** | **Poultry** |
|---|---|---|---|---|---|
| **Number of Animals in One Animal Unit** | 2.5 | 1 | 10 | 0.5 | 250 |
| | | | | | |
| **Total Number of Head in County** | | | | | |
| Decatur | 179,324 | 11,479 | 1,302 | 389 | 399 |
| Fayette | 12,730 | 6,470 | 884 | 315 | 416 |
| Franklin | 19,941 | 12,323 | 842 | 581 | 1,015 |
| Rush | 133,430 | 14,388 | 1,408 | 510 | 646 |
| | | | | | |
| **Total Number of Animal Units in Subwatersheds** | | | | | |
| | Headwaters Salt Creek | Righthand Fork Salt Creek | Bull Fork | Little Salt Creek | Fremont Branch |
| Hogs and Pigs | 3,300 | 1,700* | 1,086 | 1,333 | 507 |
| Cattle and Calves | 528 | 893 | 550 | 820 | 782 |
| Sheep and Goats | 2 | 4 | 2 | 4 | 3 |
| Horses and Ponies | 36 | 80 | 48 | 71 | 74 |
| Poultry | 0 | 0 | 0 | 0 | 0 |
| **Total** | **3,866** | **2,677** | **1,686** | **2,228** | **1,366** |
| **Animal Unit Density (animal units/mi²)** | **223** | **94** | **78** | **89** | **55** |

*Numbers adjusted based on known CFO farms in the subwatershed.

#### *Confined Feeding Operations (CFOs)*

A CFO is an agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and

Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

The number of animal present meets the requirements for the state permitting action.

Confined feeding operations that are not classified as CAFOs are known as confined feeding operations (CFOs) in Indiana. Non-CAFO animal feeding operations are considered nonpoint sources by USEPA. CAFOs have federal permits and fall under the jurisdiction of the NPDES program, as described in Section 6.2.1.1. Indiana's CFOs have state-issued permits but are not under the jurisdiction of the federal NPDES program and are therefore categorized as nonpoint sources for the purposes of this TMDL. CFO permits are "no discharge" permits. Therefore it is prohibited for these facilities to discharge to any water of the State.

The CFO regulations (327 IAC 19, 327 IAC 15-16) require that operations "not cause or contribute to an impairment of surface waters of the state". IDEM regulates these confined feeding operations under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 19, which implement the statute regulating confined feeding operations, were effective on July 1, 2012. The rule at 327 IAC 15-16, which regulates concentrated animal feeding operations and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012.

Like CAFOs, the animals raised in CFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. CFOs, however, can also be potential sources of TSS, total nitrogen, total phosphorus, and *E. coli* due to the following:

Manure can leak or spill from storage pits, lagoons, tanks, etc.

Improper application of manure can contaminate surface or ground water.

Manure overapplication or improper application can adversely impact soil productivity.

There are eight CFOs in the Salt Creek watershed as shown in Table 50 and **Error! Reference source not found.**.

**Table 25. CFOs in the Salt Creek Subwatersheds**

| Subwatershed | Operation Name | Farm ID | AUID | Animal Type and Number |
|---|---|---|---|---|
| Headwaters Salt Creek | Geis Farms | 4803 | ING0351_T1002 | 1680 Nursery Pigs<br>1620 Finishers<br>780 Sows |
| | Geis Farms | 6282 | ING0351_T1002 | 200 Nursery Pigs<br>1000 Finishers<br>100 Sows |
| | Jeffrey Berkemeier | 6503 | ING0351_01 | 2000 Finishers |
| | Flodder Site | 6517 | ING0351_T1003 | 2300 Finishers |
| | Ricke Livestock Home Farm | 954 | ING0351_T1002 | 1200 Nursery Pigs;<br>1200 Finishers |
| Righthand Fork Salt Creek | Philip & Don Kramer | 4480 | ING0352_T1005 | 1000 Nursery Pigs<br>2300 Finishers<br>95 Sows |
| | RJR Farms Inc. | 6137 | ING0352_T1003 | 180 Nursery Pigs<br>860 Finishers<br>136 Sows<br>80 Beef Cattle |
| | Dale O. Thie | 6163 | ING0352_01 | 230 Nursery Pigs<br>690 Finishers<br>20 beef Cattle |
| | D & S Volk Farming Inc. | 4021 | ING0352_T1002 | 1600 Nursery Pigs;<br>3850 Finishers |
| Bull Fork | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA |
| Fremont Branch | Steinfort Farms | 3711 | ING0355_T1001 | 180 Nursery Pigs;<br>730 Finishers;<br>54 Sows |

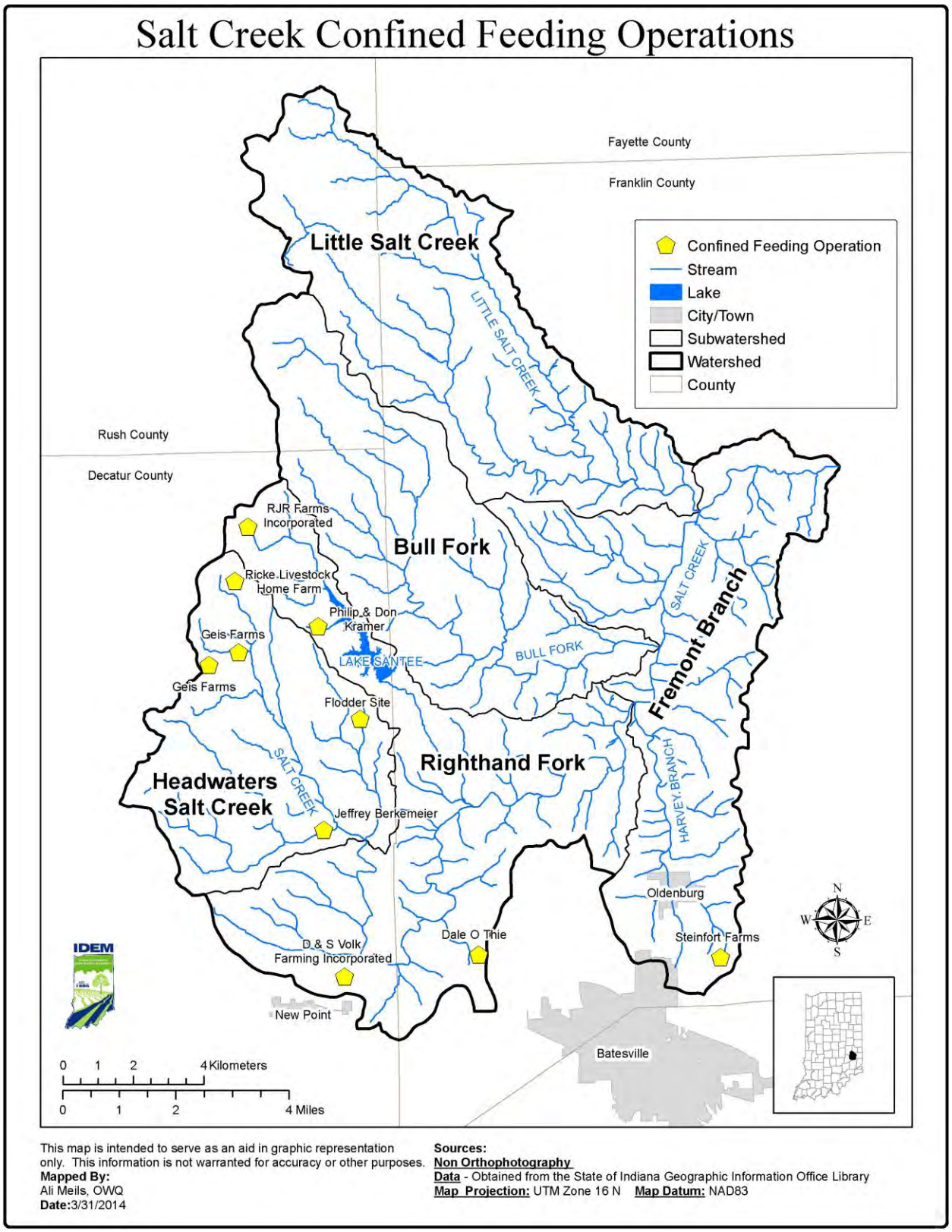


**Figure 25 Confined Feeding Operations in the Salt Creek Subwatersheds**

#### *Streambank Erosion*

Streambank erosion is potentially a significant source of TSS in the Salt Creek watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities:

Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots.

Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion due to high velocities and shear stress.

The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid runoff of rainfall and higher stream velocities that might cause streambank erosion.

#### *Onsite Wastewater Treatment Systems*

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure are: seasonal water tables, compact glacial till, bedrock, coarse sand and gravel outwash and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters due to *E. coli,* nitrate + nitrite, and total phosphorus (Horsely and Witten, 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pathogens and nutrients.

The Indiana State Department of Health (ISDH) regulates (410 IAC 6-8.3) through the local health departments the residential onsite sewage disposal program. Onsite sewage disposal systems (i.e., septic systems) are those, which do not result in an off-lot discharge of treated effluent, typically consisting of a septic tank to settle out and digest sewage solids, followed by a system of perforated piping to distribute the treated wastewater for absorption into the soil. More than 800,000 onsite sewage disposal systems are currently used in Indiana. Local health departments issue more than 15,000 permits per year for new systems, and about 6,000 permits for repairs.

**410 IAC 6-8.3-52 General sewage disposal requirements**

Sec. 52. (a) No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or ground waters of this state, or cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into such waters, any organic or inorganic matter from a dwelling or residential onsite sewage system that would cause or contribute to a health hazard or water pollution.
(b) The: (1) design; (2) construction; (3) installation; (4) location; (5) maintenance; and (6) operation; of residential onsite sewage systems shall comply with the provisions of this rule.

**410 IAC 6-8.3-55 Violations; permit denial and revocation**

Sec. 55. (a) Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer. (b) If any component of a residential onsite sewage system is found to be: (1) defective; (2) malfunctioning; or (3) in need of service; the health officer may require the repair, replacement, or service of that component. The repair, replacement, or service shall be conducted within the time limit set by the health officer. (c) Any person found to be violating this rule may be served by the health officer with a written order stating the nature of the violation and providing a time limit for satisfactory correction thereof.

A comprehensive database of septic systems within the Southern Whitewater River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The US Census provides the total number of people within a county as well as the total urban and rural population of the county. Subwatershed population is estimated by dividing the subwatershed area by the total county area and multiplying it by the county census population. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural population density. An additional estimate of septic systems can be made using the 1990 US Census, as that is the last Census that inventoried how household wastewater is disposed. The rural households in the Salt Creek subwatersheds are shown in Table 52, along with a calculated density (total rural households divided by total area). The rural household density can be used to compare the different subwatersheds within the Salt Creek watershed.

It should also be noted that hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement.

**Table 26** Hydrologic Soil Groups in the Salt Creek Subwatersheds

| Subwatershed | Hydrologic Soil Group | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Headwaters Salt Creek | 0 | 17.48% | 82.46% | 0.06% |
| Righthand Fork Salt Creek | 0.06% | 14.34% | 84.38% | 1.22% |
| Bull Fork | 0 | 30.36% | 69.56% | 0.08% |
| Little Salt Creek | 0.15% | 42.81% | 56.63% | 0.41% |
| Fremont Branch | 0.77% | 10.62% | 88.53% | 0.08% |

**Table 27. Rural Population Density in the Salt Creek Subwatersheds**

| Subwatershed | County | Area of County in Subwatershed ($mi^2$) | County Households in Subwatershed | Urban Households | Rural Households | Rural Household Density (Houses/$mi^2$) |
|---|---|---|---|---|---|---|
| Headwaters Salt Creek | Decatur | 17.29 | 315 | 0 | 315 | **20** |
| | Franklin | 0.03 | 30 | 0 | 30 | |
| | Total | 17.32 | 345 | 0 | 345 | |
| Righthand Fork Salt Creek | Decatur | 4.74 | 744 | 0 | 744 | **40** |
| | Franklin | 23.70 | 402 | 0 | 402 | |
| | Total | 28.44 | 1,146 | 0 | 1,146 | |
| Bull Fork | Decatur | 3.95 | 137 | 0 | 137 | **20** |
| | Franklin | 13.11 | 246 | 0 | 0246 | |
| | Rush | 4.50 | 38 | 0 | 038 | |
| | Total | 21.56 | 421 | 0 | 421 | |
| Little Salt Creek | Fayette | 0.10 | 17 | 0 | 17 | **30** |
| | Franklin | 17.6 | 633 | 0 | 633 | |
| | Rush | 7.43 | 113 | 0 | 113 | |
| | Total | 25.13 | 763 | 0 | 763 | |
| Fremont Branch | Franklin | 24.86 | 1,294 | 566 | 728 | **29** |
| | Total | 24.86 | 1,294 | 566 | 728 | |

#### *Urban Storm Water*

In areas not covered under the NPDES MS4 program, storm water runoff from developed areas is not regulated under a permit and is therefore a nonpoint source. Runoff from urban areas can carry a variety of pollutants originating from a variety of sources. Typically urban sources of nutrients are fertilizer application to lawns and pet waste, which is also a source of *E. coli*. Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation. The percent and distribution of developed land in the Headwaters Salt Creek watershed is discussed in Section 4.2.1. However, inputs from urban sources are difficult to quantify. Estimates can be made of pet populations and residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of nutrients, sediment and *E. coli* in the Salt Creek watershed.

Dog and cat populations were estimated for the Salt Creek subwatersheds using statistics reported in the *2007 U.S. Pet Ownership & Demographics Sourcebook*[1]. Specifically, the *Sourcebook* reports that on average 37.2 percent of households own dogs and 32.4 percent of households own cats. Typically, the average number of pets per household is 1.7 dogs and 2.2 cats. However, pets are likely only a significant source of *E. coli* and nutrients in population centers (i.e., cities and towns). The estimates of domestic pets in cities and towns in the watershed are presented in **Error! Reference source not found.** and are based on the average number of pets per household multiplied by the households in the urban areas of the subwatersheds.

**Table 28. Estimated Pet Populations in the Cities and Towns in the Salt Creek Watershed**

| Subwatershed | City/Town | Households in 2010 | Estimated Number of Cats | Estimated Number of Dogs |
|---|---|---|---|---|
| Headwaters Salt Creek | NA | NA | NA | NA |
| Righthand Fork Salt Creek | NA | NA | NA | NA |
| Bull Fork | NA | NA | NA | NA |
| Little Salt Creek | NA | NA | NA | NA |
| Fremont Branch | Oldenburg | 362 | 796 | 615 |
| | Batesville | 204 | 449 | 347 |
| | **Total** | 566 | 1,245 | 962 |

#### *Wildlife*

The Indiana Department of Natural Resources (IDNR) is the primary entity responsible for monitoring wildlife populations and habitats throughout Indiana. Wildlife such as deer, geese, ducks, etc. can be sources of *E. coli*. Little information exist surrounding feces depositional patterns of wildlife and a direct inventory of wildlife populations is generally not available. However, based on the *Bacteria Source Load Calculator* developed by the Center for TMDL and Watershed Studies, bacteria production by animal type is estimated as well as their preferred habitat. Higher concentrations of wildlife in the habitats described in Table 29 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.

[1] http://www.avma.org/reference/marketstats/sourcebook.asp

**Table 29. Bacteria Source Load by species**

| Wildlife Type | *E. coli* Production Rate (cfu/day – animal) | Habitat |
|---|---|---|
| Deer | $1.86 \times 10^8$ | Entire Watershed |
| Raccoon | $2.65 \times 10^7$ | Low density on forests in rural areas; high density on forest near a permanent water source or near cropland |
| Muskrat | $1.33 \times 10^7$ | Near ditch, medium sized stream, pond or lake edge |
| Goose | $4.25 \times 10^8$ | Near main streams and impoundments |
| Duck | $1.27 \times 10^9$ | Near main streams and impoundments |
| Beaver | $2.00 \times 10^5$ | Near streams and impoundments in forest and pastures |

Managed lands include natural and recreation areas which are owned or managed by the Indiana Department of Natural Resources, federal agencies, local agencies, non-profit organizations, and conservation easements. Classified lands are public or private lands containing areas supporting growth of native or planted trees, native or planted grasses, wetlands or other acceptable types of cover that have been set aside for managed production of timber, wildlife habitat and watershed protection. These natural areas provide ideal habitat for wildlife. Some of the more common wildlife often found in natural areas include white-tailed deer, raccoon, muskrat, fowl and beaver. While wildlife is known to contribute *E.coli* and nutrients to the surface waters, natural areas provide economic, ecological and social benefits and should be preserved and protected. Management practices such as reducing impervious surfaces, native vegetation plantings, wetland creation and riparian buffers will help in reducing stormwater runoff transporting pollutants to the streams. Figure 25 shows the managed lands within the Salt Creek watershed. There are 6,282 acres of managed and classified lands in the Salt Creek watershed.

**Table 30** Managed Land and Classified Land in the Salt Creek Watershed

| **Managed Lands** | | | | | | |
|---|---|---|---|---|---|---|
| **Subwatershed** | **Unit Name** | | | **Manager** | | **Area (acres)** |
| Fremont Branch | Kaufman Tract Forest Legacy Area | | | Private Landowner | | 245 |
| | | | | | Total | 245 |
| **Classified Lands (Acres)** | | | | | | |
| **Subwatershed** | **Grassland** | **Woodland** | **Shrubland** | **Wetland** | **Other** | **Total** |
| Headwaters Salt Creek | 0 | 633.90 | 0 | 0 | 0 | 633.90 |
| Righthand Fork | 21.1 | 1475.76 | 17.7 | 2.8 | 38 | 1,555.36 |
| Bull Fork | 37.05 | 909.52 | 13.9 | 0 | 0 | 960.47 |
| Little Salt Creek | 4 | 469.57 | 13.35 | 1.5 | 0 | 488.42 |
| Fremont Branch | 37.54 | 2,275.43 | 84.66 | 1 | 0 | 2,398.63 |

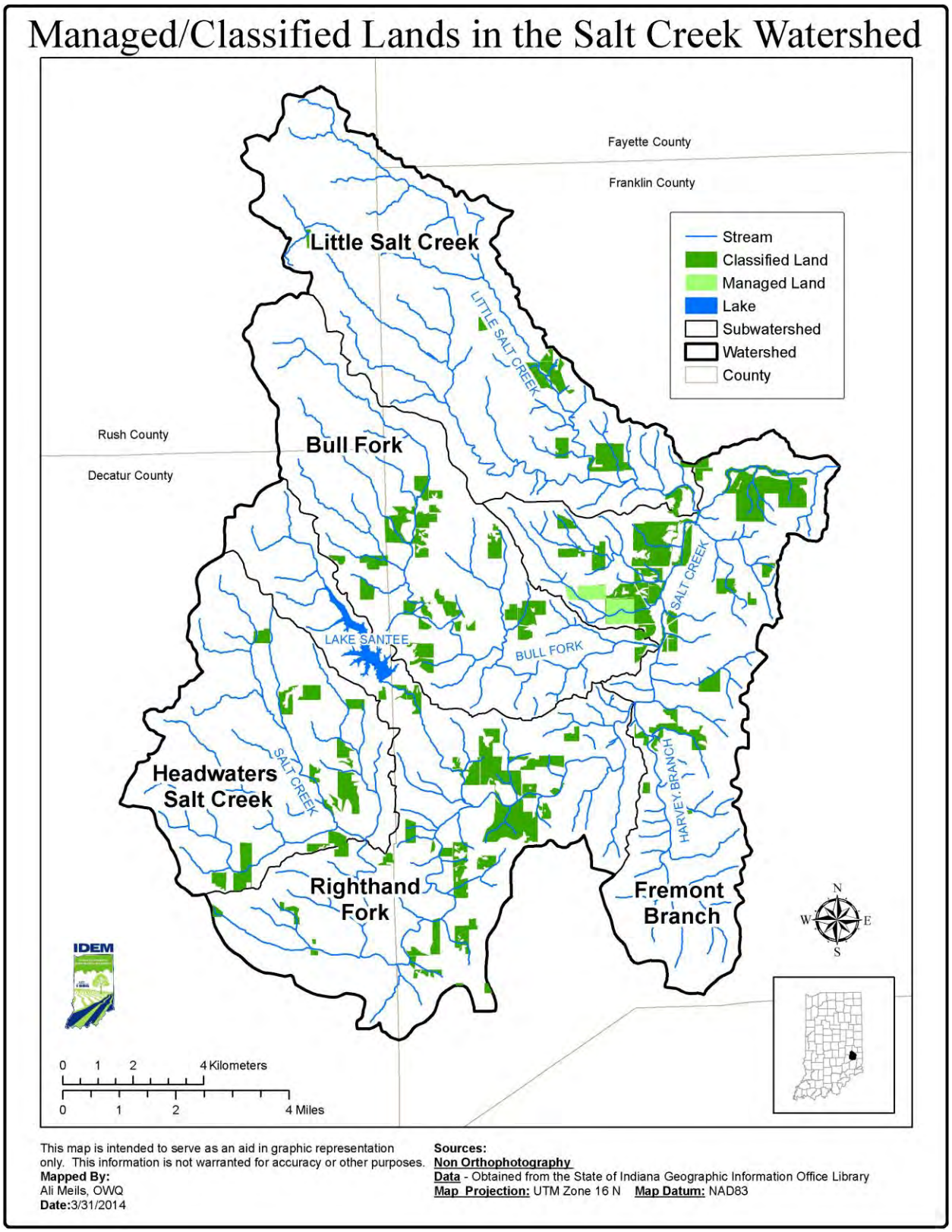


**Figure 26** Managed Lands in the Salt Creek Watershed

# 5.0 DESCRIPTION OF THE PIPE CREEK WATERSHED

This section of the TMDL report contains a brief characterization of the Pipe Creek watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to the *E. coli*, nutrients and sediment impairment. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

The Pipe Creek watershed (HUC 0508000306) is located in the middle of the Southern Whitewater River watershed. The watershed covers 118 square miles and drains a total of 842 square miles. Whitewater River flows through the middle of the watershed in Franklin County. The tributaries flowing into the Whitewater River from the north include Duck Creek, Little Duck Creek and Yellow Bank River. The tributaries flowing into Whitewater River from the south include Pipe Creek, Clear Fork, Walnut Fork, Snail Creek, and McCartys Run. The watershed encompasses parts of Fayette, Franklin, Dearborn and Ripley counties. The Pipe Creek watershed is mostly rural with portions of the Town of Brookville in the eastern part of the watershed and portions of the Town of Sunman and City of Batesville in the southern part of the watershed. Land use throughout the watershed is predominantly forested land.

There are a number of existing impairments in the Pipe Creek watershed from the approved Draft 2012 303(d) List of Impaired Waters (Figure 26). The listings and causes of impairment have been adjusted as a result of reassessment data collected at 13 sampling locations in the watershed (Figures 27). Within the Pipe Creek watershed a total of 34 assessment unit IDs (AUIDs) are cited as impaired for *E. coli* (189 stream miles), biological communities (17 stream miles), dissolved oxygen (11 stream miles), or PCBs (25 stream miles) on the Indiana's Draft 2106 303(d) list (Figure 28). These impaired segments account for approximately 205 stream miles. Table 31 presents listing information for the Pipe Creek watershed, including a comparison of the updated listings with the 2012 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Pipe Creek watershed are available in Appendix A.

IDEM identifies the Pipe Creek watershed and its tributaries using a watershed numbering system developed by United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (i.e., those with shorter HUCs) to smallest (i.e., those with longer HUCs). (For more information on HUCs, go to http://www.in.gov/idem/nps/2422.htm.) **Error! Reference source not found.** 29 shows the 12-digit HUCs located in the Pipe Creek watershed.

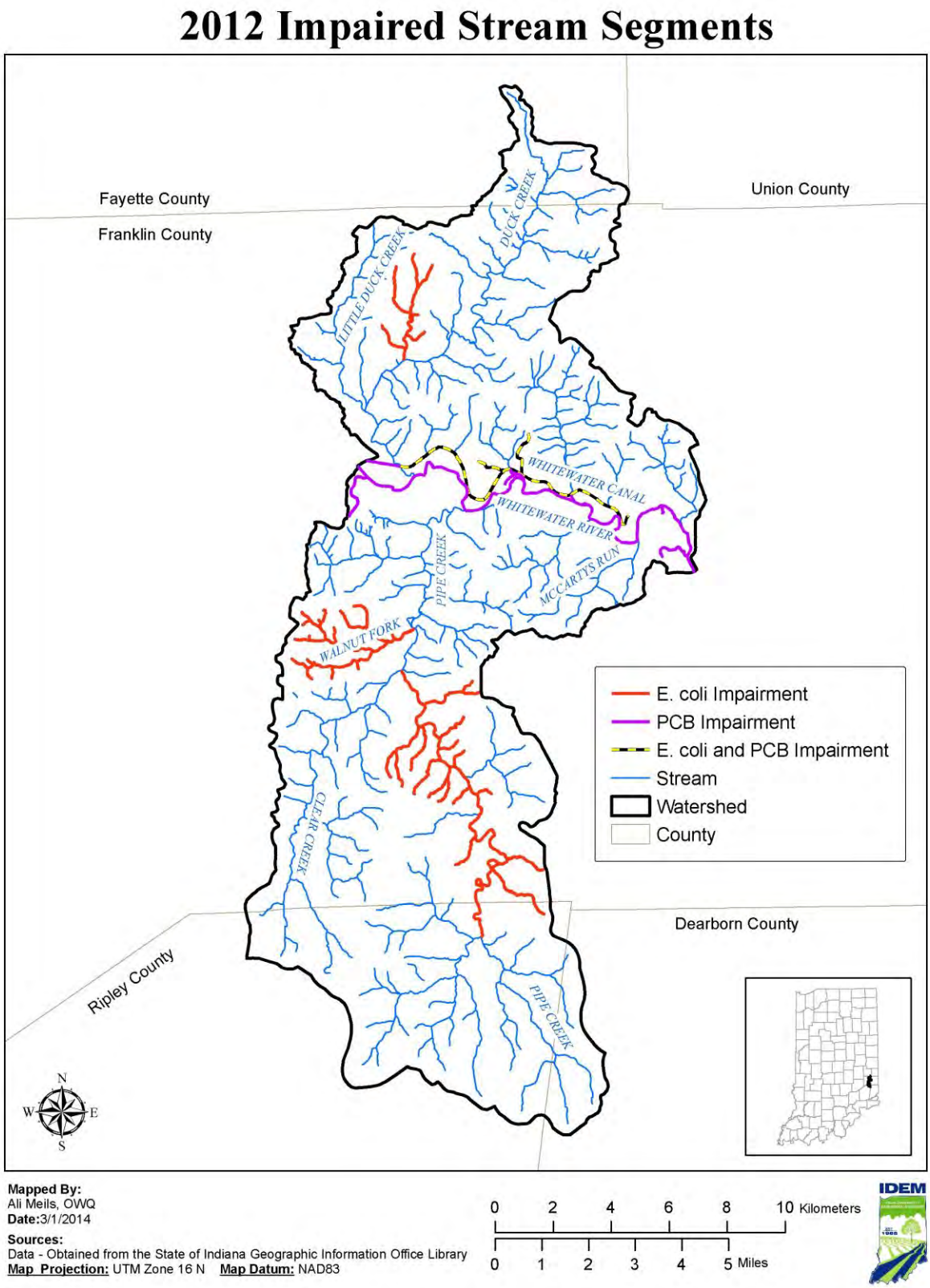


Figure 27 Streams Listed on the Draft 2012 Section 303(d) List in the Pipe Creek Watershed

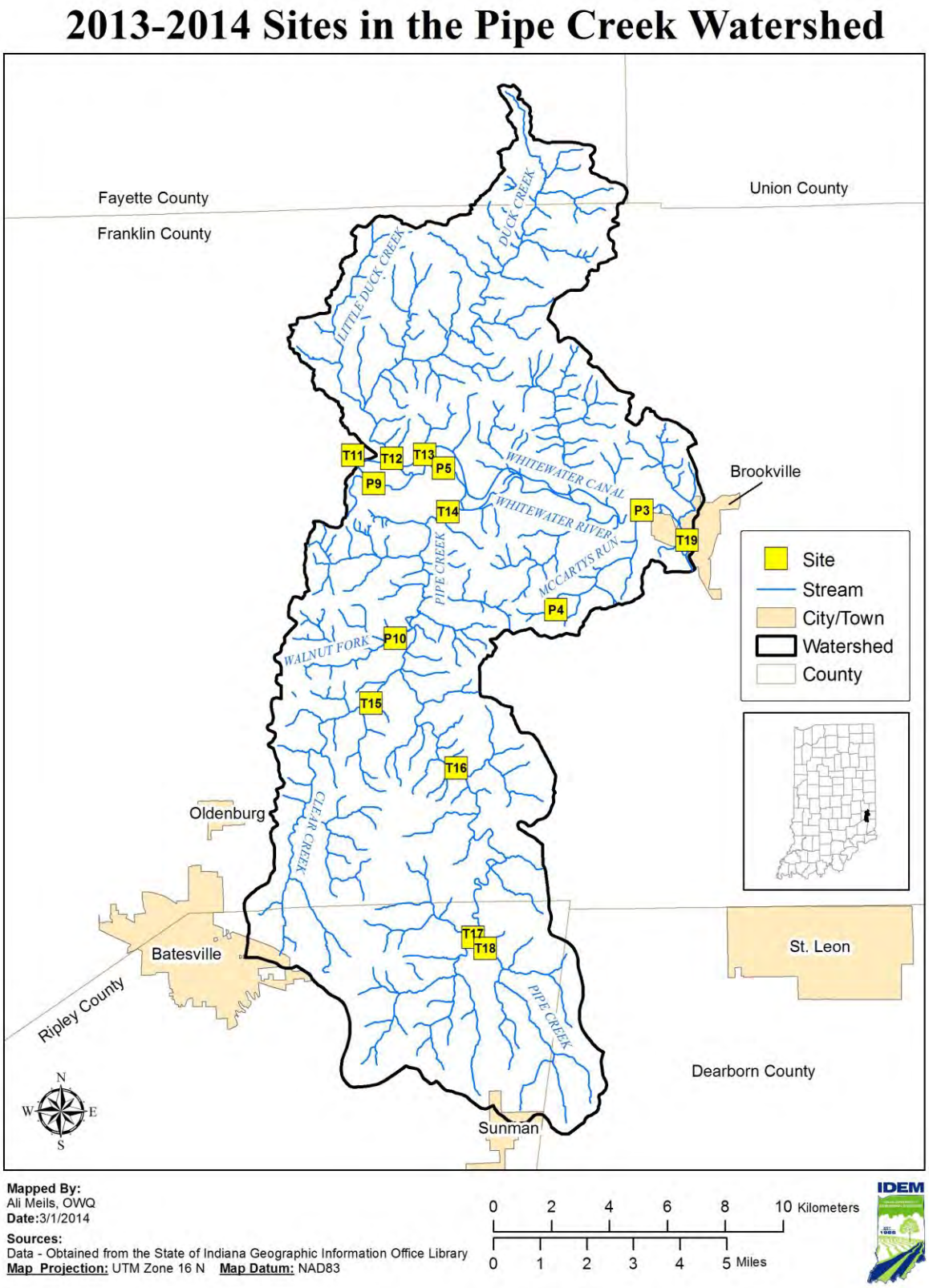


Figure 28 2013 Sampling Locations in the Pipe Creek Watershed

**Table 31 Pipe Creek Sampling Site Information**

| Site # | L-Site # | Stream Name | Road Name | AUID 2012 |
|---|---|---|---|---|
| T11* | GMW-04-0018 | Whitewater River | US 52 | ING0348_03 |
| T12 | GMW-06-0019 | Duck Creek | US 52 | ING0363_02 |
| T13 | GMW-06-0022 | Whitewater Canal | Unnamed Road | ING0362_01 |
| T14 | GMW-06-0015 | Pipe Creek | Silver Creek Road | ING0364_01 |
| T15 | GMW-06-0013 | Clear Fork | Schwegman Road | ING0362_02 |
| T16 | GMW-06-0020 | Pipe Creek | St. Marys Road | ING0364_01 |
| T17 | GMW-06-0014 | Tributary of Pipe Creek | St Marys Road | ING0361_T1005 |
| T18 | GMW060-0027 | Pipe Creek | Pipe Creek Road | ING0361_02 |
| T19 | GMW-06-0012 | Whitewater River | Saint Mary Road | ING0365_01 |
| P3 | GMW-06-0002 | Whitewater River | Saint Mary Road | ING0365_01 |
| P4 | GMW-06-0003 | McCartys Run | Saint Mary Road | ING0365_T1003 |
| P5 | GMW-06-0004 | Whitewater River | Silver Creek Road | ING0365_01 |
| P9 | GMW-06-0005 | Whitewater River | Pennington Road | ING0365_01 |
| P10 | GMW-06-0006 | Walnut Fork | Walnut Fork Road | ING0364_T1003 |

***This site is not located within the boundaries of the watershed but the data will be used to account for load contributions from the West Fork Whitewater River before it flows through the study area.

***Understanding Table 31:***

- *Column 1: Site #.* Lists the site number that corresponds to the site location in Figure 31.
- *Column 2: Station #.* Provides the IDEM site identification number.
- *Column 3: Stream Name*. Identifies the Stream Name where the site is located.
- *Column 4: Road Name.* Identifies the Road Name where the site is located.
- *Column 5 AUID 2012.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2014 Section 303(d) listing assessment process.

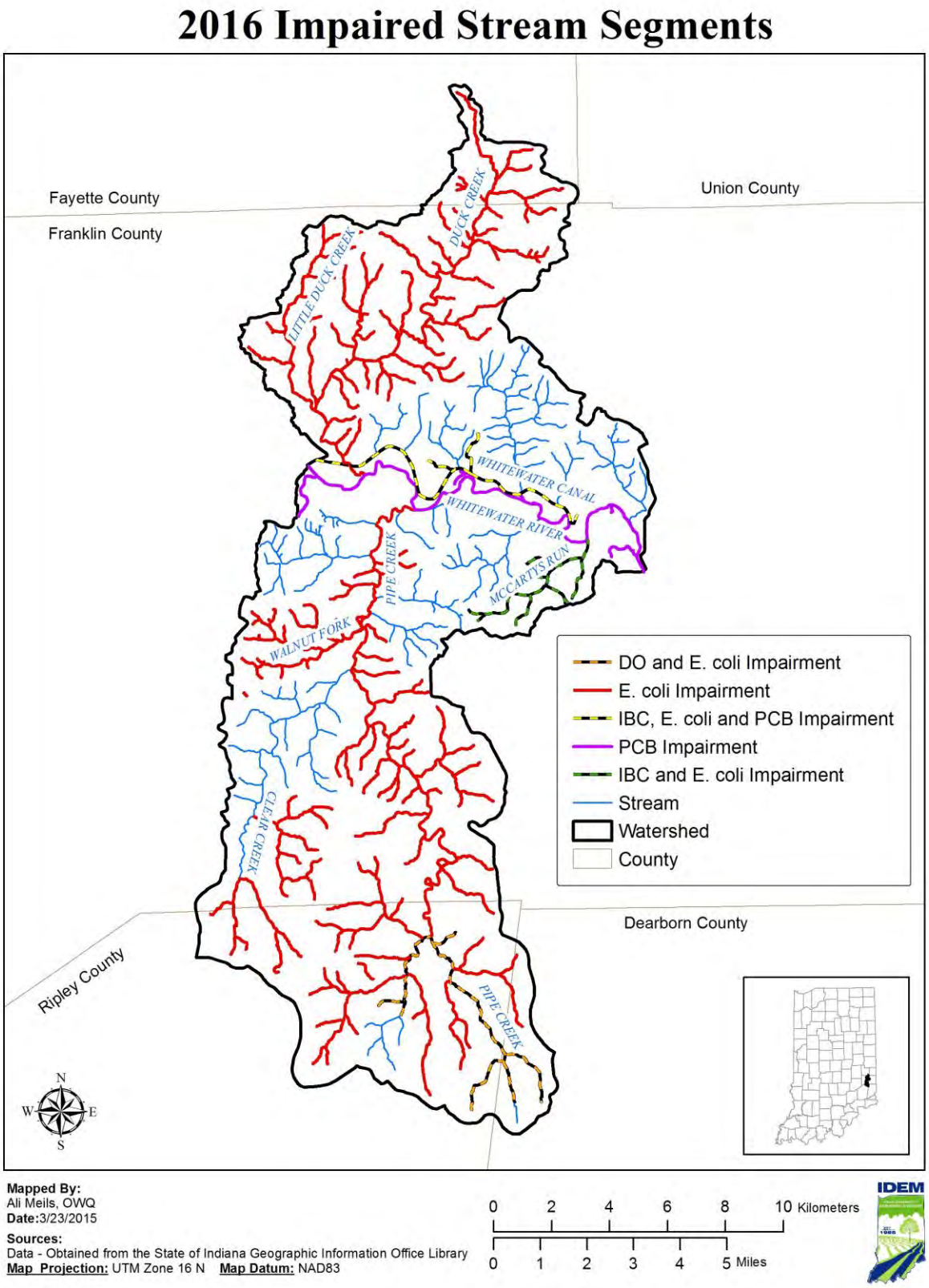


**Figure 29 Streams Listed on the Draft 2016 Section 303(d) List in the Pipe Creek Watershed**

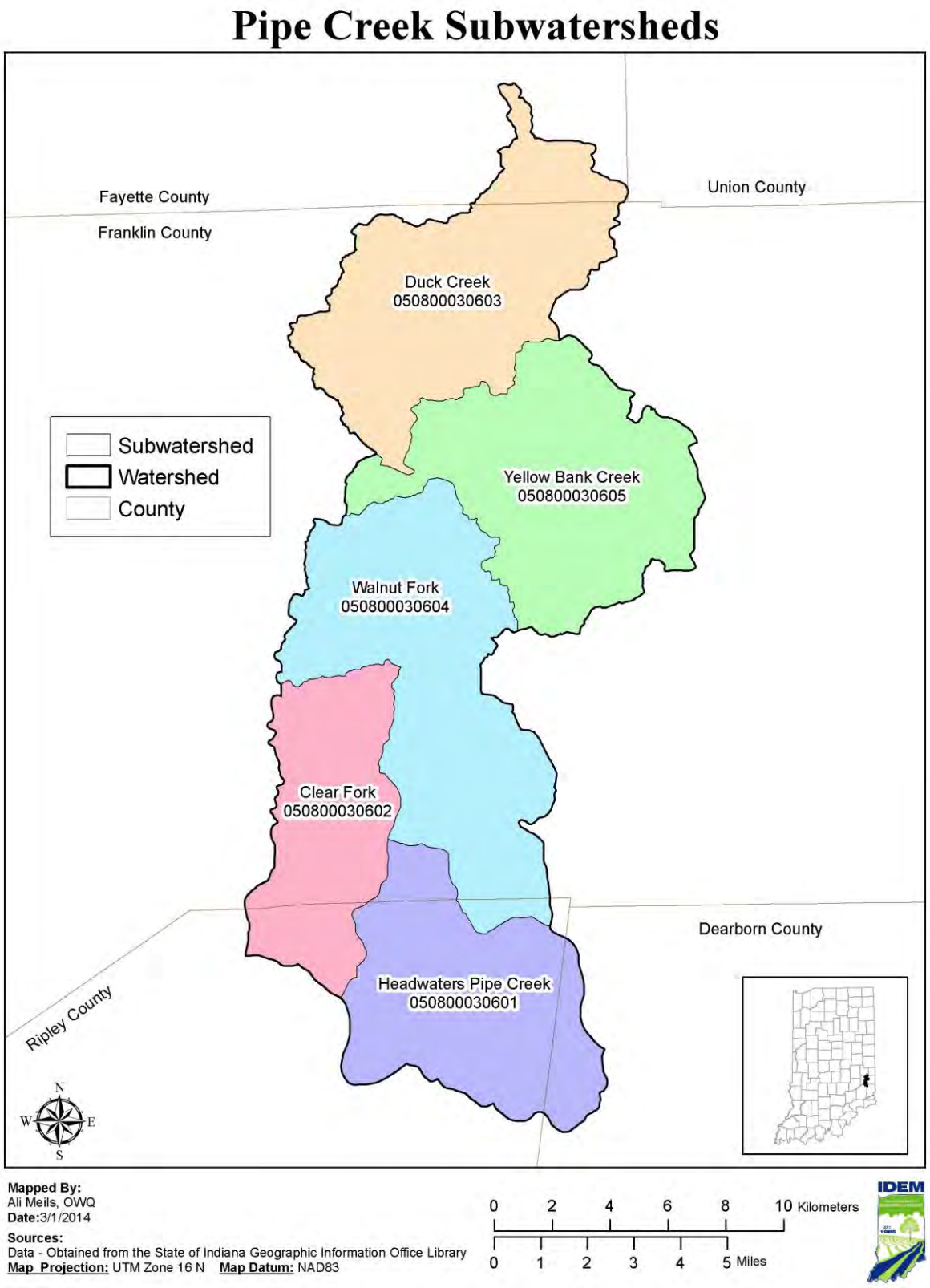


**Figure 30 Subwatersheds (12-Digit HUCs) in the Pipe Creek Watershed**

## 5.1 Land Use

Land use patterns provide important clues to the potential sources of *E. coli*, nutrients and sediment in a watershed. Land use information for the Pipe Creek watershed is available from the National Agricultural Statistics Service (NASS), which is part of the United States Department of Agriculture (USDA). The Cropland Data Layer (CDL) categorizes the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2012. Figure 10 displays the spatial distribution of the land uses and the data are summarized in Table 8.

Land use in the Pipe Creek watershed is primarily forested land, comprising 59 percent of the Pipe Creek watershed. Approximately 19 percent of the land is cropland and 15 percent is pasture lands. Pasture land and agricultural practices represent 34 percent of the watershed and indicate the presence of animal feedlots and potentially the application of manure on fields, both uses can be significant sources of *E. coli*, nutrients and sediment. There is a low percentage of developed land in the watershed but those areas surrounding the Town of Brookville and Batesville have increased levels of impervious surfaces that can be significant sources of *E. coli* and sediment.

The Pipe Creek watershed has a diverse network of streams. Tributaries include Pipe Creek, Duck Creek, Walnut Fork, Yellow Bank among others. Many of these tributaries are shown in **Error! Reference source not found.** and
**Error! Reference source not found.**. The headwaters of the watershed have more agricultural land uses with narrow riparian buffers surrounding the streams, but landscape becomes steep and forested moving closer to the mainstem Whitewater River. Agricultural fields in the area are drained using tiles because otherwise it would be too wet to farm and there are a few legal drains in the watershed. Pipe Creek has very sandy substrates with much more substrate embeddedness than the Salt Creek watershed. Salt Creek tributaries tended to be dominated by cobble and gravel substrates, with little embeddedness. The variegate darter (*Etheostoma variatum*) is an Indiana State Endangered fish species that is found in Whitewater River along the mainstem only. The variegate darter is restricted to the Ohio River drainage and are only found in the Whitewater River watershed in Indiana. They are an indicator of good water quality and are abundant in high quality streams. They are found in medium to large streams and rivers with swift flowing riffles with gravel, cobble or boulders on the stream bottom. Additional information on state endangered, threatened and rare species can be found on the DNR website (http://www.in.gov/dnr/naturepreserve/4666.htm).

**Table 32 Land Use of Pipe Creek Watershed**

| Land Use | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Agricultural Lands | 14,792.37 | 23.11 | 19.43 |
| Developed Land | 3,513.84 | 5.49 | 4.62 |
| Forested Land | 45,193.75 | 70.62 | 59.40 |
| Pasture/Hay | 11,521.16 | 18.00 | 15.14 |
| Shrub/Scrub | 648.06 | 1.01 | 0.85 |
| Wetlands | 3.56 | 0.01 | 0.01 |
| Open Water | 415.66 | 0.65 | 0.55 |
| TOTAL | **76,088.40** | **118.89** | **100** |

***Understanding Table 8:*** The predominant land use types in the Pipe Creek watershed can indicate potential sources of *E. coli*, nutrients and sediment loadings. Different types of land uses are characterized

by different types of hydrology. For example, developed lands are characterized by impervious surfaces that increase the potential of storm water events during high flow periods delivering *E. coli*, nutrients and sediment to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water to running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute *E. coli*, nutrients and sediment to the watershed. Understanding types of land uses will help identify the type of implementation approaches that watershed stakeholders can use to achieve *E. coli*, nutrients and sediment load reductions.

## 5.2 Crop Land

Land use patterns provide important clues to the potential sources of *E.coli,* nutrients and sediment in a watershed. Land use information for the Pipe Creek watershed is available from the Multi-Resolution Land Characteristics Consortium (MRLCC). These data categorize the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from 2012. Figure 10 displays the spatial distribution of the cropland and the data are summarized in Table 8.

Land use in the Pipe Creek watershed is primarily forested, comprising approximately 59 percent of the Pipe Creek watershed. However there is a significant portion of the watershed that is agricultural (19 percent). Corn and soybean crops are not typically associated with high *E.coli,* nutrients and sediment loads, unless they have been fertilized with manure. Approximately 92 percent of the crop land is corn or soybean.

**Table 33 Crop Land of Pipe Creek Watershed**

| Crop Data | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Corn | 7618.36 | 11.90 | 48.74 |
| Soybean | 6758.13 | 10.56 | 43.23 |
| Alfalfa and other Hay | 840.65 | 1.31 | 5.38 |
| Double Crop Winter Wheat/Corn or Soybeans | 247.52 | 0.38 | 1.58 |
| Winter Wheat | 162.57 | 0.25 | 1.04 |
| Tobacco | 3.78 | 0.01 | <0.01 |
| Pop or Orn Corn | 1.11 | <0.01 | <0.01 |
| Dry Beans | 0.67 | <0.01 | <0.01 |
| Rye | 0.22 | <0.01 | <0.01 |
| TOTAL | 15,633.01 | 24.41 | 100 |

***Understanding Table 5:*** The predominant cropland types in the Pipe Creek watershed can indicate potential sources of *E.coli,* nutrients and sediment loadings. Crop land use in the Pipe Creek watershed is primarily corn and soybean. Understanding types of cropland will help identify the type of implementation approaches that watershed stakeholders use to achieve *E.coli,* nutrients and sediment load reductions.

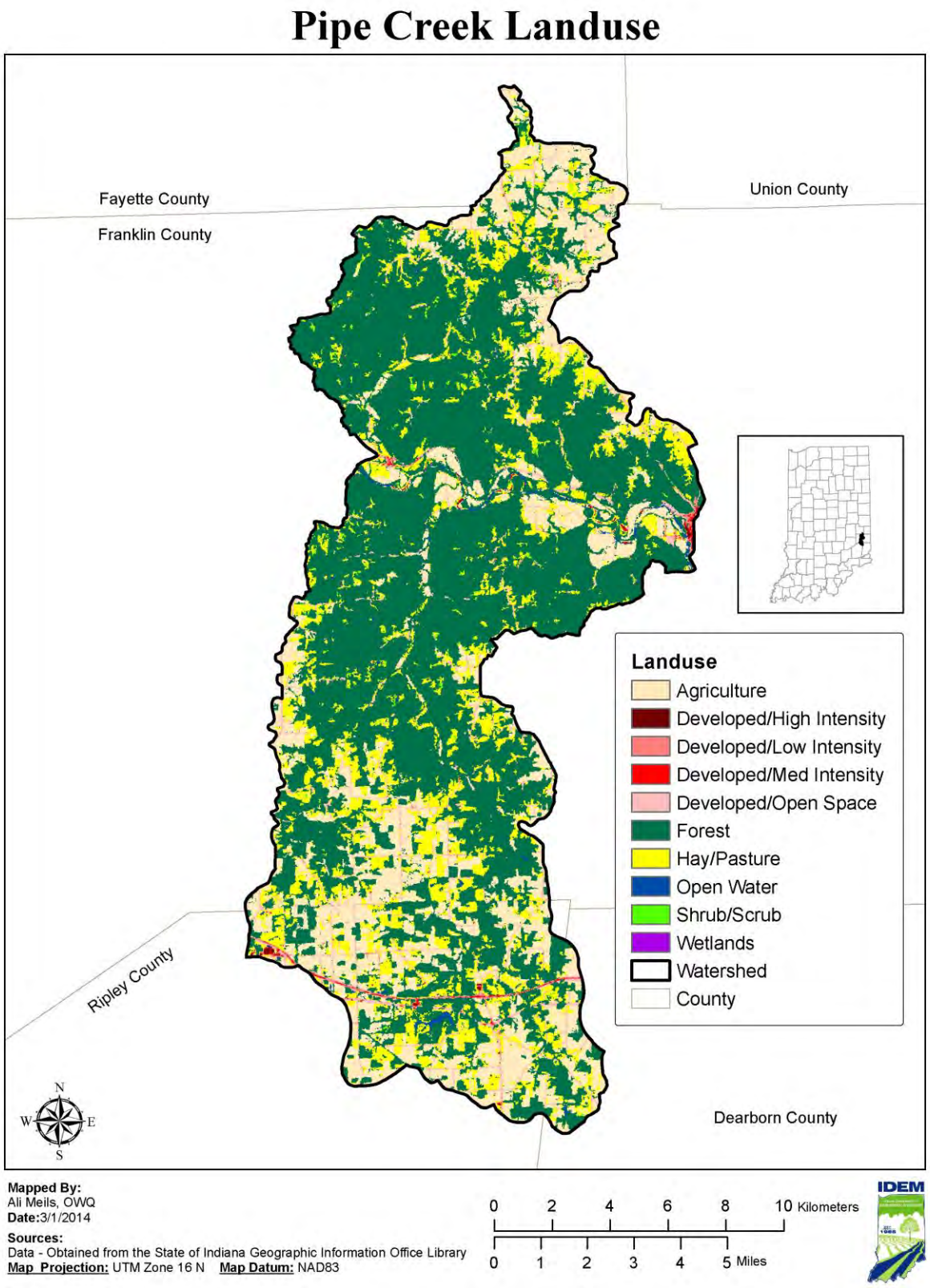


**Figure 31 Land Use in the Pipe Creek Watershed**

## 5.3 Human Population

Counties with land located in the Pipe Creek watershed include Dearborn, Fayette, Franklin, Ripley and Union. Major incorporated and unincorporated cities and towns with jurisdiction at least partially within the Pipe Creek watershed include Metamora, Saint Marys, Blooming Grove, Penntown, Oak Forest, and portions of Batesville, Sunman and Brookville. U.S. Census data for each county during the past three decades are provided in **Error! Reference source not found.**. Cities and towns are labeled in Figure 12.

**Table 34. Population Data for Counties in the Pipe Creek Watershed**

| County | 1990 | 2000 | 2010 |
|---|---|---|---|
| Dearborn | 38,835 | 46,109 | 50,047 |
| Fayette | 26,015 | 25,588 | 24,277 |
| Franklin | 19,580 | 22,151 | 23,087 |
| Ripley | 24,616 | 26,523 | 28,818 |
| TOTAL | ***109,046*** | ***120,371*** | ***126,229*** |

Source: U.S. Census Bureau.

***Understanding* Error! Reference source not found.*:*** Water quality is linked to population growth because a growing population often leads to more development, translating into more houses, roads, and infrastructure to support more people. **Error! Reference source not found.** provides information that shows how population has changed in each of the counties located in the Pipe Creek watershed over time. In addition, understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action now could help prevent further water quality degradation.

Estimates of population within Pipe Creek watershed are based on US Census data (2010) and the percentage of the total county and urban area that is within the watershed (Table 11). Based on this analysis, the estimated population of the watershed is 9,059 with approximately 84 percent of the population classified as rural residents and 16 percent classified as urban residents. Figure 13 indicates population density within the Pipe Creek watershed.

**Table 35. Estimated Population in the Pipe Creek Watershed**

| County | 2010 Population | Total Estimated Watershed Population | Percent of Total Watershed Population | Rural Population | Urban Population |
|---|---|---|---|---|---|
| Dearborn | 50,047 | 441 | 4.86 | 441 | 0 |
| Fayette | 24,277 | 431 | 4.76 | 431 | 0 |
| Franklin | 23,087 | 6,162 | 68.02 | 5,356 | 806 |
| Ripley | 28,818 | 2,025 | 22.36 | 1,389 | 636 |
| TOTAL | ***126,229*** | ***9,059*** | ***100*** | ***7,617*** | ***1,442*** |

***Understanding Table 11:*** Understanding where the greatest population is concentrated within the Pipe Creek watershed will help watershed stakeholders understand where different types of water quality pressures might currently exist.

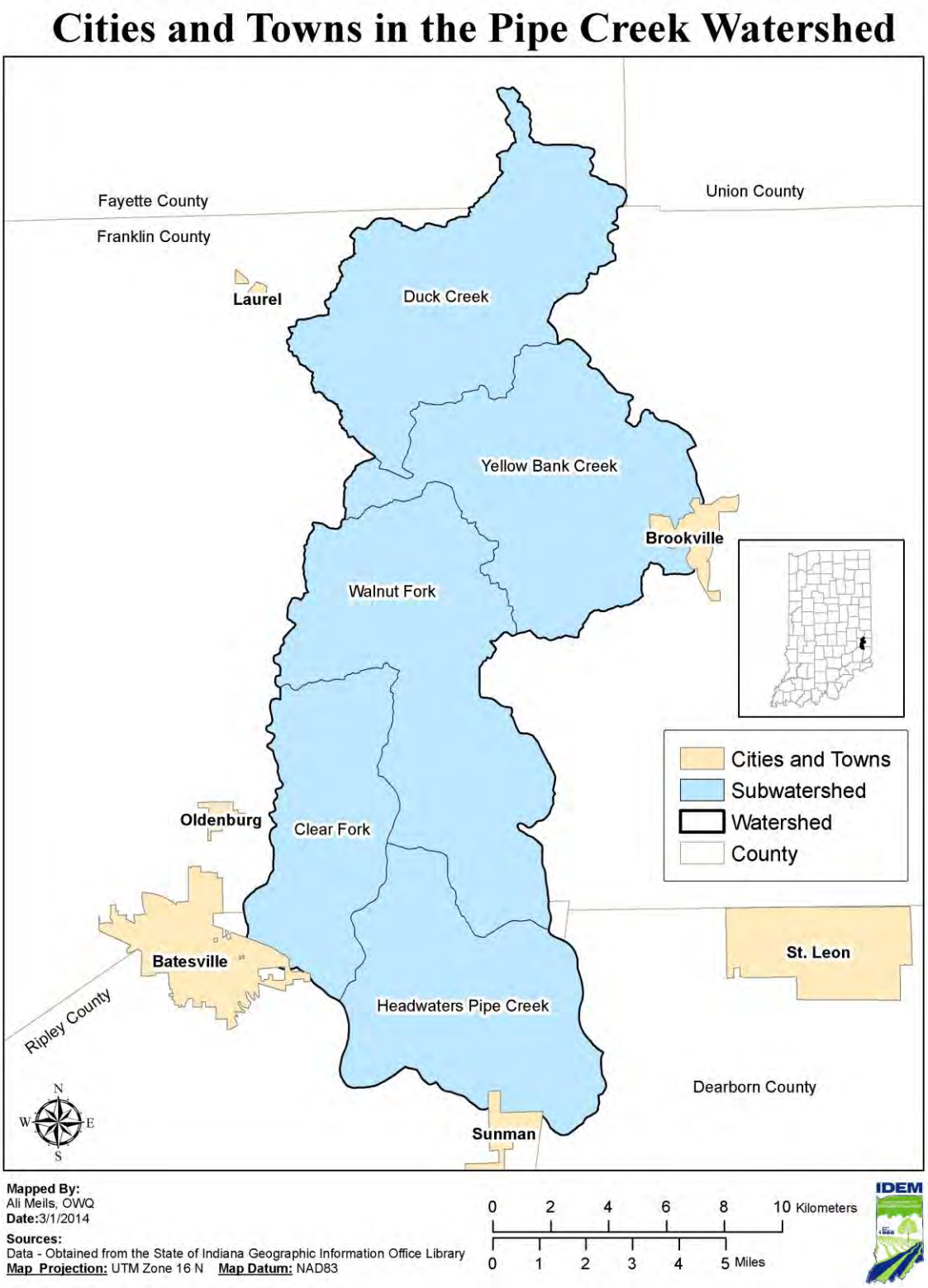


**Figure 32. Municipalities in the Pipe Creek Watershed**

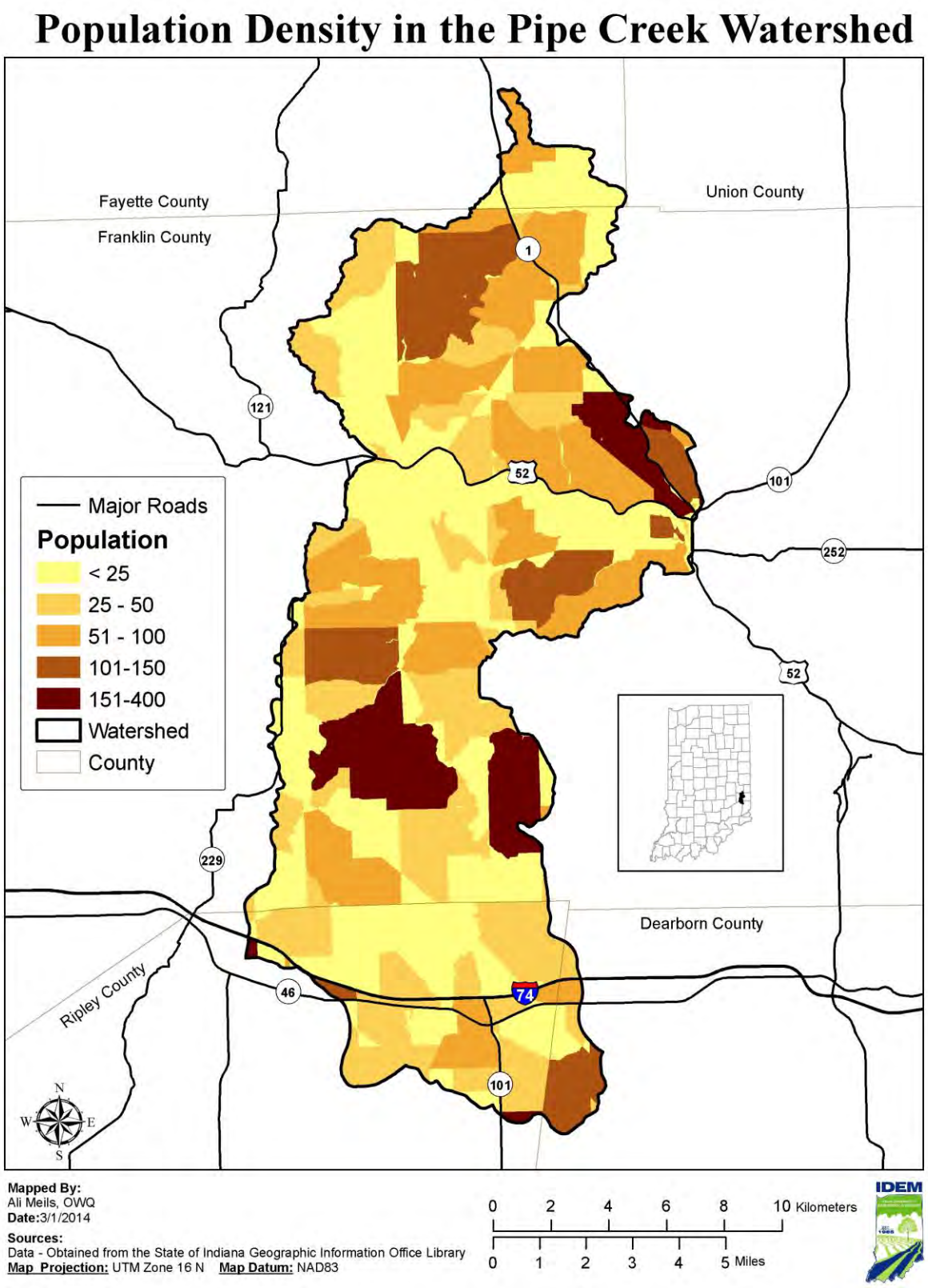


**Figure 33. Population Density in the Pipe Creek Watershed**

## 5.4 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Information concerning the topography and geology within the Pipe Creek watershed is available from the Indiana Geologic Survey (IGS). The majority of Pipe Creek watershed is located in the Eastern Corn Belt Plain (ECBP) ecoregion with a part of the Interior Plateau (IP) dissecting the watershed through the center. The ECBP is characterized by extensive cropland agriculture with some natural forest cover and gently rolling glacial till plains dissected by moraines, kames and outwash plains. The IP ecoregion includes a till plain of low topographic relief formed from Illinoian glacial drift materials, rolling to modestly or deeply dissected basin terrain. Layers of sandstone, siltstone, shale and limestone underlie much of the Interior Plateau. Limestone outcrops are common, as are areas pitted with limestone sinks. Elevations in the watershed range from 610 feet to 1060 feet. Figure 14 shows the topography of the Pipe Creek watershed. National Elevation Data (NED) is available from the USGS National Map seamless server (http://seamless.usgs.gov/website/seamless/viewer.htm).

Based on information gathered in the Atlas of Hydrogeologic Terrains and Settings of Indiana, the Pipe Creek watershed is sensitive to ground water pollution through surface water. Hydrogeologic settings help to interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to the surface and subsurface environment. Generally, the Pipe Creek watershed is located in the bottomlands of southern Indiana, which are often associated with large bedrock valleys and significant quantities of late glacial till outwash. These outwash deposits are the major ground water resources for the entire southern part of the state. They are characterized by shallow water table conditions and are consequently also zones of significant interaction between surface water and ground water.

Specifically, the outwash in the Southern Whitewater River valley constitutes the primary source of ground water in this part of the state, as suitable aquifers are generally sparse in the adjoining uplands. Most of the valley bottom is in floodplain, so water table depths are typically between 5 and 15 feet. A considerable amount of ground water is transmitted down-valley within the outwash and interacts with the river at frequent meanders that cut across the aquifer. The valley as a whole is generally a ground water discharge area, although it is unlikely that there is an appreciable volume of actual discharge to this segment of the valley in view of the poor water-transmitting properties of the surrounding bedrock and till. Overall characteristics indicate that ground water beneath the valley floor is likely to be relatively sensitive to contamination, and that finding replacement water sources would be difficult should contamination affect a part of the aquifer. This should be of special concern since there is currently one surface drinking water source known in the Salt Creek watershed. All other drinking water sources are ground water sources.

While the topography of the watershed can have an effect on hydrology, it is also likely that soil characteristics will play a role in affecting hydrologic processes.

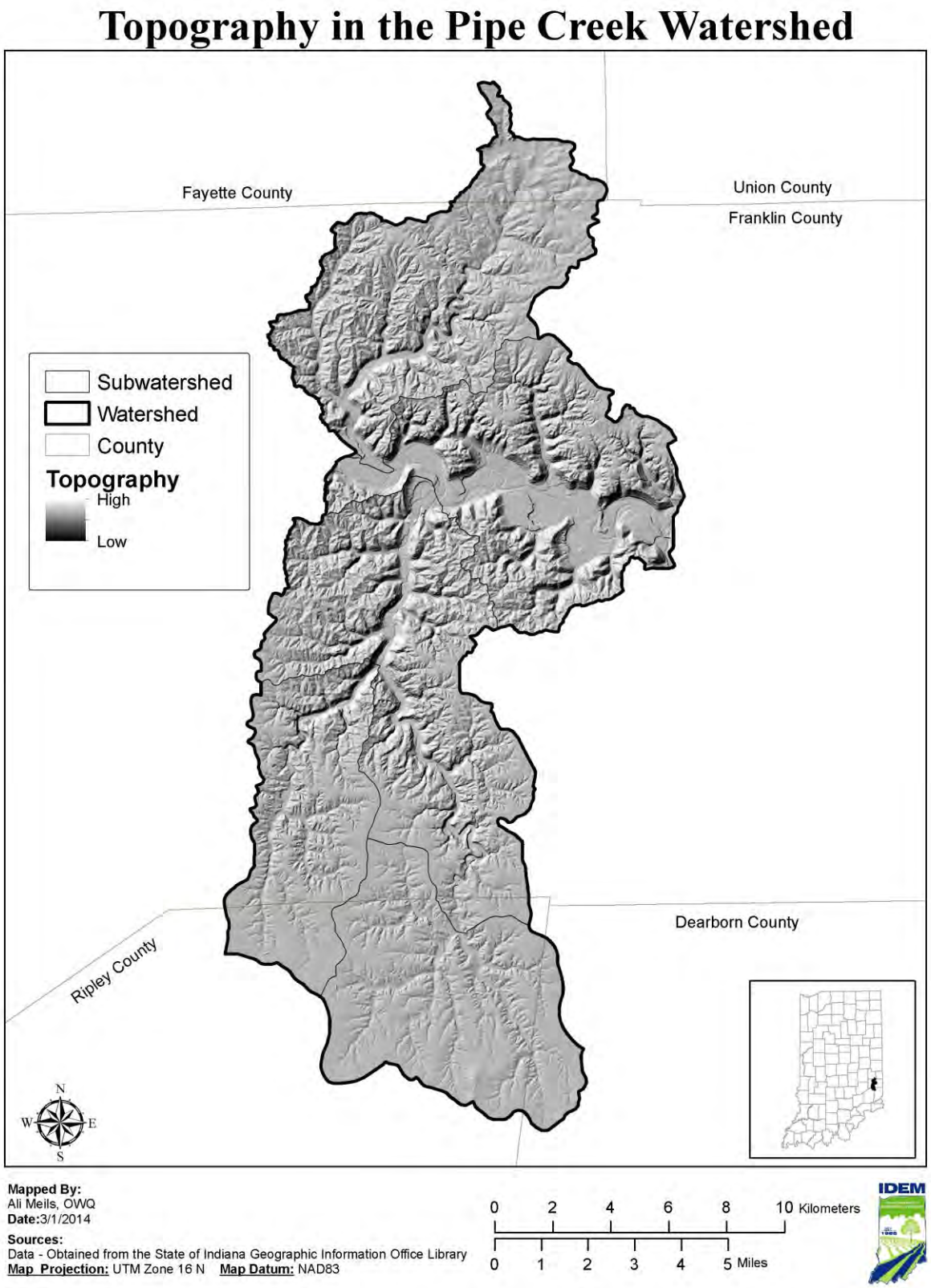


**Figure 34 Topography of the Pipe Creek Watershed**

## 5.5 Soils

There are different soil characteristics that can affect the health of the watershed. These characteristics include soil drainage, septic tank suitability, soil saturation, and soil erodibility.

### 5.5.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and runoff characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils, described in Table 12 (NRCS, 2001). Data for the Pipe Creek watershed were obtained from the Soil Survey Geographic (SSURGO) database. Downloaded data were summarized based on the major hydrologic group in the surface layers of the map unit and are displayed in Figure 15.

The majority of the watershed is covered by type C soils (79%) followed by type B soils (19%), type A soils (1%) and less than one percent type D soils.

**Table 36. Hydrologic Soil Groups**

| Hydrologic Soils Group | Description |
|---|---|
| A | Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little runoff. |
| B | Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils. |
| C | Soils with slow infiltration rates. Soils with finer textures and slow water movement. |
| D | Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff. |

***Understanding Table 12:*** Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect *E. coli*, nutrients and sediment loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high *E. coli*, nutrients and sediment loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of *E. coli*, nutrients and sediment to streams.

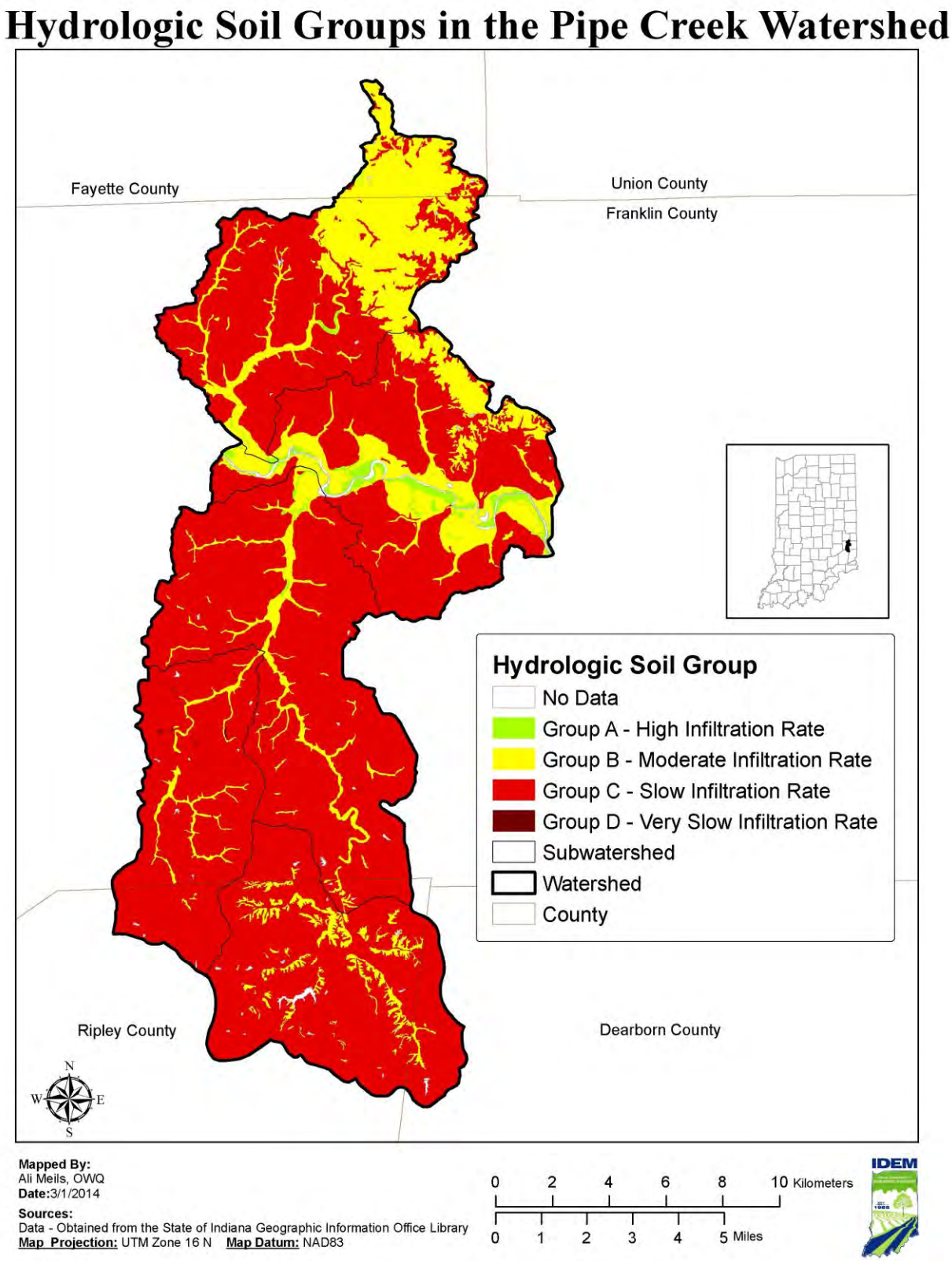


**Figure 35 Hydrologic Soil Groups in the Pipe Creek Watershed**

### 5.5.2 Septic Tank Suitability

Septic systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design can often overcome these limitations (i.e., perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system.

Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems.

The septic system is considered failing when the system exhibits one or more of the following:

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures

2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters

3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water.

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Pipe Creek watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 98 percent of the Pipe Creek watershed is considered “very limited” in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation or expensive installation designs. Less than one percent of the soils within the Pipe Creek watershed are “not rated,” meaning these soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations and less than one percent of the soils in the Pipe Creek watershed are designated “not limited,” meaning that the soil type is suitable for septic systems.

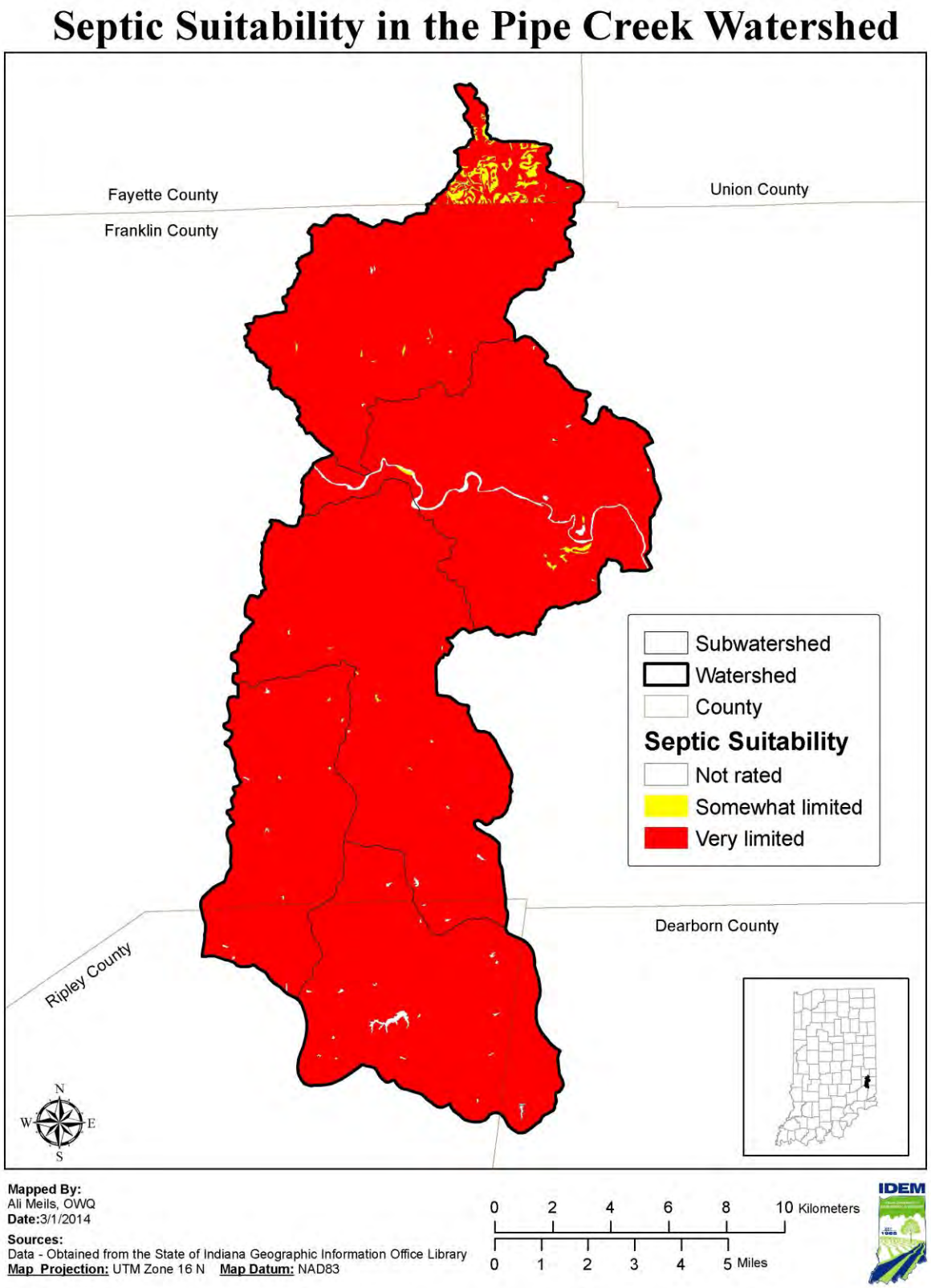


**Figure 36 Suitability of Soils for Septic Systems in the Pipe Creek Watershed**

### 5.5.3 Soil Saturation

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Hydric soils have been identified in the Pipe Creek watershed and are important in consideration of wetland restoration activities. Approximately 3,693 acres or five percent of the Pipe Creek watershed area contains soils that are considered hydric, as shown in Table 13. However, a large majority of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils, as shown in Figure 17, can be used to consider possible locations of wetland creation or enhancement. There are many components in addition to soil type that must be considered before moving forward with wetland design and creation. Additional information on wetlands can be found on the IDEM website (http://www.in.gov/idem/4138.htm).

**Table 37. Hydric Soils by County in the Pipe Creek Watershed**

| County | Map Symbol | Hydric Soil Type | Acres | Total Percent |
|---|---|---|---|---|
| Dearborn | Ct | Clermont silt loam | 594.78 | 100 |
| | | **Total** | **594.78** | **100** |
| Fayette | Co | Cope silt loam | 61.29 | 43.60 |
| | We | Westland silt loam | 79.27 | 56.40 |
| | | **Total** | **140.56** | **100** |
| Franklin | Cm | Cobbsfork silt loam | 790.18 | 93.73 |
| | Cy | Cyclone silt loam | 52.85 | 6.27 |
| | | **Total** | **843.03** | **100** |
| Ripley | Cm | Cobbsfork silt loam | 2,115.28 | 100 |
| | | **Total** | **2,115.28** | **100** |

***Understanding Table 13:*** In the Pipe Creek watershed, Ripley County has the most acreage of hydric soils. Areas within these counties might contain opportunities for wetland restoration activities that could help address water quality impairments.

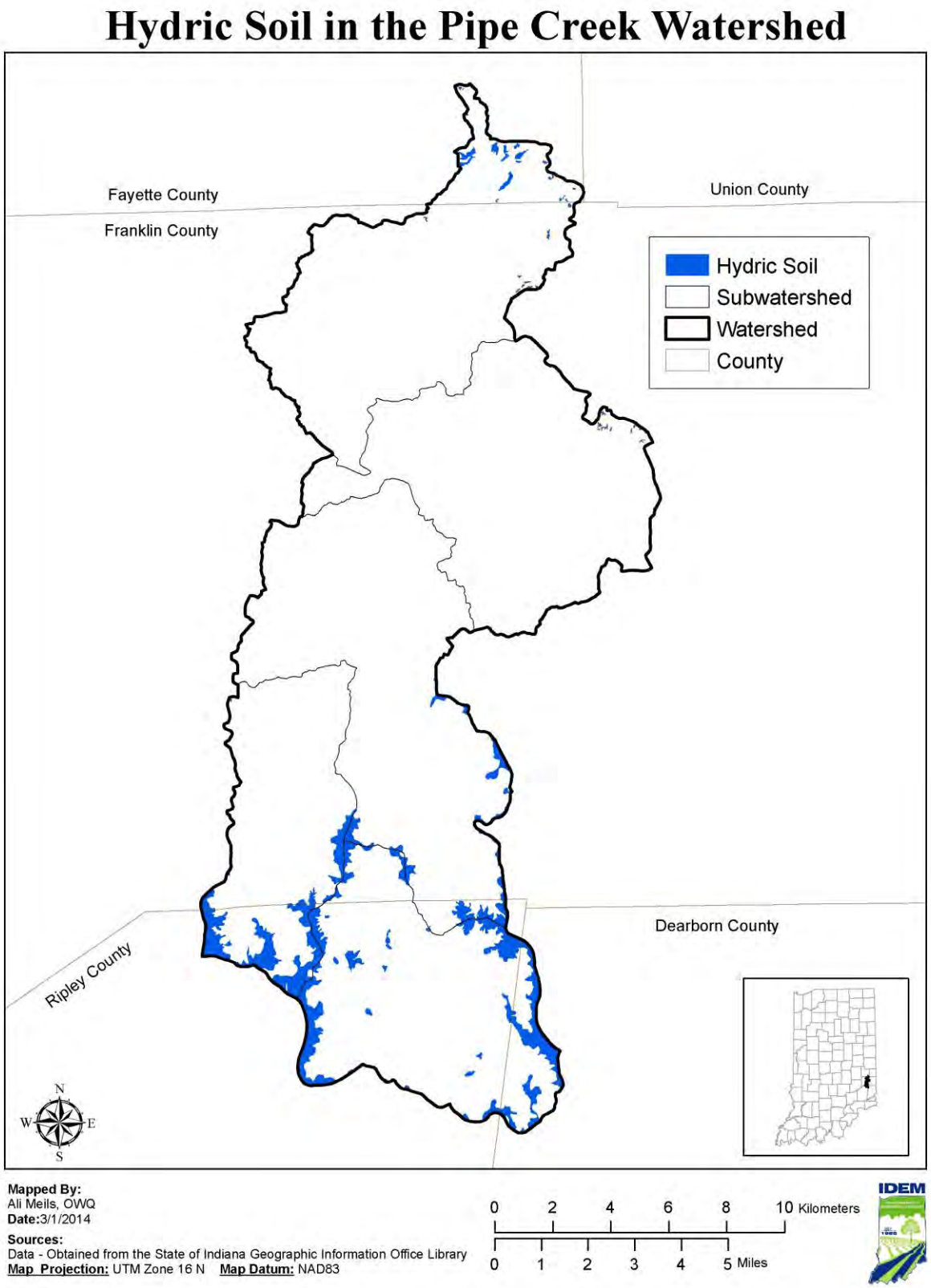


**Figure 37. Hydric Soils in the Pipe Creek Watershed**

Wetland areas act to buffer wide variations in flow conditions that result from storm events. They also allow water to infiltrate slowly thus reducing the risks of contaminated water runoff into waterbodies. Agencies such as the USGS and U.S. Fish and Wildlife Service (USFWS) estimate that Indiana has lost approximately 85 percent of the state's original wetlands. (See http://www.in.gov/dnr/fishwild/files/partner.pdf and http://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html) Currently, the Pipe Creek watershed contains approximately 1,281 acres of wetlands or 1.5 percent of the total surface area

(USFWS, 2003).

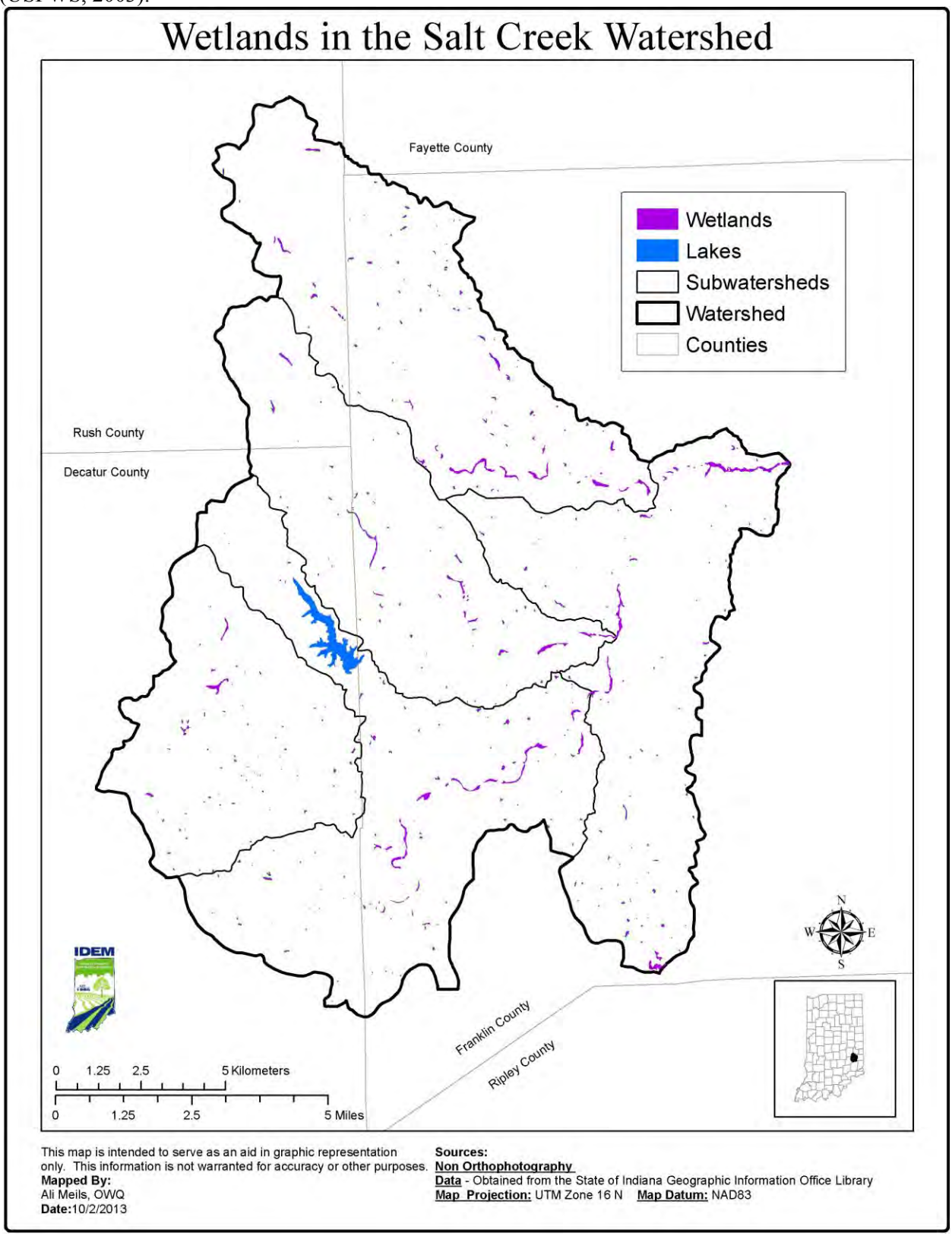


Figure 18 shows estimated locations of wetlands as defined by the USFWS's National Wetland Inventory (NWI). Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at <

http://www.fws.gov/wetlands/Data/Web-Map-Services.html>. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground surveys, and boundaries are generalized in most cases. The wetland information is from the MRLCC dataset and is based on soil types, whereas, aerial photography interpretation techniques were used to compile the NWI. Therefore the estimate of the current extent of wetlands in the Pipe Creek watershed from the NWI may not agree with those based upon the MRLCC dataset.

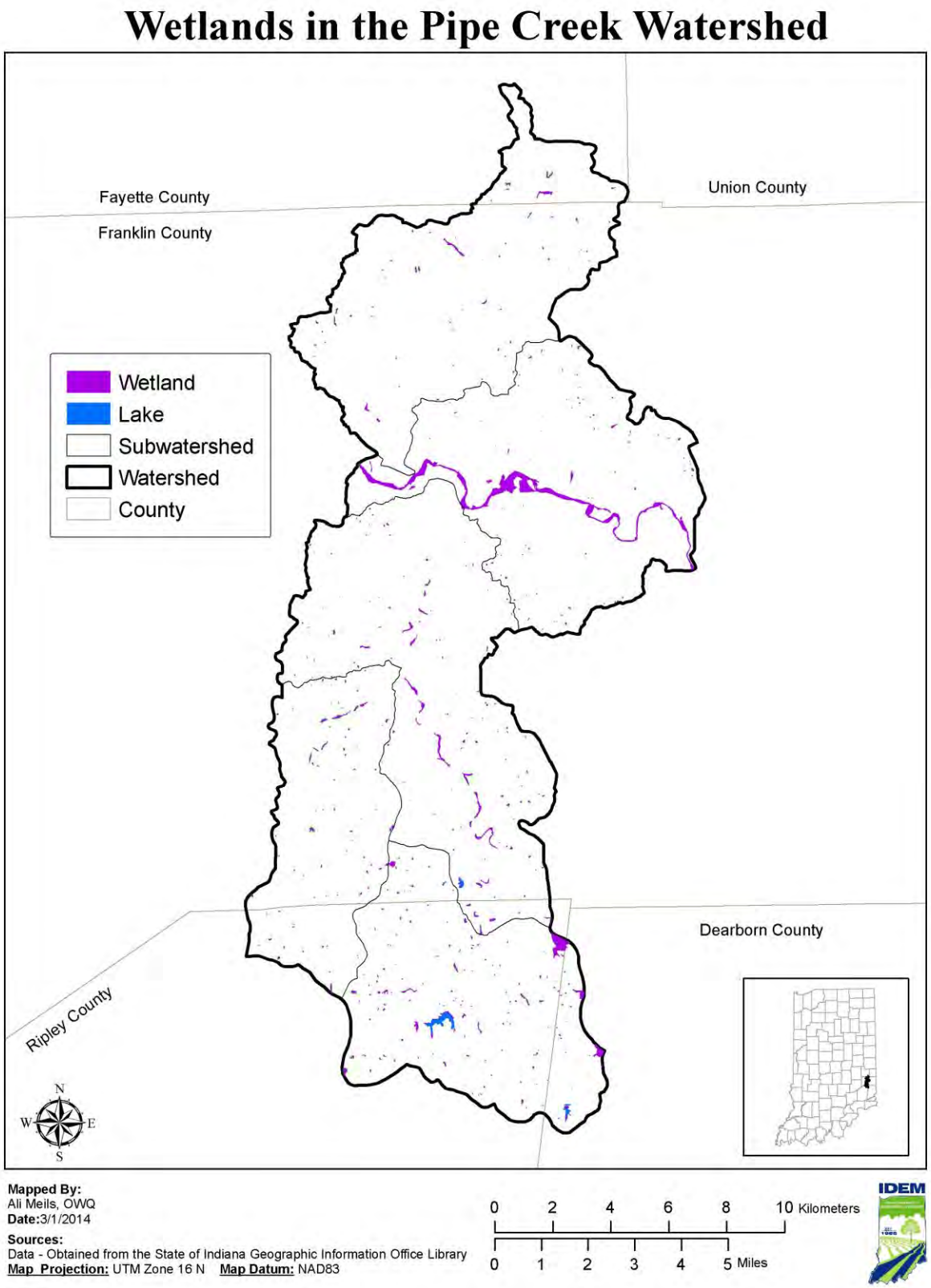


**Figure 38. Locations of Wetlands in Pipe Creek Watershed**

Changes to the natural drainage patterns of a watershed are referred to as hydromodifications. Historically, drain tiles have been used throughout Indiana to drain marsh or wetlands and make it either habitable or tillable for agricultural purposes. While tile drainage is understood to be pervasive – estimated at thousands of miles in Indiana – it is extremely challenging to quantify on a watershed basis because these tiles were established by varying authorities including County Courts, County Commissioners, or County Drainage Boards. Records were not kept by private landowners as to the location and quantity of these tiles.

In addition to tile drainage, regulated drains are another form of hydromodification. A regulated drain is a drain which was established through either a Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated drains can be an open ditch, a tile drain, or a combination of both. The Drainage Board can construct, maintain, reconstruct or vacate a regulated drain.

### 5.5.4 Soil Erodibility

Although erosion is a natural process within stream ecosystems, excessive erosion negatively impacts the health of watersheds. Erosion increases sedimentation of the streambeds, which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as runoff, it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms.

The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land. HELs are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another. The classification for HELs is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, which is the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. The soil types and acreages in the Pipe Creek watershed are

listed by county in Table 14. HELs and potential HELs in the Pipe Creek watershed are mapped in

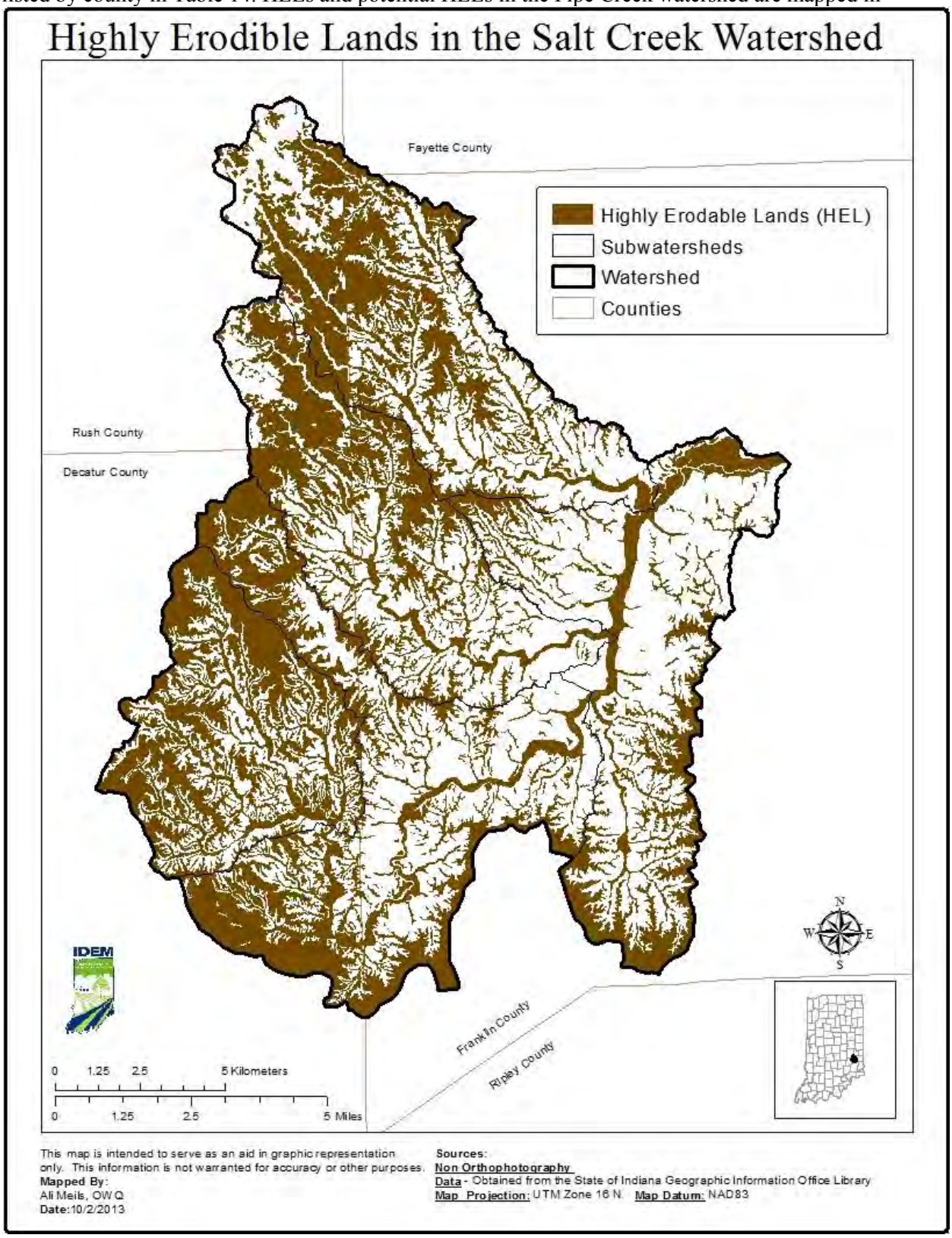

Figure 19. The data used to create

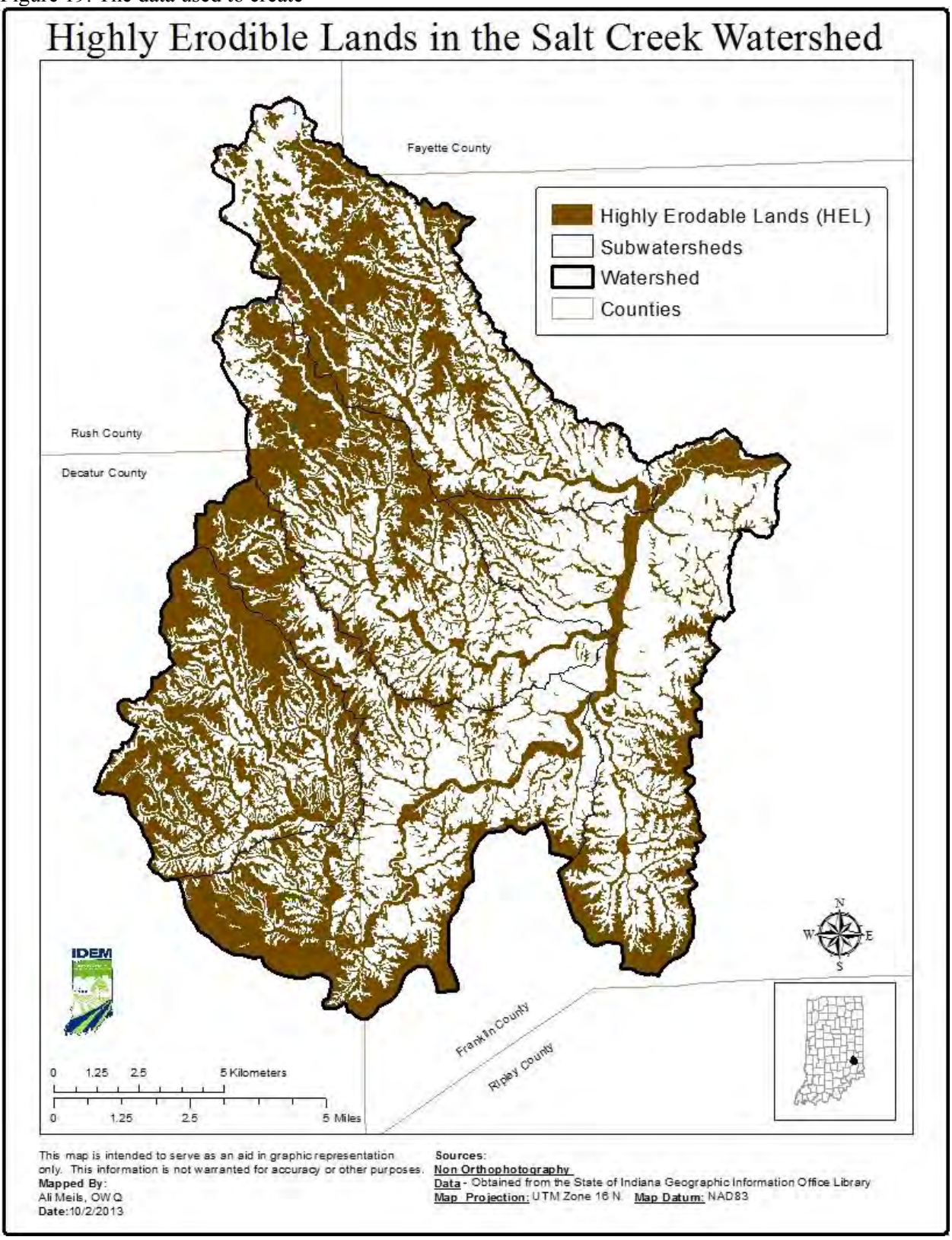


Figure 19 was collected from the NRCS offices of Dearborn, Fayette, Franklin and Ripley counties. A total of 30,239 acres or 40 percent of the Pipe Creek watershed is considered highly erodible or

potentially highly erodible. Rainfall within the Pipe Creek watershed is moderately heavy with an annual average of 43 inches. This rainfall and climate data specific to the watershed is available from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html). Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases.

**Table 38. HEL/Potential HEL Total Acres in the Counties in the Pipe Creek Watershed**

| County | Map Symbol | HEL/Potential HEL Soil Types | Acres |
|---|---|---|---|
| Dearborn | BaA | Bartle silt loam | 3.41 |
| | BeD2, BeD3, BeE | Bonnell silt loam | 88.32 |
| | CnB2, CnC2, CnC3 | Cincinnati silt loam | 273.95 |
| | EdE3 | Eden flaggy silty clay loam | 11.12 |
| | RoB2 | Rossmoyne silt loam | 300.68 |
| | SwC2, SwC3 | Switzerland silt loam | 13.53 |
| | WbB2, WbC2, WbC3 | Weisburg silt loam | 58.72 |
| | | **Total** | **749.73** |
| Fayette | CcB2, CcC2 | Cincinnati silt loam | 5.94 |
| | FeB2 | Fincastle and Crosby silt loams | 9.30 |
| | FcB1, FcB2 | Fincastle silt loam | 11.39 |
| | FtD2, FtE2 | Fox and Rodman loams | 11.02 |
| | FnB1, FnB2, FnD2 | Fox silt loam | 31.17 |
| | Gv | Gravel Pits | 2.31 |
| | HeF1, HeF2, HeG2 | Hennepin loam | 48.25 |
| | MmD2 | Miami silt loam | 10.85 |
| | MsD3, MsE3 | Miami soils | 12.11 |
| | ReB2 | Reesville silt loam | 1.56 |
| | RuB1, RuB2, RuC2 | Russell and Miami silt loams | 157.07 |
| | RvB3, RvC3 | Russell and Miami soils | 68.98 |
| | RsB1, RsB2, RsC1, RsC2, RsD1, RsD2, RsE2 | Russell silt loam | 707.40 |
| | RtB3, RtC3, RtD3, RtE3 | Russell soils | 433.60 |
| | WhB | Whitaker silt loam | 14.00 |

| | | | |
|---|---|---|---|
| | XnB1, XnB2 | Xenia and Celina silt loams | 76.66 |
| | XeB1, XeB2 | Xenia silt loam | 44.37 |
| | | **Total** | **1,645.98** |
| Franklin | AlB | Alvin sandy loam | 545.98 |
| | AvA | Avonburg silt loam | 2,751.71 |
| | CkB2 | Cincinnati silt loam | 3,001.70 |
| | Cm | Cobbsfork silt loam | 790.19 |
| | Cy | Cyclone silt loam | 52.85 |
| | Db | Dearborn loam | 1414.48 |
| | ElA, ElB | Eldean loam | 453.17 |
| | FfA | Fincastle-Reesville silt loams | 33.26 |
| | FcB | Fincastle silt loam | 920.27 |
| | Gd, Ge | Gessie loam | 2,201.03 |
| | Ht | Holton silt loam | 245.49 |
| | MmB2 | Miami silt loam | 373.59 |
| | Mt, Mx | Moundhaven sandy loam | 735.01 |
| | OcA, OcB2 | Ockley loam | 616.23 |
| | Og | Oldenburg silt loam | 417.18 |
| | Pg | Gravel pits | 21.96 |
| | PrC | Princeton fine sandy loam | 170.34 |
| | Rm | Ross silt loam | 100.83 |
| | RsA, RsB2 | Rossmoyne silt loam | 3,064.73 |
| | RuB2 | Russell silt loam | 823.43 |
| | UaB | Uniontown silt loam | 83.59 |
| | WmB | Williamstown silt loam | 25.04 |
| | Wn | Wirt loam | 469.16 |
| | WoB | Woolper silty clay loam | 253.14 |
| | XnA, XnB2 | Xenia silt loam | 644.34 |
| | | **Total** | **20,208.70** |
| Ripley | AvB2 | Avonburg silt loam | 330.45 |
| | BeD3, BeE | Bonnell silt loam | 5.24 |
| | CbE | Carmel silt loam | 7.63 |
| | CcB2, CcC2, CcC3, CcD2 | Cincinnati silt loam | 2,743.40 |
| | EdE | Eden flaggy silty clay loam | 19.38 |
| | HkE | Hickory loam | 1,019.52 |
| | HkD2, HkD3 | Hickory silt loam | 1,683.16 |
| | PeB2 | Pekin silt loam | 4.60 |
| | RoB2 | Rossmoyne silt loam | 1,805.44 |
| | SwC2, SwD2 | Switzerland silt loam | 15.88 |
| | | **Total** | **7,634.70** |

***Understanding Table 14:*** In the Pipe Creek watershed, Franklin County has the most acreage of HEL/potential HEL soils. Areas within these counties might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.

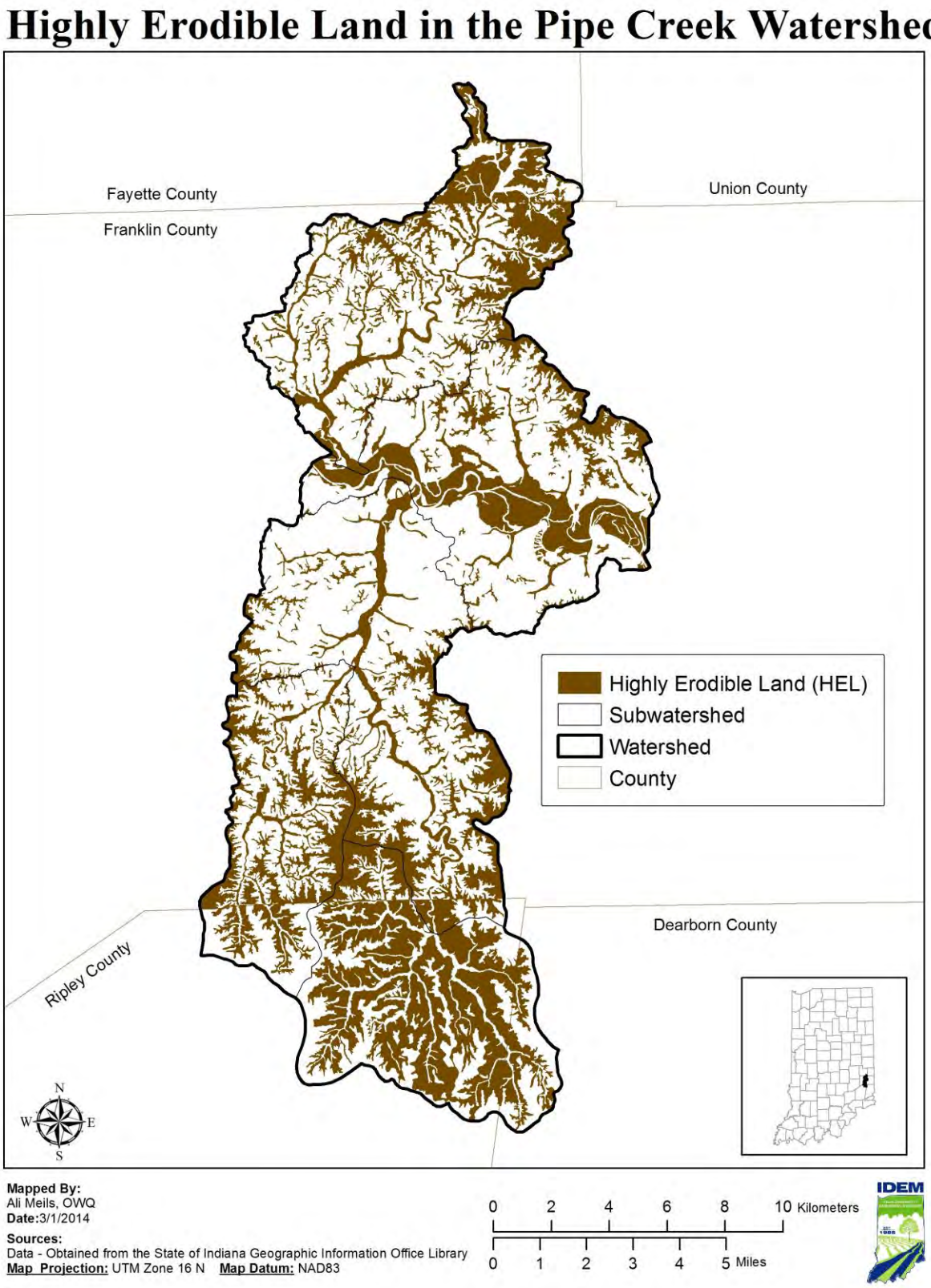


**Figure 39. HEL/Potential HEL Soils in the Pipe Creek Watershed**

The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect help determine adoption of conservation practices and estimate the average annual soil loss from Indiana's agricultural lands. The latest figures for the counties in the Pipe Creek watershed are shown in Table 15. Tillage practices captured in ISDA's tillage transect include No-Till, Mulch-Till, and conventional tillage practices. ISDA defines No-Till as any direct seeding system including site preparation, with minimal soil disturbance. Mulch-Till is any tillage system leaving greater than 30 percent residue cover after planting, excluding no-till. Reduced tillage is a tillage system leaving 16 percent to 30 percent residue cover after planting. Conventional tillage is any tillage system leaving less than 30 percent residue cover after planting.

**Table 39. County Tillage Transect Data from 2009 to 2013 in the Pipe Creek Watershed**

| Crop | Tillage Practice | Dearborn | | | Fayette | | | Franklin | | | Ripley | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 |
| Corn | No-Till | 38 | 46 | 39 | 22 | 39 | 40 | 19 | 23 | 21 | 33 | 45 | 36 |
| | Mulch-Till | 18 | 21 | 6 | 7 | 21 | 11 | 15 | 15 | 14 | 18 | 8 | 10 |
| | Reduced-Till | 9 | 32 | 13 | 18 | 31 | 19 | 33 | 43 | 54 | 0 | 0 | 0 |
| | Conventional-Till | 35 | 0 | 42 | 53 | 9 | 30 | 33 | 19 | 11 | 49 | 47 | 53 |
| Soybean | No-Till | 75 | 88 | 71 | 69 | 53 | 46 | 70 | 50 | 62 | 76 | 76 | 55 |
| | Mulch-Till | 4 | 0 | 0 | 15 | 39 | 32 | 11 | 32 | 22 | 17 | 14 | 22 |
| | Reduced-Till | 8 | 6 | 13 | 10 | 6 | 16 | 7 | 14 | 14 | 0 | 0 | 0 |
| | Conventional-Till | 13 | 6 | 16 | 5 | 2 | 6 | 13 | 3 | 2 | 7 | 10 | 23 |

***Understanding Table 15:*** According to Table 15, No-Till practices for soybeans are predominant in all counties in the Pipe Creek watershed. There has been a reduction in conventional tillage practices for corn in both Franklin County since 2009.

## 5.6 Climate and Precipitation

Climate varies in Indiana depending on latitude, topography, soil types, and lakes. Information on Indiana's climate is available through sources including the Indiana State Climate Office at Purdue University (http://climate.agry.purdue.edu/climate/narrative.asp).

Climate data from Station 121030 located in Brookville were used for climate analysis of the Pipe Creek watershed. Monthly data from 1948-2013 were available at the time of analysis. In general, the climate of the region has hot, humid summers and cold winters. From 1948 to 2013, the average winter temperature in Brookville was 32°F and the average summer temperature was 85°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 183 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of runoff on water quality. From 1948 to 2013, the annual average precipitation in Brookville at Station 121030 was approximately 43 inches, including approximately 15.5 inches of snowfall. More detailed discussions on precipitation data during sampling periods are presented in a later Section.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of storm water on the Pipe Creek watershed. Using data from 121030 during 1948 to 2013, 52 percent of the measureable precipitation events were very low intensity (i.e., less than 0.2 inches), while 8 percent of the measurable precipitation events were greater than one inch.

Knowing when precipitation events occur helps in the linkage analysis, which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Pipe Creek watershed occurs between the months of April and May.

## 5.7 Summary

The information presented in Section 5 helps to provide a better comprehensive understanding of the conditions and characteristics in the Pipe Creek watershed that, when coupled with the sources presented, affect both water quality and water quantity. In summary, the predominant land uses in the Pipe Creek watershed of forested lands and agricultural lands serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the Pipe Creek watershed. Human population, which is greatest in Franklin and Ripley counties in the Pipe Creek watershed, indicates where more infrastructure related pressures on water quality might exist. The subsections on topography and geology, as well as soils, provide information on the natural features that affect hydrology in the Pipe Creek watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Pipe Creek watershed. Lastly, the subsection on climate and precipitation provides information on water quantity and the factors that influence flow, which ultimately affects the influence of stormwater on the watershed. Collectively, this information plays an important role in understanding the sources that contribute to water quality impairment during TMDL development and crafting the linkage analysis that connects the observed water quality impairment to what has caused that impairment.

# 6.0 SOURCE ASSESSMENT

This section presents information concerning IDEM's segmentation process as it applies to the Pipe Creek watershed in order to present a source assessment specific to the Pipe Creek watershed as well as summaries of significant sources of *E. coli*, nutrients and sediment for each subwatershed within the Pipe Creek watershed.

## 6.1 Understanding Subwatersheds and Assessment Units

As briefly discussed in Section 5, the Pipe Creek watershed contains five 12-digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include (**Error! Reference source not found.**):

- Headwaters Pipe Creek (050800030601)
- Clear Fork (050800030602)
- Duck Creek (050800030603)
- Walnut Fork (050800030604)
- Yellow Bank Creek (050800030605)

Within each 12-digit HUC subwatershed, IDEM has identified several AUIDs, which represent individual stream segments. Through the process of segmenting subwatersheds into AUIDs, IDEM identifies streams reaches and stream networks that are representative for the purposes of assessment. In practice, this process leads to grouping tributary streams into smaller catchment basins of similar hydrology, land use, and other characteristics such that all tributaries within the catchment basin can be expected to have similar potential water quality impacts. Catchment basins, as defined by the aforementioned factors and are typically very small, which significantly reduces the variability in the water quality expected from one stream or stream reach to another. Given this, all tributaries within a catchment basin are assigned a single AUID. Grouping tributary systems into smaller catchment basins also allows for better characterization of the larger watershed and more localized recommendations for implementation activities. Variability within the larger watershed will be accounted for by the differing AUIDs assigned to the different catchment basins.

Table 16 contains the AUIDs in the subwatersheds of the Pipe Creek watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.

**Table 40 Assessment Units in Pipe Creek Watershed**

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| Headwaters Pipe Creek (050800030601) | 21.73 | 18.28 | ING0361_02 | 8.29 | 18.28 |
| | | | ING0361_P1001 | 0.45 | |
| | | | ING0361_P1002 | 1.15 | |
| | | | ING0361_T1003 | 3.04 | |
| | | | ING0361_T1004 | 4.00 | |
| | | | ING0361_T1005 | 2.90 | |
| | | | ING0361_T1005A | 0.26 | |
| | | | ING0361_T1005B | 1.39 | |
| | | | ING0361_T1005C | 0.34 | |

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| | | | ING0361_T1006 | 6.83 | |
| | | | ING0361_T1006A | 0.56 | |
| | | | ING0361_T1007 | 3.29 | |
| | | | ING0361_T1008 | 0.69 | |
| | | | ING0361_T1009 | 7.43 | |
| Clear Fork (050800030602) | 15.80 | 13.30 | ING0362_01 | 0.76 | 13.30 |
| | | | ING0362_02 | 12.47 | |
| | | | ING0362_02A | 0.13 | |
| | | | ING0362_T1002 | 2.91 | |
| | | | ING0362_T1003 | 3.47 | |
| | | | ING0362_T1004 | 8.14 | |
| | | | ING0362_T1005 | 3.65 | |
| | | | ING0362_T1006 | 1.79 | |
| Duck Creek (050800030603) | 25.74 | 21.65 | ING0363_01 | 9.61 | 21.65 |
| | | | ING0363_02 | 7.75 | |
| | | | ING0363_T1001 | 3.07 | |
| | | | ING0363_T1002 | 2.76 | |
| | | | ING0363_T1003 | 1.82 | |
| | | | ING0363_T1004 | 3.32 | |
| | | | ING0363_T1005 | 1.62 | |
| | | | ING0363_T1006 | 2.81 | |
| | | | ING0363_T1007 | 2.21 | |
| | | | ING0363_T1008 | 6.11 | |
| | | | ING0363_T1009 | 1.81 | |
| | | | ING0363_T1010 | 10.82 | |
| Walnut Fork (050800030604) | 29.67 | 24.96 | ING0364_01 | 23.77 | 56.54 |
| | | | ING0364_02 | 12.02 | |
| | | | ING0364_T1001 | 1.93 | |
| | | | ING0364_T1002 | 5.54 | |
| | | | ING0364_T1003 | 10.91 | |
| | | | ING0364_T1004 | 4.64 | |
| | | | ING0364_T1005 | 3.91 | |
| | | | ING0364_T1006 | 9.77 | |
| | | | ING0364_T1007 | 1.90 | |
| | | | ING0364_T1008 | 1.31 | |
| Yellow Bank Creek (050800030605) | 25.92 | 21.81 | ING0365_01 | 15.47 | 842.10 |
| | | | ING0365_02 | 8.41 | |
| | | | ING0365_T1001 | 1.63 | |
| | | | ING0365_T1002 | 7.49 | |
| | | | ING0365_T1003 | 7.82 | |
| | | | ING0365_T1004 | 7.10 | |
| | | | ING0365_T1005 | 2.13 | |
| | | | ING0365_T1006 | 1.54 | |

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| | | | ING0365_T1007 | 3.97 | |
| | | | ING0365_T1008 | 16.79 | |
| | | | ING0365_T1009 | 2.30 | |

***Understanding Table 16:*** Land area helps IDEM to define the pollutant load reductions needed for each AU in each 12-digit HUC subwatershed that comprises the Pipe Creek watershed. Information in each column is as follows:

- *Column 1: Name of Subwatershed.* Lists the name of the subwatersheds.
- *Column 2: Surface Area.* Indicates the total surface area for each subwatershed.
- *Column 3: Percent of Total Drainage Area.* Indicates the percent of the total surface area, providing a relative understanding of the portion of each subwatershed in the Pipe Creek watershed.
- *Column 4: Current AUID*. Provides the updated AUIDs associated with each subwatershed.
- *Column 5: Length.* Quantifies the length of each AUID stream segment.
- *Column 6: Drainage Area.* Quantifies the area the subwatershed drains.

IDEM bases percent load reductions on the drainage area for each AUID in the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations found in this report. This table will help watershed stakeholders look at the smaller segments within the Pipe Creek watershed and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

## 6.2 Source Assessment by Subwatershed

This section summarizes the available information on significant point and nonpoint sources of *E. coli*, nutrients and sediment in the five subwatersheds of the Pipe Creek watershed.

The term “point source” refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel or conduit, by which pollutants are transported to a waterbody. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term “point source” also includes: concentrated animal feeding operations (CAFO) which are places where animals are confined and fed; storm water runoff from Municipal Separate Storm Sewer Systems (MS4s), construction site of one acre or more of land disturbance, and specific categories of industrial activities that convey storm water; and illicitly connected “straight pipe” discharges of household waste. Permitted point sources are regulated through the NPDES.

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, runoff from lawn fertilizer applications, pet waste, storm water runoff (outside of MS4 communities), and other sources. In rural areas, nonpoint sources can include runoff from cropland, pastures and animal feeding operations and inputs from streambank erosion, leaking or failing septic systems, and wildlife.

### 6.2.1 Pipe Creek Subwatershed Summary

This section of the report presents the available information on the sources of *E. coli*, nutrients and sediment in the Pipe Creek subwatersheds.

**Table 41 Land Use in the Pipe Creek Subwatersheds**

| Subwatershed | Area | Land Use | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Developed | Forest | Hay/ Pasture | Shrub | Open Water | Wetlands | |
| Headwaters Pipe Creek | Acres | 4,748 | 962 | 5,151 | 2,882 | 43 | 116 | <1 | 13,902 |
| | Sq. Mi. | 7 | 2 | 8 | 5 | <1 | <1 | <1 | 22 |
| | Percent | 34 | 7 | 37 | 21 | <1 | 1 | <1 | 100 |
| Clear Fork | Acres | 2655 | 628 | 4766 | 1982 | 44 | 40 | 0 | 10,115 |
| | Sq. Mi. | 4 | 1 | 8 | 3 | <1 | <1 | 0 | 16 |
| | Percent | 26 | 6 | 47 | 20 | <1 | <1 | 0 | 100 |
| Duck Creek | Acres | 3,318 | 596 | 10,277 | 2,010 | 256 | 17 | 1 | 16,475 |
| | Sq. Mi. | 5 | 1 | 16 | 3 | <1 | <1 | <1 | 25 |
| | Percent | 20 | 4 | 62 | 12 | 2 | <1 | <1 | 100 |
| Walnut Fork | Acres | 2,052 | 555 | 13,662 | 2,514 | 148 | 61 | <1 | 18,992 |
| | Sq. Mi. | 3 | 1 | 21 | 4 | <1 | <1 | <1 | 29 |
| | Percent | 11 | 3 | 72 | 13 | 1 | <1 | <1 | 100 |
| Yellow Bank Creek | Acres | 1,991 | 779 | 11,349 | 2,134 | 157 | 181 | 1 | 16,592 |
| | Sq. Mi. | 3 | 1 | 18 | 3 | <1 | <1 | <1 | 25 |
| | Percent | 12 | 5 | 68 | 13 | 1 | 1 | <1 | 100 |

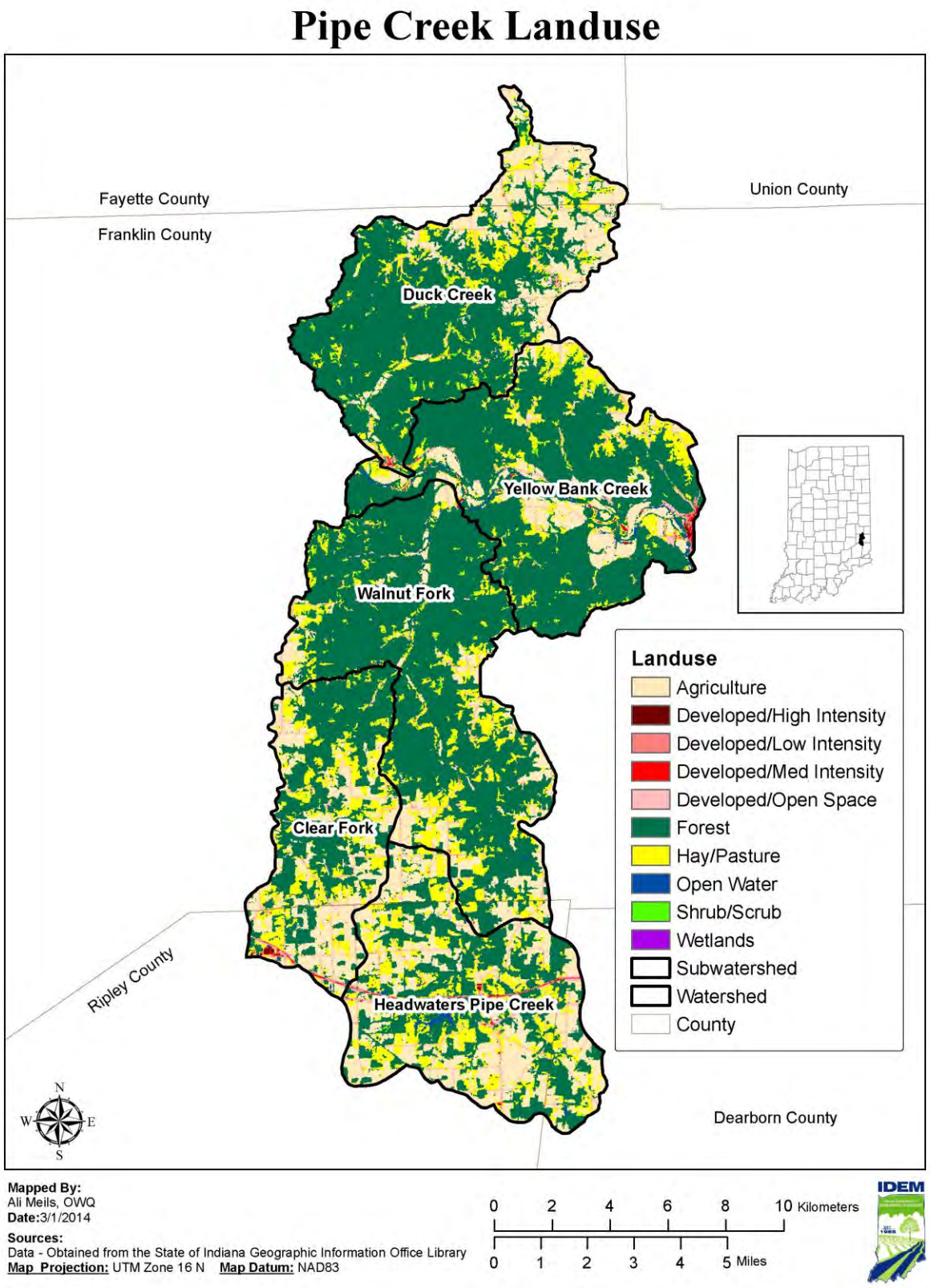


Figure 40 Landuse in the Pipe Creek Subwatersheds

#### 6.2.1.1 Point Sources

The State of Indiana regulates the direct discharge of pollutants to waters of the State through the National Pollutant Discharge Elimination System (NPDES) Permit Program. The permits issued place limits on the amount of pollutants that may be discharged to surface waters by each facility. These limits are set at levels protective of both aquatic life in the waters which receive the discharge and protective of human health. This section summarizes the potential point sources of *E. coli*, nutrients and sediment in the Pipe Creek watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

***Municipal Facilities***

A municipal facility, or wastewater treatment plant (WWTP), is designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes. Some of the functions of a WWTP include agricultural wastewater treatment, sewage treatment and industrial wastewater treatment. WWTPs are critical for maintaining public sanitation and a healthy environment.

Municipal facilities in Indiana are required to disinfect their effluent during the recreational season (April 1 to October 31). IDEM does not require disinfection for waste-stabilization lagoons as long as *E. coli* limits from the permit are met utilizing the lagoon's retention time. **Error! Reference source not found.** contains the maximum design flow for the active facilities.

Treated municipal sewage is a point source of nutrients. WWTPs may release water with elevated concentrations of nutrients into streams. As discussed in Section 2.2, the target value for total phosphorus is 0.30 mg/L and the target value for total nitrogen is 10 mg/L. These target values are used to establish potential permit limits.

Flows used to calculate nutrient loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Nutrient concentrations used to calculate nutrient loads from each treatment plant are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels). Because the phosphorus loads from these NPDES facilities had to be estimated, it is recommended that effluent monitoring be added to the WWTP permits. Additional in-stream monitoring should also be performed.

The TMDL target value for TSS is set at the WWTP's permit effluent limit for TSS. Therefore, a target of 30 mg/L for total suspended solids TSS has been identified as a permit limit for NPDES facilities.

There are no known facilities contributing polluted runoff containing *E. coli*, nutrients and sediment within the Pipe Creek watershed. The Metamora Regional Sewer District Wastewater Treatment Plant is listed in this Section but is located outside the project area (Figure 40 and Table 42).. This facility information will be used to calculate pollutant loadings entering the stream from the West Fork Whitewater River and could potentially impact the mainstem Whitewater River downstream. A summary of the WWTP permit is described below.

**Table 42. NPDES Permitted Wastewater Treatment Plants Discharging within the Pipe Creek Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Pipe Creek | NA | NA | NA | NA | NA |
| Clear Fork | NA | NA | NA | NA | NA |
| Duck Creek | NA | NA | NA | NA | NA |
| Walnut Fork | NA | NA | NA | NA | NA |
| Yellow Bank Creek | NA | NA | NA | NA | NA |
| ** | Metamora RSD WWTP | IN0062391 | ING0348_03 | West Fork Whitewater River | 0.06 |

** Site is located outside the Pipe Creek watershed but data will be used to calculate pollutant contributions from West Fork Whitewater River.

The Metamora Regional Sewer District WWTP is a Class 1 extended aeration treatment facility consisting of a lift station, headworks with fine screens, a flow equalization basin, two aeration tanks, a final clarifier, ultraviolet light disinfection, an effluent flow meter and post aeration. Sludge facilities include an aerobic sludge holding talk with final solids hauled off site by a licensed contractor. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points. There have been six notices of noncompliance issued to the facility in the last five years. Based on this information, in April of 2014, IDEM revoked the wastewater operator certification of the WWTP manager. A new plant operator is currently managing the WWTP.

**Error! Reference source not found.** presents a summary of permit compliance for WWTP NPDES facilities in the Pipe Creek watershed for the five year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). The table also presents the total number of violations in the five year period for the NPDES permitted parameters. According to **Error! Reference source not found.**, there have been five NPDES facility inspections resulting in violations in the five year period. Overall, there are a total of four permit violations for the NPDES permitted parameters in the Pipe Creek watershed.

**Table 43. Summary of WWTP Inspections and Permit Compliance in the Pipe Creek Subwatersheds for the Five Year Period Ending September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Month | Year | Parameter | Type | # Violations |
| Headwaters Pipe Creek | NA | NA | NA | NA | NA | | | | |
| Clear Fork | NA | NA | NA | NA | NA | | | | |
| Duck Creek | NA | NA | NA | NA | NA | | | | |
| Walnut Fork | NA | NA | NA | NA | NA | | | | |
| Yellow Bank Creek | NA | NA | NA | NA | NA | | | | |
| ** | Metamora RSD WWTP | IN0062391 | ING0348_03 | 08/12/2010: Potential problems observed<br>09/14/2010: Potential problems observed<br>09/30/2010: Potential problems observed<br>01/13/2011: Violations observed<br>08/11/2011: Violations observed<br>06/15/2012: No violations observed<br>08/20/2012: No violations observed<br>01/10/2013: Violations observed<br>07/10/2013: Violations observed<br>06/12/2014: Violations observed | Dec<br>Dec<br>Jan<br>Oct | 2009<br>2009<br>2010<br>2010 | TSS<br>TSS<br>TSS<br>TSS | Mo Avg<br>Max Wk Avg<br>Max Wk Avg<br>Mo Avg | 1<br>1<br>1<br>1 |

** Site is located outside the Pipe Creek watershed but data will be used to calculate pollutant contributions from West Fork Whitewater River.

### *Industrial Facilities*

Industrial facilities with NPDES permits produce wastewater generated through producing a product. Wastewater discharges from industrial sources may contain pollutants at levels that could affect the quality of receiving waters. The NPDES permit program establishes specific requirements for dischargers from industrial sources. If the industrial facility discharges wastewater directly to a surface water then it requires an individual or general NPDES permit. A general permit, or permit-by-rule, is a "one size fits all" type of activity-specific permit. The general permit rule (327 IAC 15-1 through 15-4) covers the following activities: coal mining, coal processing, and reclamation activities, noncontact cooling water, petroleum products terminals, groundwater petroleum remediation systems, hydrostatic testing of commercial pipelines, and sand, gravel and stone operations. In contrast, individual permits are tailored to the specific activities of the facility and may regulate a number of additional pollutants other than those described under the general permits.

There is one industrial facility with a NPDES permits within the Pipe Creek watershed (Table XX). Based on the industrial activities and the regulated parameters within the specific permits the facility does not discharge wastewater within the Pipe Creek watershed (**Error! Reference source not found.** and **Error! Reference source not found.**). A summary of the industrial permit within the Pipe Creek watershed are described below.

**Figure 44. NPDES Permitted Industrial Facilities in the Pipe Creek Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Pipe Creek | NA | NA | NA | NA | NA |
| Clear Fork | NA | NA | NA | NA | NA |
| Duck Creek | NA | NA | NA | NA | NA |
| Walnut Fork | NA | NA | NA | NA | NA |
| Yellow Bank Creek | Owens Corning Roofing & Asphalt LLC | INP000122 | NA | NA | 0.064 |

Owens Corning Roofing and Asphalt LLC manufacture residential roofing products. The manufacturing process includes coating fiberglass mats with hot filled asphalt and cooling of product with water. Part of the water evaporates and is exhausted to the atmosphere. The remainder of the water flows to settling pits where solids settle out and the overflow water discharges to the city sewer through a weir. The company retains a pretreatment permit which covers the discharge from the facility into the Brookville Publicly Owned Treatment Works. There is no direct discharge into a stream.

**Error! Reference source not found.** presents a summary of permit compliance for industrial NPDES facilities in the Pipe Creek watershed for the five year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). According to **Error! Reference source not found.**, there have been no NPDES industrial facility inspections resulting in violations in the five year period.

**Table 45. Summary of Inspections and Permit Compliance for Industrial Facilities in the Pipe Creek Watershed for the Five Year Period Ending September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 |
|---|---|---|---|---|---|
| Headwaters Pipe Creek | NA | NA | NA | NA | NA |
| Clear Fork | NA | NA | NA | NA | NA |
| Duck Creek | NA | NA | NA | NA | NA |
| Walnut Fork | NA | NA | NA | NA | NA |
| Yellow Bank Creek | Owens Corning Roofing & Asphalt LLC | INP000122 | NA | 6/9/2011: No violations observed<br>6/28/2013: No violations observed<br>8/14/2014: No violations observed | NA |

***Industrial Storm Water***

Depending on the type of industrial facility operated more than one NPDES program may apply. Some industrial facilities require an additional permit under the storm water program which will be discussed in this section.

Industrial storm water permits are required for facilities where activities of the industrial operation are exposed to storm water and run-off is discharged though a point source to waters of the state. The general permit 327 IAC 15-6 (Rule 6) applies to specific categories of industrial activities that must obtain permit coverage. Determination of applicable industrial activities is based on a facility's Standard Industrial Classification (SIC) Code(s) or facility activities included in the listed narrative descriptions within the rule. Under certain circumstances, a facility may require an individual storm water permit. This permit is typically required only if a regulated industrial activity category has established effluent limitations or IDEM determines the storm water discharge will significantly lower water quality. Industrial storm water permits in the Pipe Creek watershed are shown in Figure 40.

The facility must develop and implement a Storm Water Pollution Prevention Plan (SWP3), and submit a completed SWP3 Checklist Form certifying to IDEM that such a plan is in place. The SWP3 is used to identify potential and actual storm water pollutant sources, and to determine best management practices and measures that will minimize the pollutants transported in storm water run-off. The SWP3 itself must be retained at the facility, and made available for review during any on-site inspection. Periodically, the plan must be reviewed, and revised if changes at the facility alter conditions that could affect run-off.

**Figure 46. NPDES Industrial Storm Water Permits in the Pipe Creek Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Area (Sq. Mi.) |
|---|---|---|---|---|---|
| Headwaters Pipe Creek | Paul H Rohe Company Incorporated | INR700041 | ING0361_T1007 | Tributary to Pipe Creek | 0.032 |
| | Taylor Corporation McPhersons Division | INR14X065 | ING0361_02 | Pipe Creek | 0.016 |
| Clear Fork | Virtus Incorporated | INRX00251 | ING0362_T1002 | Tributary to Clear Creek | 0.007 |
| | General Electric Lighting Large Order Center | INR800268 | ING0362_T1002 | Tributary to Clear Creek | 0.052 |
| Duck Creek | None | NA | NA | NA | NA |
| Walnut Fork | Cummins & Sons | INR00C218<br>INR600241 | ING0364_T1006<br>ING0364_T1007 | Trace Branch Tributary to Pipe Creek | 0.013 |
| Yellow Bank Creek | Owens Corning | INR700015 | ING0365_01 | Whitewater River | 0.045 |

***Construction Storm Water***

Storm water run-off associated with construction activity is regulated under 327 IAC 15-5 which is commonly known as Rule 5. Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities.

The requirements of Rule 5 now apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land disturbing activity results in the disturbance of less than one (1) acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to storm water permitting.

In Indiana most construction projects subject to Rule 5 are administered through a general permit. A general permit is a permit by rule, and as such it is not "issued" in the same manner as an individual NPDES permit would be issued. Rather, Rule 5 was "conditionally issued" to all future "project site owners" at the time that the rule was adopted by the Indiana Water Pollution Control Board. The permit conditions within Rule 5 apply universally to all "project site owners" who are eligible to operate under the rule.

Rule 5 requires the development of a Construction Plan and an integral part of the Construction Plan is a SWP3. The SWP3 addresses several issues. First, the plan outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. Second, the plan addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. Finally, the plan should also address pollutants that will be associated with the post construction land use. It is the responsibility of the project site owner to implement the storm water pollution prevention plan. In addition, it is critical that the site is monitored during the construction process and in field modifications are made to address the discharge of sediment and other pollutants from the project site. This may require modification of the plan and field

changes on the project site, as necessary, to prevent pollutants, including sediment, from leaving the project site.

If an adverse environmental impact from a project site is evident, a Rule 5 permit or, in more significant situations, an individual storm water permit may be required. An individual storm water permit is typically required only if IDEM determines the discharge will significantly lower water quality. If an individual storm water permit is required, notice will be given to the project site owner. The acreage numbers in Table 47 were calculated by using an area weighted approach with using the past five years of permitted construction sites in Fayette, Franklin, Dearborn and Ripley counties.

**Table 47. Permitted Construction Acreage in the Pipe Creek Subwatersheds**

| Subwatershed | Estimated Construction Acreage |
|---|---|
| Headwaters Pipe Creek | 2.45 |
| Clear Fork | 0.96 |
| Duck Creek | 1.40 |
| Walnut Fork | 1.64 |
| Yellow Bank Creek | 1.40 |

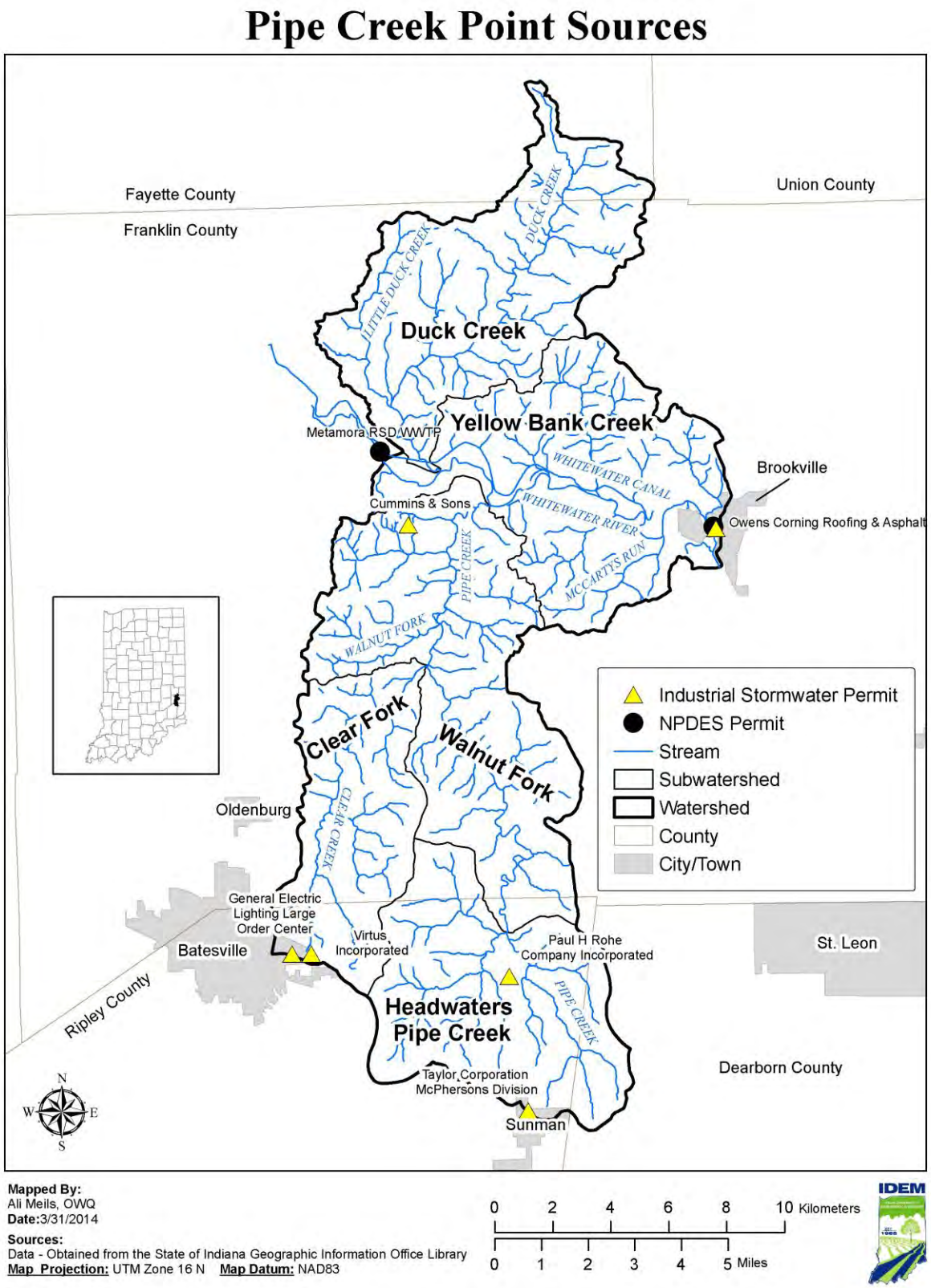


**Figure 41 Point Sources in the Pipe Creek Watershed**

#### *Illicitly Connected "Straight Pipe" Systems*

Some household wastes within Indiana and potentially within the Pipe Creek watershed directly discharge to a stream or are illegally connected directly to tile-drainage pipes in rural areas, providing a direct source of pollutants such as *E. coli*, nutrients, and TSS to the stream (these systems are sometimes referred to as "straight pipe" discharges).

### Nonpoint Sources

This section summarizes the potential nonpoint sources of *E. coli*, nutrients and sediment in the Pipe Creek watershed that are not regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

#### *Cropland*

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from decomposition of residual crop material, fertilization with chemical (e.g., anyhdrous ammonia) and manure fertilizers, inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal and industrial wastewater treatment facilities. The majority of nutrient loading from cropland occurs from fertilization with commercial and manure fertilizers (USEPA, 2003). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (USEPA, 2003).

Watershed specific data are not available for field specific crops. However, county-wide data available from the National Agricultural Statistic Service (NASS) were downloaded and area weighted to estimate crop acreage in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total acreage of crops in the county based on the NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of cropland with the watershed. The 2012 NASS statistics was used in the analysis as shown in Table 48.

**Table 48. Major Cash Crop Acreage in the Pipe Creek watershed**

| Crop | Total Acreage in County | | | |
|---|---|---|---|---|
| | Dearborn | Fayette | Franklin | Ripley |
| Corn | 9,300 | 38,100 | 39,600 | 48400 |
| Soybean | 9,600 | 35,700 | 35,800 | 55600 |
| Winter Wheat | NA | 1,600 | 1,800 | NA |

| Subwatershed Area (mi²) | Crop | Total Acreage | Percentage of Subwatershed Crop Acreage |
|---|---|---|---|
| Headwaters Pipe Creek (21.73 mi²) | Corn | 2106 | 47 |
| | Soybean | 2365 | 53 |
| | Winter Wheat | 8 | <1 |
| | **Total** | **4479** | **100** |

| | | | |
|---|---|---|---|
| **Clear Fork (15.80 mi²)** | Corn | 1623 | 50 |
| | Soybean | 1557 | 48 |
| | Winter Wheat | 57 | 2 |
| | **Total** | **3237** | **100** |
| **Duck Creek (25.74 mi²)** | Corn | 2876 | 51 |
| | Soybean | 2621 | 47 |
| | Winter Wheat | 129 | 2 |
| | **Total** | **5626** | **100** |
| **Walnut Fork (29.67mi²)** | Corn | 3010 | 51 |
| | Soybean | 2748 | 47 |
| | Winter Wheat | 132 | 2 |
| | **Total** | **5890** | **100** |
| **Yellow Bank Creek (25.92 mi²)** | Corn | 2624 | 51 |
| | Soybean | 2372 | 46 |
| | Winter Wheat | 119 | 3 |
| | **Total** | **5115** | **100** |

### *Pastures and Livestock Operations*

Runoff from pastures and livestock operations can be potential agricultural sources of *E. coli*, nutrients, and TSS. For example, animals grazing in pasturelands deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated runoff during a storm event.

Livestock are a potential source of *E. coli*, nutrients, and stream bank erosion in streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county-wide data available from the National Agricultural Statistic Service were downloaded and area weighted to estimate animal population in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total number of animals in the county based on the NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of animals with the subwatersheds. There are an estimated 6,339 animal units in the Pipe Creek watershed and the animal unit density is 53 animal units per square mile as shown in Table 49.

**Table 49. Animal Unit Density in the Pipe Creek Subwatersheds**

| | Hogs and Pigs | Cattle and Calves | Sheep and Goats | Horses and Ponies | Poultry |
|---|---|---|---|---|---|
| **Number of Animals in One Animal Unit** | 2.5 | 1 | 10 | 0.5 | 250 |
| | | | | | |
| **Total Number of Head in County** | | | | | |
| Dearborn | 342 | 7,133 | 619 | 568 | 777 |
| Fayette | 12,730 | 6,470 | 884 | 315 | 416 |
| Franklin | 19,941 | 12,323 | 842 | 581 | 1,015 |
| Ripley | 32,591 | 9,474 | 1,268 | 593 | 915 |
| | | | | | |
| **Total Number of Animal Units in Subwatersheds** | | | | | |
| | Headwaters Pipe Creek | Clear Fork | Duck Creek | Walnut Fork | Yellow Bank Creek |
| Hogs and Pigs | 531 | 352 | 537 | 614 | 528 |
| Cattle and Calves | 415 | 463 | 806 | 924 | 816 |
| Sheep and Goats | 21 | 2 | 4 | 4 | 3 |
| Horses and Ponies | 50 | 46 | 76 | 88 | 77 |
| Poultry | 0 | 0 | 0 | 0 | 0 |
| **Total** | **999** | **863** | **1423** | **1630** | **1424** |
| **Animal Unit Density (animal units/mi²)** | **46** | **55** | **55** | **55** | **55** |

#### *Confined Feeding Operations (CFOs)*

A CFO is an agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and

Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

The number of animal present meets the requirements for the state permitting action.

Confined feeding operations that are not classified as CAFOs are known as confined feeding operations (CFOs) in Indiana. Non-CAFO animal feeding operations are considered nonpoint sources by USEPA. CAFOs have federal permits and fall under the jurisdiction of the NPDES program, as described in Section 6.2.1.1. Indiana's CFOs have state-issued permits but are not under the jurisdiction of the federal NPDES program and are therefore categorized as nonpoint sources for the purposes of this TMDL. CFO permits are "no discharge" permits. Therefore it is prohibited for these facilities to discharge to any water of the State.

The CFO regulations (327 IAC 19, 327 IAC 15-16) require that operations "not cause or contribute to an impairment of surface waters of the state". IDEM regulates these confined feeding operations under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 19, which implement the statute regulating confined feeding operations, were effective on July 1, 2012. The rule at 327 IAC 15-16, which regulates concentrated animal feeding operations and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012.

Like CAFOs, the animals raised in CFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. CFOs, however, can also be potential sources of TSS, total nitrogen, total phosphorus, and *E. coli* due to the following:

Manure can leak or spill from storage pits, lagoons, tanks, etc.

Improper application of manure can contaminate surface or ground water.

Manure overapplication or improper application can adversely impact soil productivity.

There are five CFOs in the Pipe Creek watershed as shown in Table 50 and **Error! Reference source not found.**.

**Table 50. CFOs in the Pipe Creek Subwatersheds**

| Subwatershed | Operation Name | Farm ID | AUID | Animal Type and Number |
|---|---|---|---|---|
| Headwaters Pipe Creek | Brent Sarringhaus | 4764 | ING0361_T1006 | 240 Nursery Pigs<br>720 Finishers<br>74 Sows |
| Clear Fork | D & L Werner Farms | 6328 | ING0362_02 | 400 Nursery Pigs<br>810 Finishers<br>104 Sows<br>48 Beef Cattle |
| Duck Creek | NA | NA | NA | NA |
| Walnut Fork | Kopp Land & Livestock | 4481 | ING0364_01 | 600 Beef Cattle |
| | Joe Schwegman Farm | 4635 | ING0364_01 | 200 Nursery Pigs<br>700 Finishers<br>125 Sows<br>25 Beef Cattle |
| Yellow Bank Creek | Alan Vanmeter | 4121 | ING0363_T1004 | 270 Nursery Pigs<br>1000 Finishers<br>124 Sows |

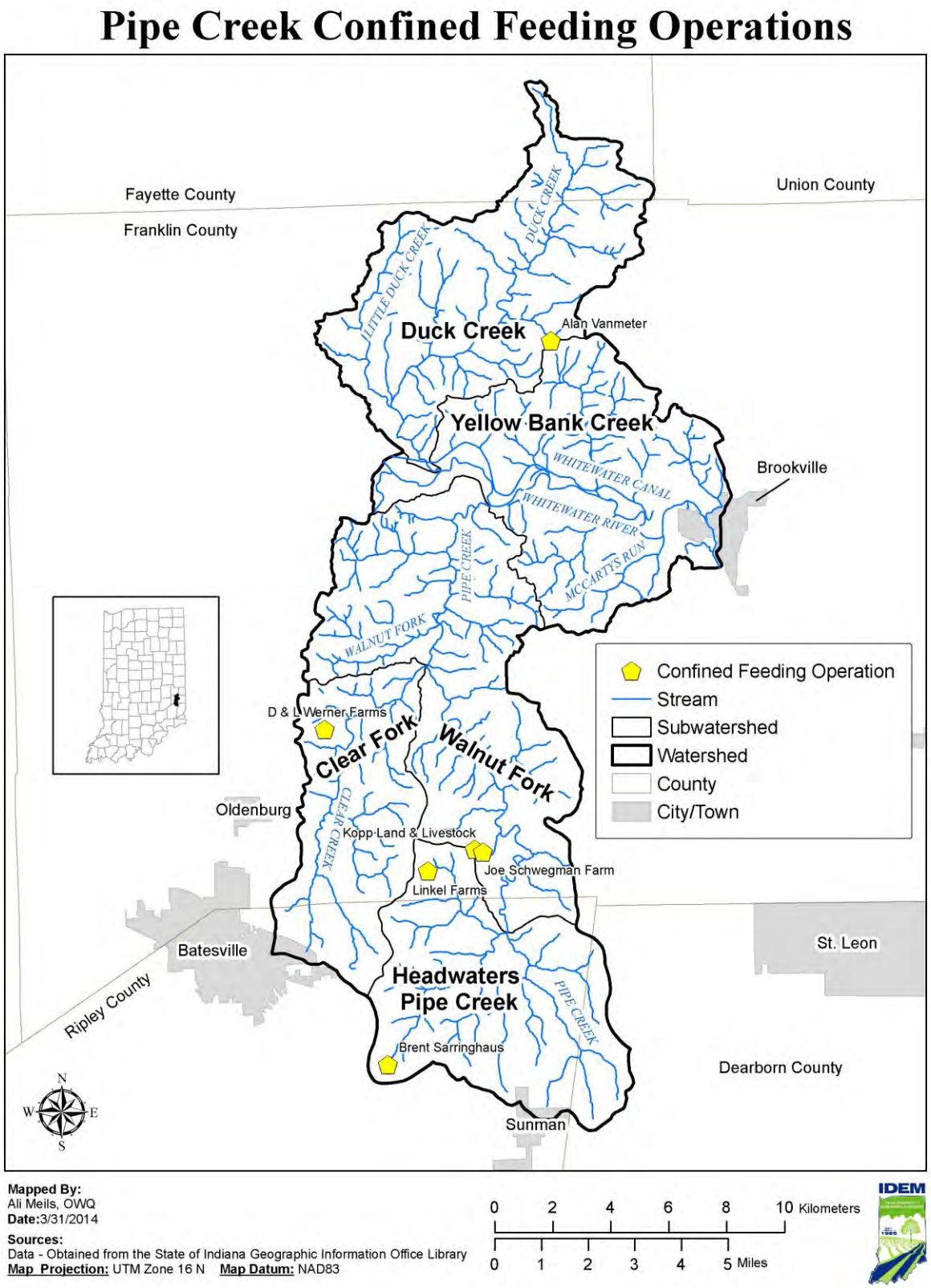


**Figure 42 Confined Feeding Operations in the Pipe Creek Subwatersheds**

#### *Streambank Erosion*

Streambank erosion is potentially a significant source of TSS in the Pipe Creek watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities:

Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots.

Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion due to high velocities and shear stress.

The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid runoff of rainfall and higher stream velocities that might cause streambank erosion.

#### *Onsite Wastewater Treatment Systems*

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure are: seasonal water tables, compact glacial till, bedrock, coarse sand and gravel outwash and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters due to *E. coli,* nitrate + nitrite, and total phosphorus (Horsely and Witten, 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pathogens and nutrients.

The Indiana State Department of Health (ISDH) regulates (410 IAC 6-8.3) through the local health departments the residential onsite sewage disposal program. Onsite sewage disposal systems (i.e., septic systems) are those, which do not result in an off-lot discharge of treated effluent, typically consisting of a septic tank to settle out and digest sewage solids, followed by a system of perforated piping to distribute the treated wastewater for absorption into the soil. More than 800,000 onsite sewage disposal systems are currently used in Indiana. Local health departments issue more than 15,000 permits per year for new systems, and about 6,000 permits for repairs.

**410 IAC 6-8.3-52 General sewage disposal requirements**
Sec. 52. (a) No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or ground waters of this state, or cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into such waters, any organic or inorganic matter from a dwelling or residential onsite sewage system that would cause or contribute to a health hazard or water pollution.
(b) The: (1) design; (2) construction; (3) installation; (4) location; (5) maintenance; and (6) operation; of residential onsite sewage systems shall comply with the provisions of this rule.

**410 IAC 6-8.3-55 Violations; permit denial and revocation**
Sec. 55. (a) Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer. (b) If any component of a residential onsite sewage system is found to be: (1) defective; (2) malfunctioning; or (3) in need of service; the health officer may require the repair, replacement, or service of that component. The repair, replacement, or service shall be conducted within the time limit set by the health officer. (c) Any person found to be violating this rule may be served by the health officer with a written order stating the nature of the violation and providing a time limit for satisfactory correction thereof.

A comprehensive database of septic systems within the Southern Whitewater River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The US Census provides the total number of people within a county as well as the total urban and rural population of the county. Subwatershed population is estimated by dividing the subwatershed area by the total county area and multiplying it by the county census population. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural population density. An additional estimate of septic systems can be made using the 1990 US Census, as that is the last Census that inventoried how household wastewater is disposed. The rural households in the Pipe Creek subwatersheds are shown in Table 52, along with a calculated density (total rural households divided by total area). The rural household density can be used to compare the different subwatersheds within the Pipe Creek watershed.

It should also be noted that hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement. Table 51 illustrates the hydrologic soil groups for the Pipe Creek subwatersheds.

**Table 51** Hydrologic Soil Groups in the Pipe Creek Subwatersheds

| Subwatershed | Hydrologic Soil Group | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Headwaters Pipe Creek | 0 | 1,167.36 | 14,375.35 | 0 |
| Clear Fork | 0 | 682.99 | 12,417.96 | 23.00 |
| Duck Creek | 98.62 | 7,261.35 | 11,133.94 | 0 |
| Walnut Fork | 87.68 | 1,778.32 | 20,441.32 | 2.42 |
| Yellow Bank Creek | 877.40 | 6,017.39 | 12,314.44 | 0 |

**Table 52. Rural Population Density in the Pipe Creek Subwatersheds**

| Subwatershed | County | Area of County in Subwatershed ($mi^2$) | County Households in Subwatershed | Urban Households | Rural Households | Rural Household Density ($Houses/mi^2$) |
|---|---|---|---|---|---|---|
| Headwaters Pipe Creek | Dearborn | 2.92 | 126 | 0 | 126 | **29** |
| | Franklin | 1.74 | 46 | 0 | 46 | |
| | Ripley | 17.07 | 459 | 5 | 454 | |
| | Total | 21.73 | 631 | 5 | 626 | |
| Clear Fork | Franklin | 12.41 | 199 | 0 | 199 | **26** |
| | Ripley | 3.39 | 302 | 95 | 207 | |
| | Total | 15.80 | 501 | 95 | 406 | |
| Duck Creek | Fayette | 3.57 | 51 | 0 | 51 | **22** |
| | Franklin | 22.17 | 517 | 0 | 517 | |
| | Total | 25.74 | 568 | 0 | 568 | |
| Walnut Fork | Franklin | 28.66 | 498 | 0 | 498 | **18** |
| | Ripley | 1.01 | 24 | 0 | 24 | |
| | Total | 29.67 | 522 | 0 | 522 | |
| Yellow Bank Creek | Franklin | 25.92 | 1,076 | 280 | 796 | **31** |
| | Total | 25.92 | 1,076 | 280 | 796 | |

#### *Urban Storm Water*

In areas not covered under the NPDES MS4 program, storm water runoff from developed areas is not regulated under a permit and is therefore a nonpoint source. Runoff from urban areas can carry a variety of pollutants originating from a variety of sources. Typically urban sources of nutrients are fertilizer application to lawns and pet waste, which is also a source of *E. coli*. Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation. The percent and distribution of developed land in the Headwaters Pipe Creek watershed is discussed in Section 4.2.1. However, inputs from urban sources are difficult to quantify. Estimates can be made of pet populations and residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of nutrients or *E. coli* in the Pipe Creek watershed.

Dog and cat populations were estimated for the Pipe Creek subwatersheds using statistics reported in the *2007 U.S. Pet Ownership & Demographics Sourcebook*[1]. Specifically, the *Sourcebook* reports that on average 37.2 percent of households own dogs and 32.4 percent of households own cats. Typically, the average number of pets per household is 1.7 dogs and 2.2 cats. However, pets are likely only a significant source of *E. coli* and nutrients in population centers (i.e., cities and towns). The estimates of domestic pets in cities and towns in the watershed are presented in **Error! Reference source not found.** and are based on the average number of pets per household multiplied by the households in the urban areas of the subwatersheds.

**Table 53. Estimated Pet Populations in the Cities and Towns in the Pipe Creek Watershed**

| Subwatershed | City/Town | Households in 2010 | Estimated Number of Cats | Estimated Number of Dogs |
|---|---|---|---|---|
| Headwaters Pipe Creek | Sunman | 5 | 11 | 9 |
| Clear Fork | Batesville | 95 | 209 | 162 |
| Duck Creek | NA | NA | NA | NA |
| Walnut Fork | NA | NA | NA | NA |
| Yellow Bank Creek | Brookville | 280 | 616 | 476 |
| | **Total** | 380 | 836 | 647 |

#### *Wildlife*

The Indiana Department of Natural Resources (IDNR) is the primary entity responsible for monitoring wildlife populations and habitats throughout Indiana. Wildlife such as deer, geese, ducks, etc. can be sources of *E. coli*. Little information exist surrounding feces depositional patterns of wildlife and a direct inventory of wildlife populations is generally not available. However, based on the *Bacteria Source Load Calculator* developed by the Center for TMDL and Watershed Studies, bacteria production by animal type is estimated as well as their preferred habitat. Higher concentrations of wildlife in the habitats described in Table 54 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.

**Table 54. Bacteria Source Load by species**

| Wildlife Type | *E. coli* Production Rate (cfu/day – animal) | Habitat |
|---|---|---|
| Deer | $1.86 \times 10^8$ | Entire Watershed |
| Raccoon | $2.65 \times 10^7$ | Low density on forests in rural areas; high density on forest near a permanent water source or near cropland |
| Muskrat | $1.33 \times 10^7$ | Near ditch, medium sized stream, pond or lake edge |
| Goose | $4.25 \times 10^8$ | Near main streams and impoundments |
| Duck | $1.27 \times 10^9$ | Near main streams and impoundments |
| Beaver | $2.00 \times 10^5$ | Near streams and impoundments in forest and pastures |

[1] http://www.avma.org/reference/marketstats/sourcebook.asp

Managed lands include natural and recreation areas which are owned or managed by the Indiana Department of Natural Resources, federal agencies, local agencies, non-profit organizations, and conservation easements. Classified lands are public or private lands containing areas supporting growth of native or planted trees, native or planted grasses, wetlands or other acceptable types of cover that have been set aside for managed production of timber, wildlife habitat and watershed protection. These natural areas provide ideal habitat for wildlife. Some of the more common wildlife often found in natural areas include white-tailed deer, raccoon, muskrat, fowl and beaver. While wildlife is known to contribute *E.coli* and nutrients to the surface waters, natural areas provide economic, ecological and social benefits and should be preserved and protected. Management practices such as reducing impervious surfaces, native vegetation plantings, wetland creation and riparian buffers will help in reducing stormwater runoff transporting pollutants to the streams. Figure 42 shows the managed lands within the Pipe Creek watershed. There are 5,269 acres of managed and classified lands in the Pipe Creek watershed.

**Table 55. Managed Land and Classified Land in the Pipe Creek Watershed**

| **Managed Lands** | | | | | | |
|---|---|---|---|---|---|---|
| **Subwatershed** | **Unit Name** | | | **Manager** | | **Area (acres)** |
| Yellow Bank Creek/Duck Creek | Whitewater Canal State Historic Site | | | Indiana State Museum and Historical Sites Corporation | | 250 |
| | | | | | Total | 250 |
| **Classified Lands (Acres)** | | | | | | |
| **Subwatershed** | **Grassland** | **Woodland** | **Shrubland** | **Wetland** | **Other** | **Total** |
| Headwaters Pipe Creek | 0 | 526.03 | 14.59 | 0 | 0 | 540.62 |
| Clear Fork | 2 | 512.14 | 1.32 | 3.2 | 33.18 | 551.84 |
| Duck Creek | 131.1 | 852.39 | 36.5 | 0.5 | 0.57 | 1,021.06 |
| Walnut Fork | 37.38 | 1428.13 | 25 | 6.65 | 0 | 1,497.16 |
| Yellow Bank Creek | 22.48 | 1245.02 | 101.83 | 36.17 | 2.89 | 1,408.39 |
| | | | | | Total | 5,019.07 |

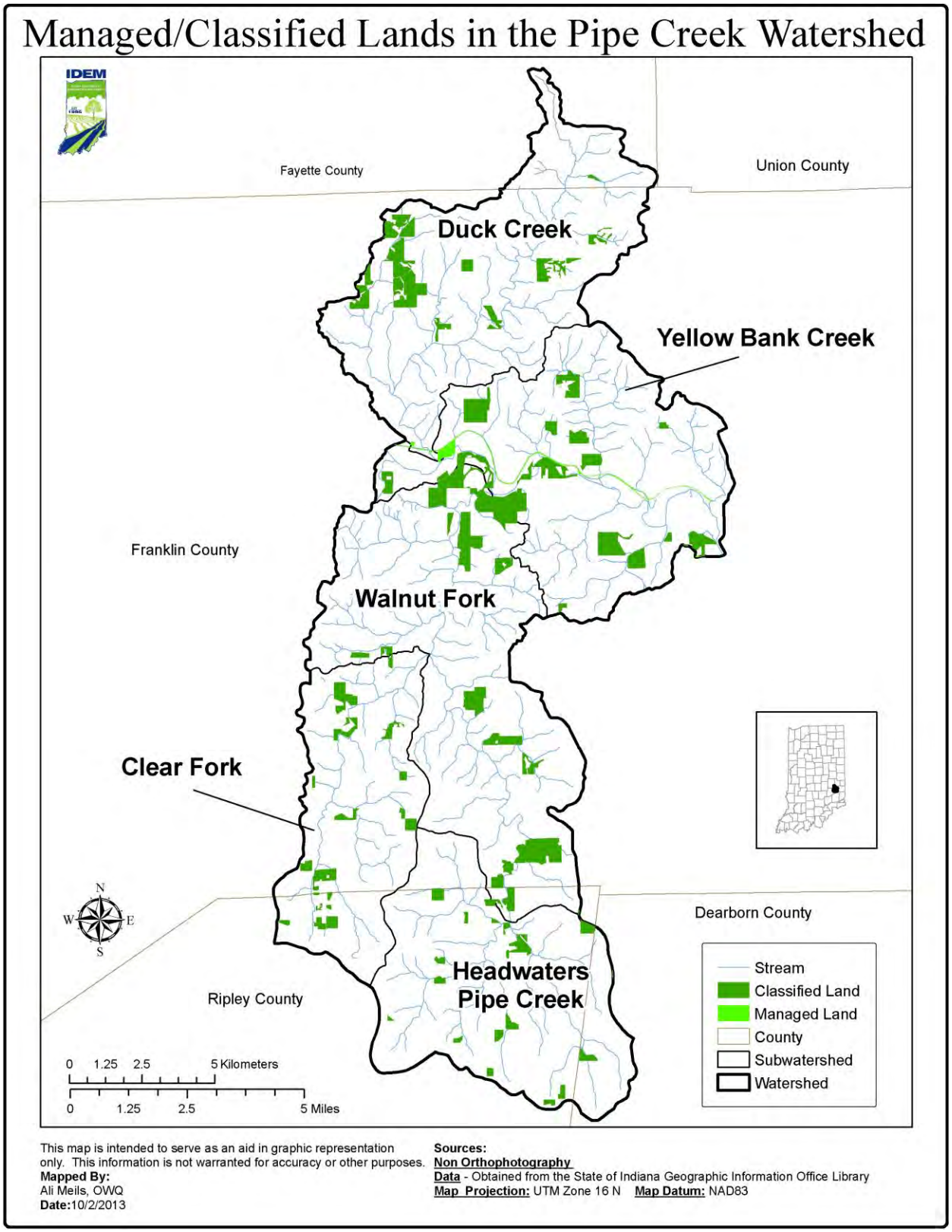


**Figure 43 Managed Lands in the Pipe Creek Watershed**

# 7.0 DESCRIPTION OF THE WHITEWATER RIVER WATERSHED

This section of the TMDL report contains a brief characterization of the Whitewater River watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to the *E. coli*, nutrients and sediment impairment. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

The Whitewater River watershed (0508000308), shown in **Error! Reference source not found.** is located on the east side of the Southern Whitewater River watershed along the state border with Ohio. The watershed comprises 175 square miles and drains a total of 1,370 square miles. The Whitewater River watershed originates near Brookville just downstream of the confluence with the East Branch Whitewater River (downstream of Brookville Reservoir). Whitewater River flows southeast through Franklin and Dearborn counties before flowing into Ohio where it ultimately empties into the Ohio River near Cincinnati, Ohio. Land use throughout the watershed is predominantly forested land. The Whitewater River is not a source of drinking water in the watershed.

There are a number of existing impairments in the Whitewater River watershed from Indiana's Draft 2012 303(d) List of Impaired Waters (Figure 43). The listings and causes of impairment have been adjusted as a result of reassessment data collected at 17 sampling locations in the watershed (Figures 44). Within the Whitewater River watershed a total of 23 assessment unit IDs (AUIDs) are cited as impaired for *E. coli* (205 stream miles), biological communities (31 stream miles), dissolved oxygen (70 stream miles), PCBs (38 stream miles), and mercury (34 stream miles) on the Indiana's Draft 2016 303(d) list (Figure 45). These impaired segments account for approximately 214 miles. Table 56 presents listing information for the Whitewater River watershed, including a comparison of the updated listings with the 2012 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Whitewater River watershed are available in Appendix A.

IDEM identifies the Whitewater River watershed and its tributaries using a watershed numbering system developed by United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (i.e., those with shorter HUCs) to smallest (i.e., those with longer HUCs). (For more information on HUCs, go to http://www.in.gov/idem/nps/2422.htm.) **Error! Reference source not found.** 46 shows the 12-digit HUCs located in the Whitewater River watershed.

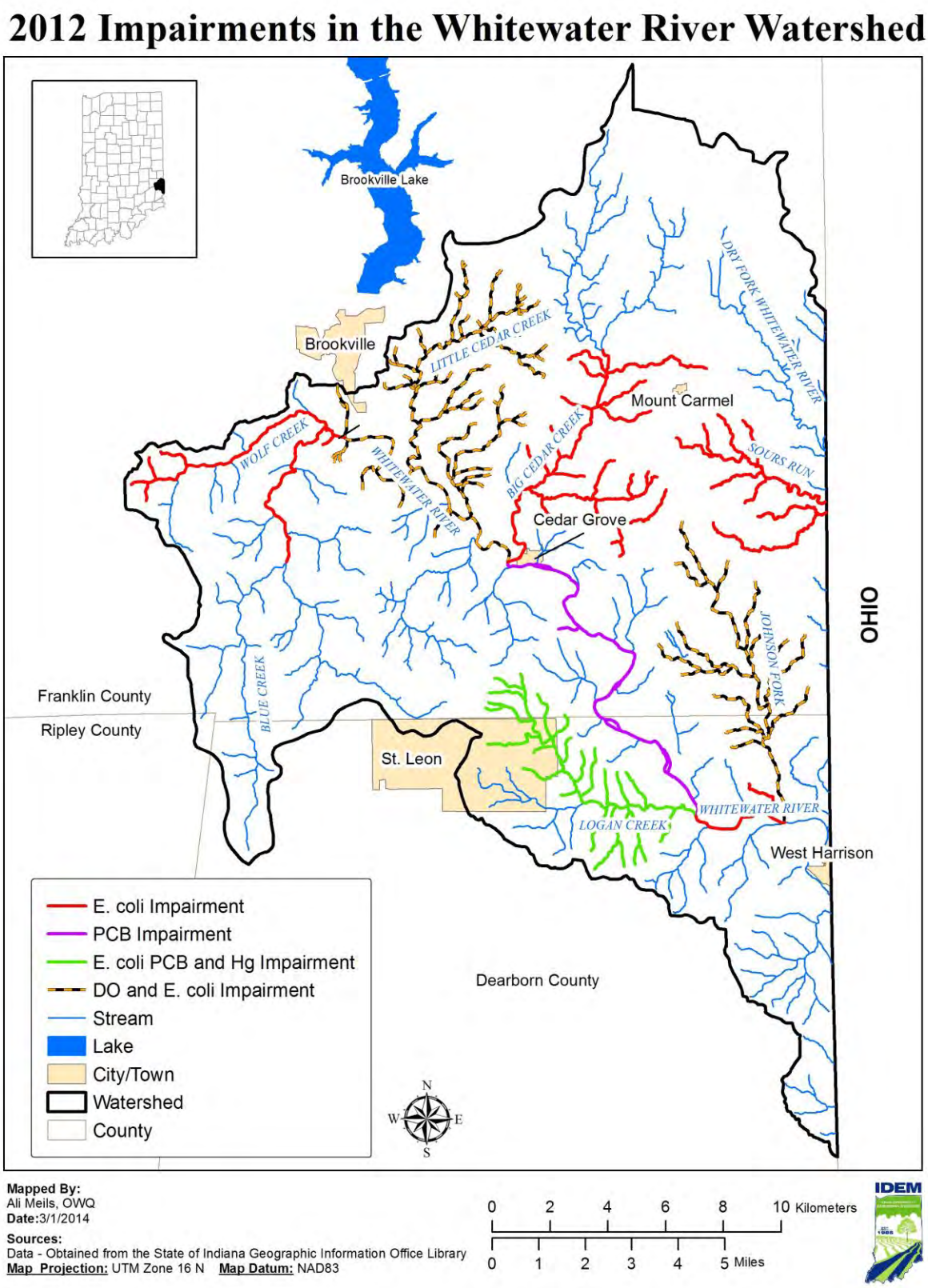


Figure 44. Streams Listed on the Draft 2012 Section 303(d) List in the Whitewater River Watershed

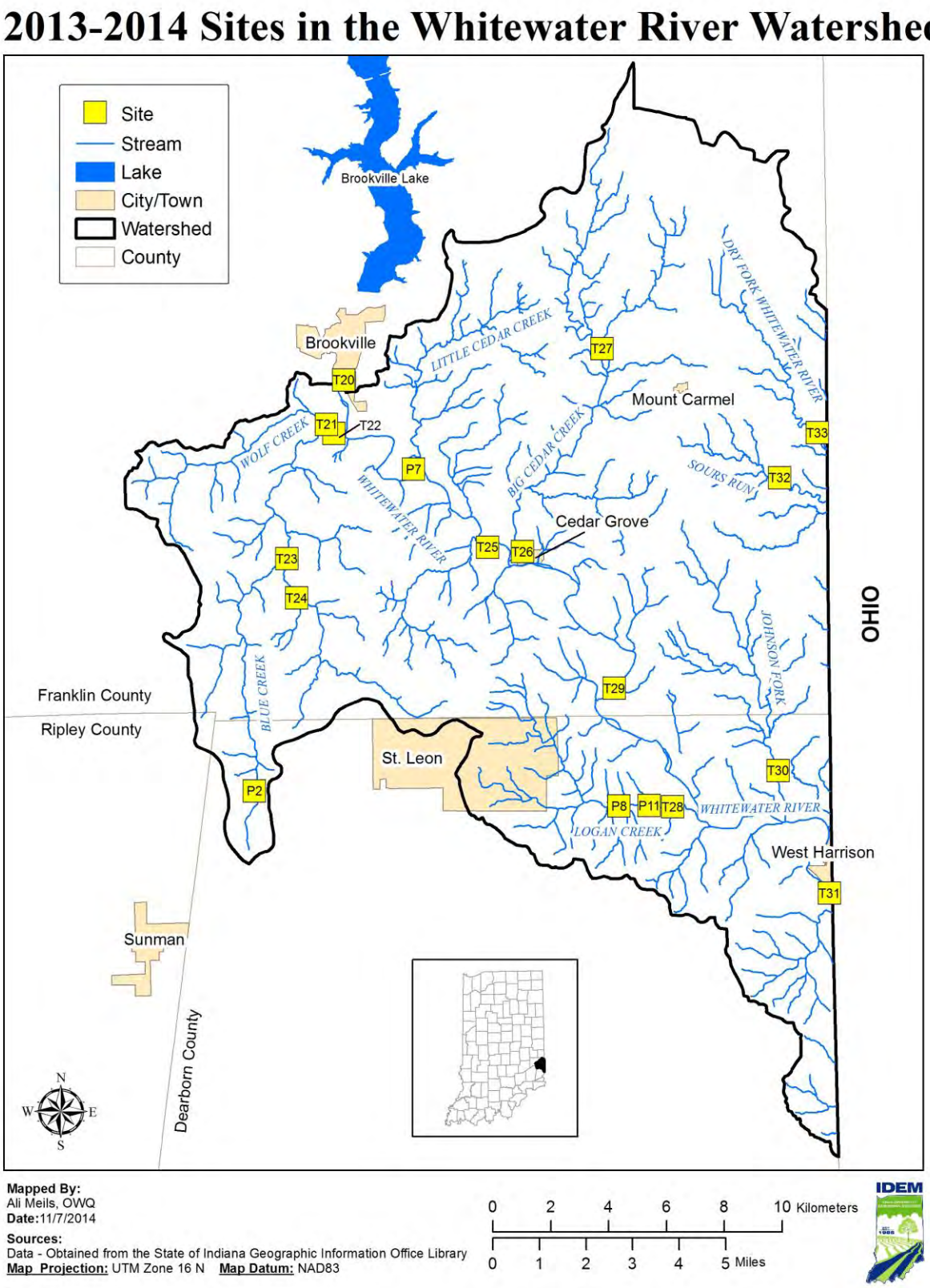


Figure 45 Sampling Locations in Whitewater River Watershed Study

**Table 56 Whitewater River Watershed Sampling Site Information**

| Site # | Station # | Stream Name | Road Name | AUID 2012 |
|---|---|---|---|---|
| T20* | GMW-07-0026 | East Fork Whitewater River | US 52 | ING037H_01 |
| T21 | GMW-08-0026 | Wolf Creek | Blue Creek Rd | ING0382_02 |
| T22 | GMW080-0003 | Blue Creek | Highland Center Rd | ING0382_01 |
| T23 | GMW-08-0014 | Blue Creek | Blue Creek Rd | ING0382_01 |
| T24 | GMW-08-0022 | East Fork Blue Creek | Blue Creek Rd | ING0381_02 |
| T25 | GMW-08-0015 | Whitewater River | SR 1 | ING0384_01 |
| T26 | GMW-08-0016 | Big Cedar Creek | US 52 | ING0383_02 |
| T27 | GMW-08-0024 | Big Cedar Creek | Big Cedar Rd | ING0380_01 |
| T28 | GMW-08-0019 | Logan Creek | SR 46 | ING0386_T1001 |
| T29 | GMW-08-0030 | Whitewater River | St. Peters Rd | ING0385_01 |
| T30 | GMW-08-0018 | Johnson Fork | Johnson Fork Rd | ING0386_02 |
| T31 | GMW-08-0021 | Whitewater River | Jamison Rd | ING038A_01 |
| T32 | GMW-08-0027 | Sours Run | Drewersburg Rd | ING0388_01 |
| T33 | GMW-08-0020 | Dry Fork Whitewater River | Dickson Rd | ING0387_02 |
| P2 | GMW-08-0001 | Blue Creek | County Line Rd | ING0364_01 |
| P7 | GMW-08-0013 | Whitewater River | River Rd | ING0384_01 |
| P8 | GMW-08-0003 | Logan Creek | Covered Bridge Rd | ING0386_T1001 |
| P11 | GMW-08-0005 | Logan Creek | Higher Ground Lane | ING0386_T1001 |

*****This site is not located within the boundaries of the watershed but the data will be used to account for load contributions from East Fork Whitewater River before it joins the West Fork Whitewater River.

***Understanding Table 56:***

- *Column 1: Site #.* Lists the site number that corresponds to the site location in Figure 56.
- *Column 2: Station #* .Provides the IDEM identification number.
- *Column 3: Stream Name*. Identifies the Stream Name where the site is located.
- *Column 4: Road Name.* Identifies the Road Name where the site is located.
- *Column 5: AUID 2012.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2014 Section 303(d) listing assessment process.

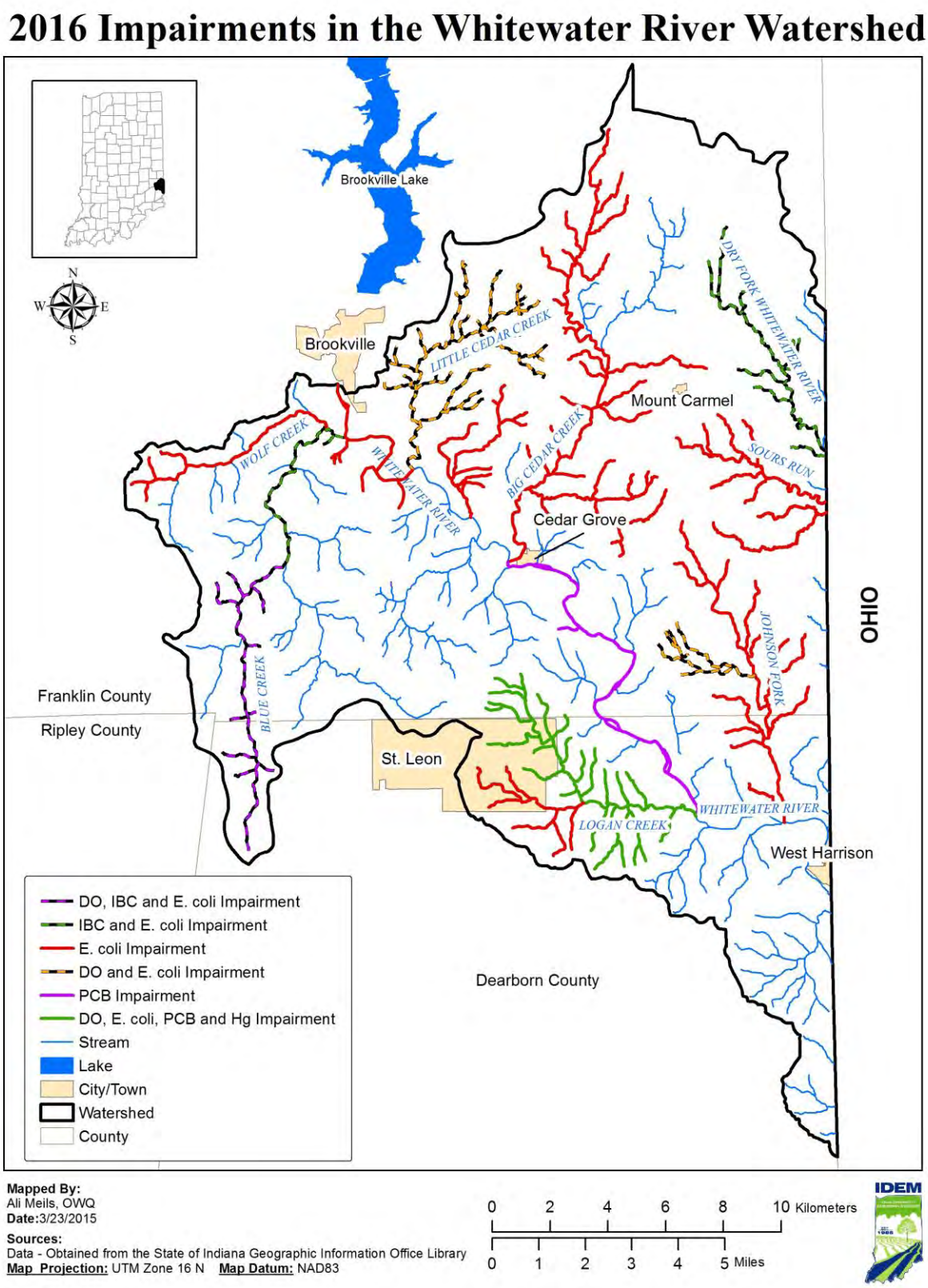


**Figure 46 Streams Listed on the Draft 2016 Section 303(d) List in the Whitewater River Watershed**

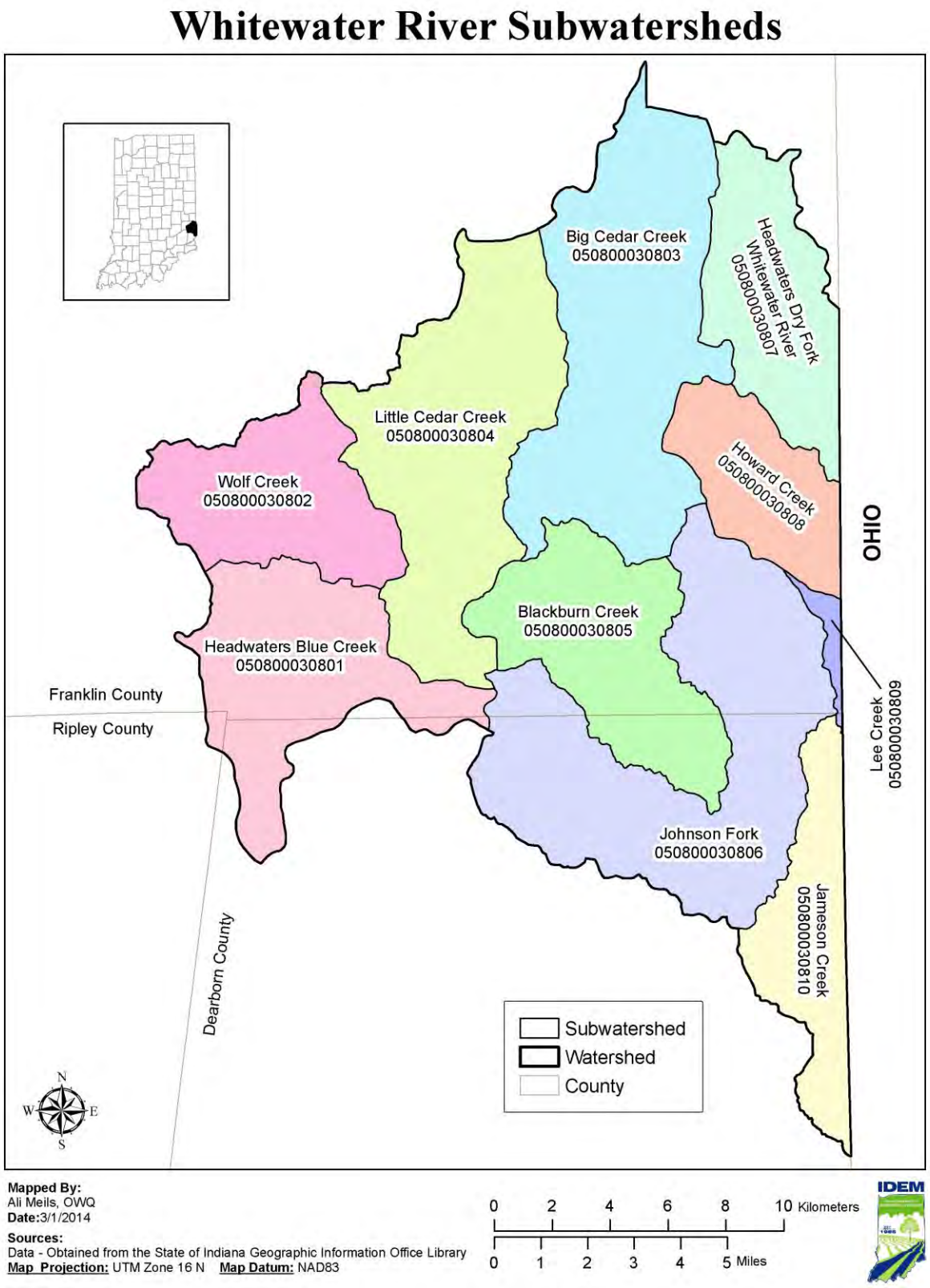


**Figure 47 Subwatersheds (12-Digit HUCs) in the Whitewater River Watershed**

## 7.1 Land Use

Land use patterns provide important clues to the potential sources of *E. coli*, nutrients and sediment in a watershed. Land use information for the Whitewater River watershed is available from the National Agricultural Statistics Service (NASS), which is part of the United States Department of Agriculture (USDA). The Cropland Data Layer (CDL) categorizes the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2012. Figure 10 displays the spatial distribution of the land uses and the data are summarized in Table 8.

Land use in the Whitewater River watershed is primarily forested land, comprising 43 percent of the Whitewater River watershed. Approximately 29 percent of the land is agricultural and 20 percent is pasture and hay fields. Pasture lands and agriculture represent nearly half of the watershed and indicates the presence of animal feedlots and agricultural practices (ex. manure application) that can be significant sources of *E. coli*, nutrients and sediment. Overall there is a low percentage of developed land in the watershed. However as you get closer to the Ohio State line there are increased developed areas due to the proximity to Cincinnati, Ohio. This increase in developed lands is an indicator of high levels of impervious surfaces that can be significant sources of *E. coli*, nutrients and sediment.

The Whitewater River watershed has a diverse network of streams. Tributaries include the Big Cedar Creek, Little Cedar Creek, Jameson Creek, Logan Creek, Johnson Fork, Blue Creek, Dry Fork, Gobles Creek, and Wolf Creek among others. Many of these tributaries are shown in **Error! Reference source not found.**. The natural topography of the watershed allows stream channels to maintain natural meandering for the most part. The high gradient streams often dry up in the summer months creating isolated pools which can often lower dissolved oxygen and impact biological communities. While this is problematic for biological communities it can also be understood as a natural condition that cannot be addressed through management efforts. The variegate darter (*Etheostoma variatum*) is an Indiana State Endangered fish species that is found in Whitewater River along the mainstem only. The variegate darter is restricted to the Ohio River drainage and are only found in the Whitewater River watershed in Indiana. They are an indicator of good water quality and are abundant in high quality streams. They are found in medium to large streams and rivers with swift flowing riffles with gravel, cobble or boulders on the stream bottom. Additional information on state endangered, threatened and rare species can be found on the DNR website (http://www.in.gov/dnr/naturepreserve/4666.htm).

**Table 57. Land Use of Whitewater River Watershed**

| Land Use | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Agricultural Lands | 32,996.50 | 51.56 | 29.42 |
| Developed Land | 6,727.22 | 10.51 | 6.00 |
| Forested Land | 48,942.21 | 76.47 | 43.63 |
| Pasture/Hay | 22,299.75 | 34.85 | 19.88 |
| Grasslands and Shrubs | 568.22 | 0.89 | 0.51 |
| Wetlands | 9.12 | 0.01 | 0 |
| Open Water | 627.60 | 0.98 | 0.56 |
| TOTAL | **112,170.62** | **175.27** | **100** |

***Understanding Table 8:*** The predominant land use types in the Whitewater River watershed can indicate potential sources of *E. coli*, nutrients and sediment loadings. Different types of land uses are characterized by different types of hydrology. For example, developed lands are characterized by impervious surfaces

that increase the potential of storm water events during high flow periods delivering *E. coli*, nutrients and sediment to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water to running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute *E. coli*, nutrients and sediment to the watershed. Understanding types of land uses will help identify the type of implementation approaches that watershed stakeholders can use to achieve *E. coli*, nutrients and sediment load reductions.

## 7.2 Crop Land

Land use patterns provide important clues to the potential sources of *E.coli*, nutrients and sediments in a watershed. Land use information for the Whitewater River watershed is available from the Multi-Resolution Land Characteristics Consortium (MRLCC). These data categorize the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from 2012. Figure 107 displays the spatial distribution of the cropland and the data are summarized in Table 8.

Land use in the Whitewater River watershed is primarily forested, comprising approximately 43 percent of the Whitewater River watershed. However there is a significant portion of the watershed that is agricultural (29 percent). Corn and soybean crops are not typically associated with high *E. coli* loads, unless they have been fertilized with manure. Approximately 96 percent of the cropland is corn or soybean.

**Table 58 Crop Land of Whitewater River Watershed**

| Crop Data | Watershed | | |
|---|---|---|---|
| | Area | | Percent |
| | Acres | Square Miles | |
| Corn | 17380.82 | 27.16 | 51.37 |
| Soybean | 15212.25 | 23.77 | 44.96 |
| Alfalfa and other Hay | 1027.46 | 1.6 | 3.04 |
| Double Crop Winter Wheat/Corn or Soybeans | 213.28 | 0.33 | 0.63 |
| Pop or Orn Corn | 0.44 | <0.01 | <0.01 |
| Watermelons | 0.22 | <0.01 | <0.01 |
| Pumpkins | 0.22 | <0.01 | <0.01 |
| Double Crop Soybeans/Oats | 0.22 | <0.01 | <0.01 |
| TOTAL | 33834.47 | 52.86 | 100 |

***Understanding Table 58:*** The predominant cropland types in the Whitewater River watershed can indicate potential sources of *E.coli*, nutrient and sediment loadings. Cropland use in the Whitewater River watershed is primarily corn and soybean. Understanding types of cropland will help identify the type of implementation approaches that watershed stakeholders use to achieve *E.coli*, nutrient and sediment load reductions.

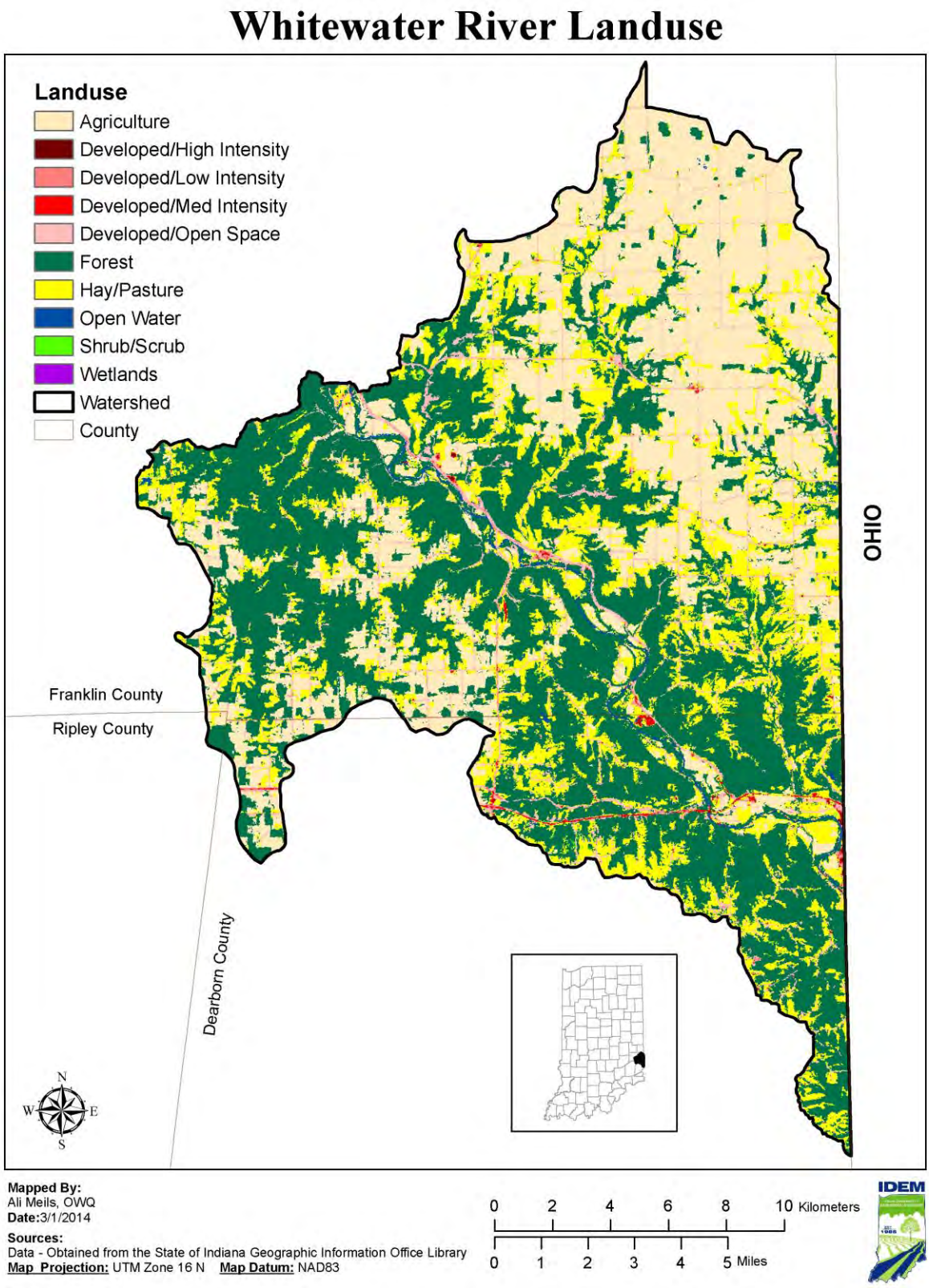


**Figure 48 Land Use in the Whitewater River Watershed**

## 7.3 Human Population

Counties with land located in the Whitewater River watershed include Dearborn, Franklin and Ripley. Major cities and towns with jurisdiction at least partially within the Whitewater River watershed include Hidden Valley, Brookville, Bright, Mount Carmel, Cedar Grove, St. Leon, and West Harrison. United States census data for each county during the past three decades are provided in **Error! Reference source not found.**9. Cities and towns are labeled in Figure 1248.

**Table 59 Population Data for Counties in the Whitewater River Watershed**

| County | 1990 | 2000 | 2010 |
|---|---|---|---|
| Dearborn | 38,835 | 46,109 | 50,047 |
| Franklin | 19,580 | 22,151 | 23,087 |
| Ripley | 24,616 | 26,523 | 28,818 |
| TOTAL | ***83,031*** | ***94,783*** | ***101,952*** |

Source: U.S. Census Bureau.

***Understanding*** **Error! Reference source not found.**9***:*** Water quality is linked to population growth because a growing population often leads to more development, translating into more houses, roads, and infrastructure to support more people. **Error! Reference source not found.**9 provides information that shows how population has changed in each of the counties located in the Whitewater River watershed over time. In addition, understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action now could help prevent further water quality degradation. Census data illustrates that population in Dearborn County has increased nearly 30 percent in the last two decades. This is likely due to Whitewater River watersheds proximity to Cincinnati, Ohio.

Estimates of population within Whitewater River watershed are based on US Census data 2010 and the percentage of the total county and urban area that is within the watershed (Table 11). Based on this analysis, the estimated population of the watershed is 16,614 with approximately 84 percent of the population classified as rural residents and 16 percent classified as urban residents. Figure 1349 indicates population density within the Whitewater River watershed.

**Table 60 Estimated Population in the Whitewater River Watershed**

| County | 2010 Population | Total Estimated Watershed Population | Percent of Total Watershed Population | Non-urban Population | Urban Population |
|---|---|---|---|---|---|
| Dearborn | 50,047 | 8,909 | 53.62 | 6,506 | 2,403 |
| Franklin | 23,087 | 7,672 | 46.18 | 7,336 | 336 |
| Ripley | 28,818 | 33 | 0.20 | 33 | 0 |
| TOTAL | ***101,952*** | ***16,614*** | ***100*** | ***13,875*** | ***2,739*** |

***Understanding Table 110:*** Understanding where the greatest population is concentrated within the Whitewater River watershed will help watershed stakeholders understand where different types of water quality pressures might currently exist. In general, watersheds with large urban populations are more likely to have problems associated with lots of impervious surfaces, poor riparian habitat, flashy storm water flows, and large wastewater inputs. Alternatively, watersheds with mostly a non-urban population are more likely to suffer problems from failing septic systems, agricultural runoff, and other types of poor riparian habitat (e.g., channelized streams).

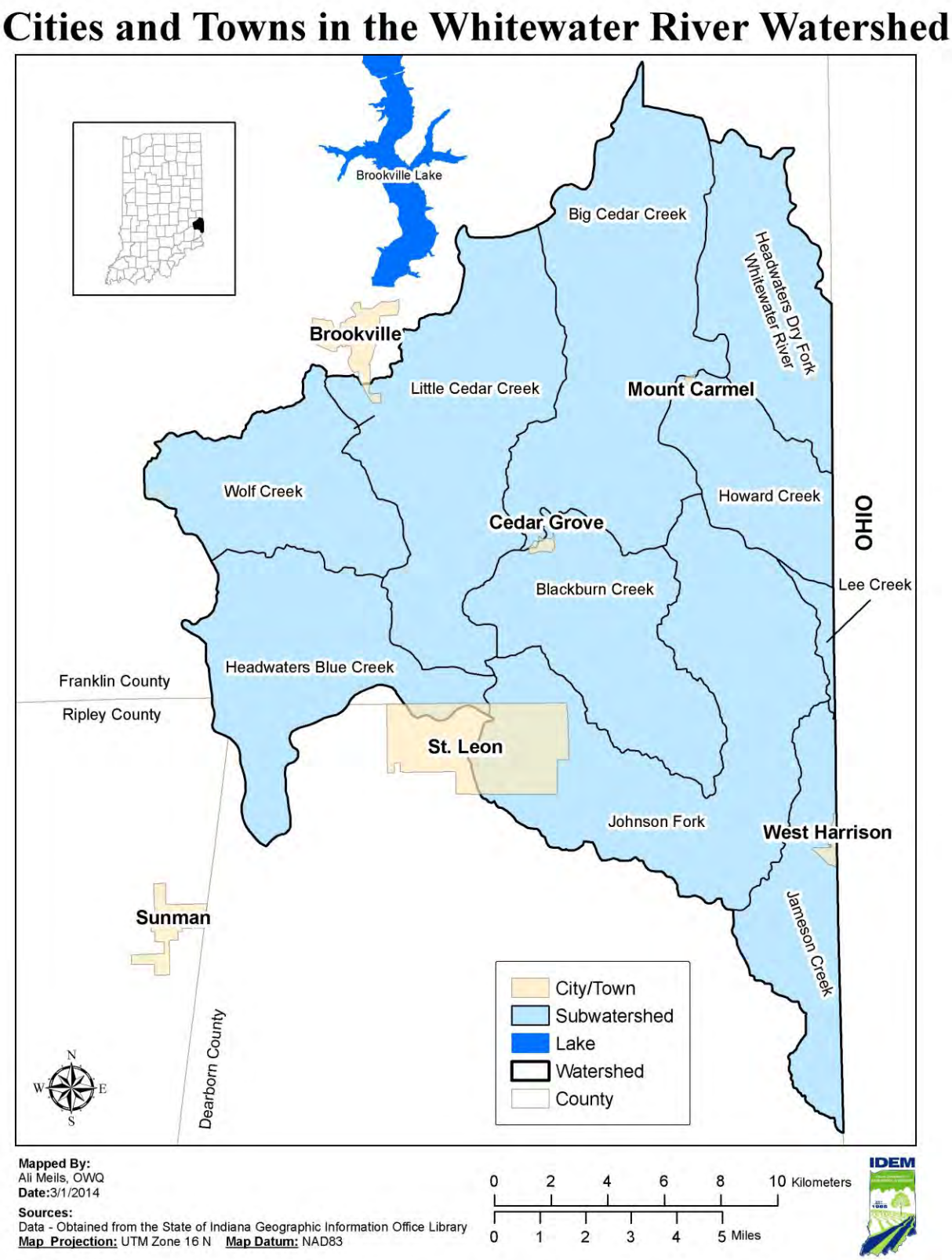


**Figure 49. Municipalities in the Whitewater River Watershed**

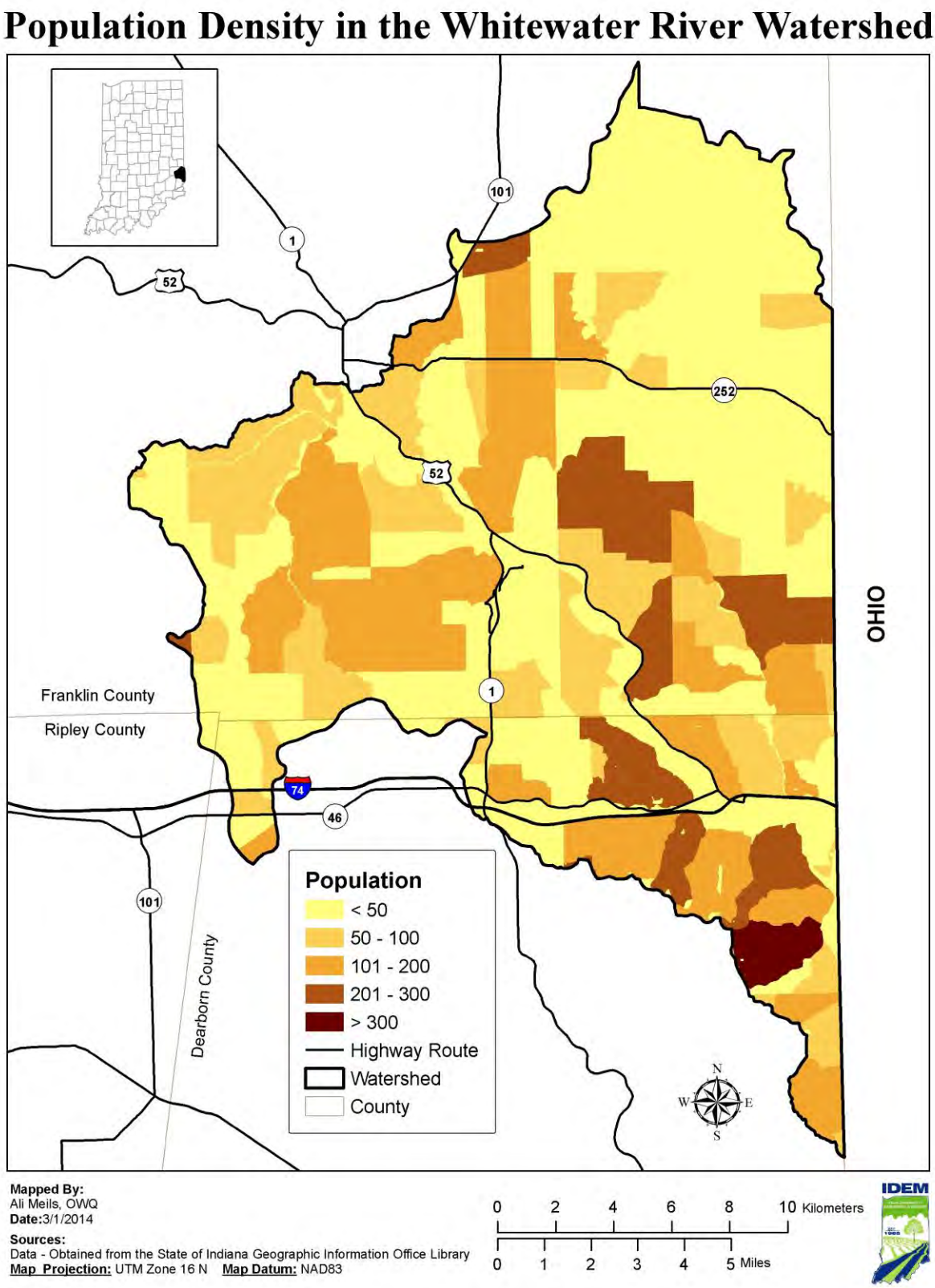


**Figure 50 Population Density in the Whitewater River Watershed**

## 7.4 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Information concerning the topography and geology within the Whitewater River watershed is available from the Indiana Geologic Survey (IGS). The Whitewater River watershed originates in Franklin County near Brookville and travels southwest through Franklin and Dearborn Counties, eventually flowing into Ohio before discharging in the Ohio River. Portions of Whitewater River watershed are located in the Eastern Corn Belt Plain (ECBP) and the Interior Plateau (IP) physiographic regions. The ECBP is characterized by extensive cropland agriculture with some natural forest cover and gently rolling glacial till plains dissected by moraines, kames and outwash plains. The IP ecoregion, which encompasses the area around the mainstem, includes a till plain of low topographic relief formed from Illinoian glacial drift materials, rolling to modestly or deeply dissected basin terrain. Layers of sandstone, siltstone, shale and limestone underlie much of the Interior Plateau. Limestone outcrops are common, as are areas pitted with limestone sinks. Figure 14 shows the topography of the Whitewater River watershed. National Elevation Data (NED) is available from the USGS National Map seamless server (http://seamless.usgs.gov/website/seamless/viewer.htm).

Based on information gathered in the Atlas of Hydrogeologic Terrains and Settings of Indiana, the Salt Creek watershed is sensitive to ground water pollution through surface water. Hydrogeologic settings help to interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to the surface and subsurface environment. Generally the Whitewater River watershed is located in the bottomlands of southern Indiana, which are often associated with large bedrock valleys and significant quantities of late glacial till outwash. These outwash deposits are the major ground water resources for the entire southern part of the state. They are characterized by shallow water table conditions and are consequently also zones of significant interaction between surface water and ground water.

Specifically, the outwash in the Southern Whitewater River valley constitutes the primary source of ground water in this part of the state, as suitable aquifers are generally sparse in the adjoining uplands. Most of the valley bottom is in floodplain, so water table depths are typically between 5 and 15 feet. A considerable amount of ground water is transmitted down-valley within the outwash and interacts with the river at frequent meanders that cut across the aquifer. The valley as a whole is generally a ground water discharge area, although it is unlikely that there is an appreciable volume of actual discharge to this segment of the valley in view of the poor water-transmitting properties of the surrounding bedrock and till. Overall characteristics indicate that ground water beneath the valley floor is likely to be relatively sensitive to contamination, and that finding replacement water sources would be difficult should contamination affect a part of the aquifer. This should be of special concern since there is currently one surface drinking water source known in the Salt Creek watershed. All other drinking water sources are ground water sources.

While the topography of the watershed can have an effect on hydrology, it is also likely that soil characteristics will play a role in affecting hydrologic processes.

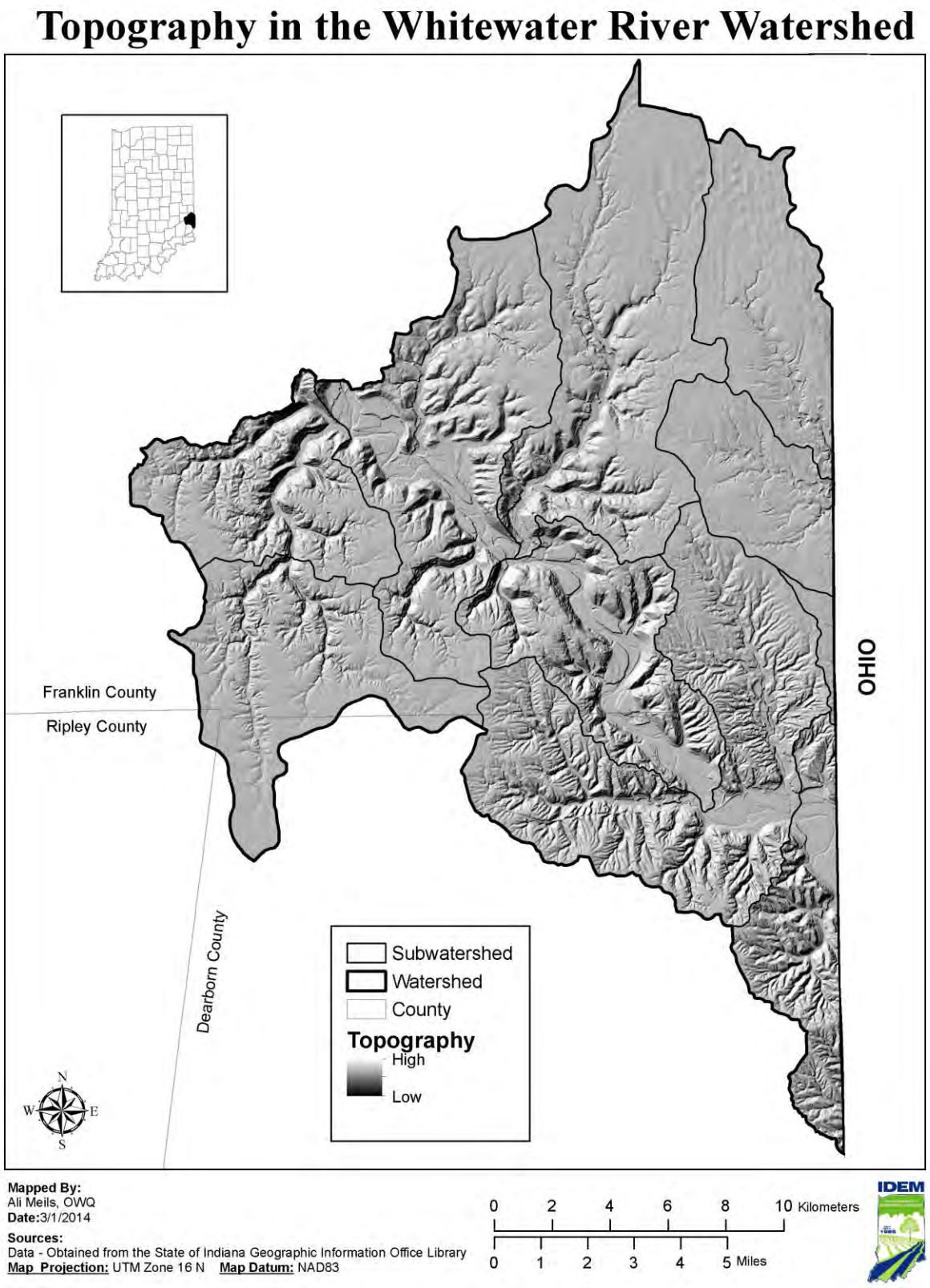


**Figure 51 Topography of the Whitewater River Watershed**

## 7.5 Soils

There are different soil characteristics that can affect the health of the watershed. These characteristics include soil drainage, septic tank suitability, soil saturation, and soil erodibility.

### 7.5.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and runoff characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils, described in Table 12 (NRCS, 2001). Data for the Whitewater River watershed were obtained from the Soil Survey Geographic (SSURGO) database. Downloaded data were summarized based on the major hydrologic group in the surface layers of the map unit and are displayed in Figure 15.

The majority of the watershed is covered by soil group C soils (60%) followed by soil group B (39%), soil group A (1%) and there are no group D soils in the watershed.

**Table 61 Hydrologic Soil Groups**

| Hydrologic Soils Group | Description |
|---|---|
| A | Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little runoff. |
| B | Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils. |
| C | Soils with slow infiltration rates. Soils with finer textures and slow water movement. |
| D | Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff. |

***Understanding Table 12:*** Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect *E. coli*, nutrients and sediment loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high *E. coli*, nutrients and sediment loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of *E. coli*, nutrients and sediment to streams.

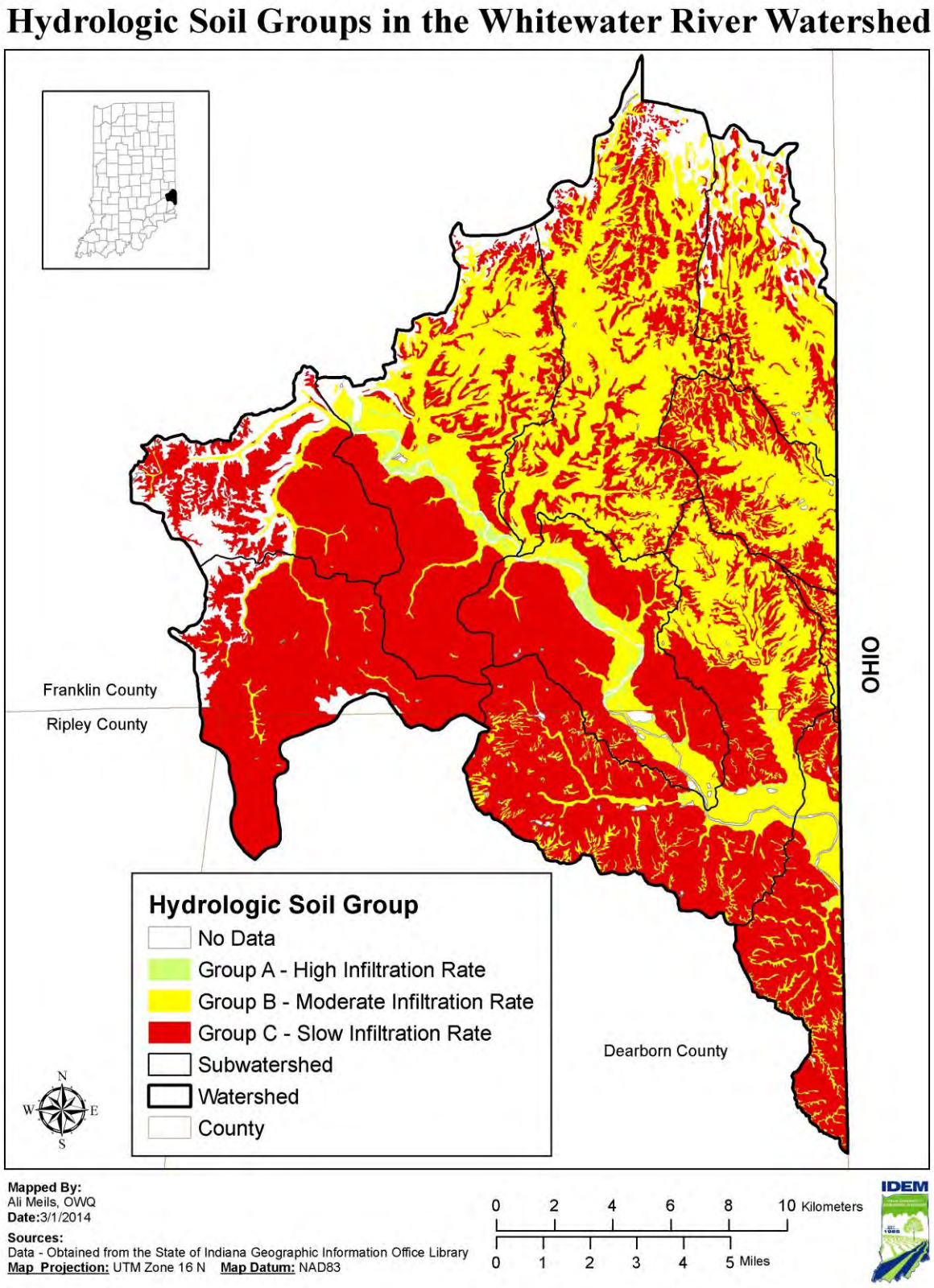


**Figure 52 Hydrologic Soil Groups in the Whitewater River Watershed**

### 7.5.2 Septic Tank Suitability

Septic systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design can often overcome these limitations (i.e., perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system.

Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems.

The septic system is considered failing when the system exhibits one or more of the following:

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures

2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters

3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water.

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Whitewater River watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 99 percent of the Whitewater River watershed is considered “very limited” in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation, special design or expensive installation procedures. Less than one percent of the soils within the Whitewater River watershed are designated as “somewhat limited” or “not rated.” “Somewhat limited” means that the soil has features that are moderately favorable for septic systems. The limitations can be overcome or minimized by special planning, design or installation. “Not rated,” means these soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. There are no soils in the Whitewater River watershed designated as “not limited,” meaning that the soil type is suitable for septic systems.

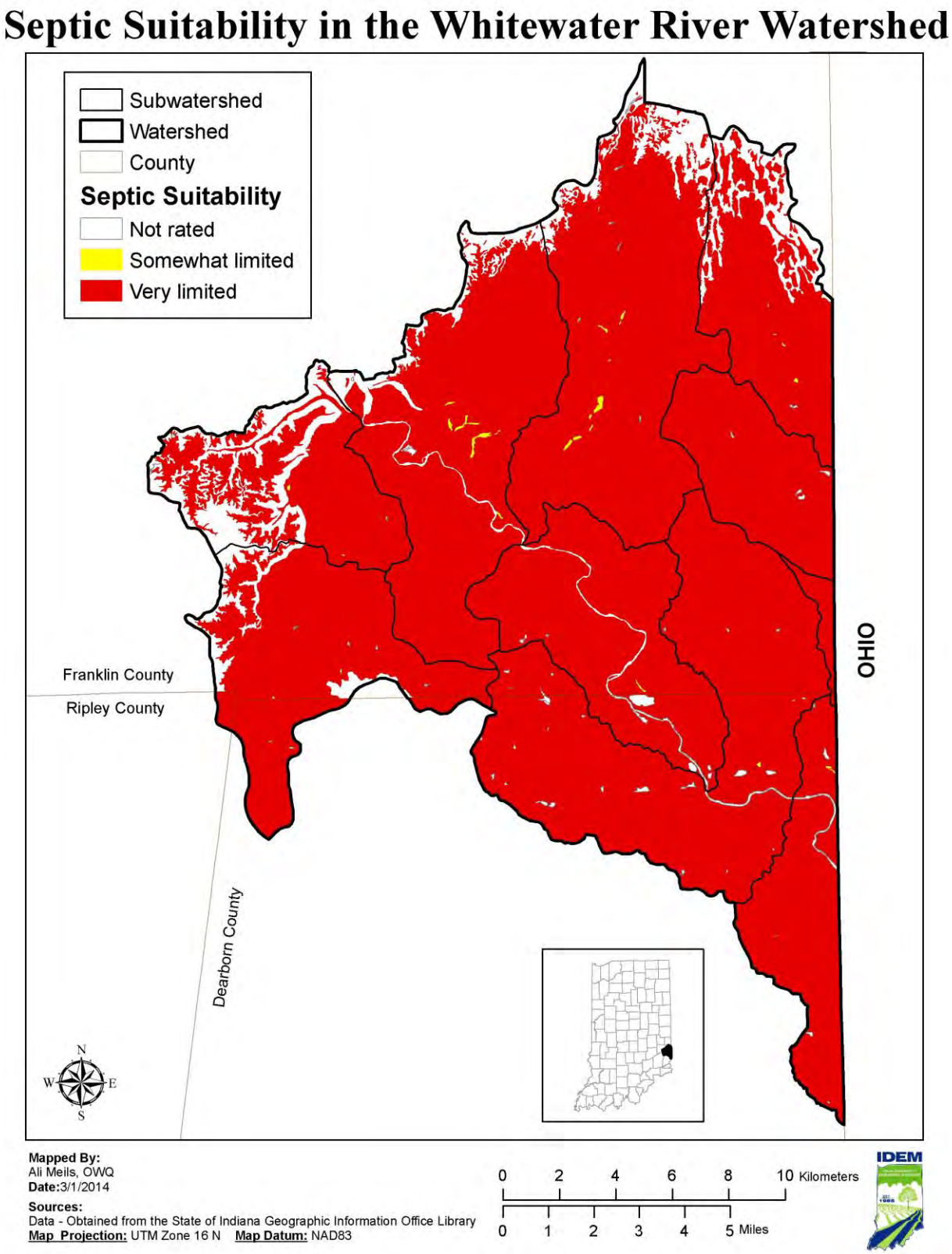


**Figure 53 Suitability of Soils for Septic Systems in the Whitewater River Watershed**

### 7.5.3 Soil Saturation

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Hydric soils have been identified in the Whitewater River watershed and are important in consideration of wetland restoration activities. Approximately 8,500 acres or eight percent of the Whitewater River watershed area contains soils that are considered hydric, as shown in Table 13. However, a large majority of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils, as shown in Figure 17, can be used to consider possible locations of wetland creation or enhancement. There are many components in addition to soil type that must be considered before moving forward with wetland design and creation. Additional information on wetlands can be found on the IDEM website (http://www.in.gov/idem/4138.htm).

**Table 62. Hydric Soils by County in the Whitewater River Watershed**

| County | Map Symbol | Hydric Soil Type | Acres | Total Percent |
|---|---|---|---|---|
| Dearborn | Ct | Clermont silt loam | 1,248.49 | 100 |
| | | **Total** | **1,248.49** | **100** |
| Franklin | Cm | Cobbsfork silt loam | 2,197.43 | 31.00 |
| | Cy | Cyclone silt loam | 4,825.53 | 68.08 |
| | Mr | Milford silty clay loam | 65.27 | 0.92 |
| | | **Total** | **7,088.23** | **100** |
| Ripley | Cm | Cobbsfork silt loam | 172.28 | 100 |
| | | **Total** | **172.28** | **100** |

***Understanding Table 13:*** In the Whitewater River watershed, Franklin County has the most acreage of hydric soils. Areas within these counties might contain opportunities for wetland restoration activities that could help address water quality impairments.

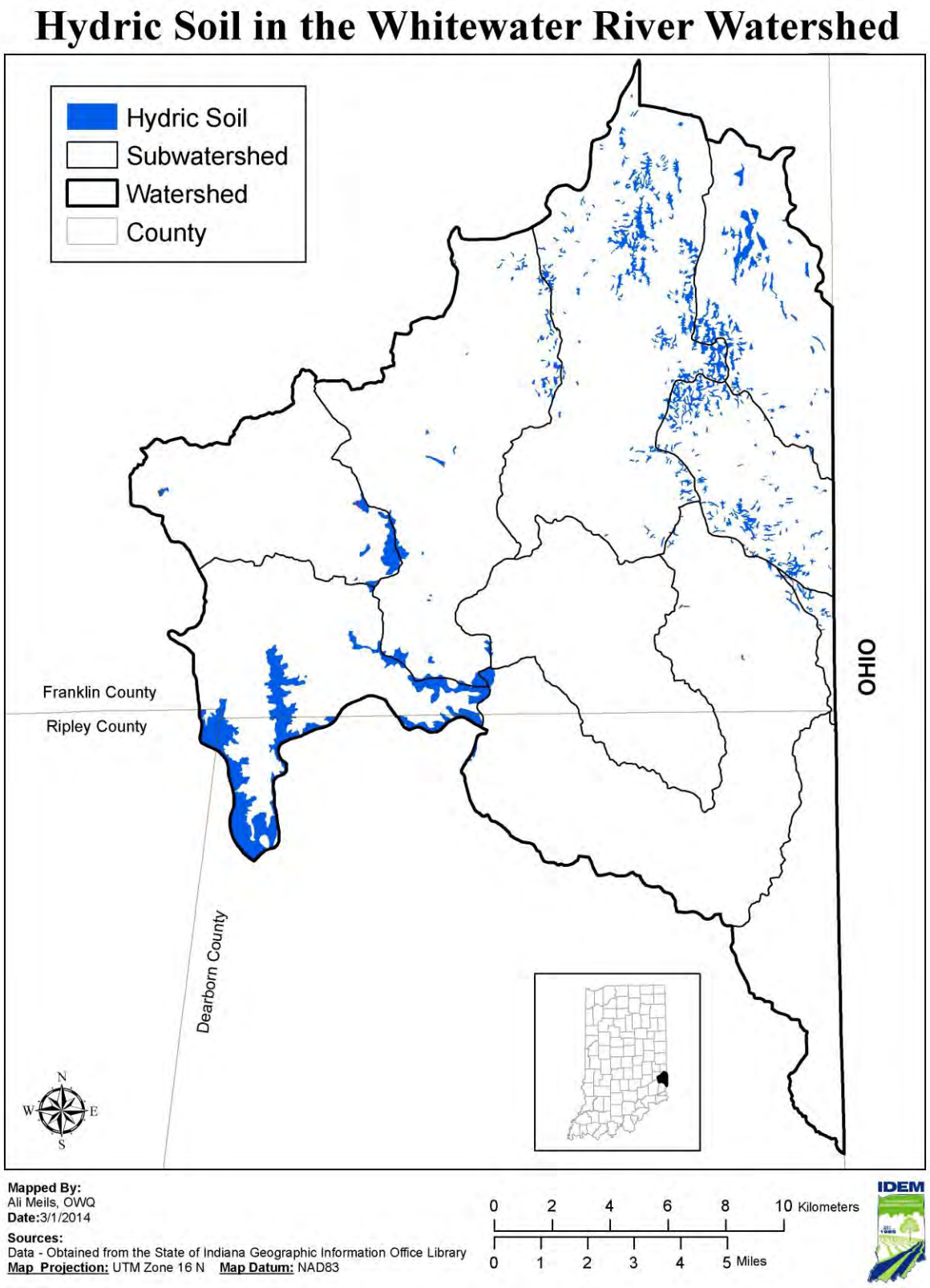


**Figure 54. Hydric Soils in the Whitewater River Watershed**

Wetland areas act to buffer wide variations in flow conditions that result from storm events. They also allow water to infiltrate slowly thus reducing the risks of contaminated water runoff into waterbodies. Agencies such as the USGS and U.S. Fish and Wildlife Service (USFWS) estimate that Indiana has lost approximately 85 percent of the state's original wetlands. (See http://www.in.gov/dnr/fishwild/files/partner.pdf and http://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html) Currently, the Whitewater River watershed contains approximately 2,889 acres of wetlands or two and a half percent of the total surface

area (USFWS, 2003).

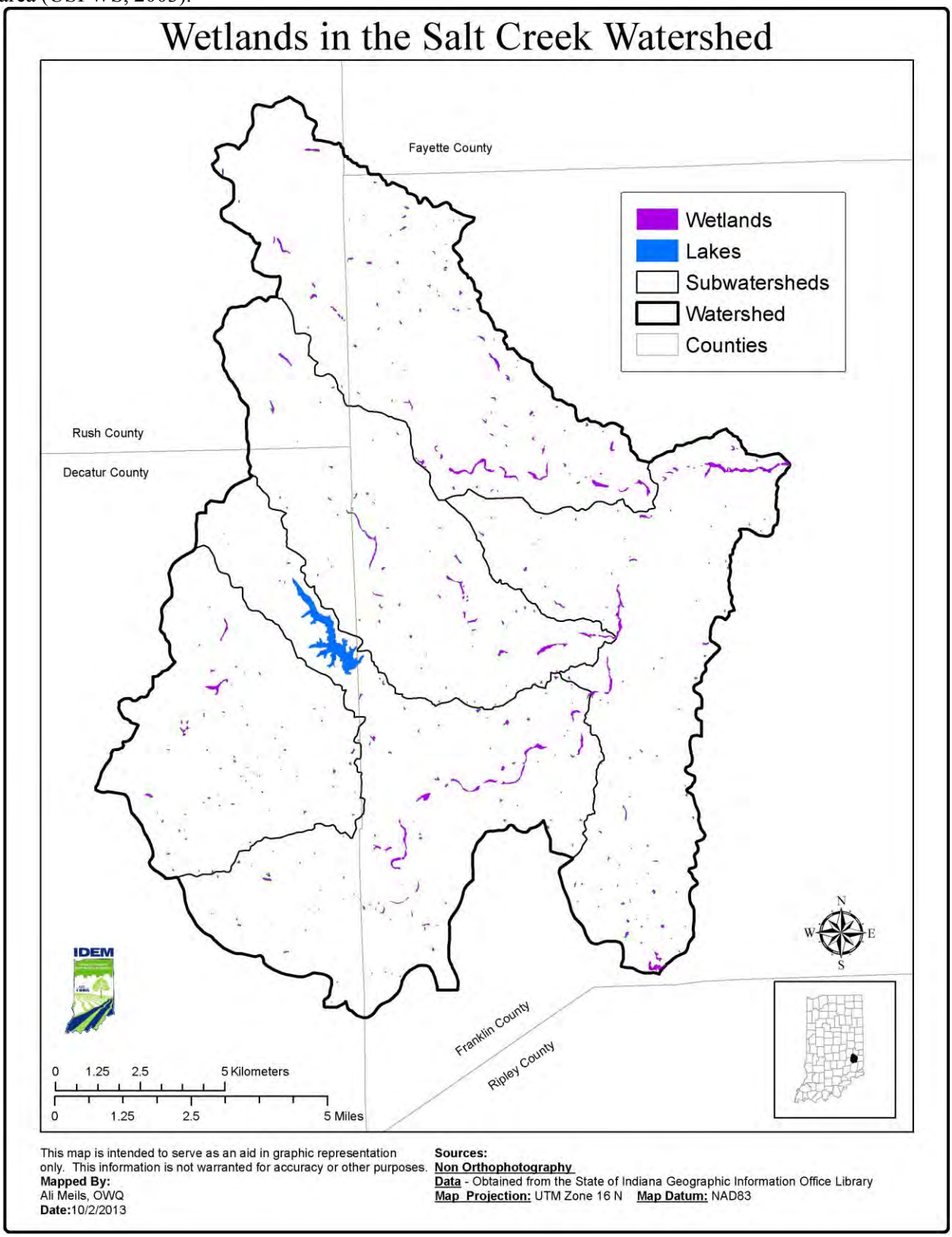


Figure 18 shows estimated locations of wetlands as defined by the USFWS's National Wetland Inventory (NWI). Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at <

http://www.fws.gov/wetlands/Data/Web-Map-Services.html>. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground surveys, and boundaries are generalized in most cases. The wetland information used in Section 3.1 was from the MRLCC dataset and is based on soil types, whereas, aerial photography interpretation techniques were used to compile the NWI. Therefore the estimate of the current extent of wetlands in the Whitewater River watershed from the NWI may not agree with those listed in Section 3.1, which are based upon the MRLCC dataset.

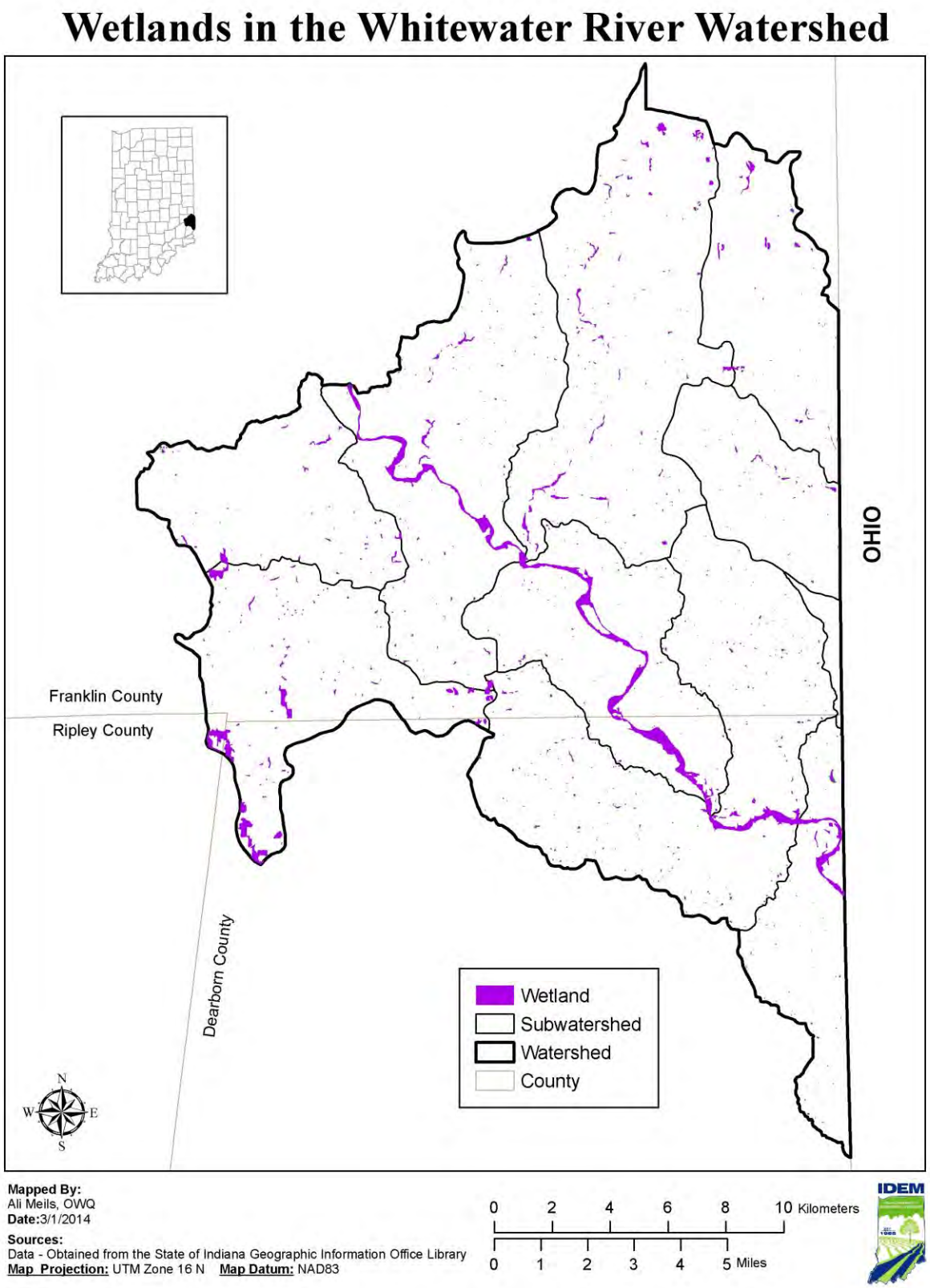


**Figure 55. Locations of Wetlands in Whitewater River Watershed**

Changes to the natural drainage patterns of a watershed are referred to as hydromodifications. Historically, drain tiles have been used throughout Indiana to drain marsh or wetlands and make it either habitable or tillable for agricultural purposes. While tile drainage is understood to be pervasive – estimated at thousands of miles in Indiana – it is extremely challenging to quantify on a watershed basis because these tiles were established by varying authorities including County Courts, County Commissioners, or County Drainage Boards (see http://boonecounty.in.gov/Default.aspx?tabid=167). Records were not kept by private landowners as to the location and quantity of these tiles.

In addition to tile drainage, regulated drains are another form of hydromodification. A regulated drain is a drain which was established through either a Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated drains can be an open ditch, a tile drain, or a combination of both. The County Drainage Board can construct, maintain, reconstruct or vacate a regulated drain. In the Whitewater River watershed, there are approximately XX tile drains and XX open ditches under the jurisdiction of the [County name] County Drainage Board. [Insert other relevant drainage information compiled from information provided by the relevant County Drainage Boards.]

### 7.5.4 Soil Erodibility

Although erosion is a natural process within stream ecosystems, excessive erosion negatively impacts the health of watersheds. Erosion increases sedimentation of the streambeds, which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as runoff, it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms.

The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land. HELs are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another. The classification for HELs is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, which is the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. The soil types and acreages in the Whitewater River watershed are listed by county in Table 14. HELs and potential HELs in the Whitewater River watershed

are mapped in

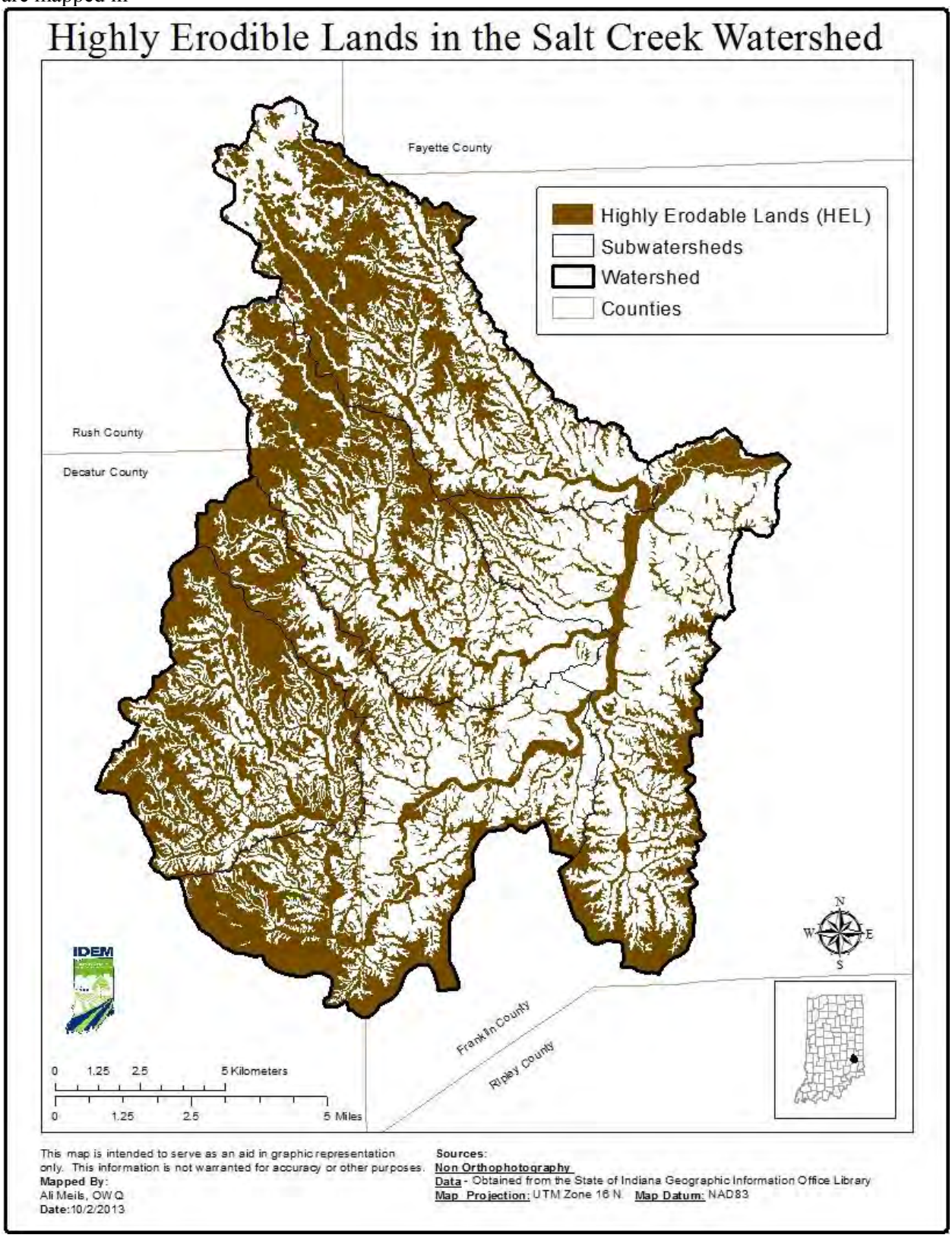

Figure 19. The data used to create

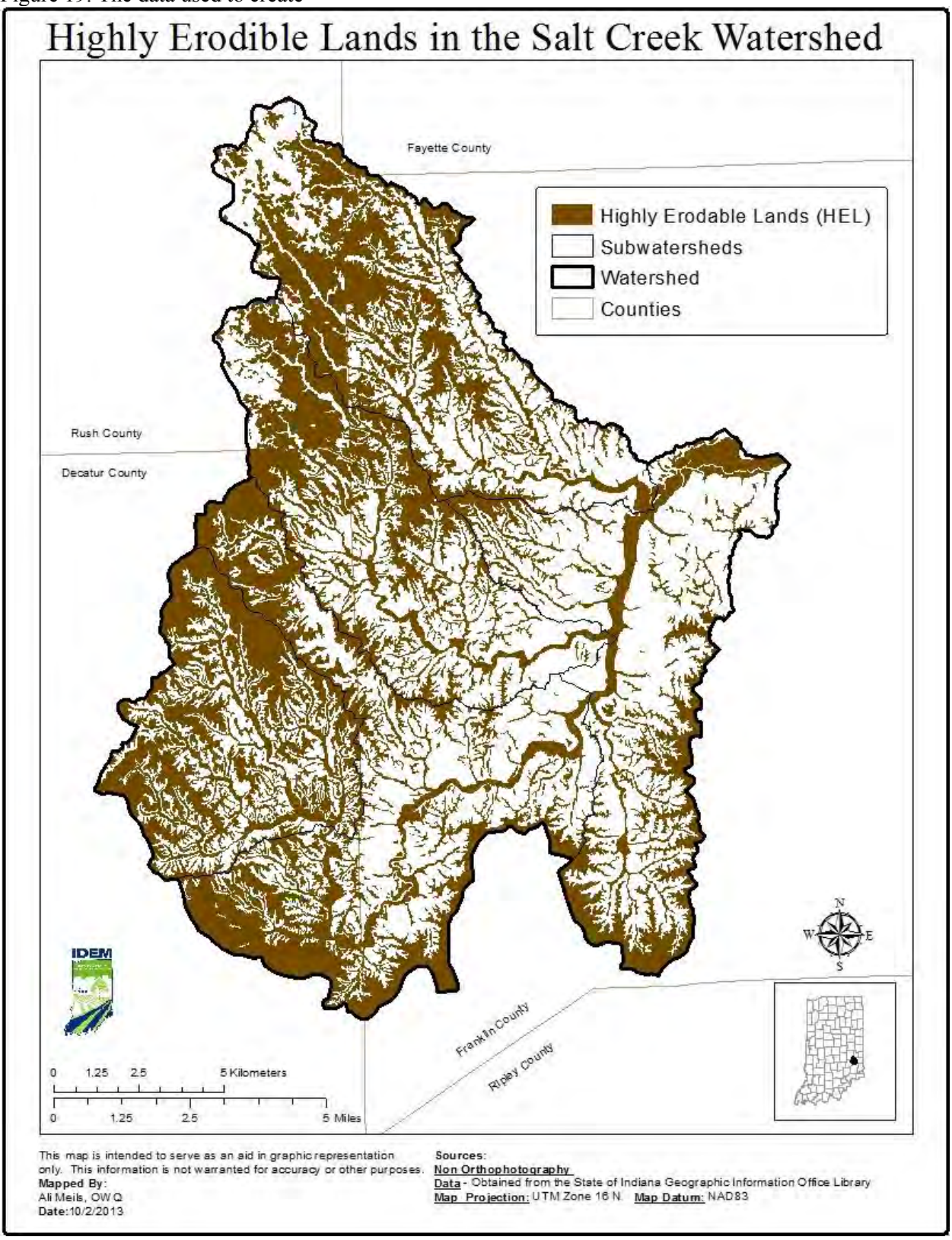


Figure 19 was collected from the NRCS offices of Dearborn, Franklin and Ripley counties. A total of 76,103 acres or 68 percent of the Whitewater River watershed is considered highly erodible or potentially

highly erodible. Rainfall within the Whitewater River watershed is moderately heavy with an annual average of 43 inches. This rainfall and climate data specific to the watershed is available from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html). Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases.

**Table 63. HEL/Potential HEL Total Acres in the Counties in the Whitewater River Watershed**

| County | Map Symbol | HEL/Potential HEL Soil Types | Acres |
|---|---|---|---|
| Dearborn | BaA | Bartle silt loam | 8.25 |
| | BeD2, BeD3, BeE, BeC2, BeC3 | Bonnell silt loam | 549.14 |
| | CaC2, CaD2, CaE2, | Carmel silt loam | 862.85 |
| | CcC3, CcD3, CcE3 | Carmel silty clay loam | 1,707.29 |
| | CnB2, CnC2, CnC3 | Cincinnati silt loam | 567.85 |
| | EdE3 | Eden flaggy silty clay loam | 1,971.50 |
| | EdF | Eden flaggy silty clay | 7,158.07 |
| | EcE2 | Eden silty clay loam | 1,125.64 |
| | EkC2 | Elkinsville silt loam | 6.70 |
| | FoB2 | Fox silt loam | 227.83 |
| | HcG | Hennepin loam | 191.27 |
| | MaF2, MaB2 | Markland silt loam | 169.58 |
| | MbD3 | Markland silty clay loam | 6.79 |
| | PaD2, PaE2 | Pate silty clay loam | 732.56 |
| | Pg | Gravel pits | 103.65 |
| | RdG | Rodman sandy loam | 126.89 |
| | RoB2 | Rossmoyne silt loam | 452.12 |
| | RxB | Russell-Fincastle silt loam | 161.25 |
| | SwB2, SwC2, SwC3, SwD2 | Switzerland silt loam | 2,241.35 |
| | Ud | Udorthents, loamy | 82.44 |
| | WbB2, WbC2, WbC3 | Weisburg silt loam | 1,188.07 |
| | | **Total** | **19,641.09** |
| Franklin | AlB | Alvin sandy loam | 163.30 |
| | AvA | Avonburg silt loam | 4006.79 |
| | BpD3 | Bonnell clay loam | 950.70 |
| | BnF | Bonnell loam | 281.53 |
| | BoC2, BoD2, BoE2 | Bonnell silt loam | 2,176.63 |
| | BrC3 | Bonnell silty clay loam | 89.07 |

| | | | |
|---|---|---|---|
| | CbC2 | Carmel silt loam | 2,397.39 |
| | CkB2, CkC2, CkC3 | Cincinnati silt loam | 4,302.78 |
| | EbE2 | Eden flaggy silty clay | 3,563.23 |
| | EdG | Eden very flaggy silty clay | 10,423.71 |
| | EeD2 | Edenton silt loam | 378.90 |
| | ElB | Eldean loam | 439.52 |
| | FxC3 | Fox complex | 141.89 |
| | HeG | Hennepin loam | 1,447.07 |
| | MoC3, MoD3 | Miami clay loam | 6,082.15 |
| | MmB2, MmC2 | Miami silt loam | 4,871.84 |
| | OcA | Ockley loam | 547.39 |
| | Pg | Gravel pits | 21.89 |
| | PrC | Princeton fine sandy loam | 37.76 |
| | RkF | Rodman gravelly coarse sandy loam | 302.35 |
| | RsB2 | Rossmoyne silt loam | 3,008.15 |
| | RuB2 | Russell silt loam | 3,174.80 |
| | SdB | Sidell silt loam | 95.80 |
| | UaB | Uniontown silt loam | 142.83 |
| | WeB2 | Weisburg silt loam | 573.27 |
| | WoB | Woolper silty clay loam | 372.99 |
| | WrB, WrC2 | Wynn silt loam | 605.51 |
| | WyC3 | Wynn silty clay loam | 809.32 |
| | XnB2 | Xenia silt loam | 5,031.57 |
| | | **Total** | **56,440.13** |
| Ripley | AvB2 | Avonburg silt loam | 9.77 |
| | CcC2 | Cincinnati silt loam | 8.45 |
| | RoB2 | Rossmoyne silt loam | 4.10 |
| | | **Total** | **22.32** |

***Understanding Table 14:*** In the Whitewater River watershed, Franklin County has the most acreage of HEL/potential HEL soils. Areas within these counties might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.

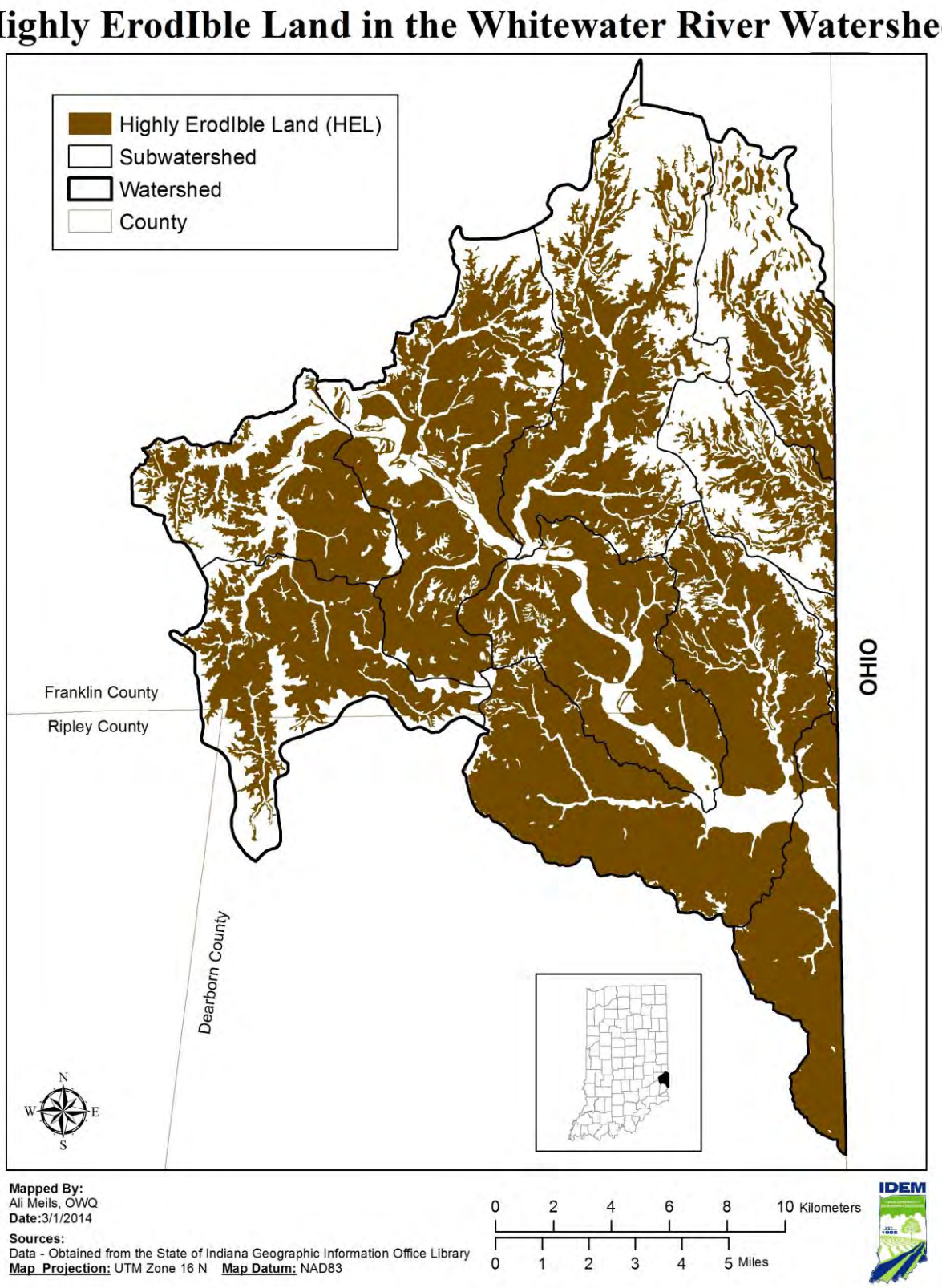


**Figure 56. HEL/Potential HEL Soils in the Whitewater River Watershed**

The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect help determine adoption of conservation practices and estimate the average annual soil loss from Indiana's agricultural lands. The latest figures for the counties in the Whitewater River watershed are shown in Table 15. Tillage practices captured in ISDA's tillage transect include No-Till, Mulch Till, and conventional tillage practices. ISDA defines No-Till as any direct seeding system including site preparation, with minimal soil disturbance. Mulch Till is any tillage system leaving greater than 30 percent residue cover after planting, excluding no-till. Reduces tillage is an tillage system leaving 16 percent to 30 percent residue cover after planting. Conventional tillage is any tillage system leaving less than 30 percent residue cover after planting.

**Table 64. County Tillage Transect Data from 2009 to 2013 in the Whitewater River Watershed**

| Crop | Tillage Practice | Dearborn | | | Franklin | | | Ripley | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 | 2009 | 2011 | 2013 |
| Corn | % No-Till | 38 | 46 | 39 | 19 | 23 | 21 | 33 | 45 | 36 |
| | % Mulch-Till | 18 | 21 | 6 | 15 | 15 | 14 | 18 | 8 | 10 |
| | % Reduced-Till | 9 | 32 | 13 | 33 | 43 | 54 | 0 | 0 | 0 |
| | % Conventional-Till | 35 | 0 | 42 | 33 | 19 | 11 | 49 | 47 | 53 |
| Soybeans | % No-Till | 75 | 88 | 71 | 70 | 50 | 62 | 76 | 76 | 55 |
| | % Mulch-Till | 4 | 0 | 0 | 11 | 32 | 22 | 17 | 14 | 22 |
| | % Reduced-Till | 8 | 6 | 13 | 7 | 14 | 14 | 0 | 0 | 0 |
| | % Conventional-Till | 13 | 6 | 16 | 13 | 3 | 2 | 7 | 10 | 23 |

***Understanding Table 15:*** According to Table 15, No-Till practices for soybeans are predominant in all counties in the Whitewater River watershed. There has been a reduction in conventional tillage practices for corn in Franklin County since 2009.

## 7.6 Climate and Precipitation

Climate varies in Indiana depending on latitude, topography, soil types, and lakes. Information on Indiana's climate is available through sources including the Indiana State Climate Office at Purdue University (http://climate.agry.purdue.edu/climate/narrative.asp).

Climate data from Station 121030 located in Brookville were used for climate analysis of the Whitewater River watershed. Monthly data from 1948-2013 were available at the time of analysis. In general, the climate of the region has hot, humid summers and cold winters. From 1948 to 2013, the average winter temperature in Brookville was 32°F and the average summer temperature was 85°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 183 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of runoff on water quality. From 1948 to 2013, the annual average precipitation in Brookville at Station 121030 was approximately 43 inches, including approximately 15.5 inches of snowfall. More detailed discussions on precipitation data during sampling periods are presented in Section 0.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of storm water on the Whitewater River watershed. Using data from 121030 during 1948 to 2013, 52 percent of the measureable precipitation events were very low intensity (i.e., less than 0.2 inches), while eight percent of the measurable precipitation events were greater than one inch.

Knowing when precipitation events occur helps in the linkage analysis (Section 0), which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Whitewater River watershed occurs between the months of April and May.

## 7.7 Summary

The information presented in Section 7 helps to provide a better comprehensive understanding of the conditions and characteristics in the Whitewater River watershed that, when coupled with the sources, affect both water quality and water quantity. In summary, the predominant land uses in the Whitewater River watershed of forested and agricultural lands serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the Whitewater River watershed. Human population, which is greatest in Dearborn County in the Whitewater River watershed, indicates where more infrastructure related pressures on water quality might exist. The subsections on topography and geology, as well as soils, provide information on the natural features that affect hydrology in the Whitewater River watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Whitewater River watershed. Lastly, the subsection on climate and precipitation provides information on water quantity and the factors that influence flow, which ultimately affects the influence of storm water on the watershed. Collectively, this information plays an important role in understanding the sources that contribute to water quality impairment during TMDL development and crafting the linkage analysis that connects the observed water quality impairment to what has caused that impairment.

# 8.0 SOURCE ASSESSMENT

This section presents information concerning IDEM's segmentation process as it applies to the Whitewater River watershed in order to present a source assessment specific to the Whitewater River watershed as well as summaries of significant sources of *E. coli*, nutrients and sediment for each subwatershed within the Whitewater River watershed.

## 8.1 Understanding Subwatersheds and Assessment Units

As briefly discussed in Section 2.3, the Whitewater River watershed contains ten 12-digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include (**Error! Reference source not found.**):

- Headwaters Blue Creek (050800030801)
- Wolf Creek (050800030802)
- Big Cedar Creek (050800030803)
- Little Cedar Creek (050800030804)
- Blackburn Creek (050800030805)
- Johnson Fork (050800030806)
- Headwaters Dry Fork Whitewater River (050800030807)
- Howard Creek (050800030808)
- Lee Creek (050800030809)
- Jameson Creek (050800030810)

Within each 12-digit HUC subwatershed, IDEM has identified several AUIDs, which represent individual stream segments. Through the process of segmenting subwatersheds into AUIDs, IDEM identifies streams reaches and stream networks that are representative for the purposes of assessment. In practice, this process leads to grouping tributary streams into smaller catchment basins of similar hydrology, land use, and other characteristics such that all tributaries within the catchment basin can be expected to have similar potential water quality impacts. Catchment basins, as defined by the aforementioned factors and are typically very small, which significantly reduces the variability in the water quality expected from one stream or stream reach to another. Given this, all tributaries within a catchment basin are assigned a single AUID. Grouping tributary systems into smaller catchment basins also allows for better characterization of the larger watershed and more localized recommendations for implementation activities. Variability within the larger watershed will be accounted for by the differing AUIDs assigned to the different catchment basins.

Table 16 contains the AUIDs in the subwatersheds of the Whitewater River watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.

**Table 65. Assessment Units in Whitewater River Watershed**

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| Headwaters Blue Creek (050800030801) | 18.31 | 10.43 | ING0381_01 | 12.50 | 18.31 |
| | | | ING0381_02 | 8.66 | |

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| | | | ING0381_T1001 | 3.14 | |
| | | | ING0381_T1002 | 1.81 | |
| | | | ING0381_T1003 | 0.91 | |
| | | | ING0381_T1004 | 2.33 | |
| Wolf Creek (050800030802) | 14.54 | 8.29 | ING0382_01 | 5.11 | 32.85 |
| | | | ING0382_02 | 6.83 | |
| | | | ING0382_T1001 | 4.19 | |
| | | | ING0382_T1002 | 3.76 | |
| | | | ING0382_T1003 | 2.23 | |
| | | | ING0382_T1004 | 0.54 | |
| | | | ING0382_T1005 | 2.25 | |
| | | | ING0382_T1006 | 1.65 | |
| | | | ING0382_T1007 | 1.01 | |
| | | | ING0382_T1008 | 0.60 | |
| | | | ING0382_T1009 | 0.87 | |
| Big Cedar Creek (050800030803) | 29.61 | 16.87 | ING0383_01 | 14.02 | 29.61 |
| | | | ING0383_02 | 11.42 | |
| | | | ING0383_T1001 | 2.49 | |
| | | | ING0383_T1002 | 8.69 | |
| | | | ING0383_T1003 | 2.59 | |
| | | | ING0383_T1004 | 2.68 | |
| | | | ING0383_T1005 | 9.38 | |
| | | | ING0383_T1006 | 1.36 | |
| Little Cedar Creek (050800030804) | 26.64 | 15.18 | ING0384_01 | 14.32 | 1284.04 |
| | | | ING0384_T1001 | 9.29 | |
| | | | ING0384_T1002 | 3.69 | |
| | | | ING0384_T1003 | 24.85 | |
| | | | ING0384_T1004 | 11.22 | |
| Blackburn Creek (050800030805) | 17.19 | 9.80 | ING0385_01 | 11.71 | 1330.85 |
| | | | ING0385_01A | 2.32 | |
| | | | ING0385_T1001 | 6.50 | |
| | | | ING0385_T1002 | 2.54 | |
| | | | ING0385_T1003 | 1.52 | |
| | | | ING0385_T1004 | 1.06 | |
| | | | ING0385_T1005 | 4.00 | |
| | | | ING0385_T1006 | 1.25 | |
| | | | ING0385_T1007 | 4.34 | |
| | | | ING0385_T1008 | 0.74 | |
| | | | ING0385_T1009 | 0.99 | |
| | | | ING0385_T1010 | 1.24 | |
| Johnson Fork (050800030806) | 32.88 | 18.74 | ING0386_01 | 2.22 | 1363.73 |
| | | | ING0386_02 | 17.65 | |
| | | | ING0386_T1001 | 26.20 | |

| Name of Subwatershed | Surface Area (sq.miles) | Percent of Total Surface Area | Current AUID 2012 | Length (mi) | Drainage Area (sq. miles) |
|---|---|---|---|---|---|
| | | | ING0386_T1002 | 7.99 | |
| | | | ING0386_T1003 | 6.13 | |
| | | | ING0386_T1004 | 4.79 | |
| | | | ING0386_T1005 | 1.67 | |
| | | | ING0386_T1006 | 5.04 | |
| | | | ING0386_T1006A | 1.29 | |
| | | | ING0386_T1007 | 3.22 | |
| | | | ING0386_T1008 | 1.23 | |
| Headwaters Dry Fork Whitewater River (050800030807) | 14.01 | 7.98 | ING0387_02 | 13.85 | 14.01 |
| | | | ING0387_03 | 3.13 | |
| Howard Creek (050800030808) | 10.05 | 5.73 | ING0388_01 | 8.94 | 10.05 |
| | | | ING0388_P1001 | 0.21 | |
| | | | ING0388_T1005 | 1.35 | |
| | | | ING0388_T1006 | 0.91 | |
| | | | ING0388_T1007 | 5.57 | |
| | | | ING0388_T1008 | 0.51 | |
| Lee Creek (050800030809) | 1.04 | 0.59 | ING0389_01 | 0.94 | 1.04 |
| Jameson Creek (050800030810) | 11.21 | 6.39 | ING038A_01 | 2.91 | 1374.94 |
| | | | ING038A_01A | 0.69 | |
| | | | ING038A_P1001 | 0.28 | |
| | | | ING038A_T1001 | 3.41 | |
| | | | ING038A_T1002 | 13.41 | |
| | | | ING038A_T1003 | 3.96 | |

***Understanding Table 16:*** Land area helps IDEM to define the pollutant load reductions needed for each AUID in each 12-digit HUC subwatershed that comprises the Whitewater River watershed. Information in each column is as follows:

- *Column 1: Name of Subwatershed.* Lists the name of the subwatersheds.
- *Column 2: Surface Area.* Indicates the total surface area for each subwatershed.
- *Column 3: Percent of Total Drainage Area.* Indicates the percent of the total surface area, providing a relative understanding of the portion of each subwatershed in the Whitewater River watershed.
- *Column 4: Current AUID*. Provides the updated AUIDs associated with each subwatershed.
- *Column 5: Length.* Quantifies the length of each AUID stream segment.
- *Column 6: Drainage Area.* Quantifies the area the subwatershed drains.

IDEM bases percent load reductions on the drainage area for each AUID in the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations. This table will help watershed stakeholders look at the smaller segments within the Whitewater River watershed and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

## 8.2 Source Assessment by Subwatershed

This section summarizes the available information on significant point and nonpoint sources of *E. coli*, nutrients and TSS in the 10 subwatersheds of the Whitewater River watershed.

The term "point source" refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel or conduit, by which pollutants are transported to a waterbody. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term "point source" also includes: concentrated animal feeding operations (CAFO) which are places where animals are confined and fed; storm water runoff from Municipal Separate Storm Sewer Systems (MS4s), construction site of one acre or more of land disturbance, and specific categories of industrial activities that convey storm water; and illicitly connected "straight pipe" discharges of household waste. Permitted point sources are regulated through the NPDES.

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, runoff from lawn fertilizer applications, pet waste, storm water runoff (outside of MS4 communities), and other sources. In rural areas, nonpoint sources can include runoff from cropland, pastures and animal feeding operations and inputs from streambank erosion, leaking or failing septic systems, and wildlife.

### 8.2.1 Whitewater River Subwatershed Summary

This section of the report presents the available information on the sources of *E.coli*, nutrients and TSS in the Whitewater River subwatersheds. The Whitewater River watershed is located along the Ohio state line. Most of the subwatersheds described in this section drain into the Whitewater River mainstem before entering Ohio. However, there are a few subwatersheds (Headwaters Dry Fork, Howard Creek, Jameson Creek and Lee Creek) that drain into Ohio before entering the Whitewater River. This section addresses only those parts of the subwatersheds located within the State of Indiana.

**Table 66. Land Use in the Whitewater River Subwatersheds**

| Subwatershed | Area | Land Use | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Developed | Forest | Hay/ Pasture | Shrub | Open Water | Wetlands | |
| Headwaters Blue Creek | Acres | 3,623 | 558 | 5,818 | 1,681 | 23 | 24 | 0 | 11,727 |
| | Sq. Mi. | 5 | 1 | 9 | 3 | <1 | <1 | 0 | 18 |
| | Percent | 31 | 5 | 50 | 14 | <1 | <1 | 0 | 100 |
| Wolf Creek | Acres | 1,615 | 335 | 5,891 | 1,379 | 56 | 27 | 1 | 9,304 |
| | Sq. Mi. | 3 | 1 | 9 | 2 | <1 | <1 | <1 | 15 |
| | Percent | 17 | 4 | 63 | 15 | 1 | <1 | <1 | 100 |
| Big Cedar Creek | Acres | 9,620 | 922 | 5,114 | 3,179 | 101 | 12 | <1 | 18,948 |
| | Sq. Mi. | 15 | 1 | 8 | 5 | <1 | <1 | <1 | 30 |
| | Percent | 50 | 5 | 27 | 17 | 1 | <1 | <1 | 100 |
| Little Cedar Creek | Acres | 4,677 | 1,200 | 7,658 | 3,223 | 121 | 172 | 1 | 17,052 |
| | Sq. Mi. | 7 | 2 | 12 | 5 | <1 | <1 | <1 | 27 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Percent | 27 | 7 | 45 | 19 | 1 | 1 | <1 | 100 |
| Blackburn Creek | Acres | 1,181 | 770 | 6,725 | 2,081 | 53 | 188 | 4 | 11,002 |
| | Sq. Mi. | 2 | 1 | 11 | 3 | <1 | <1 | <1 | 17 |
| | Percent | 11 | 7 | 61 | 19 | <1 | 2 | <1 | 100 |
| Johnson Fork | Acres | 1,622 | 1,577 | 11,505 | 6,066 | 167 | 109 | 2 | 21,048 |
| | Sq. Mi. | 3 | 3 | 18 | 9 | <1 | <1 | <1 | 33 |
| | Percent | 8 | 7 | 55 | 29 | 1 | <1 | <1 | 100 |
| Headwaters Dry Fork Whitewater River | Acres | 6,406 | 419 | 915 | 1,196 | 9 | 5 | 0 | 8,950 |
| | Sq. Mi. | 10 | 1 | 1 | 2 | <1 | <1 | 0 | 14 |
| | Percent | 72 | 5 | 10 | 13 | <1 | <1 | 0 | 100 |
| Howard Creek | Acres | 3,786 | 364 | 798 | 1,421 | 11 | 20 | 1 | 6,401 |
| | Sq. Mi. | 6 | 1 | 1 | 2 | <1 | <1 | <1 | 10 |
| | Percent | 59 | 6 | 12 | 22 | <1 | <1 | <1 | 100 |
| Lee Creek | Acres | 312 | 53 | 69 | 227 | <1 | <1 | 0 | 662 |
| | Sq. Mi. | <1 | <1 | <1 | <1 | <1 | <1 | 0 | 1 |
| | Percent | 47 | 8 | 10 | 34 | <1 | <1 | 0 | 100 |
| Jameson Creek | Acres | 173 | 533 | 4,457 | 1,843 | 29 | 68 | 1 | 7,104 |
| | Sq. Mi. | <1 | 1 | 7 | 3 | <1 | <1 | <1 | 11 |
| | Percent | 2 | 8 | 63 | 26 | <1 | 1 | <1 | 100 |

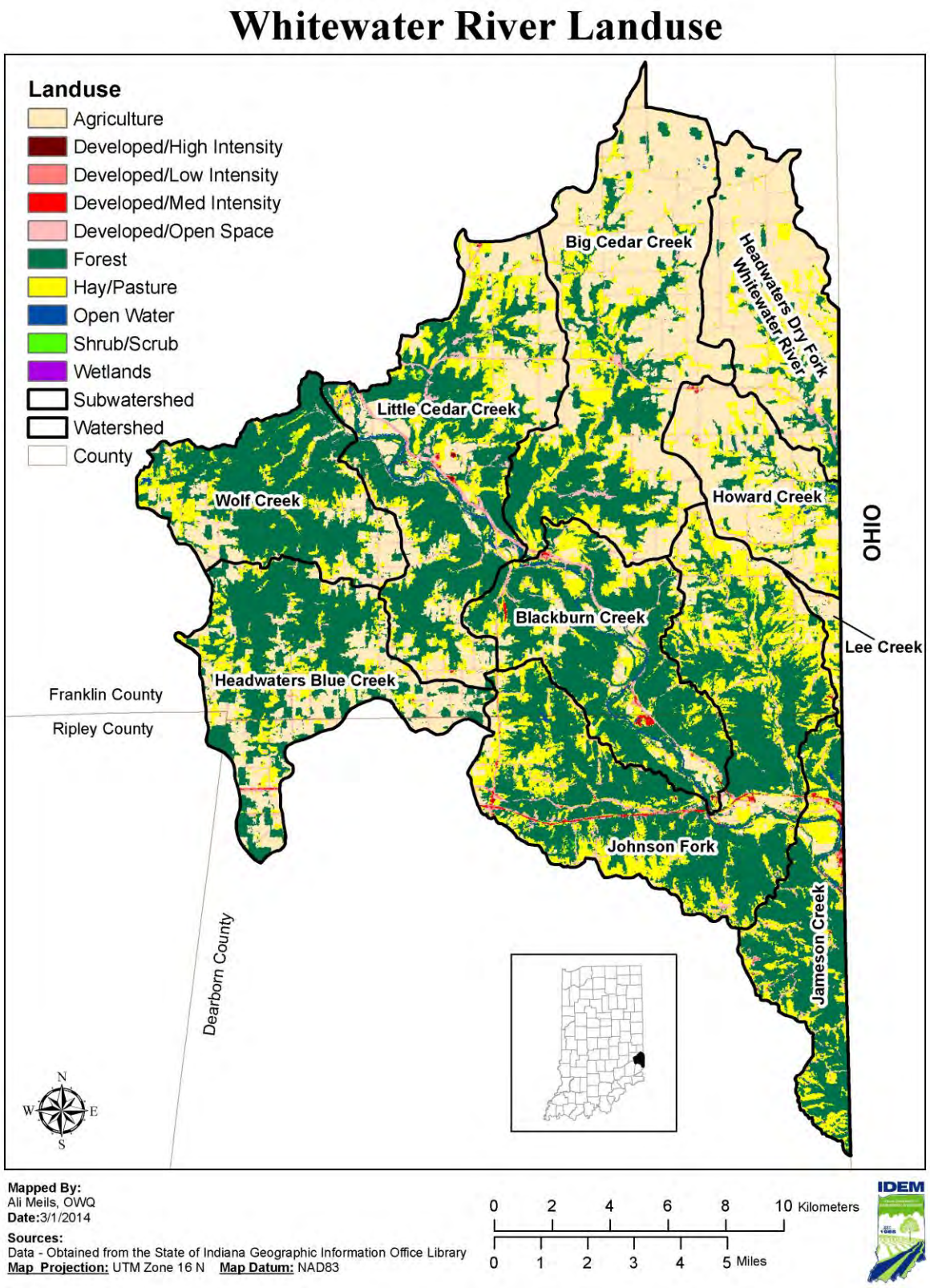


Figure 57 Landuse in the Whitewater River Subwatersheds

## Point Sources

The State of Indiana regulates the direct discharge of pollutants to waters of the State through the National Pollutant Discharge Elimination System (NPDES) Permit Program. The permits issued place limits on the amount of pollutants that may be discharged to surface waters by each facility. These limits are set at levels protective of both aquatic life in the waters which receive the discharge and protective of human health. This section summarizes the potential point sources of *E. coli*, nutrients and sediment in the Whitewater River watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

### *Municipal Facilities*

A municipal facility, or wastewater treatment plant (WWTP), is designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes. Some of the functions of a WWTP include agricultural wastewater treatment, sewage treatment and industrial wastewater treatment. WWTPs are critical for maintaining public sanitation and a healthy environment.

Municipal facilities in Indiana are required to disinfect their effluent during the recreational season (April 1 to October 31). IDEM does not require disinfection for waste-stabilization lagoons as long as *E. coli* limits from the permit are met utilizing the lagoon's retention time. **Error! Reference source not found.** contains the maximum design flow for the active facilities.

Treated municipal sewage is a point source of nutrients. WWTPs may release water with elevated concentrations of nutrients into streams. As discussed in Section 2.2, the target value for total phosphorus is 0.30 mg/L and the target value for total nitrogen is 10 mg/L. These target values are used to establish potential permit limits.

Flows used to calculate nutrient loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Nutrient concentrations used to calculate nutrient loads from each treatment plant are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels). Because the phosphorus loads from these NPDES facilities had to be estimated, it is recommended that effluent monitoring be added to the WWTP permits. Additional in-stream monitoring should also be performed. If the monitoring confirms that the WWTP loads represent a large proportion of low flow [name of waterbody] loads, this will need to be addressed by IDEM and the individual facilities after the sampling results are available.

The TMDL target value for TSS is set at the WWTP's permit effluent limit for TSS. Therefore, a target of 30 mg/L for total suspended solids TSS has been identified as a permit limit for NPDES facilities.

There are four WWTP dischargers that discharge wastewater containing within the Whitewater River watershed (Figure 57 and Table 67). These facilities are as follows: Big Cedar Mobile Home Park, St. Leon WWTP, Mount Carmel Elementary School and Brookville WWTP. Summaries of the WWTP permits within the Whitewater River watershed are described below.

The Big Cedar Mobile Home Park WWTP is a minor, semi-public Class I extended aeration treatment facility consisting of a flow equalization tank, an aeration tank, a clarifier, and chlorination/dechlorination stations. The collection system is comprised entirely of separate sanitary sewers by design with no overflow or bypass points. A violation letter was issued in 2011 based on the frequency and magnitude of ammonia and total suspended solids violations from 2009 to 2011. The violations were considered instances of significant noncompliance. A formal enforcement action was also initiated in March of 2012

for effluent violations and failure to submit reports. In total, there have been eight informal enforcement actions and one formal enforcement action in the last five years resulting in a penalty of $1,025. The most recent enforcement action was 11/4/2013.

The town of St. Leon operates a minor Class II wastewater treatment plant that was upgraded in 2011. The facility now operates an activated sludge-type wastewater treatment facility consisting of three sequencing batch reactor basins, two aerobic digesters, sludge drying beds, ultraviolet light disinfection facilities, and an effluent flow meter. Final solids are disposed of in a landfill. The collection system is comprised of 100% separate sanitary sewers with no overflows and one bypass point.

The Mount Carmel Elementary School operates a minor semi-public Class I extended aeration treatment facility with flow equalization, aerobic digestion, final clarification, a 24-hour settling tank, ultraviolet light disinfection, post aeration, and an effluent flow meter. Solids are dewatered by settling and drawing off of supernatant and eventually hauled off site. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points. In August 2014 the school had a mound system put in for sewage disposal. This facility no longer discharges to waters of the state and no longer require an NPDES permit. Facility information for the past five years is included in the table but the facility will not be included in the TMDL wasteload allocation.

The town of Brookville operates a Class II oxidation ditch treatment facility consisting of screening, an oxidation ditch, two final clarifiers, ultraviolet light disinfection, and an effluent flow meter. Sludge handing includes aerobic digestion and drying beds. Sludge is then land applied or hauled offsite. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points.

**Table 67. NPDES Permitted Wastewater Treatment Plants Discharging within the Whitewater River Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Blue Creek | NA | NA | NA | NA | NA |
| Wolf Creek | NA | NA | NA | NA | NA |
| Big Cedar Creek | Big Cedar Mobile Home Park WWTP | IN0037168 | ING0383_02 | Tributary to Big Cedar Creek | 0.0108 |
| Little Cedar Creek | NA | NA | NA | NA | NA |
| Blackburn Creek | St. Leon WWTP | IN0058408 | ING0385_01 | Whitewater River | 0.57 |
| Johnson Fork | NA | NA | NA | NA | NA |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA | NA |
| Howard Creek | Mount Carmel Elementary School | IN0054534 | ING0388_01 | Sours Run | NA |
| Lee Creek | NA | NA | NA | NA | NA |
| Jameson Creek | NA | NA | NA | NA | NA |
| ** | Brookville WWTP | IN0022446 | ING037H_01 | East Fork Whitewater River | 0.702 |

** Site is located outside the Whitewater River watershed but data will be used to calculate East Fork

Whitewater River pollutant loadings.

**Error! Reference source not found.** presents a summary of permit compliance for WWTP NPDES facilities in the Whitewater River watershed for the five year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). The table also presents the total number of violations in the five year period for the NPDES permitted parameters. According to **Error! Reference source not found.**, there have been six NPDES facility inspections resulting in violations in the five year period. Overall, there are a number of permit violations for *E. coli*, TSS, DO, pH, CBOD and ammonia in the Whitewater River watershed.

**Table 68. Summary of WWTP Inspections and Permit Compliance in the Whitewater River Subwatersheds for the Five Year Period Ending September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Month | Year | Parameter | Type | # Violations |
| Headwaters Blue Creek | NA | NA | NA | NA | NA | | | | |
| Wolf Creek | NA | NA | NA | NA | NA | | | | |
| Big Cedar Creek | Big Cedar Mobile Home Park WWTP | IN0037168 | ING0383_02 | 3/23/2010: Violations observed<br>3/6/2012: Violations observed<br>8/5/2013: Violations observed<br>11/4/2013: Violations observed | Apr | 2009 | TSS | Max Wk Avg | 1 |
| | | | | | May | 2009 | TSS | Max Wk Avg | 1 |
| | | | | | Nov | 2009 | TSS | Max Wk Avg | 1 |
| | | | | | Dec | 2009 | TSS | Max Wk Avg | 1 |
| | | | | | Dec | 2009 | TSS | Month Avg | 1 |
| | | | | | Jan | 2010 | TSS | Max Wk Avg | 1 |
| | | | | | Feb | 2010 | TSS | Max Wk Avg | 1 |
| | | | | | Feb | 2010 | TSS | Month Avg | 1 |
| | | | | | Mar | 2010 | TSS | Max Wk Avg | 1 |
| | | | | | Mar | 2010 | TSS | Month Avg | 1 |
| | | | | | Apr | 2010 | TSS | Max Wk Avg | 1 |
| | | | | | Apr | 2010 | Ammonia | Max Wk Avg | 1 |
| | | | | | Dec | 2010 | Ammonia | Max Wk Avg | 1 |
| | | | | | Dec | 2010 | Ammonia | Month Avg | 1 |
| | | | | | Jan | 2011 | TSS | Max Wk Avg | 1 |
| | | | | | Jan | 2011 | TSS | Month Avg | 1 |
| | | | | | Jan | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Jan | 2011 | Ammonia | Month Avg | 1 |
| | | | | | Feb | 2011 | TSS | Max Wk Avg | 1 |
| | | | | | Feb | 2011 | TSS | Month Avg | 1 |
| | | | | | Feb | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Feb | 2011 | Ammonia | Month Avg | 1 |
| | | | | | Mar | 2011 | TSS | Max Wk Avg | 1 |
| | | | | | Mar | 2011 | TSS | Month Avg | 1 |
| | | | | | Mar | 2011 | CBOD | Max Wk Avg | 1 |
| | | | | | May | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Jun | 2011 | TSS | Max Wk Avg | 1 |
| | | | | | Jun | 2011 | TSS | Month Avg | 1 |
| | | | | | Jun | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Jun | 2011 | Ammonia | Month Avg | 1 |
| | | | | | Jul | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Jul | 2011 | Ammonia | Month Avg | 1 |
| | | | | | Oct | 2011 | Ammonia | Max Wk Avg | 1 |
| | | | | | Oct | 2011 | TSS | Max Wk Avg | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Oct | 2011 | TSS | Month Avg | 1 |
| | | | | | Feb | 2012 | TSS | Month Avg | 1 |
| | | | | | Feb | 2012 | TSS | Max Wk Avg | 1 |
| | | | | | Feb | 2012 | CBOD | Month Avg | 1 |
| | | | | | Feb | 2012 | CBOD | Max Wk Avg | 1 |
| | | | | | Mar | 2012 | CBOD | Max Wk Avg | 1 |
| | | | | | May | 2012 | Chlorine | Max Wk Avg | 1 |
| | | | | | May | 2012 | Chlorine | Month Avg | 1 |
| | | | | | Jun | 2012 | Chlorine | Max Wk Avg | 1 |
| | | | | | Jul | 2012 | Chlorine | Max Wk Avg | 1 |
| | | | | | Aug | 2012 | Chlorine | Max Wk Avg | 1 |
| | | | | | Aug | 2012 | Chlorine | Month Avg | 1 |
| | | | | | Sep | 2012 | Chlorine | Max Wk Avg | 1 |
| | | | | | Oct | 2012 | DO | Daily Min | 1 |
| | | | | | Jun | 2012 | TSS | Max Wk Avg | 1 |
| | | | | | Dec | 2012 | TSS | Month Avg | 1 |
| | | | | | Dec | 2012 | CBOD | Max Wk Avg | 1 |
| | | | | | Dec | 2012 | CBOD | Month Avg | 1 |
| | | | | | Dec | 2012 | TSS | Max Wk Avg | 1 |
| | | | | | Feb | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Mar | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Apr | 2013 | DO | Daily Min | 1 |
| | | | | | Apr | 2013 | Chlorine | Max Wk Avg | 1 |
| | | | | | May | 2013 | DO | Daily Min | 1 |
| | | | | | May | 2013 | Chlorine | Max Wk Avg | 1 |
| | | | | | Jun | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Jul | 2013 | *E. coli* | Daily Max | 1 |
| | | | | | Jul | 2013 | Chlorine | Max Wk Avg | 1 |
| | | | | | Jul | 2013 | Chlorine | Month Avg | 1 |
| | | | | | Aug | 2013 | Chlorine | Max Wk Avg | 1 |
| | | | | | Aug | 2013 | Chlorine | Month Avg | 1 |
| | | | | | Aug | 2013 | CBOD | Max Wk Avg | 1 |
| | | | | | Aug | 2013 | TSS | Month Avg | 1 |
| | | | | | Aug | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Sep | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Sep | 2013 | *E. coli* | Monthly Geo | 1 |
| | | | | | Oct | 2013 | TSS | Month Avg | 1 |
| | | | | | Oct | 2013 | TSS | Month Avg | 1 |
| | | | | | Nov | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Dec | 2013 | TSS | Month Avg | 1 |
| | | | | | Dec | 2013 | TSS | Max Wk Avg | 1 |
| | | | | | Jan | 2014 | TSS | Month Avg | 1 |
| | | | | | Jan | 2014 | DO | Daily Min | 1 |
| Little Cedar | NA | NA | NA | NA | NA | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Creek | | | | | | | | | |
| Blackburn Creek | St. Leon WWTP | IN0058408 | ING0385_01 | 6/29/2009: Potential problems observed<br>7/5/2011: No violations observed<br>1/4/2012: No violations observed<br>7/30/2013: Potential problems observed<br>2/24/2014: Potential problems observed | Feb | 2010 | Ammonia | Monthly Avg | 1 |
| Johnson Fork | NA | NA | NA | NA | NA | | | | |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA | NA | | | | |
| Howard Creek | Mount Carmel Elementary School | IN0054534 | ING0388_01 | 4/15/2009: Potential problems observed<br>9/14/2010: No violations observed<br>11/17/2011: No violations observed<br>10/4/2013: Violations observed<br>8/14/2014: No violations observed | Apr<br>Apr<br>Nov<br>Dec<br>Dec<br>Dec<br>Dec<br>Jan<br>Feb<br>Mar<br>Mar<br>Mar<br>Oct<br>Dec<br>Jan<br>Jan<br>Nov<br>Feb<br>Feb | 2009<br>2009<br>2009<br>2009<br>2009<br>2009<br>2009<br>2010<br>2010<br>2010<br>2010<br>2010<br>2011<br>2012<br>2013<br>2013<br>2013<br>2014<br>2014 | pH<br>pH<br>pH<br>TSS<br>CBOD<br>Ammonia<br>Ammonia<br>TSS<br>TSS<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia<br>Ammonia | Daily Min<br>Daily Min<br>Daily Min<br>Max Wk Avg<br>Monthly Avg<br>Max Wk Avg<br>Monthly Avg<br>Monthly Avg<br>Monthly Avg<br>Max Wk Avg<br>Max Wk Avg<br>Monthly Avg<br>Monthly Avg<br>Max Wk Avg<br>Max Wk Avg<br>Monthly Avg<br>Max Wk Avg<br>Max Wk Avg<br>Monthly Avg | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 |
| Lee Creek | NA | NA | NA | NA | NA | | | | |
| Jameson Creek | NA | NA | NA | NA | NA | | | | |
| ** | Brookville WWTP | IN0022446 | ING037H_01 | 12/28/2009: Potential problems observed<br>7/18/2011: No violations observed | None | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | 6/11/2012: No violations observed<br>2/26/2013: No violations observed<br>1/29/2014: Violations observed | |

### *Industrial Facilities*

Industrial facilities with NPDES permits produce wastewater generated through producing a product. Wastewater discharges from industrial sources may contain pollutants at levels that could affect the quality of receiving waters. The NPDES permit program establishes specific requirements for dischargers from industrial sources. If the industrial facility discharges wastewater directly to a surface water then it requires an individual or general NPDES permit. A general permit, or permit-by-rule, is a "one size fits all" type of activity-specific permit. The general permit rule (327 IAC 15-1 through 15-4) covers the following activities: coal mining, coal processing, and reclamation activities, noncontact cooling water, petroleum products terminals, groundwater petroleum remediation systems, hydrostatic testing of commercial pipelines, and sand, gravel and stone operations. In contrast, individual permits are tailored to the specific activities of the facility and may regulate a number of additional pollutants other than those described under the general permits.

There are a total of two industrial facilities with NPDES permits within the Whitewater River watershed (Table 69). Based on the industrial activities and the regulated parameters within the specific permits there are only two active industrial facilities that discharge wastewater within the Whitewater River watershed (**Error! Reference source not found.**69 and 57). These facilities are as follows: Sperry and Rice Manufacturing Company and Elrod Water Company. Summaries of the industrial permits within the Whitewater River watershed are described below.

**Figure 69. NPDES Permitted Industrial Facilities in the Whitewater River Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Maximum Design Flow (MGD) |
|---|---|---|---|---|---|
| Headwaters Blue Creek Wolf Creek | NA | NA | NA | NA | NA |
| | NA | NA | NA | NA | NA |
| Wolf Creek | NA | NA | NA | NA | NA |
| Big Cedar Creek | NA | NA | NA | NA | NA |
| Little Cedar Creek | Sperry and Rice Mfg. Co. | IN0001473 | ING0384_01 | Tributary to Richland Creek | 0.15 |
| | Elrod Water Co. | IN0058947 | ING0384_01 | Tributary to Whitewater River | 0.068 |
| Blackburn Creek | NA | NA | NA | NA | NA |
| Johnson Fork | NA | NA | NA | NA | NA |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA | NA |
| Howard Creek | NA | NA | NA | NA | NA |
| Lee Creek | NA | NA | NA | NA | NA |
| Jameson Creek | NA | NA | NA | NA | NA |

Elrod Water Company is a Class A-SO industrial wastewater treatment plant which discharges filter backwash wastewater from one outfall. Groundwater is the source of the permitted facility's drinking water supply. The wastewater regulated by the permit consists of filter backwash, which may contain total residual chlorine. The filter backwash wastewater is stored and settled in a lagoon prior to discharging to a tributary of Whitewater River. Discharge occurs every 35-40 days.

Sperry and Rice Manufacturing Company is a rubber and sponge rubber manufacturing company. The facility is authorized to discharge from a single outfall and the effluent is limited to process, non-contact cooling, boiler blowdown, storm water and sanitary wastewaters. The facility has been in noncompliance status seven out of the last twelve quarters and has had nine informal enforcement actions in the last five years.

**Error! Reference source not found.** presents a summary of permit compliance for industrial NPDES facilities in the Whitewater River watershed for the five year period between 2009 and 2014. It presents the date of the facility's last inspection and findings from the inspection (i.e., compliance or violation for facility maintenance). The table also presents the total number of violations in the five year period for NPDES permitted parameters. According to **Error! Reference source not found.**, there have been seven NPDES industrial facility inspections resulting in violations in the five year period. Overall, there have been a total of two DO violations and one TSS permit violations in the Whitewater River watershed.

**Table 70. Summary of Inspections and Permit Compliance for Industrial Facilities in the Whitewater River Subwatersheds for the Five Year Period Ending September 30, 2014**

| Subwatershed | Facility Name | Permit Number | AUID | Date of Last Inspection and Findings | Violations from 4/2009 through 9/2014 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Month | Year | Parameter | Type | # Violations |
| Headwaters Blue Creek Wolf Creek | NA | NA | NA | NA | NA | | | | |
| Wolf Creek | NA | NA | NA | NA | NA | | | | |
| Big Cedar Creek | NA | NA | NA | NA | NA | | | | |
| Little Cedar Creek | Sperry and Rice Mfg. Co. | IN0001473 | ING0384_01 | 8/29/2009: Violations observed<br>6/28/2010: Violations observed<br>11/9/2010: Violations observed<br>2/8/2012: Violations observed<br>9/25/2012: Violations observed<br>1/2/2013: Violations observed<br>9/19/2014: Violations observed | Aug<br>Sep | 2012<br>2012 | DO<br>DO | Daily Min<br>Daily Min | 1<br>1 |
| | Elrod Water Co. | IN0058947 | ING0384_01 | 9/16/2009: No violations observed<br>1/11/2013: Potential problems observed<br>2/20/2014: Potential problems observed | Apr | 2014 | TSS | Monthly Avg | 1 |
| Blackburn Creek | NA | NA | NA | NA | NA | | | | |
| Johnson Fork | NA | NA | NA | NA | NA | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA | NA |
| Lee Creek | NA | NA | NA | NA | NA |
| Jameson Creek | NA | NA | NA | NA | NA |
| Howard Creek | NA | NA | NA | NA | NA |
| Lee Creek | NA | NA | NA | NA | NA |
| Jameson Creek | NA | NA | NA | NA | NA |

### *Industrial Storm Water*

Depending on the type of industrial facility operated more than one NPDES program may apply. Some industrial facilities require an additional permit under the storm water program which will be discussed in this section.

Industrial storm water permits are required for facilities where activities of the industrial operation are exposed to storm water and run-off is discharged though a point source to waters of the state. The general permit 327 IAC 15-6 (Rule 6) applies to specific categories of industrial activities that must obtain permit coverage. Determination of applicable industrial activities is based on a facility's Standard Industrial Classification (SIC) Code(s) or facility activities included in the listed narrative descriptions within the rule. Under certain circumstances, a facility may require an individual storm water permit. This permit is typically required only if a regulated industrial activity category has established effluent limitations or IDEM determines the storm water discharge will significantly lower water quality. Industrial storm water permits in the Whitewater River watershed are shown in Figure 57.

The facility must develop and implement a Storm Water Pollution Prevention Plan (SWP3), and submit a completed SWP3 Checklist Form certifying to IDEM that such a plan is in place. The SWP3 is used to identify potential and actual storm water pollutant sources, and to determine best management practices and measures that will minimize the pollutants transported in storm water run-off. The SWP3 itself must be retained at the facility, and made available for review during any on-site inspection. Periodically, the plan must be reviewed, and revised if changes at the facility alter conditions that could affect run-off.

**Table 71. NPDES Industrial Storm Water Permits within the Whitewater River Subwatersheds**

| Subwatershed | Facility Name | Permit Number | AUID | Receiving Stream | Area (Sq. Mi.) |
|---|---|---|---|---|---|
| Headwaters Blue Creek | NA | NA | NA | NA | NA |
| Wolf Creek | NA | NA | NA | NA | NA |
| Big Cedar Creek | NA | NA | NA | NA | NA |
| Little Cedar Creek | Owens Corning Whites Off Site Storage Facility | INR700036 | ING0384_T1001 | Little Cedar Creek | 0.022 |
| Blackburn Creek | Rudicil Sand & Gravel | INR00R073 | ING0385_01 | Whitewater River | 0.126 |
| Johnson Fork | NA | NA | NA | NA | NA |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA | NA |
| Howard Creek | NA | NA | NA | NA | NA |
| Lee Creek | NA | NA | NA | NA | NA |
| Jameson Creek | Wagner Auto Parts | INR00W108 | ING038A_01 | Whitewater River | 0.0004 |

### *Construction Storm Water*

Storm water run-off associated with construction activity is regulated under 327 IAC 15-5 which is commonly known as Rule 5. Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities.

The requirements of Rule 5 now apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land disturbing activity results in the disturbance of less than one (1) acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to storm water permitting.

In Indiana most construction projects subject to Rule 5 are administered through a general permit. A general permit is a permit by rule, and as such it is not "issued" in the same manner as an individual NPDES permit would be issued. Rather, Rule 5 was "conditionally issued" to all future "project site owners" at the time that the rule was adopted by the Indiana Water Pollution Control Board. The permit conditions within Rule 5 apply universally to all "project site owners" who are eligible to operate under the rule.

Rule 5 requires the development of a Construction Plan and an integral part of the Construction Plan is a SWP3. The SWP3 addresses several issues. First, the plan outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. Second, the plan addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. Finally, the plan should also address pollutants that will be associated with the post construction land use. It is the responsibility of the project site owner to implement the storm water pollution prevention plan. In addition, it is critical that the site is monitored during the construction process and in field modifications are made to address the discharge of sediment and other pollutants from the project site. This may require modification of the plan and field changes on the project site, as necessary, to prevent pollutants, including sediment, from leaving the project site.

If an adverse environmental impact from a project site is evident, a Rule 5 permit or, in more significant situations, an individual storm water permit may be required. An individual storm water permit is typically required only if IDEM determines the discharge will significantly lower water quality. If an individual storm water permit is required, notice will be given to the project site owner. The acreage numbers in Table 72 were calculated by using an area weighted approach with using the past five years of permitted construction sites in Franklin, Ripley and Dearborn counties

**Table 72. Permitted Construction Acreage in the Whitewater River Subwatersheds**

| Subwatershed | Estimated Construction Acreage |
|---|---|
| Headwaters Blue Creek | 1.98 |
| Wolf Creek | 0.79 |
| Big Cedar Creek | 1.60 |
| Little Cedar Creek | 1.44 |
| Blackburn Creek | 1.91 |

| | |
|---|---|
| Johnson Fork | 6.93 |
| Headwaters Dry Fork Whitewater River | 0.76 |
| Howard Creek | 0.54 |
| Lee Creek | 0.05 |
| Jameson Creek | 3.42 |

***Regulated Storm Water Sources – Municipal Separate Storm Sewer Systems (MS4s)***

327 IAC 15-13 regulates Municipal Separate Storm Sewer Systems (MS4s). 327 IAC 15-13 (Rule 13) (Scroll to the bottom of Page 74 to access the Rule) is a storm water general permit rule. MS4s are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits. It does not include combined sewer overflows and publicly owned treatment works.

The federal Clean Water Act requires storm water discharges from certain types of urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. In 1990, Phase I of these requirements became effective, and municipalities with a population served by a municipal separate storm sewer system (MS4) of 100,000, or more, were regulated. Under Phase I federal storm water regulations, regulated MS4 entities were required to obtain individual permits. In 1999, Phase II became effective, and any entity responsible for an MS4 conveyance, regardless of population size, could potentially be regulated. IDEM foresees that the vast majority, if not all, of the Phase II MS4 entities in Indiana will be covered under general permits. A general permit is a single permit that is written to cover multiple permittees with similar characteristics. No written draft permit is issued to the permittee under a general permit. Under 327 IAC 15-2-9(b), an individual NPDES permit is required when water quality standards are not being met under the general permit, technology or regulatory change has occurred that causes the implementation of specific controls or limitations not expressed in the general permit, or a general permit is no longer appropriate based on permittee changes. If any of these situations occur, MS4 entities covered under this general permit rule may be required to terminate coverage, and apply for an individual MS4 permit.

MS4 conveyances within urbanized areas have one of the greatest potentials for polluted storm water runoff. The Federal Register Final Rule explains the reason as: “urbanization alters the natural infiltration capacity of the land and generates...pollutants...causing an increase in storm water runoff volumes and pollutant loadings.” Based on increased population and proportionally higher pollutant sources, urbanization results “in a greater concentration of pollutants that can be mobilized by, or disposed into, storm water discharges.” MS4s can be significant sources of *E. coli*, nutrients, and sediment because they transport urban runoff that can be affected by pet waste, illicit sewer connections, failing septic systems, fertilizer, construction, and streambank erosion from hydrologic modifications.

There are two MS4 entities in the Whitewater River Watershed as shown in Table 73 and Figure 57. The City of Cincinnati is the co-permittee located within the watershed that is covered under

the Hamilton County MS4 permit. Both of the MS4s located in the Whitewater River watershed are regulated by Ohio EPA.

**Table 73. Whitewater River Watershed MS4 Communities**

| Subwatershed | MS4 Facility Permit ID | MS4 Name | Total Area (Sq. Mi) | Developed Area (Sq. Mi.) |
|---|---|---|---|---|
| Headwaters Blue Creek | NA | NA | NA | NA |
| Wolf Creek | NA | NA | NA | NA |
| Big Cedar Creek | NA | NA | NA | NA |
| Little Cedar Creek | NA | NA | NA | NA |
| Blackburn Creek | NA | NA | NA | NA |
| Johnson Fork | 1GQ00046*BG | Hamilton County and 37 co-permittees | 0.1234 | 0.0771 |
| Jameson Creek | 1GQ00034*BG | City of Harrison | 0.2060 | 0.1546 |
| | 1GQ00046*BG | Hamilton County and 37 co-permittees | 0.1196 | 0.0606 |
| Headwaters Dry Fork Salt Creek | NA | NA | NA | NA |
| Howard Creek | NA | NA | NA | NA |

Municipal boundaries and MS4 boundaries are not always the same, but are often used to delineate the regulated MS4 area if a system map is not readily available. **Error! Reference source not found.** shows the MS4 boundaries in the Whitewater River subwatersheds.

#### *Illicitly Connected "Straight Pipe" Systems*

Some household wastes within Indiana and potentially within the Whitewater River watershed directly discharge to a stream or are illegally connected directly to tile-drainage pipes in rural areas, providing a direct source of pollutants such as *E. coli*, nutrients, and sediments to the stream (these systems are sometimes referred to as "straight pipe" discharges). Dearborn County Health Department is the primary regulatory agency for onsite systems in the county. Information from the health department's sanitarian estimated the septic system failure rate at 50 percent throughout the county and identified several problem clusters in the Southern Whitewater River watershed. The following clusters were identified: Longnecker Road (Bonnie Lane and Herberts Lane, ~40 houses), Old U.S. 52 (~30 houses, ~12 businesses), Pinhook Road (~20 houses), and the Town of West Harrison (not on State Street, ~40 houses).

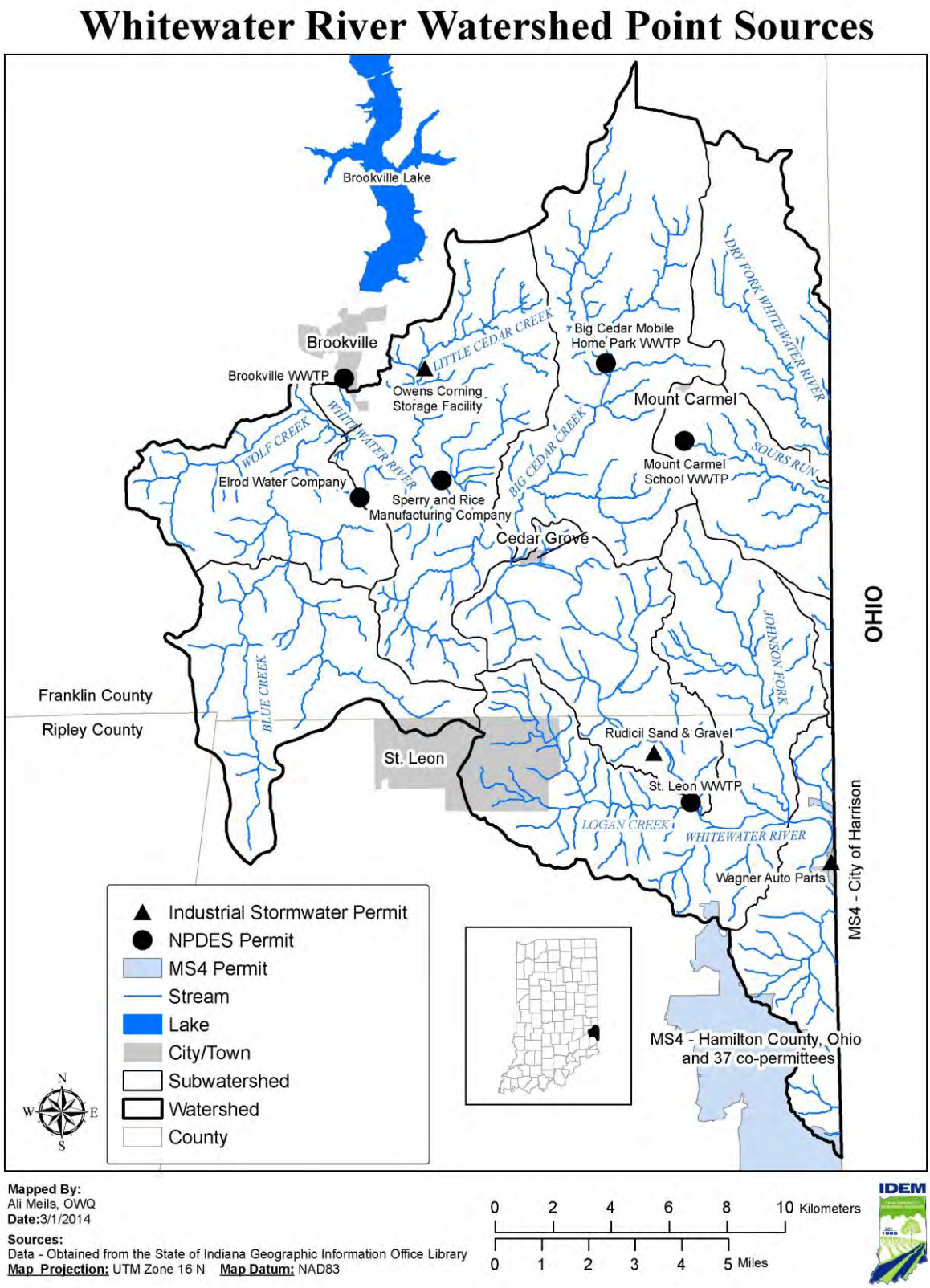


**Figure 58. Point Sources in the Whitewater River Subwatersheds**

## Nonpoint Sources

This section summarizes the potential nonpoint sources of *E. coli*, nutrients and sediment in the Whitewater River watershed that are not regulated through the National Pollutant Discharge Elimination System (NPDES) Program.

### *Cropland*

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from decomposition of residual crop material, fertilization with chemical (e.g., anyhdrous ammonia) and manure fertilizers, inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal and industrial wastewater treatment facilities. The majority of nutrient loading from cropland occurs from fertilization with commercial and manure fertilizers (USEPA, 2003). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (USEPA, 2003).

Watershed specific data are not available for field specific crops. However, county-wide data available from the National Agricultural Statistic Service (NASS) were downloaded and area weighted to estimate crop acreage in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total acreage of crops in the county based on the NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of cropland with the watershed. The 2012 NASS statistics were used in the analysis as shown in Table 74.

**Table 74. Major Cash Crop Acreage in the Whitewater River watershed**

| Crop | Total Acreage in County | | |
|---|---|---|---|
| | Dearborn | Franklin | Ripley |
| Corn | 9,300 | 39,600 | 48,400 |
| Soybean | 9,600 | 35,800 | 55,600 |
| Winter Wheat | 0 | 1,800 | 0 |

| Subwatershed Area (mi²) | Crop | Total Acreage | Percentage of Subwatershed Crop Acreage |
|---|---|---|---|
| Headwaters Blue Creek (18.32 mi²) | Corn | 1,601 | 51 |
| | Soybean | 1,470 | 47 |
| | Winter Wheat | 66 | 2 |
| | **Total** | **3,137** | **100** |
| Wolf Creek (14.54 mi²) | Corn | 1,472 | 51 |
| | Soybean | 1,331 | 46 |
| | Winter Wheat | 67 | 3 |
| | **Total** | **2,870** | **100** |
| Big Cedar Creek (29.61 mi²) | Corn | 2,997 | 51 |
| | Soybean | 2,710 | 46 |
| | Winter Wheat | 136 | 3 |

| | | | |
|---|---|---|---|
| | **Total** | **5,843** | **100** |
| **Little Cedar Creek (26.64 mi²)** | Corn | 2,697 | 51 |
| | Soybean | 2,438 | 46 |
| | Winter Wheat | 123 | 3 |
| | **Total** | **5,258** | **100** |
| **Blackburn Creek (17.19 mi²)** | Corn | 1,467 | 51 |
| | Soybean | 1,341 | 47 |
| | Winter Wheat | 61 | 2 |
| | **Total** | **2,869** | **100** |
| **Johnson Fork (32.88 mi²)** | Corn | 1,877 | 51 |
| | Soybean | 1,776 | 48 |
| | Winter Wheat | 57 | 1 |
| | **Total** | **3,710** | **100** |
| **Headwaters Dry Fork Whitewater River (14.01 mi²)** | Corn | 1,418 | 51 |
| | Soybean | 1,282 | 46 |
| | Winter Wheat | 64 | 3 |
| | **Total** | **2,765** | **100** |
| **Howard Creek (10.05 mi²)** | Corn | 1,017 | 51 |
| | Soybean | 920 | 46 |
| | Winter Wheat | 46 | 3 |
| | **Total** | **1,983** | **100** |
| **Lee Creek (1.04 mi²)** | Corn | 102 | 51 |
| | Soybean | 93 | 47 |
| | Winter Wheat | 5 | 2 |
| | **Total** | **200** | **100** |
| **Jameson Creek (11.21 mi²)** | Corn | 339 | 49 |
| | Soybean | 350 | 51 |
| | Winter Wheat | 0 | 0 |
| | **Total** | **689** | **100** |

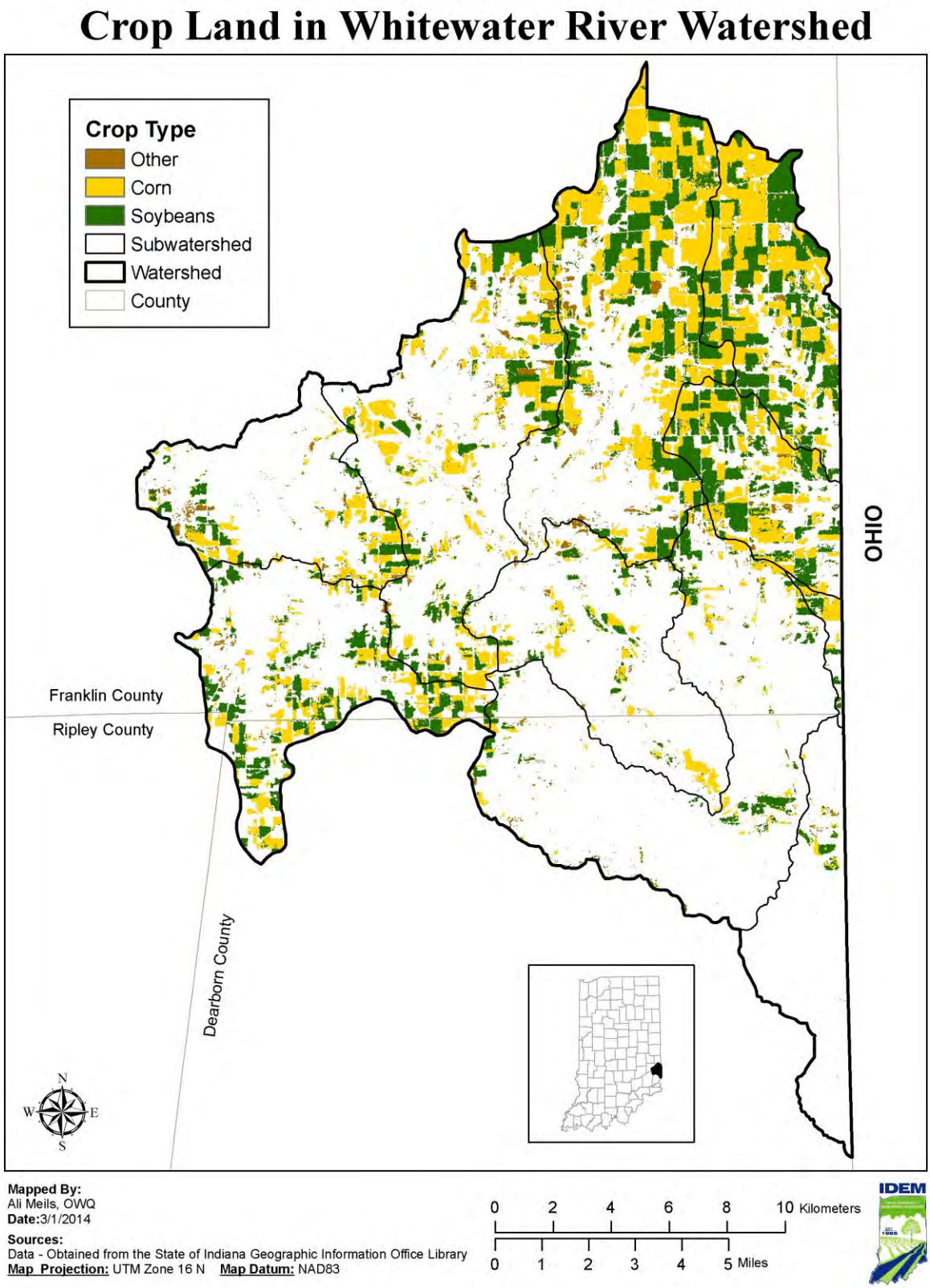


**Figure 59. Crop Land in the Whitewater River Subwatersheds**

### *Pastures and Livestock Operations*

Runoff from pastures and livestock operations can be potential agricultural sources of *E. coli*, nutrients, and sediment. For example, animals grazing in pasturelands deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated runoff during a storm event.

Livestock are potential source of *E. coli*, nutrients, and streambank erosion in streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. However, county-wide data available from the National Agricultural Statistic Service were downloaded and area weighted to estimate animal population in the subwatersheds. The area of the county within the subwatersheds is divided by the area of the entire county and multiplied by the total number of animals in the county based on the 2007 NASS survey. This is done for each county in the subwatersheds and summed to get an area weighted estimate of animals with the subwatersheds. There are an estimated 9,420 animal units in the Whitewater River watershed and the animal unit density is 54 animal units per square mile as shown in Table 49.

**Table 75. Animal Unit Density in the Whitewater River Subwatersheds**

| | **Hogs and Pigs** | **Cattle and Calves** | **Sheep and Goats** | **Horses and Ponies** | **Poultry** |
|---|---|---|---|---|---|
| **Number of Animals in One Animal Unit** | 2.5 | 1 | 10 | 0.5 | 250 |
| | | | | | |
| **Total Number of Head in County** | | | | | |
| Dearborn | 342 | 7,133 | 619 | 568 | 777 |
| Franklin | 19,941 | 12,323 | 842 | 581 | 1,015 |
| Ripley | 32,591 | 9,474 | 1,268 | 593 | 915 |

| **Total Number of Animal Units in Subwatersheds** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Subwatershed | Hogs and Pigs | Cattle and Calves | Sheep and Goats | Horses and Ponies | Poultry | **Total** | **Animal Unit Density (animal units/mi²)** |
| Headwaters Blue Creek | 891* | 560 | 4 | 57 | 0 | 1512 | 83 |
| Wolf Creek | 352* | 458 | 3 | 43 | 0 | 856 | 59 |
| Big Cedar Creek | 604 | 933 | 6 | 88 | 0 | 1,631 | 55 |
| Little Cedar Creek | 719* | 839 | 6 | 79 | 0 | 1,643 | 62 |
| Blackburn Creek | 274 | 510 | 4 | 54 | 0 | 841 | 49 |
| Johnson Fork | 262 | 866 | 7 | 113 | 0 | 1,248 | 38 |
| Headwaters Dry Fork Whitewater River | 286 | 441 | 3 | 42 | 0 | 772 | 55 |
| Howard Creek | 205 | 317 | 2 | 30 | 0 | 554 | 55 |
| Lee Creek | 20 | 32 | 0 | 3 | 0 | 55 | 53 |
| Jameson Creek | 5 | 260 | 2 | 41 | 0 | 308 | 27 |

*Numbers adjusted based on known CFO farms in the subwatershed.

#### *Confined Feeding Operations (CFOs)*

A CFO is an agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and

Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

The number of animal present meets the requirements for the state permitting action.

Confined feeding operations that are not classified as CAFOs are known as confined feeding operations (CFOs) in Indiana. Non-CAFO animal feeding operations are considered nonpoint sources by USEPA. CAFOs have federal permits and fall under the jurisdiction of the NPDES program, as described in Section 6.2.1.1. Indiana's CFOs have state-issued permits but are not under the jurisdiction of the federal NPDES program and are therefore categorized as nonpoint sources for the purposes of this TMDL. CFO permits are "no discharge" permits. Therefore it is prohibited for these facilities to discharge to any water of the State.

The CFO regulations (327 IAC 19, 327 IAC 15-16) require that operations "not cause or contribute to an impairment of surface waters of the state". IDEM regulates these confined feeding operations under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 19, which implement the statute regulating confined feeding operations, were effective on July 1, 2012. The rule at 327 IAC 15-16, which regulates concentrated animal feeding operations and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012.

Like CAFOs, the animals raised in CFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. CFOs, however, can also be potential sources of TSS, total nitrogen, total phosphorus, and *E. coli* due to the following:

Manure can leak or spill from storage pits, lagoons, tanks, etc.

Improper application of manure can contaminate surface or ground water.

Manure overapplication or improper application can adversely impact soil productivity.

There are eight CFOs in the Whitewater River watershed as shown in Table 50 and **Error! Reference source not found.**.

**Table 76. CFOs in the Whitewater River Subwatersheds**

| Subwatershed | Operation Name | Farm ID | AUID | Animal Type and Number |
|---|---|---|---|---|
| Headwaters Blue Creek | Harold and Steve Wendel | 4063 | ING0381_02 | 650 Nursery Pigs<br>1950 Finishers<br>278 Sows |
| Wolf Creek | Greg Kunkel | 4956 | ING0382_T1001 | 880 Finishers |
| Big Cedar Creek | NA | NA | NA | NA |
| Little Cedar Creek | Virgil Kunkel | 3962 | ING0384_T1004 | 900 Nursery Pigs<br>1300 Finishers<br>497 Sows |
| Blackburn Creek | Victor Frey | 3168 | ING0385_T1005 | 480 Nursery Pigs<br>480 Finishers<br>84 Sows |
| Johnson Fork | NA | NA | NA | NA |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA |
| Howard Creek | NA | NA | NA | NA |
| Lee Creek | NA | NA | NA | NA |
| Jameson Creek | NA | NA | NA | NA |

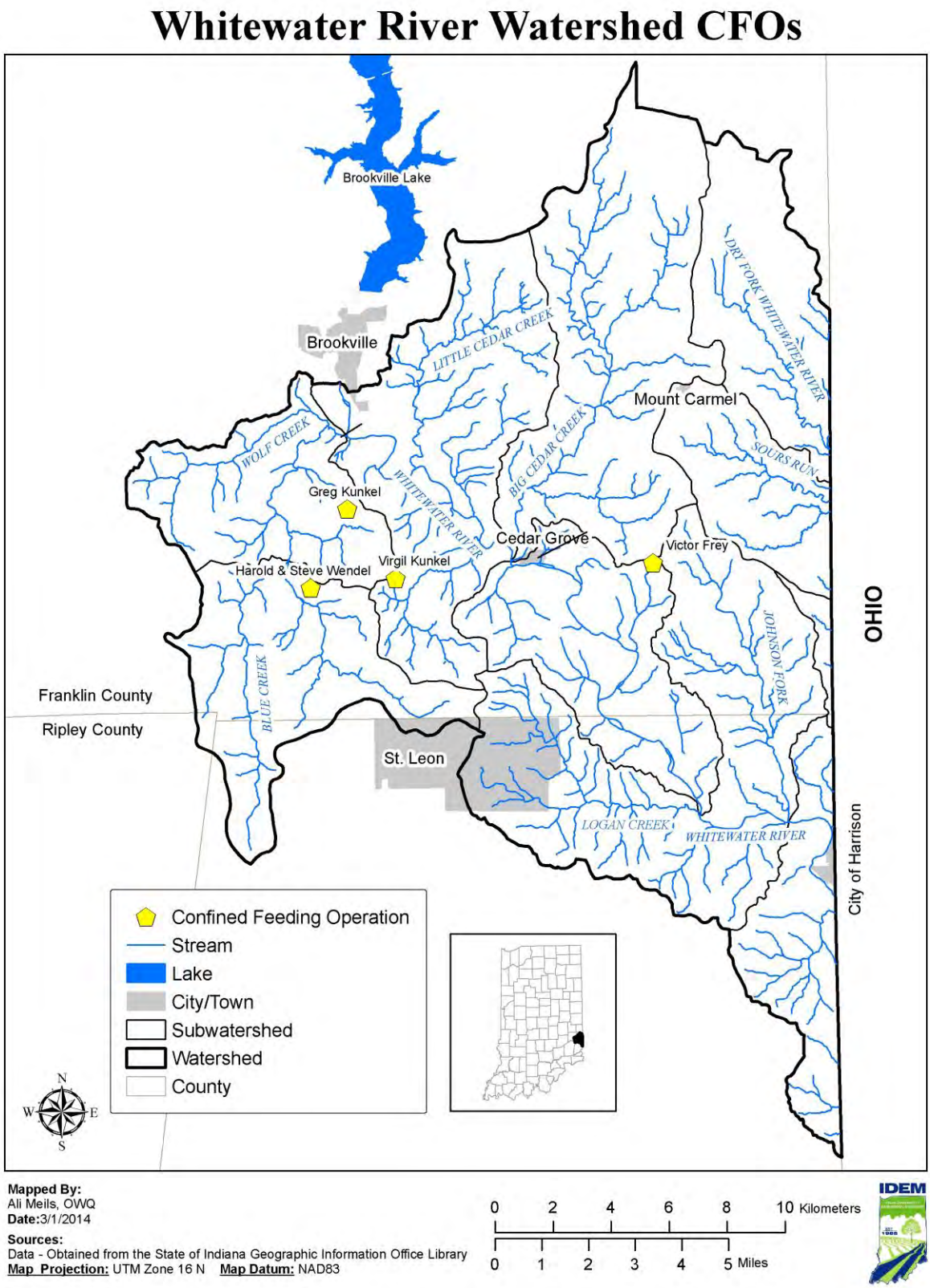


**Figure 60 Confined Feeding Operations in the Whitewater River Subwatersheds**

#### *Streambank Erosion*

Streambank erosion is potentially a significant source of TSS in the Whitewater River watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities:

- Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots.
- Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion due to high velocities and shear stress.
- The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid runoff of rainfall and higher stream velocities that might cause streambank erosion.

#### *Onsite Wastewater Treatment Systems*

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure are: seasonal water tables, compact glacial till, bedrock, coarse sand and gravel outwash and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters due to *E. coli,* nitrate + nitrite, and total phosphorus (Horsely and Witten, 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pathogens and nutrients.

The sanitarian at the Dearborn County Health Department estimated the septic system failure rate at about 50 percent throughout the county. Several of the problem clusters were identified in the Dearborn County WQMP which was updated in 2009, and those finding will be discussed in the site assessment portion of the document.

The Indiana State Department of Health (ISDH) regulates (410 IAC 6-8.3) through the local health departments the residential onsite sewage disposal program. Onsite sewage disposal systems (i.e., septic systems) are those, which do not result in an off-lot discharge of treated effluent, typically consisting of a septic tank to settle out and digest sewage solids, followed by a system of perforated piping to distribute the treated wastewater for absorption into the soil. More than 800,000 onsite sewage disposal systems are currently used in Indiana. Local health departments issue more than 15,000 permits per year for new systems, and about 6,000 permits for repairs.

**410 IAC 6-8.3-52 General sewage disposal requirements**

Sec. 52. (a) No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or ground waters of this state, or cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into such waters, any organic or inorganic matter from a dwelling or residential onsite sewage system that would cause or contribute to a health hazard or water pollution.
(b) The: (1) design; (2) construction; (3) installation; (4) location; (5) maintenance; and (6) operation; of residential onsite sewage systems shall comply with the provisions of this rule.

**410 IAC 6-8.3-55 Violations; permit denial and revocation**

Sec. 55. (a) Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer. (b) If any component of a residential onsite sewage system is found to be: (1) defective; (2) malfunctioning; or (3) in need of service; the health officer may require the repair, replacement, or service of that component. The repair, replacement, or service shall be

conducted within the time limit set by the health officer. (c) Any person found to be violating this rule may be served by the health officer with a written order stating the nature of the violation and providing a time limit for satisfactory correction thereof.

A comprehensive database of septic systems within the Whitewater River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The US Census provides the total number of people within a county as well as the total urban and rural population of the county. Subwatershed population is estimated by dividing the subwatershed area by the total county area and multiplying it by the county census population. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural population density. An additional estimate of septic systems can be made using the 1990 US Census, as that is the last Census that inventoried how household wastewater is disposed. The rural households in the Whitewater River subwatersheds are shown in Table 52, along with a calculated density (total rural households divided by total area). The rural household density can be used to compare the different subwatersheds within the Whitewater River watershed.

It should also be noted that hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement. Table 77 illustrates the hydrologic soil groups for the Whitewater River subwatersheds.

**Table 77** Hydrologic Soil Groups in the Whitewater River Subwatersheds

| Subwatershed | Hydrologic Soil Group (Acres) | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Headwaters Blue Creek | 0 | 323.02 | 11,386.02 | 0 |
| Wolf Creek | 0 | 220.92 | 4,103.60 | 0 |
| Big Cedar Creek | 24.39 | 12,277.88 | 6,624.59 | 0 |
| Little Cedar Creek | 590.44 | 7,695.41 | 8,564.39 | 0 |
| Blackburn Creek | 481.06 | 2,801.8 | 7,388.11 | 0 |
| Johnson Fork | 59.6 | 7,033.74 | 13,770.5 | 0 |
| Headwaters Dry Fork Whitewater River | 30.34 | 6,427.44 | 2,481.15 | 0 |
| Howard Creek | 6.08 | 3,591.68 | 2,787.18 | 0 |
| Lee Creek | 0 | 325.86 | 326.53 | 0 |
| Jameson Creek | 43.2 | 1,817.24 | 5,145.5 | 0 |

**Table 78. Rural Population Density in the Whitewater River Subwatersheds**

| Subwatershed | County | Area of County in Subwatershed ($mi^2$) | County Households in Subwatershed | Urban Households | Rural Households | Rural Household Density ($Houses/mi^2$) |
|---|---|---|---|---|---|---|
| Headwaters Blue Creek | Dearborn | 3.6 | 167 | 30 | 137 | **34** |
| | Franklin | 14.41 | 470 | 0 | 470 | |
| | Ripley | 0.31 | 12 | 0 | 12 | |
| | Total | 18.32 | 649 | 30 | 619 | |
| Wolf Creek | Franklin | 14.54 | 507 | 0 | 507 | **35** |
| | Total | 14.54 | 507 | 0 | 507 | |
| Big Cedar Creek | Franklin | 29.61 | 667 | 23 | 644 | **22** |
| | Total | 29.61 | 667 | 23 | 644 | |
| Little Cedar Creek | Franklin | 26.64 | 871 | 22 | 849 | **32** |
| | Total | 26.64 | 871 | 22 | 849 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Blackburn Creek | Dearborn | 3.85 | 288 | 0 | 288 | **60** |
| | Franklin | 13.34 | 825 | 89 | 736 | |
| | Total | 17.19 | 1,113 | 89 | 1,024 | |
| Johnson Fork | Dearborn | 20.45 | 1,768 | 397 | 1,371 | **69** |
| | Franklin | 12.43 | 887 | 0 | 887 | |
| | Total | 32.88 | 2,655 | 397 | 2,258 | |
| Headwaters Dry Fork Whitewater River | Franklin | 14.01 | 215 | 0 | 215 | **15** |
| | Total | 14.01 | 215 | 0 | 215 | |
| Howard Creek | Franklin | 10.05 | 414 | 32 | 382 | **38** |
| | Total | 10.05 | 414 | 32 | 382 | |
| Lee Creek | Dearborn | 0.04 | 9 | 0 | 9 | **100** |
| | Franklin | 1 | 95 | 0 | 95 | |
| | Total | 1.04 | 99 | 0 | 104 | |
| Jameson Creek | Dearborn | 11.21 | 2,063 | 374 | 1,689 | **151** |
| | Total | 11.21 | 2,063 | 374 | 1,689 | |

#### *Urban Storm Water*

In areas not covered under the NPDES MS4 program, storm water runoff from developed areas is not regulated under a permit and is therefore a nonpoint source. Runoff from urban areas can carry a variety of pollutants originating from a variety of sources. Typically urban sources of nutrients are fertilizer application to lawns and pet waste, which is also a source of *E. coli*. Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation. The percent and distribution of developed land in the Whitewater River watershed is discussed in Section 8.2.1. However, inputs from urban sources are difficult to quantify. Estimates can be made of pet populations and residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of sediment, nutrients or *E. coli* in the Whitewater River watershed.

Dog and cat populations were estimated for the Whitewater River subwatersheds using statistics reported in the *2007 U.S. Pet Ownership & Demographics Sourcebook*[1]. Specifically, the *Sourcebook* reports that on average 37.2 percent of households own dogs and 32.4 percent of households own cats. Typically, the average number of pets per household is 1.7 dogs and 2.2 cats. However, pets are likely only a significant source of *E. coli* and nutrients in population centers (i.e., cities and towns). The estimates of domestic pets in cities and towns in the watershed are presented in **Error! Reference source not found.** and are based on the average number of pets per household multiplied by the households in the urban areas of the subwatersheds.

**Table 79. Estimated Pet Populations in the Cities and Towns in the Whitewater River Watershed**

| Subwatershed | City/Town | Households in 2010 | Estimated Number of Cats | Estimated Number of Dogs |
|---|---|---|---|---|
| Headwaters Blue Creek | St. Leon | 30 | 66 | 51 |
| Wolf Creek | NA | NA | NA | NA |
| Big Cedar Creek | Cedar Grove | 23 | 51 | 39 |
| Little Cedar Creek | Brookville | 22 | 48 | 37 |

[1] http://www.avma.org/reference/marketstats/sourcebook.asp

| | | | | |
|---|---|---|---|---|
| Blackburn Creek | Cedar Grove | 89 | 196 | 151 |
| Johnson Fork | St. Leon | 263 | 579 | 447 |
| | Cincinnati, OH – IN Urban Cluster | 134 | 295 | 228 |
| Headwaters Dry Fork Whitewater River | NA | NA | NA | NA |
| Howard Creek | Mount Carmel | 32 | 70 | 54 |
| Lee Creek | NA | NA | NA | NA |
| Jameson Creek | Harrison, OH – IN Urban Cluster | 199 | 438 | 338 |
| | Cincinnati, OH – IN Urban Cluster | 175 | 385 | 298 |
| | **Total** | 967 | 2,128 | 1,643 |

***Wildlife***

The Indiana Department of Natural Resources (IDNR) is the primary entity responsible for monitoring wildlife populations and habitats throughout Indiana. Wildlife such as deer, geese, ducks, etc. can be sources of *E. coli*. Little information exist surrounding feces depositional patterns of wildlife and a direct inventory of wildlife populations is generally not available. However, based on the *Bacteria Source Load Calculator* developed by the Center for TMDL and Watershed Studies, bacteria production by animal type is estimated as well as their preferred habitat. Higher concentrations of wildlife in the habitats described in Table 80 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.

**Table 80. Bacteria Source Load by species**

| Wildlife Type | *E. coli* Production Rate (cfu/day – animal) | Habitat |
|---|---|---|
| Deer | $1.86 \times 10^8$ | Entire Watershed |
| Raccoon | $2.65 \times 10^7$ | Low density on forests in rural areas; high density on forest near a permanent water source or near cropland |
| Muskrat | $1.33 \times 10^7$ | Near ditch, medium sized stream, pond or lake edge |
| Goose | $4.25 \times 10^8$ | Near main streams and impoundments |
| Duck | $1.27 \times 10^9$ | Near main streams and impoundments |
| Beaver | $2.00 \times 10^5$ | Near streams and impoundments in forest and pastures |

Managed lands include natural and recreation areas which are owned or managed by the Indiana Department of Natural Resources, federal agencies, local agencies, non-profit organizations, and conservation easements. Classified lands are public or private lands containing areas supporting growth of native or planted trees, native or planted grasses, wetlands or other acceptable types of cover that have been set aside for managed production of timber, wildlife habitat and watershed protection. These natural areas provide ideal habitat for wildlife. Some of the more common wildlife often found in natural areas include white-tailed deer, raccoon, muskrat, fowl and beaver. While wildlife is known to contribute *E.coli* and nutrients to the surface waters, natural areas provide economic, ecological and social benefits

and should be preserved and protected. Management practices such as reducing impervious surfaces, native vegetation plantings, wetland creation and riparian buffers will help in reducing stormwater runoff transporting pollutants to the streams. Figure 60 shows the managed lands within the Whitewater River watershed. There are 2,838 acres of managed and classified lands in the Whitewater River watershed.

**Table 81. Managed Land and Classified Land in the Whitewater River Watershed**

| Managed Lands | | | | | | |
|---|---|---|---|---|---|---|
| **Subwatershed** | **Unit Name** | | **Manager** | | | **Area (acres)** |
| Little Cedar Creek/Wolf Creek | Franklin County Park | | Franklin Park Board | | | 194 |
| | | | | | Total | 194 |
| **Classified Lands (Acres)** | | | | | | |
| **Subwatershed** | **Grassland** | **Woodland** | **Shrubland** | **Wetland** | **Other** | **Total** |
| Headwaters Blue Creek | 0 | 539.91 | 3.5 | 0 | 0 | 543.41 |
| Wolf Creek | 0 | 184.64 | 0 | 0 | 0 | 184.64 |
| Big Cedar Creek | 0 | 140.85 | 0 | 0 | 0 | 140.85 |
| Little Cedar Creek | 1.56 | 1,008.12 | 39.63 | 0 | 0 | 1,049.31 |
| Blackburn Creek | 0 | 67.02 | 18.21 | 0 | 0 | 85.23 |
| Johnson Fork | 14.64 | 354.38 | 31.49 | 0 | 0 | 400.51 |
| Headwaters Dry Fork Whitewater River | 0 | 10.00 | 0 | 0 | 0 | 10.00 |
| Howard Creek | 0 | 0 | 0 | 0 | 0 | 0 |
| Lee Creek | 0 | 0 | 0 | 0 | 0 | 0 |
| Jameson Creek | 59 | 171.09 | 0 | 0 | 0 | 230.09 |
| | | | | | Total | 2,644.04 |

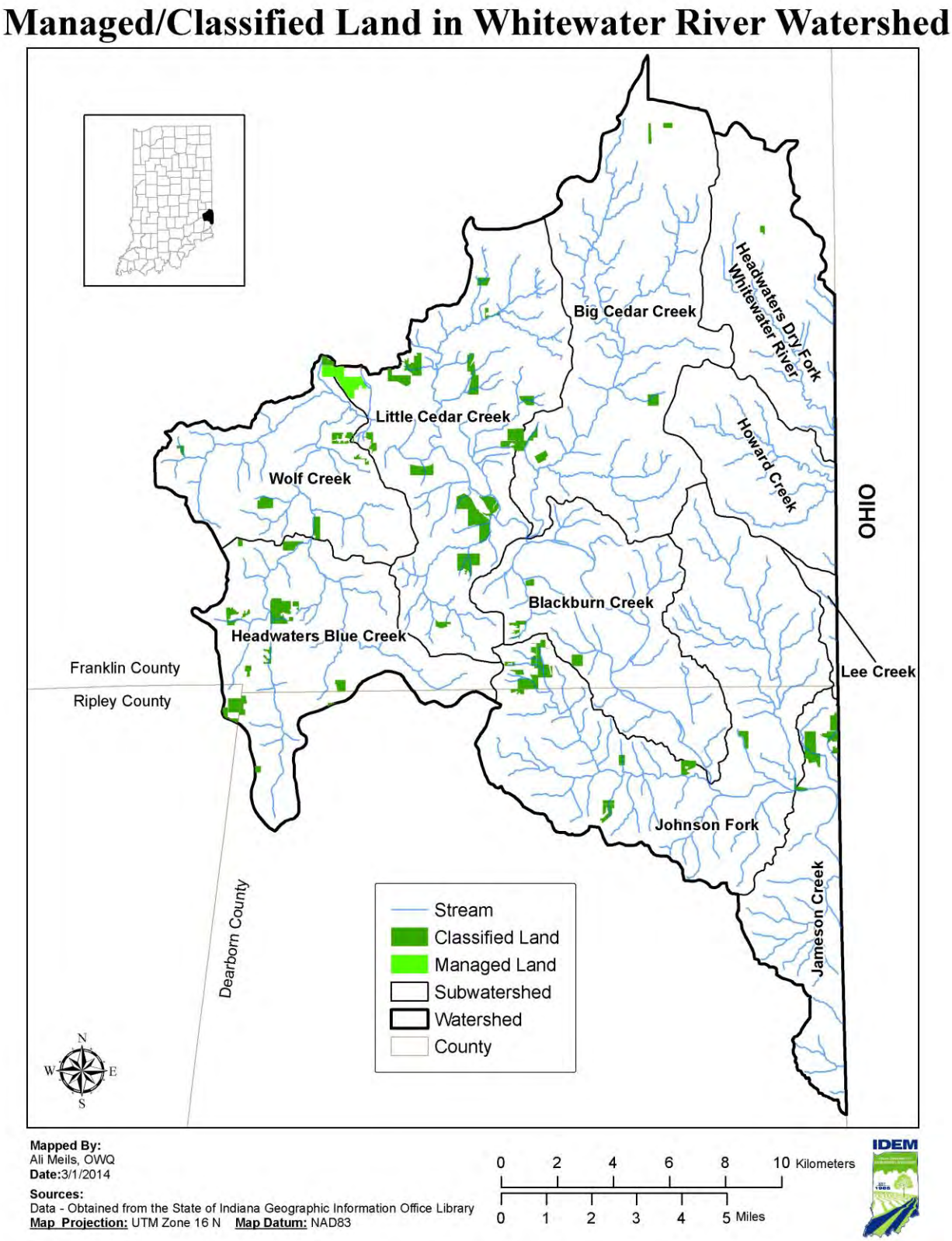


**Figure 61 Managed Lands in the Whitewater River Watershed**

# 9.0 INVENTORY AND ASSESSMENT OF WATER QUALITY INFORMATION

Below is an inventory assessment of the available biological and chemistry data for the Southern Whitewater River watershed related to *E. coli*, nutrients and sediment. Table 82 reiterates the TMDL target values presented in Section 1.0. These are the target values IDEM uses to assess water quality data collected in the Southern Whitewater River watershed.

**Table 82. Target Values Used for Development of the Southern Whitewater River Watershed TMDLs**

| Parameter | Target Value |
|---|---|
| Total nitrogen | No value should exceed 10.0 mg/L |
| Total phosphorus | No value should exceed 0.30 mg/L |
| Total Suspended Solids | No value should exceed 30.0 mg/L |
| *E. coli* | No value should exceed 125 counts/100 mL (geometric mean) |
| Dissolved Oxygen | No value should be below 4.0 mg/L |

## 9.1 Water Chemistry Data

Table 83 summarizes the water chemistry data within the Southern Whitewater River watershed by displaying the maximum concentrations at all impaired stations along with the reduction needed to meet the TMDL. Data sampled in 2013-2014 by IDEM were used for the TMDL analysis. Franklin County SWCD suggested additional data be collected for the watershed tributaries in Ohio, however IDEM could not conduct samples across state lines, so the Franklin County SWCD worked in conjunction with IDEM to monitor additional stations in the Ohio portion of the watershed.

The percent reductions were calculated as follows:

$$\%\ \text{Reduction} = \frac{(\text{Observed} - \text{Target Value or WQS})}{\text{Observed}}$$

Appendix A shows the individual sample results and summaries of all the water quality data for all 45 monitoring stations.

**Table 83. Summary of Chemistry Data in Southern Whitewater River Watershed for Nutrients and Total Suspended Solids**

| Subwatershed | Site # | Station ID | Date | Total Phosphorus Single Sample Maximum (mg/L) | % Reduction based on highest concentration | Total Suspended Solids Maximum (mg/L) | % Reduction based on highest concentration |
|---|---|---|---|---|---|---|---|
| Headwaters Salt Creek | T1 | GMW050-0023 | 4/2014 – 10/2014 | 0.122 | NA | 35 | 14.29 |
| Righthand Fork Salt Creek | T2 | GMW-05-0006 | 4/2014 – 10/2014 | 0.128 | NA | 86 | 65.12 |
| | T3 | GMW-05-0014 | 4/2014 – 10/2014 | 0.185 | NA | 14 | NA |
| | T4 | GMW-05-0011 | 4/2014 – 10/2014 | 3.945 | 92.40 | 25 | NA |
| | T6 | GMW-05-0007 | 11/2013 – 10/2014 | 0.147 | NA | 43 | 30.23 |
| | P12 | GMW-05-0003 | 5/2014 – 9/2014 | 0.094 | NA | 7 | NA |
| Bull Fork | T5 | GMW-05-0009 | 4/2014 – 10/2014 | 0.03 | NA | 21 | NA |
| | P6 | GMW-05-0002 | 5/2014 – 9/2014 | 0.025 | NA | 3 | NA |
| Little Salt Creek | T8 | GMW-05-0015 | 4/2014 – 10/2014 | 0.212 | NA | 31 | 3.23 |
| | T9 | GMW-05-0008 | 4/2014 – 10/2014 | 0.104 | NA | 51 | 41.18 |
| | P1 | GMW-05-0001 | 5/2014 – 9/2014 | 0.94 | 68.09 | 400 | 92.5 |
| Fremont Branch | T7 | GMW-05-0012 | 4/2014 – 10/2014 | 0.198 | NA | 114 | 73.68 |
| | T10 | GMW-05-0010 | 11/2013 – 10/2014 | 0.124 | NA | 30 | NA |
| Headwaters Pipe Creek | T17 | GMW-06-0014 | 4/2014 – 10/2014 | 0.343 | 12.54 | 39 | 23.07 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | T18 | GMW060-0027 | 4/2014 – 10/2014 | 0.079 | NA | 14 | NA |
| Clear Fork | T15 | GMW-06-0013 | 4/2014 – 10/2014 | 0.16 | NA | 56 | 46.43 |
| Duck Creek | T12 | GMW-06-0019 | 4/2014 – 10/2014 | 0.569 | 47.28 | 768 | 96.09 |
| Walnut Fork | T14 | GMW-06-0015 | 11/2013 – 10/2014 | 0.104 | NA | 37 | 18.92 |
| | T16 | GMW-06-0020 | 4/2014 – 10/2014 | 0.188 | NA | 29 | NA |
| | P10 | GMW-06-0006 | 5/2014 – 9/2014 | 0.025 | NA | 7 | NA |
| Yellow Bank Creek | T13 | GMW-06-0022 | 4/2014 – 10/2014 | 0.584 | 48.63 | 380 | 92.11 |
| | T19 | GMW-06-0012 | 11/2013 – 10/2014 | 0.222 | NA | 76 | 60.53 |
| | P3 | GMW-06-0002 | 5/2014 – 9/2014 | 0.26 | NA | 140 | 78.57 |
| | P4 | GMW-06-0003 | 5/2014 – 9/2014 | 0.056 | NA | 15 | NA |
| | P5 | GMW-06-0004 | 5/2014 – 9/2014 | 0.25 | NA | 140 | 78.57 |
| | P9 | GMW-06-0005 | 5/2014 – 9/2014 | 0.27 | NA | 130 | 76.92 |
| Headwaters Blue Creek | T24 | GMW-08-0022 | 4/2014 – 10/2014 | 0.099 | NA | 14 | NA |
| | P2 | GMW-08-0001 | 5/2014 – 9/2014 | 0.23 | NA | 18 | NA |
| Wolf Creek – Blue Creek | T21 | GMW-08-0026 | 4/2014 – 10/2014 | 0.05 | NA | 12 | NA |
| | T22 | GMW080-0003 | 11/2013 – 10/2014 | 0.118 | NA | 14 | NA |
| | T23 | GMW-08-0014 | 11/2013 – 10/2014 | 0.126 | NA | 99 | 69.70 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Big Cedar Creek | T26 | GMW-08-0016 | 11/2013 – 10/2014 | 0.124 | NA | 15 | NA |
| | T27 | GMW-08-0024 | 4/2014 – 10/2014 | 0.141 | NA | 11 | NA |
| Little Cedar Creek | T25 | GMW-08-0015 | 11/2013 – 10/2014 | 0.056 | NA | 41 | 26.83 |
| | P7 | GMW-08-0013 | 5/2014 – 9/2014 | 0.26 | NA | 190 | 84.21 |
| Blackburn Creek | T29 | GMW-08-0030 | 4/2014 – 10/2014 | 0.068 | NA | 28 | NA |
| Johnson Fork | T28 | GMW-08-0019 | 4/2014 – 10/2014 | 0.114 | NA | 34 | 11.76 |
| | T30 | GMW-08-0018 | 4/2014 – 10/2014 | 0.053 | NA | 4 | NA |
| | P8 | GMW-08-0003 | 5/2014 – 9/2014 | 0.06 | NA | 9 | NA |
| | P11 | GMW-08-0005 | 5/2014 – 9/2014 | 0.069 | NA | 9 | NA |
| Jameson Creek | T31 | GMW-08-0021 | 11/2013 – 10/2014 | 0.155 | NA | 48 | 37.50 |
| Headwaters Dry Fork Whitewater River | T33 | GMW-08-0020 | 4/2014 – 10/2014 | 0.159 | NA | 8 | NA |
| Howard Creek | T32 | GMW-08-0027 | 4/2014 – 10/2014 | 0.166 | NA | 11 | NA |
| *Bear Creek | T11 | GMW-04-0018 | 11/2013 – 10/2014 | 0.245 | NA | 139 | 78.42 |
| *Brookville Lake – East Fork Whitewater River | T20 | GMW-07-0026 | 11/2013 – 10/2014 | 0.087 | NA | 5 | NA |

*These sites are not within the boundaries of the watershed but the data will be used in calculating loadings

## 9.2 *E. coli* Data

Table 84 provides a summary of *E. coli* data in the Southern Whitewater River subwatersheds to show which are impaired due to pathogens. The percent reduction is based on the maximum reported *E. coli* value.

**Table 84. Summary of *E. coli* Data in Southern Whitewater River Watershed**

| Subwatershed | Site # | Station ID | Period of Record | Total Number of Samples | Percent of Samples Violating Target | Maximum MPN/100mL | Average MPN/100mL | % Reduction Based on Maximum Value |
|---|---|---|---|---|---|---|---|---|
| Headwaters Salt Creek | T1 | GMW050-0023 | 4/21/2014 – 10/20/2014 | 10 | 60 | 24196 | 5275.73 | 99.03 |
| Righthand Fork Salt Creek | T2 | GMW-05-0006 | 4/21/2014 – 10/20/2014 | 10 | 90 | 24196 | 5747.37 | 99.03 |
| | T3 | GMW-05-0014 | 4/21/2014 – 10/20/2014 | 10 | 80 | 2419.6 | 984.01 | 90.29 |
| | T4 | GMW-05-0011 | 4/21/2014 – 10/20/2014 | 10 | 70 | 2419.6 | 1013.58 | 90.29 |
| | T6 | GMW-05-0007 | 4/21/2014 – 10/20/2014 | 10 | 40 | 5475 | 922.57 | 95.71 |
| | P12 | GMW-05-0003 | 7/15/20140-08/12/2014 | 5 | 100 | 4611 | 1690.76 | 94.90 |
| Bull Fork | T5 | GMW-05-0009 | 4/21/2014 – 8/11/2014 | 10 | 30 | 2419.6 | 402.17 | 90.29 |
| | P6 | GMW-05-0002 | 7/15/20140-08/12/2014 | 5 | 40 | 344.8 | 186.04 | 31.84 |
| Little Salt Creek | T8 | GMW-05-0015 | 4/21/2014 – 10/20/2014 | 10 | 80 | 2419.6 | 846.04 | 90.29 |
| | T9 | GMW-05-0008 | 4/21/2014 – 10/20/2014 | 10 | 10 | 4352 | 483.29 | 94.60 |
| | P1 | GMW-05-0001 | 7/15/20140-08/12/2014 | 5 | 100 | 727 | 459.02 | 67.67 |

| Subwatershed | Site # | Station ID | Period of Record | Total Number of Samples | Percent of Samples Violating Target | Maximum MPN/100mL | Average MPN/100mL | % Reduction Based on Maximum Value |
|---|---|---|---|---|---|---|---|---|
| Fremont Branch | T7 | GMW-05-0012 | 4/21/2014 – 10/20/2014 | 10 | 30 | 6488 | 820.56 | 96.38 |
| | T10 | GMW-05-0010 | 4/21/2014 – 10/20/2014 | 10 | 30 | 579.4 | 209.57 | 59.44 |
| Headwaters Pipe Creek | T17 | GMW-06-0014 | 4/22/2014 – 10/21/2014 | 7 | 86 | 2419.6 | 1109.06 | 90.29 |
| | T18 | GMW060-0027 | 4/22/2014 – 10/21/2014 | 7 | 86 | 2419.6 | 1006.99 | 90.29 |
| Clear Fork | T15 | GMW-06-0013 | 4/22/2014 – 10/21/2014 | 9 | 10 | 2419.6 | 318.1 | 90.29 |
| Duck Creek | T12 | GMW-06-0019 | 4/21/2014 – 10/20/2014 | 7 | 29 | 12997 | 3767.6 | 98.19 |
| Walnut Fork | T14 | GMW-06-0015 | 4/22/2014 – 10/21/2014 | 10 | 10 | 1413.6 | 227.16 | 83.37 |
| | T16 | GMW-06-0020 | 4/22/2014 – 10/21/2014 | 10 | 40 | 2419.6 | 398.82 | 90.29 |
| | P10 | GMW-06-0006 | 7/14/20140-08/11/2014 | 5 | 20 | 4106 | 893.24 | 94.28 |
| Yellow Bank Creek | T13 | GMW-06-0022 | 4/21/2014 – 10/20/2014 | 10 | 50 | 9804 | 1423.28 | 97.60 |
| | T19 | GMW-06-0012 | 4/22/2014 – 10/21/2014 | 10 | 20 | 686.7 | 170.56 | 65.78 |
| | P3 | GMW-06-0002 | 7/14/20140-08/11/2014 | 5 | 40 | 4106 | 980.94 | 94.28 |
| | P4 | GMW-06-0003 | 7/14/20140-08/11/2014 | 5 | 80 | 17329 | 4154.56 | 98.64 |
| | P5 | GMW-06-0004 | 7/15/20140-08/12/2014 | 5 | 40 | 727 | 275.1 | 67.68 |

| Subwatershed | Site # | Station ID | Period of Record | Total Number of Samples | Percent of Samples Violating Target | Maximum MPN/100mL | Average MPN/100mL | % Reduction Based on Maximum Value |
|---|---|---|---|---|---|---|---|---|
| | P9 | GMW-06-0005 | 7/15/20140-08/12/2014 | 5 | 40 | 770.1 | 276.56 | 69.48 |
| Headwaters Blue Creek | T24 | GMW-08-0022 | 4/22/2014 – 10/21/2014 | 10 | 20 | 1732.9 | 245.09 | 86.44 |
| | P2 | GMW-08-0001 | 7/14/20140-08/11/2014 | 5 | 80 | 2419.6 | 681.92 | 90.29 |
| Wolf Creek – Blue Creek | T21 | GMW-08-0026 | 4/22/2014 – 10/21/2014 | 10 | 20 | 1119.9 | 221.23 | 79.01 |
| | T22 | GMW080-0003 | 4/22/2014 – 10/21/2014 | 10 | 30 | 2419.6 | 482.78 | 90.29 |
| | T23 | GMW-08-0014 | 4/22/2014 – 10/21/2014 | 10 | 30 | 2419.6 | 475.8 | 90.29 |
| Big Cedar Creek | T26 | GMW-08-0016 | 4/23/2014 – 10/22/2014 | 8 | 38 | 488.4 | 243.47 | 51.88 |
| | T27 | GMW-08-0024 | 4/23/2014 – 10/22/2014 | 9 | 44 | 1732.9 | 585.5 | 86.44 |
| Little Cedar Creek | T25 | GMW-08-0015 | 4/23/2014 – 10/22/2014 | 10 | 10 | 290.9 | 89.11 | 19.22 |
| | P7 | GMW-08-0013 | 7/14/20140-08/11/2014 | 5 | 40 | 4907 | 1317.92 | 95.21 |
| Blackburn Creek | T29 | GMW-08-0030 | 4/23/2014 – 10/22/2014 | 10 | 0 | 157.6 | 77.76 | NA |
| Johnson Fork | T28 | GMW-08-0019 | 4/23/2014 – 10/22/2014 | 10 | 30 | 920.8 | 194.15 | 74.48 |
| | T30 | GMW-08-0018 | 4/23/2014 – 10/22/2014 | 10 | 30 | 1299.7 | 292.64 | 81.92 |
| | P8 | GMW-08-0003 | 7/14/20140-08/11/2014 | 5 | 40 | 2419.6 | 599 | 90.29 |

| Subwatershed | Site # | Station ID | Period of Record | Total Number of Samples | Percent of Samples Violating Target | Maximum MPN/100mL | Average MPN/100mL | % Reduction Based on Maximum Value |
|---|---|---|---|---|---|---|---|---|
| | P11 | GMW-08-0005 | 7/14/20140-08/11/2014 | 5 | 40 | 770.1 | 285.04 | 69.48 |
| Jameson Creek | T31 | GMW-08-0021 | 4/23/2014 – 10/22/2014 | 10 | 0 | 143 | 75.5 | NA |
| Headwaters Dry Fork Whitewater River | T33 | GMW-08-0020 | 4/23/2014 – 10/22/2014 | 10 | 80 | 1553.1 | 629.03 | 84.87 |
| Howard Creek | T32 | GMW-08-0027 | 4/23/2014 – 10/22/2014 | 10 | 70 | 1732.9 | 667.22 | 86.44 |
| *Bear Creek | T11 | GMW-04-0018 | 4/21/2014 – 10/20/2014 | 10 | 20 | 980.4 | 232.64 | 76.03 |
| *Brookville Lake – East Fork Whitewater River | T20 | GMW-07-0026 | 4/22/2014 – 10/21/2014 | 10 | 10 | 579.4 | 81.5 | 59.44 |

## 9.3 Biological Data

Sampling performed by IDEM in between June and October 2014 documented biological impairments in the Southern Whitewater River watershed as summarized in

Table 6. Fish and macroinvertebrate community sampling took place at 43 sample sites in the Southern Whitewater River watershed. Sampling data indicate that the overall biological integrity of the Southern Whitewater River watershed was good. The explanations of each integrity class can be found in Table 4. Fourteen percent of the sample sites failed for fish community and 18 percent of the sample sites failed for macroinvertebrate community. Both communities are used in the criteria for aquatic life support.

Through the TMDL efforts, IDEM has identified several potential reasons for the widespread impairments:

- The topography of the watershed causes quick movement of water to the larger tributaries downstream. During hot and dry summer months isolated pools often form in the smaller tributaries. These isolated pools often have low dissolved oxygen, as well as, restrict the movement of aquatic life, therefore making them more susceptible to predation.
- TSS can reduce plants available for consumption by inhibiting growth of submerged aquatic plants, lower dissolved oxygen levels by reducing light penetration which impairs algal growth, impair the ability of fish to see and catch food, increase stream temperature, clog fish gills which may decrease disease resistance, slow growth rates, and prevent the development of eggs and larvae.
- Total phosphorus can cause excessive plant production resulting in increased turbidity, decrease dissolved oxygen levels, and cause greater fluctuations in diurnal dissolved oxygen and pH levels resulting in lower stream diversity.

**Table 85. Impaired Biotic Community Stream Segments in the Southern Whitewater River Watershed Identified During Biological Sampling**

| Subwatershed | Sampling Site | | Stream Name | Score | Integrity Class | QHEI | Score | Integrity Class | QHEI |
|---|---|---|---|---|---|---|---|---|---|
| | Site # | Station ID | | mIBI | mIBI | mIBI | IBI | IBI | IBI |
| Headwaters Salt Creek | T1 | GMW050-0023 | Tributary of Salt Creek | 38 | Fair | 55 | 44 | Fair | 67 |
| Righthand Fork Salt Creek | T2 | GMW-05-0006 | Salt Creek | 36 | Fair | 48 | 34 | Poor | 56 |
| | T3 | GMW-05-0014 | Righthand Fork Salt Creek | 36 | Fair | 54 | 12 | Very Poor | 59 |
| | T4 | GMW-05-0011 | Righthand Fork Salt Creek | 36 | Fair | 60 | 28 | Poor | 65 |
| | T6 | GMW-05-0007 | Salt Creek | 42 | Fair | 68 | 52 | Good | 67 |
| | P12 | GMW-05-0003 | Salt Creek | No Sample | | | No Sample | | |
| Bull Fork | T5 | GMW-05-0009 | Bull Fork | 44 | Fair | 67 | 52 | Good | 65 |
| | P6 | GMW-05-0002 | Bull Fork | 40 | Fair | 57 | 42 | Fair | 64 |
| Little Salt Creek | T8 | GMW-05-0015 | South Fork Little Salt Creek | 46 | Good | 66 | 44 | Fair | 72 |
| | T9 | GMW-05-0008 | Little Salt Creek | 42 | Fair | 61 | 38 | Fair | 60 |
| | P1 | GMW-05-0001 | Little Salt Creek | 42 | Fair | 58 | 42 | Fair | 79 |
| Fremont Branch | T7 | GMW-05-0012 | Harvey Branch | 34 | Poor | 61 | 44 | Fair | 61 |
| | T10 | GMW-05-0010 | Salt Creek | 44 | Fair | 57 | 44 | Fair | 55 |
| Headwaters Pipe Creek | T17 | GMW-06-0014 | Tributary of Pipe Creek | 36 | Fair | 61 | 36 | Fair | 66 |
| | T18 | GMW060-0027 | Pipe Creek | 38 | Fair | 49 | 38 | Fair | 50 |
| Clear Fork | T15 | GMW-06-0013 | Clear Fork | 40 | Fair | 59 | 46 | Fair | 57 |
| Duck Creek | T12 | GMW-06-0019 | Duck Creek | Dry | | | Dry | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Walnut Fork | T14 | GMW-06-0015 | Pipe Creek | 40 | Fair | 43 | 46 | Good | 58 |
| | T16 | GMW-06-0020 | Pipe Creek | 42 | Fair | 55 | 48 | Good | 66 |
| | P10 | GMW-06-0006 | Walnut Fork | 46 | Good | 51 | 40 | Fair | 55 |
| Yellow Bank Creek | T13 | GMW-06-0022 | Whitewater Canal | 36 | Fair | 24 | 16 | Very Poor | 25 |
| | T19 | GMW-06-0012 | Whitewater River | 36 | Fair | 69 | 54 | Excellent | 78 |
| | P3 | GMW-06-0002 | Whitewater River | 44 | Fair | 64 | 48 | Good | 71 |
| | P4 | GMW-06-0003 | McCartys Run | 38 | Fair | 63 | 22 | Very Poor | 67 |
| | P5 | GMW-06-0004 | Whitewater River | 42 | Fair | 70 | 54 | Excellent | 82 |
| | P9 | GMW-06-0005 | Whitewater River | 44 | Fair | 71 | 54 | Excellent | 80 |
| Headwaters Blue Creek | T24 | GMW-08-0022 | East Fork Blue Creek | 40 | Fair | 64 | 40 | Fair | 64 |
| | P2 | GMW-08-0001 | Blue Creek | 28 | Poor | 46 | 32 | Poor | 62 |
| Wolf Creek – Blue Creek | T21 | GMW-08-0026 | Wolf Creek | 36 | Fair | 62 | 38 | Fair | 64 |
| | T22 | GMW080-0003 | Blue Creek | 34 | Poor | 63 | 48 | Good | 52 |
| | T23 | GMW-08-0014 | Blue Creek | 36 | Fair | 58 | 42 | Fair | 56 |
| Big Cedar Creek | T26 | GMW-08-0016 | Big Cedar Creek | 38 | Fair | 61 | 42 | Fair | 59 |
| | T27 | GMW-08-0024 | Big Cedar Creek | 42 | Fair | 58 | 40 | Fair | 68 |
| Little Cedar Creek | T25 | GMW-08-0015 | Whitewater River | 36 | Fair | 77 | 56 | Excellent | 82 |
| | P7 | GMW-08-0013 | Whitewater River | 36 | Fair | 56 | 44 | Fair | 83 |
| Blackburn Creek | T29 | GMW-08-0030 | Whitewater River | 34 | Poor | 73 | 50 | Good | 82 |
| Johnson Fork | T28 | GMW-08-0019 | Logan Creek | 38 | Fair | 45 | 36 | Fair | 47 |
| | T30 | GMW-08-0018 | Johnson Fork | 42 | Fair | 59 | 46 | Good | 61 |
| | P8 | GMW-08-0003 | Logan Creek | 36 | Fair | 55 | 54 | Excellent | 67 |
| | P11 | GMW-08-0005 | Logan Creek | 32 | Poor | 64 | 48 | Good | 72 |
| Jameson Creek | T31 | GMW-08-0021 | Whitewater River | 34 | Poor | 65 | 54 | Excellent | 75 |
| Headwaters Dry Fork Whitewater River | T33 | GMW-08-0020 | Dry Fork Whitewater River | 28 | Poor | 50 | 48 | Good | 63 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Howard Creek | T32 | GMW-08-0027 | Sours Run | 36 | Fair | 56 | 38 | Fair | 58 |
| *Bear Creek | T11 | GMW-04-0018 | Whitewater River | 42 | Fair | 70 | 52 | Good | 70 |
| *Brookville Lake – East Fork Whitewater River | T20 | GMW-07-0026 | East Fork Whitewater River | 22 | Very Poor | 65 | 44 | Fair | 70 |

Notes: IBI = Index of Biotic Integrity. Scores were calculated using IDEM's *Summary of Protocols: Probability Based Site Assessment*. (IDEM, 2005).

# 10.0 TECHNICAL APPROACH

Previous sections of the report have provided a description of the Southern Whitewater River watershed and summarized the applicable water quality standards, water quality data, and identified the potential sources of *E. coli*, nutrients and sediment for assessment units in each subwatershed. This section presents IDEM's technical approach for using water quality sampling data and flow data for each subwatershed to estimate the current allowable loads of *E. coli*, nutrients and sediment in each subwatershed. This section focuses on describing the methodology and is helpful in understanding subsequent sections of the TMDL report.

## 10.1.1 Load Duration Curves

To determine allowable loads for the TMDL, IDEM uses a load duration curve approach. This approach helps to characterize water quality problems across flow conditions and provide a visual display that assists in determining whether loadings originate from point or nonpoint sources. Load duration curves present the frequency and magnitude of water quality violations in relation to the allowable loads, communicating the magnitude of the needed load reductions.

Developing a load duration curve is a multi-step process. To calculate the allowable loadings of a pollutant at different flow regimes, the load duration curve approach involves multiplying each flow by the TMDL target value or Water Quality Standard an appropriate conversion factor. The steps are as follows:

- A flow duration curve for the stream is developed by generating a flow frequency table and plotting the observed flows in order from highest (left portion of curve) to lowest (right portion of curve).
- The flow curve is translated into a load duration (or TMDL) curve. To accomplish this, each flow value is multiplied by the TMDL target value or Water Quality Standard with the appropriate conversion factor and the resulting points are graphed. Conversion factors are used to convert the units of the target (e.g., #/100 mL for *E. coli*) to loads (e.g., G-org/day for *E. coli* [G-org=1E+09 organisms]) with the following factors used for this TMDL:
- Flow (cfs) x TMDL Concentration Target (#/100mL) x Conversion Factor (0.024463) = Load (G-org/day)
- Flow (cfs) x TMDL Concentration Target (mg/L) x Conversion Factor (5.39) = Load (lb/day)
- To estimate existing loads, each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected and the appropriate conversion factor. Then, the existing individual loads are plotted on the TMDL graph with the curve.
- Points plotting above the curve represent violations of the applicable water quality standard or exceedances of the applicable target and the daily allowable load. Those points plotting below the curve represent compliance with standards and the daily allowable load.
- The area beneath the load duration curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions above the curve is the load that must be reduced to meet water quality standards.

The load duration curve approach can consider seasonal variation in TMDL development as required by the CWA and USEPA's implementing regulations. Because the load duration curve approach establishes

loads based on a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions.

The stream flows displayed on water quality or load duration curves may be grouped into various flow regimes to aid with interpretation of the load duration curves. The flow regimes are typically divided into the following five "hydrologic zones" (USEPA, 2007):

- Very High Flows: Flows in this represent flooding or near flooding stages of a stream. These flows are exceeded 0 – 10 percent of the time.
- Moist Zone: Flows in this range are related to wet weather conditions. These flows are exceeded 10 – 40 percent of the time.
- Mid-Range Zone: Flows in this range represent median stream flow conditions. These flows are exceeded 40 – 60 percent of the time.
- Dry Zone: Flows in this range are related to dry weather flows. These flows are exceeded 60 -90 percent of the time.
- Very Low Flows: Flows in this range are seen in drought-like conditions. These flows are exceeded 90 -100 percent of the time.

The load duration curve approach helps to identify the sources contributing to the impairment and to roughly differentiate between sources. Exceedances of the load duration curve at higher flows (0-40 percent ranges) are indicative of wet weather sources (e.g., nonpoint sources, regulated storm water discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point source sources (e.g., wastewater treatment facilities, livestock in the stream). Table 86 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from wastewater treatment plants are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur.

**Table 86. Relationship between Load Duration Curve Zones and Contributing Sources**

| Contributing Source Area | Duration Curve Zone | | | | |
|---|---|---|---|---|---|
| | Very High | Moist | Mid-Range | Dry | Very Low |
| Wastewater treatment plants | | | | M | H |
| Livestock direct access to streams | | | | M | H |
| Wildlife direct access to streams | | | | M | H |
| On-site wastewater systems/Unsewered Areas | M | M-H | H | H | H |
| Riparian areas | | H | H | M | |
| Storm water: Impervious | | H | H | H | |
| Storm water: Upland | H | H | M | | |
| Field drainage: Natural condition | H | M | | | |
| Field drainage: Tile system | H | H | M-H | L-M | |
| Bank erosion | H | M | | | |

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)

### 10.1.2 Stream Flow Estimates

Daily stream flows are necessary to implement the load duration curve approach. Load duration assessment locations in the Southern Whitewater River watershed were chosen based on the location of the impaired stream segments and the availability of water quality samples to estimate existing loads.

The USGS gage, used for the development of the load duration curves, is located upstream of the Southern Whitewater River watershed boundary near Alpine, Indiana (USGS gage ID: 03275000). There is one additional gage located on East Fork Whitewater River in Brookville, Indiana however those flows are often influenced by water released from Brookville Reservoir. The USGS gage (03275000) is located on the mainstem Whitewater River in Fayette County.

Since the load duration approach requires a stream flow time series for each site included in the analysis, stream flows were extrapolated from USGS gage (03275000) for each assessment location by using a multiplier based upon the ratio of the upstream drainage area for a given location to the drainage area of the Southern Whitewater River watershed.

Flows were estimated using the following equation:

$$Q_{ungaged} = \frac{A_{ungaged}}{A_{gaged}} \times Q_{gaged}$$

Where,

| | |
|---|---|
| $Q_{ungaged}$: | Flow at the ungaged location |
| $Q_{gaged}$: | Flow at surrogate USGS gage station |
| $A_{ungaged}$: | Drainage area of the ungaged location |
| $A_{gaged}$: | Drainage area of the gaged location |

In this procedure, the drainage area of each of the load duration stations was divided by the drainage area of the surrogate USGS gage. The flows for each of the stations were then calculated by multiplying the flows at the surrogate gage by the drainage area ratios. Additional flows were added to certain locations to account for permitted activities, such as wastewater treatment plants and CSOs that discharge upstream and are not directly accounted for using the drainage area weighting method.

# 11.0 LINKAGE ANALYSIS

A linkage analysis connects the observed water quality impairment to what has caused that impairment. An essential component of developing a TMDL is establishing a relationship between the source loadings and the resulting water quality. Potential point and nonpoint sources are inventoried in previous sections and water quality data within the Southern Whitewater River watershed have been discussed. The purpose of this section of the report is to evaluate which of the various potential sources is most likely to be contributing to the observed water quality impairments.

Load duration curves were created for the sampling sites in the Southern Whitewater River watershed that were sampled by IDEM in 2013-2014. The load duration curve method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint). Section 10.1.1 summarizes the load duration curve approach. This section discusses the load duration curves and the linkage between the potential sources in the Southern Whitewater River watershed and the observed water quality impairment.

## 11.1 Linkage Analysis for *E. coli*

Establishing a linkage analysis for *E. coli* is challenging because there are so many potential sources and *E. coli* counts have a high degree of variability. While it is difficult to perform a site-specific assessment of the causes of high *E. coli* for each location in a watershed, it is reasonable to expect that general patterns and trends can be used to provide some perspective on the most significant sources.

To further investigate sources, *E. coli*/precipitation graphs have been created. Elevated levels of *E. coli* during rain events indicate *E. coli* contribution due to runoff. The precipitation data was taken from a weather station in Brookville, Indiana and managed by the Midwestern Regional Climate Center.

*E. coli* sources typically associated with high flow and moist conditions include failing onsite wastewater systems, urban storm water, runoff from agricultural areas, and bacterial re-suspension from the streambed. *E. coli* sources typically associated with low flow conditions include a large number of homes on failing or illicitly connected septic systems that would provide a constant source. Elevated *E. coli* levels at low flow could also result from inadequate disinfection at wastewater treatment plants or animals with direct access to streams.

## 11.2 Linkage Analysis for Nutrients

Nutrients come in many forms, including nitrogen, phosphorus, ammonia, total Kjeldahl nitrogen (TKN), nitrite and nitrate. Information presented in the water quality assessment describes nutrient conditions in the Southern Whitewater River watershed.

Total phosphorus concentrations are naturally low in surface waters, but high in rivers and streams located in agricultural and urban areas, or that receive wastewater discharges. High phosphorus levels in streams increase the growth of plants and algae, reducing the quality of the habitat and causing low oxygen levels at night when the plants and algae are respiring but not photosynthesizing.

The load duration curve indicates that the TMDL target is exceeded under dry flow conditions. This suggests that nonpoint sources as well as point sources may be contributing to the impairment. Nonpoint sources might include sediment-bound phosphorus that enters the river during erosional processes, as well as the runoff of storms over fertilized fields and residential areas. Septic systems might also be a potential source of phosphorus if the systems are failing and located adjacent to the streams.

## 11.3 Linkage Analysis for Sediment

Developing a linkage analysis to address the connection between siltation and its effect on aquatic life uses often involves an evaluation of multiple factors. The interaction between erosion processes and hydrology is an important part of the assessment, with land use, riparian areas, and channel conditions being key considerations. Each can play a potential role in both creating and solving sediment problems. A stream becomes impaired by sediment when its capacity to handle sediment loads is exceeded. The sediment issues can occur when external inputs (e.g., sediment, runoff volume) to the stream become excessive, or when stream characteristics are altered so that it can no longer assimilate the loads, or a combination of both occur.

Sheet erosion is the detachment of soil particles by raindrop impact and their removal by water flowing overland as a sheet instead of in channels or rills. Rill erosion refers to the development of small, ephemeral concentrated flow paths, which function as both sediment source and sediment delivery systems for erosion on hillslopes. Sheet and rill erosion occurs more frequently in areas that lack or have sparse vegetation.

Bank and channel erosion refers to the wearing away of the banks of a stream or river. High rates of bank and channel erosion can often be associated with water flow and sediment dynamics being out of balance. This may result from land use activities that either alter flow regimes, adversely affect the floodplain and streamside riparian areas, or a combination of both. Hydrology is a major driver for both sheet/rill and stream channel erosion. Bank and channel erosion is made worse when streams are straightened or channelized because channelization shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation. Modified stream channels often have little habitat structure and variability necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often converted to developed or agricultural lands.

Since monitoring began in November 2013, TSS in the Southern Whitewater River watershed has sporadically exceeded the target. No long-term trend is apparent, with TSS greatest during or after rainfall events. Further analysis pairing the TSS concentrations with flow conditions reveals elevated TSS concentrations during high flows and lower concentrations during mid-range and lower flow conditions. Elevated TSS concentrations during high flows are consistent with significant loads coming from stream bank and channel erosion. Based on the high gradient and steep topography in the watershed a portion of the sediment load is likely a natural condition. The high loads in the spring may also be related to the plowing and planting of agricultural fields occurs during these months, increasing the opportunity for sheet and rill erosion.
The following sections discuss the load duration curves, precipitation graphs and linkage of sources to the water quality exceedances for each subwatershed.

### 11.3.1 Headwaters Salt Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Headwaters Salt Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 87 provides a summary of the Headwaters Salt Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli,* nutrient, and TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli,* nutrient, and TSS concentrations.

**Table 87. Summary of Headwaters Salt Creek Subwatershed Characteristics**

| ***Headwaters of Salt Creek (050800030501)*** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 17.32 | | | | | |
| **TMDL Sample Sites:** GMW050-0023 (T1), GMW-05-0006 (T2), | | | | | |
| **Listed Segments:** ING0351_01, ING0351_T1001, ING0351_T1002, ING0351_T1003 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **395.8** | **129.36** | **57.93** | **26.60** | **12.20** |
| ***Wasteload Allocation (WLA): Total*** | N/A | N/A | N/A | N/A | N/A |
| ***Load Allocation (LA)*** | 357.17 | 116.74 | 52.23 | 23.97 | 10.99 |
| ***Margin Of Safety (MOS) (5%)*** | 19.8 | 6.47 | 2.90 | 1.33 | 0.61 |
| ***Future Growth (5%)*** | 18.8 | 6.1 | 2.8 | 1.3 | 0.6 |
| | | | | | |

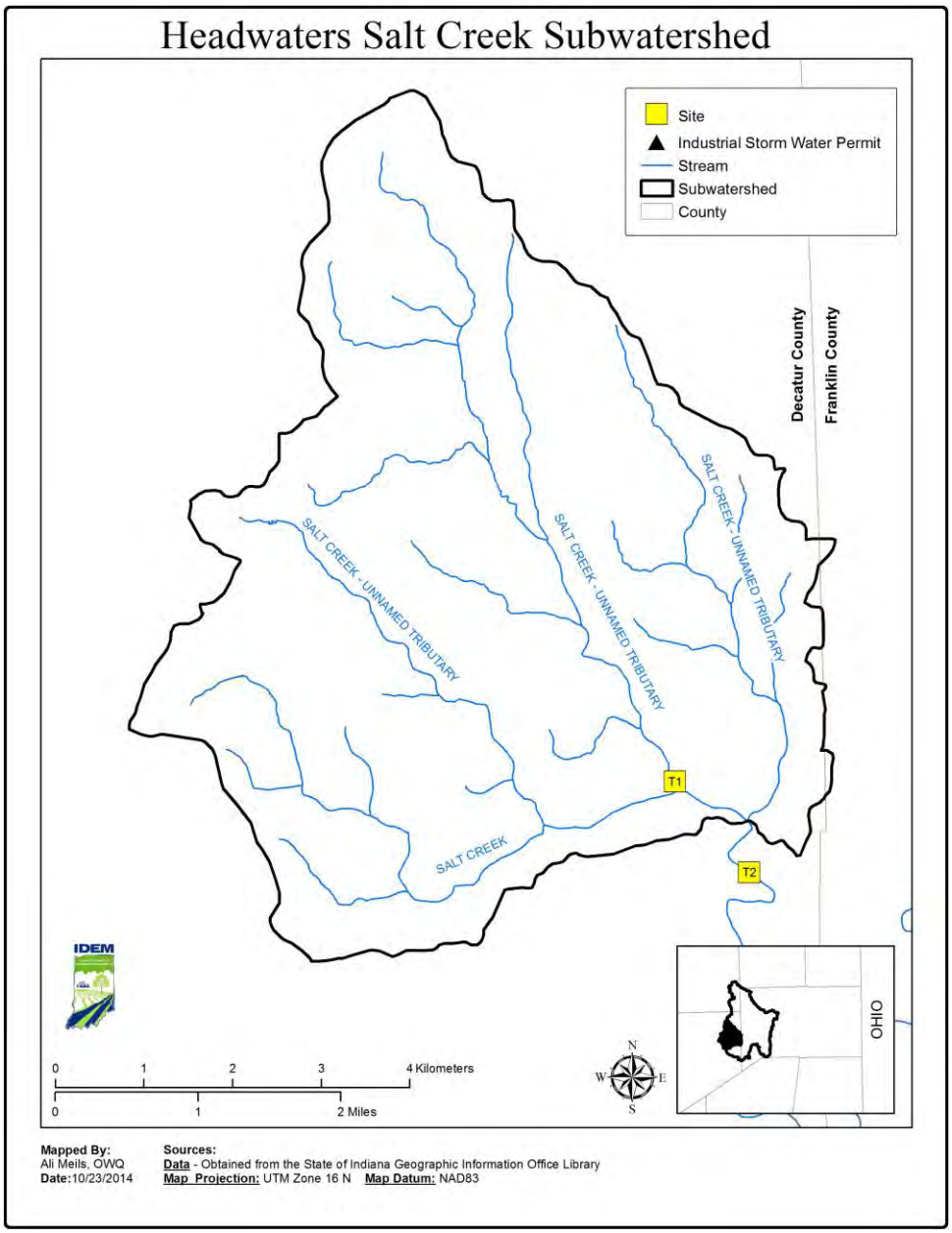


Figure 62. Sampling Stations in Headwaters Salt Creek Subwatershed

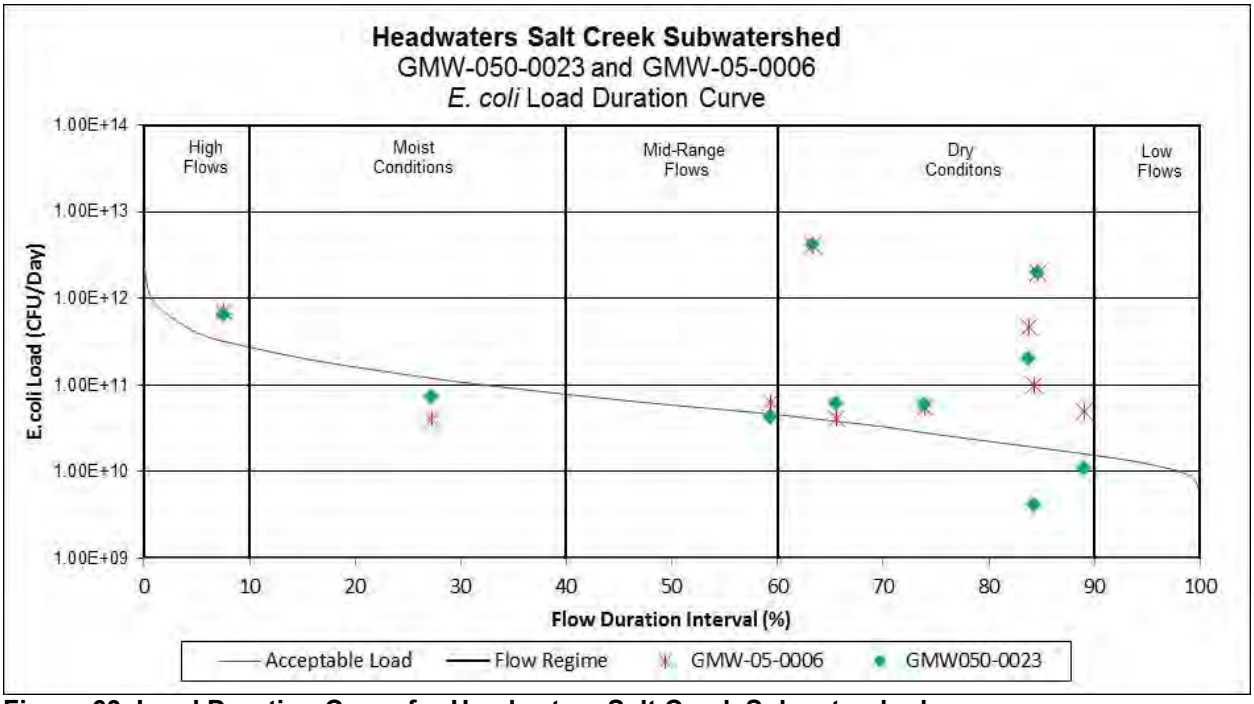


**Figure 63. Load Duration Curve for Headwaters Salt Creek Subwatershed**

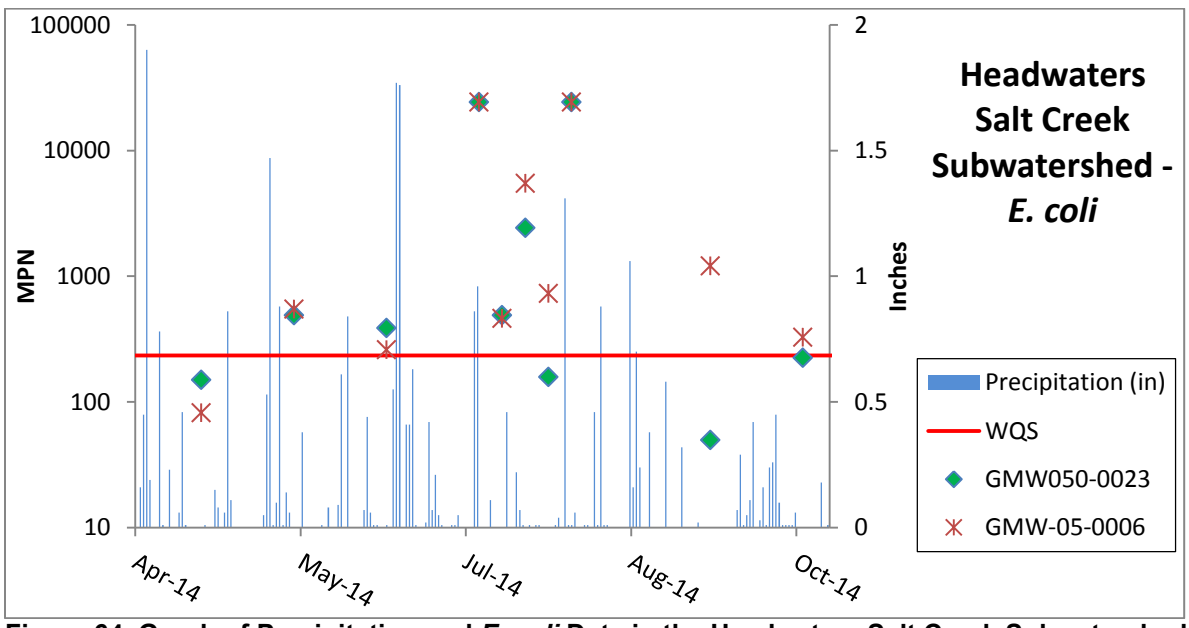


**Figure 64. Graph of Precipitation and *E. coli* Data in the Headwaters Salt Creek Subwatershed**

The Headwaters of Salt Creek drain approximately 17 square miles. The landuse is primarily agriculture (47%) followed by forested land (31%) and hay and pasture land (16%). Since there is little to no development in this subwatershed all homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types make up a good portion of this subwatershed. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There is a large area

in the north central part of the subwatershed as well as speckled areas in the extreme headwaters identified as having hydric soil types. These areas could be potential areas for wetland restoration. While there are no permitted NPDES facilities in the subwatershed there are five confined feeding operations, as well as, numerous smaller animal farms. The total number of animal units in this area (223 animals/square mile) more than doubles what was calculated for the other subwatersheds. There are approximately 34 miles of stream in the subwatershed. According to the Draft 2012 List of Impaired Waters there are no impaired stream segments in the subwatershed. There had also been no historical samples collected in the subwatershed. Based on IDEM data collected in 2009, 2013 and 2014 there will be 14 stream miles impaired for *E. coli* in the subwatershed.

In September and October of 2009 IDEM collected data from a site (GMW050-0024) along the mainstem of Salt Creek at CR 850 East. *E. coli* and hydrolab chemistry readings were sampled once per week for five weeks at this site. The *E. coli* geometric mean at this site was 1,100.38 MPN/100mL which is significantly higher than the Indiana water quality standard of (125 MPN/100mL). The riparian area around the stream is well buffered with forested land. The steep slopes, agricultural lands in the headwaters and leaky septic systems in limited use soils may be contributing to these high levels of *E.coli*.

There was an additional site (GMW050-0023) sampled in 2009 for *E. coli*. This site is located on a tributary to Salt Creek at CR 150 North, and was resampled as part of the watershed characterization study in 2013 and 2014. In figure 61 it is site T1. In 2009, the *E. coli* geometric mean was 210.78 MPN/100mL which is slightly above the Indiana water quality standard. In 2014 *E. coli* was sampled ten times between April and October. The geometric mean, calculated with the samples collected in July and August, was 2,555.72 MPN/mL which is significantly higher than the WQS. Load duration curves and precipitation graphs are presented in Appendix B. The curve for this site shows *E. coli* exceedances during extremely high flows and during dry conditions. The highest concentrations can be attributed to rainfall events but high levels of *E. coli* remained constant from May through August. The precipitation graph for this site shows the stream is susceptible to high loads of *E. coli* from run-off. There are also three hog farms located in the headwaters of this tributary surrounded by agricultural fields. The overuse of manure application to agricultural fields or the mishandling of animal waste could also contribute to high levels of bacteria in the stream. Failing septic systems and runoff from smaller animal operations could be another potential source of *E. coli*.

In 2013 and 2014 water chemistry, fish and aquatic insects were also collected at this site. There were no significant water chemistry violations. From April through June the total nitrogen levels were high but not in exceedance of the WQS (10 mg/L). Total suspended solids were above the TMDL target of 30 mg/L in July which can impact biological communities but this was the only exceedance throughout the year. The fish community IBI score was 44 which is considered fair and the habitat score was 67 which is considered good. The macroinvertebrate community IBI score was 38 which is considered fair and the habitat score was 55 which is considered good.

Site GMW-05-0006 which is site T2 on Figure 61 is not within the Headwaters of Salt Creek watershed boundary but it represents the pour point the subwatershed. The site is located on Salt Creek at CR 50 North. This site was sampled in 2013 and 2014 for *E. coli*, water chemistry, and biological communities. The *E. coli* geometric mean was collected in July and August of 2014 and was significantly higher than the WQS. The results calculated showed a geometric mean of 4,038.69 MPN/100mL. Based on the load duration curve, samples were consistently high across different flow regimes and exceeded the single sample maximum of 235 MPN/100mL nine out of ten times. The total nitrogen was never in exceedance of a WQS but it was relatively high during the months of May and June. Total suspended solids were also above the TMDL target during the July and August sampling event. The fish community IBI score was 34 which is considered poor and the habitat score was 56 which is considered fair. The

macroinvertebrate community IBI score was 36 which is considered fair and the habitat score was 48 which is considered fair. Based on the IBI scores this stream segment is considered impaired for biological communities. During a sampling event in April cows were observed having access downstream of the bridge and a manure odor was observed. Excessive algae growing on rocks in stream was also observed during a site visit which can be caused by excessive nutrient loading. The data also shows dissolved oxygen swings from month to month. In the Spring samples were reading 11-15 mg/L then fell to 5-6 mg/L the following two months and read unusually high again in July. During the July sampling events the fish crew recorded a DO of 5 mg/L and within an hour the water chemistry crew recorded a DO of 15 mg/L. After further investigation all equipment had been calibrated that day making the difference in results valid. After discussions with sampling crews is seems one crew sampled from the bridge in the sun, while the other crew sampled further upstream in the shade. The DO readings on the same day, coupled with the fact that excessive algae was present at this site, supports extreme DO swings. While our sampling was not designed to capture dissolved oxygen swings they are definitely occurring, which supports excessive nutrient loading signatures. Nitrogen and total phosphorus results were not above the water quality target, however these parameters are often linked to excessive algae growth. Excessive algae growth then causes DO swings, which impacts the biological communities that are able to inhabit the streams. Low dissolved oxygen puts stress on biological communities and could be a contributing factor in the biological impairment located at this site.

Half of the watershed is agriculture and there are five large confined feeding operations contributing to this stream. The highest levels of *E. coli* in the subwatershed occurred after rainfall events therefore, the stream is susceptible to high loads of *E. coli* from run-off. Since the results seem dependent on precipitation events non-point sources are the most likely source of the highest values. However, high levels of *E. coli* were consistent throughout the year which indicates point sources in addition to any runoff. Cattle having access to the stream is a direct source of *E. coli* and nutrients and destroys the instream habitat utilized by the biological communities. Total suspended solids were higher than the WQ target following rainfall events which indicates sediment loadings are primarily nonpoint source driven. The high percentage of agricultural lands in the subwatershed and the location of animal operations near streams can contribute to sediment loss through rainfall events. Narrow riparian buffers surrounding the stream can also lead to additional loading of sediment, nutrients and *E. coli* during rainfall events.

### 11.3.2 Righthand Fork Salt Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Righthand Fork Salt Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 88 provides a summary of the Righthand Fork Salt Creek subwatershed, including segment AUIDs assigned a TMDL, drainage area, sampling sites, NPDES facilities, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli,* total nitrogen and total phosphorus. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and nutrient concentrations.

**Table 88. Summary of Righthand Fork Salt Creek Subwatershed Characteristics**

| **Righthand Fork Salt Creek (050800030502)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 45.76 | | | | | |
| **TMDL Sample Sites:** GMW-05-0014 (T3), GMW-05-0011 (T4), GMW-05-0007 (T6), GMW-05-0003 (P12) | | | | | |
| **Listed Segments:** ING0352_01, ING0352_T1001, ING0352_T1002, ING0352_T1003, ING0352_T1004, ING0352_T1005, ING0352_T1006 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **650.7** | **213.30** | **96.01** | **44.57** | **20.93** |
| ***Wasteload Allocation (WLA): Total*** | **0.89** | **0.89** | **0.89** | **0.89** | **0.89** |
| **Lake Santee Regional Waste and Water District WWTP (IN0060704) 0.1 MGD** | **0.89** | **0.89** | **0.89** | **0.89** | **0.89** |
| ***Load Allocation (LA)*** | **586.40** | **191.61** | **85.72** | **39.36** | **17.99** |
| ***Margin Of Safety (MOS) (5%)*** | **32.5** | **10.7** | **4.8** | **2.2** | **1.0** |
| ***Future Growth (5%)*** | **30.9** | **10.1** | **4.6** | **2.1** | **1.0** |
| | | | | | |
| **Drainage Area (sq. mi.):** 5.482 | | | | | |
| **TMDL Sample Sites:** GMW-05-0011 (T4) | | | | | |
| **Listed Segments:** ING0352_T1006 | | | | | |
| **Flow Regime TMDL analysis for Total Phosphorus (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Total Phosphorus TMDL (pounds/day)** | **35.5** | **11.76** | **5.41** | **2.62** | **1.34** |
| ***Wasteload Allocation (WLA): Total*** | **0.25** | **0.25** | **0.25** | **0.25** | **0.25** |
| **Lake Santee Regional Waste and Water District WWTP (IN0060704) 0.1 MGD** | **0.25** | **0.25** | **0.25** | **0.25** | **0.25** |
| ***Load Allocation (LA)*** | **31.77** | **10.37** | **4.73** | **2.12** | **0.96** |
| ***Margin Of Safety (MOS) (5%)*** | **1.80** | **0.59** | **0.27** | **0.13** | **0.07** |
| ***Future Growth (5%)*** | **1.68** | **0.56** | **0.26** | **0.12** | **0.06** |
| | | | | | |

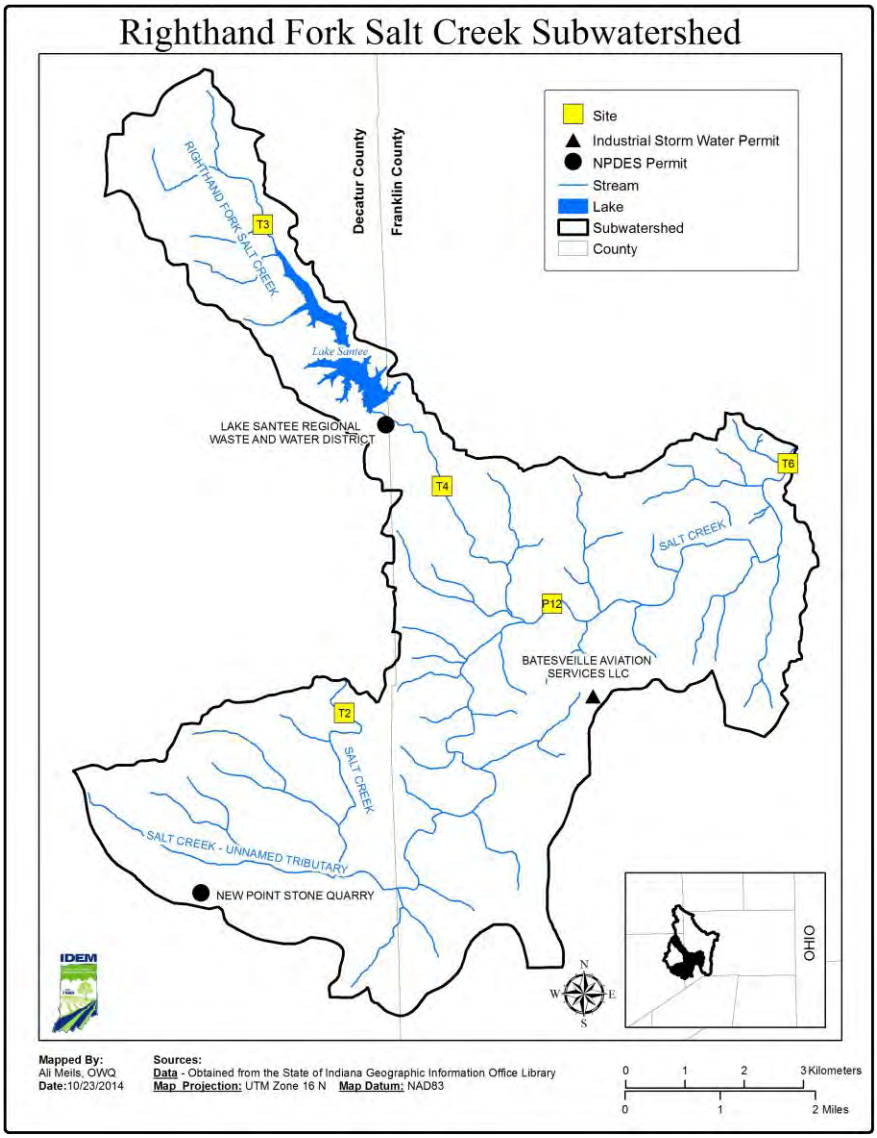


**Figure 65. Sampling Stations in Righthand Fork Salt Creek Subwatershed**

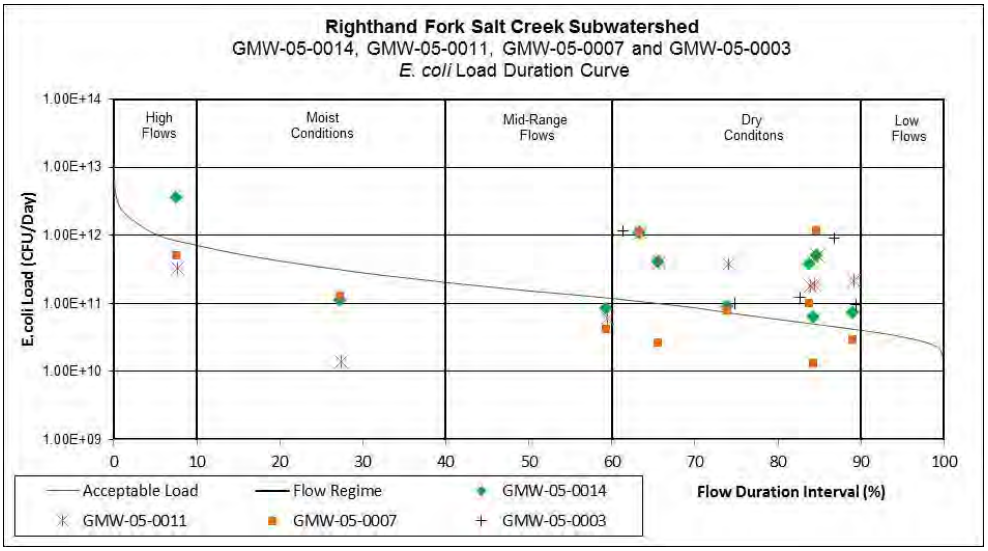


**Figure 66. Load Duration Curve for *E. coli* in the Righthand Fork Salt Creek**

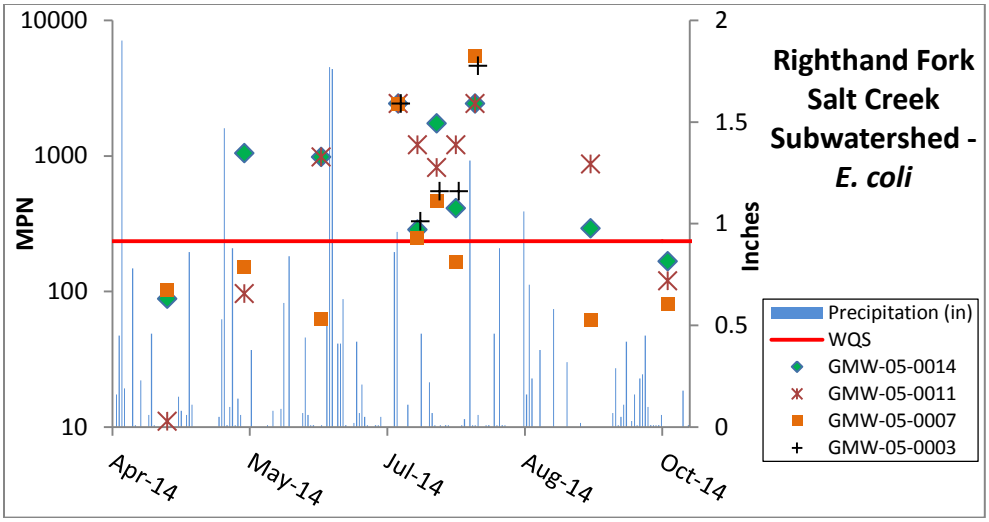


**Figure 67. Graph of Precipitation and *E. coli* Data in the Righthand Fork Salt Creek Subwatershed**

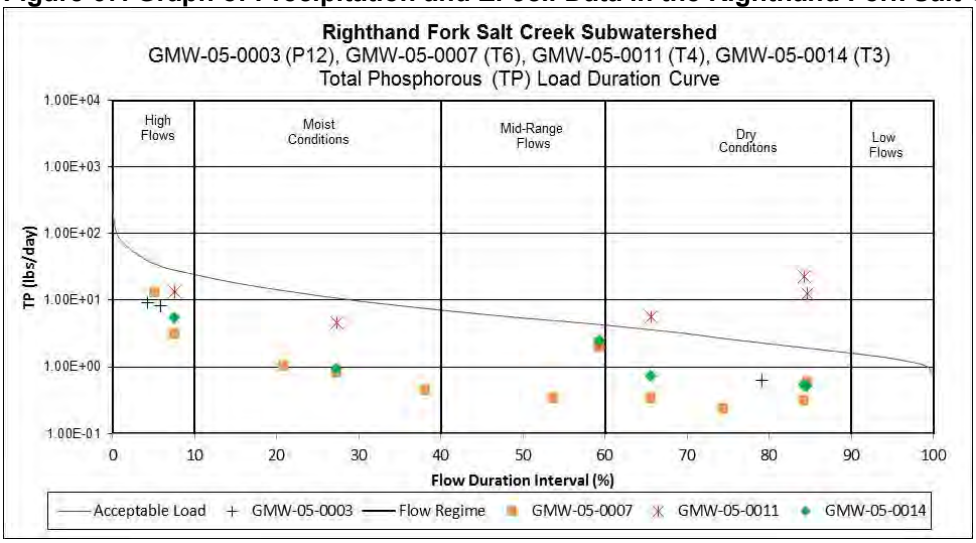

**Figure 68. Load Duration Curve for Total Phosphorus in the Righthand Fork Salt Creek**

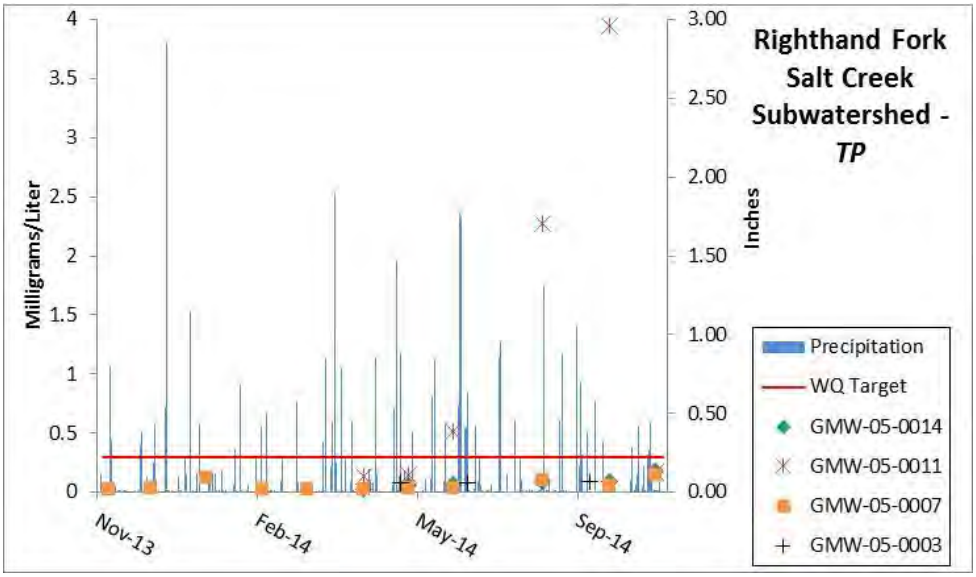


**Figure 69. Graph of Precipitation and Total Phosphorus Data in the Righthand Fork Salt Creek Subwatershed**

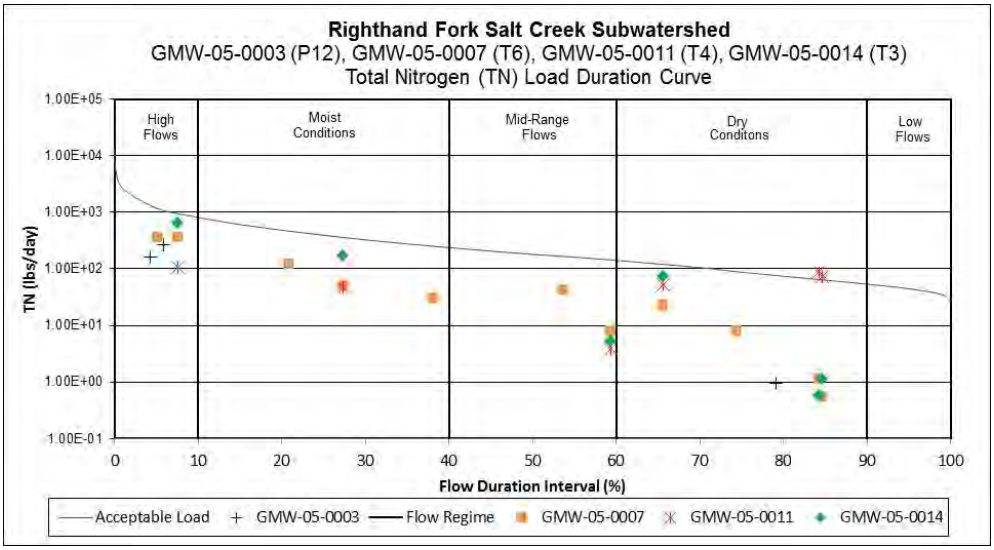


**Figure 70. Load Duration Curve for Total Nitrogen in the Righthand Fork Salt Creek**

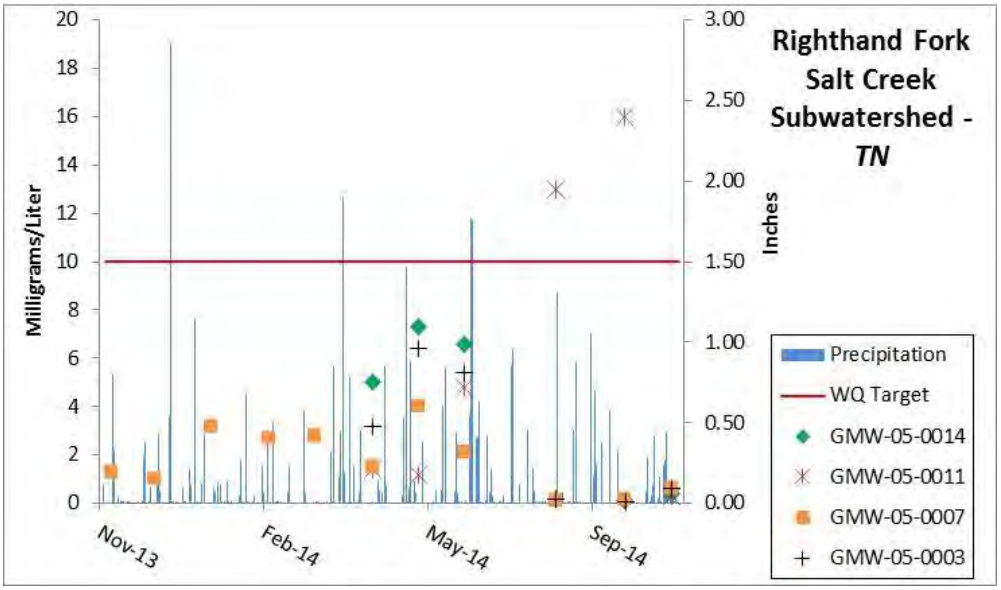


**Figure 71. Graph of Precipitation and Total Nitrogen Data in the Righthand Fork Salt Creek Subwatershed**

The Righthand Fork Salt Creek subwatershed drains approximately 46 square miles. The Headwaters Salt Creek subwatershed drains into the southern portion of this watershed. There is also the major tributary Righthand Fork Salt Creek that drains into the mainstem in this subwatershed. Righthand Fork Salt Creek has been impounded at the upper end to form Lake Santee which is a drinking water source for the surrounding area. The land use is primarily agriculture (28%) followed by forested land (48%) and hay and pasture land (15%). There are houses surrounding Lake Santee which are sewered to the Lake Santee WWTP. The remaining parts of the subwatershed are primarily rural and those homes pump to on-site septic systems. The Towns of Hamburg and Enochsburg are populated areas within the drainage with septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types make up a small portion of this subwatershed. The majority of the HEL lands are located upstream of Lake Santee, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are small patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. In addition to the Lake Santee WWTP, the New Point Stone Quarry is another NPDES permitted facility in the subwatershed. The Batesville Aviation Services LLC is a small airport with a storm water permit in the subwatershed. There are two confined feeding operations, as well as, numerous smaller animal farms. The total number of animal units in this area (94 animals/square mile) which is the second highest concentration when compared to other subwatersheds in Salt Creek. There are approximately 61 miles of stream in the subwatershed. According to the Draft 2012 List of Impaired Waters, the mainstem Salt Creek is impaired for E. coli and DO based on a sampling site in 2007. In 2009, the LARE diagnostic study results for this subwatershed indicated a nutrient problem based on TP results greater than 0.3 mg/L. Based on IDEM data collected in 2013 and 2014 there will be 49 stream miles impaired for *E. coli*, 35 stream miles impaired for nutrients and 39 stream miles with impaired biological communities listed on the 2016 List of Impaired Waters.

Site GMW-05-0006 which is site T2 is within the Righthand Fork Salt Creek subwatershed boundary, however it represents the pour point the Headwaters Salt Creek subwatershed. Based on the results of this

site we know there are high *E. coli* levels (geometric mean > 4,000 MPN) and nutrients loadings to support nuisance algae mats entering the watershed along Salt Creek. See the site discussion in Section 11.3.1. There is another site along Salt Creek located downstream of the confluence with Righthand Fork Salt Creek, GMW-05-0003 (P12), which was sampled as part of the IDEM probabilistic program. The geometric mean from this site was 1018.8 MPN which remains above the Indiana water quality standard. The fish and macroinvertebrate communities were not sampled at this site. The third site along Salt Creek is GMW-05-0007 (T6), and is the pour point of the watershed. The *E. coli* geometric mean at this site was 758.62 MPN/100mL which is significantly higher than the Indiana water quality standard of (125 MPN/100mL). White the *E. coli* levels are still in violation of the Indiana WQS, there is dilution occurring in a downstream direction. The *E. coli* geometric mean was > 4,000 MPN entering the subwatershed and is ~750 MPN exiting the subwatershed. The fish community IBI score was 52 which is considered good and the habitat score was 67 which is considered good. The macroinvertebrate community mIBI score was 42 which is considered fair and the habitat score was 68 which is considered good. Based on the IBI scores from site T2 (upstream site) this stream segment is considered impaired for biological communities, however based on biological results from site T6 (downstream site) the communities have recovered. The riparian area around the stream transitions in a downstream direction to a more forested buffer. The steep slopes, agricultural lands in the headwaters, land application of animal manure and leaky septic systems in limited use soils may be contributing to high levels of *E.coli*.
There were three sites located on the mainstem Salt Creek in this subwatershed, which was previously impaired for dissolved oxygen. No data results collected in 2013 or 2014 indicate a DO impairment exists based on IDEM WQS of 4 mg/L. Although dissolved oxygen swings and excessive algae were observed during sampling, there were no violations of the WQS. Based on this information the mainstem Salt Creek in this subwatershed will be delisted for DO on the 2016 List of Impaired Waters.

Righthand Fork Salt Creek is one of the major tributaries in this watershed and in 2013 and 2014 water chemistry, fish and aquatic insects were also collected at two sites along this stream. Site GMW-05-0014 (T3) is located upstream of Lake Santee. This is a small headwater tributary and the field notes indicate there is little flow or isolated pools during dry summer months. The *E. coli* geometric mean was 1034.99 MPN and was in violation of the single sample maximum 8/10 times. The fish community IBI score was 12 which is considered very poor and the habitat score was 59 which is considered good. The macroinvertebrate community mIBI score was 36 which is considered fair and the habitat score was 54 which is considered fair. Based on these results this stream is considered impaired for biological communities. There were no significant water chemistry violations, however total nitrogen was elevated from April through June, although not in exceedance of the WQS (10 mg/L). This same site was sampled as part of the 2009 LARE diagnostic study and results indicated high levels of both TP and nitrogen during high flow events. Nutrients were identified as being a management priority for this stream segment based on the LARE study. There is one CFO located in the drainage of this stream and several others in the surrounding watershed which indicate land application could be a potential source. There is very little riparian buffer along the stream leading to higher pollutant loadings during rain events. The Town of Clarksburg is also along this stream which is a populated area where septic's may be an issue. *E.coli* sampling results were consistently high during low flow events indicating there are possible point sources or failing septic systems entering the stream.

An additional site, GMW-05-0011 (T4), was located downstream of Lake Santee and the Lake Santee WWTP outfall. The *E. coli* geometric mean was 1472.41 MPN with 7/10 samples failing the single sample maximum. There are often low levels of *E. coli* downstream of lakes however these results indicate otherwise. The Lake Santee WWTP does have a land application permit and if those fields are in close proximity to the stream that could be contributing to the high levels of *E. coli*. The fish community IBI score was 28 which is considered poor and the habitat score was 65 which is considered good. The macroinvertebrate community mIBI score was 36 which is considered fair and the habitat score was 60 which is considered good. Based on these results this stream is considered impaired for biological

communities. The habitat scores indicate the stream could support a healthy biological community which implies there may be a chemical stressor causing the fish community impairment. Water chemistry collected at this site in August and September had high nutrient levels (TN = 13, 16 mg/L and TP = 2.278, 3.945 mg/L). These results are in exceedance of the Indiana WQ targets. There were high nutrient values upstream of the lake which could lead to high nutrient levels in the lake. Lake dischargers are often more nutrient rich than natural streams which could be contributing to high nutrient levels. There is also a possibility that the Lake Santee WWTP is discharging high levels of TP and TN. The results indicate the exceedances occur during low flow when the discharge makes up a higher percentage of the stream. These higher levels of nutrients are likely discharged year round but are diluted by the natural stream flow during normal to high flow regimes. Nutrients are not regulated in the NPDES permit unless the facility is considered a major discharger (>1.0 MGD), therefore the facility is not in violation of the parameters currently regulated. The treatment processes used in some WWTPs converts ammonia to nitrate and then to nitrite. This is the reason elevated levels of nitrate-nitrite are sometimes found downstream of dischargers. If the WWTP is contributing to the high nutrient levels, the NPDES permit program addresses facilities discharging to impaired streams during the permit renewal process. At that time the permit limits may be revised to incorporate nutrient limits. The stream is surrounded by mixed forest and agricultural land uses. A number of CFO farms are located within a 5 mile radius which makes land application a potential source for bacteria and nutrient loads.

### 11.3.3 Bull Fork Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Bull Fork subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 89 provides a summary of the Bull Fork subwatershed, including segment AUIDs, drainage area, sampling sites, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 89. Summary of Bull Fork Subwatershed Characteristics**

| **Bull Fork (050800030503)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 21.56 | | | | | |
| **TMDL Sample Sites:** GMW-05-0009 (T5), GMW-05-0002 (P6) | | | | | |
| **Listed Segments:** ING0353_01, ING0353_02, ING0353_T1001, ING0353_T1002, ING0353_T1003, ING0353_T1004, ING0353_T1005, ING0353_T1007 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 – 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **492.60** | **161.02** | **72.11** | **33.12** | **15.19** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **444.61** | **145.32** | **65.10** | **29.86** | **13.73** |
| ***Margin Of Safety (MOS) (5%)*** | **24.6** | **8.05** | **3.61** | **1.66** | **0.76** |
| ***Future Growth (5%)*** | **23.4** | **7.6** | **3.4** | **1.6** | **0.7** |
| | | | | | |

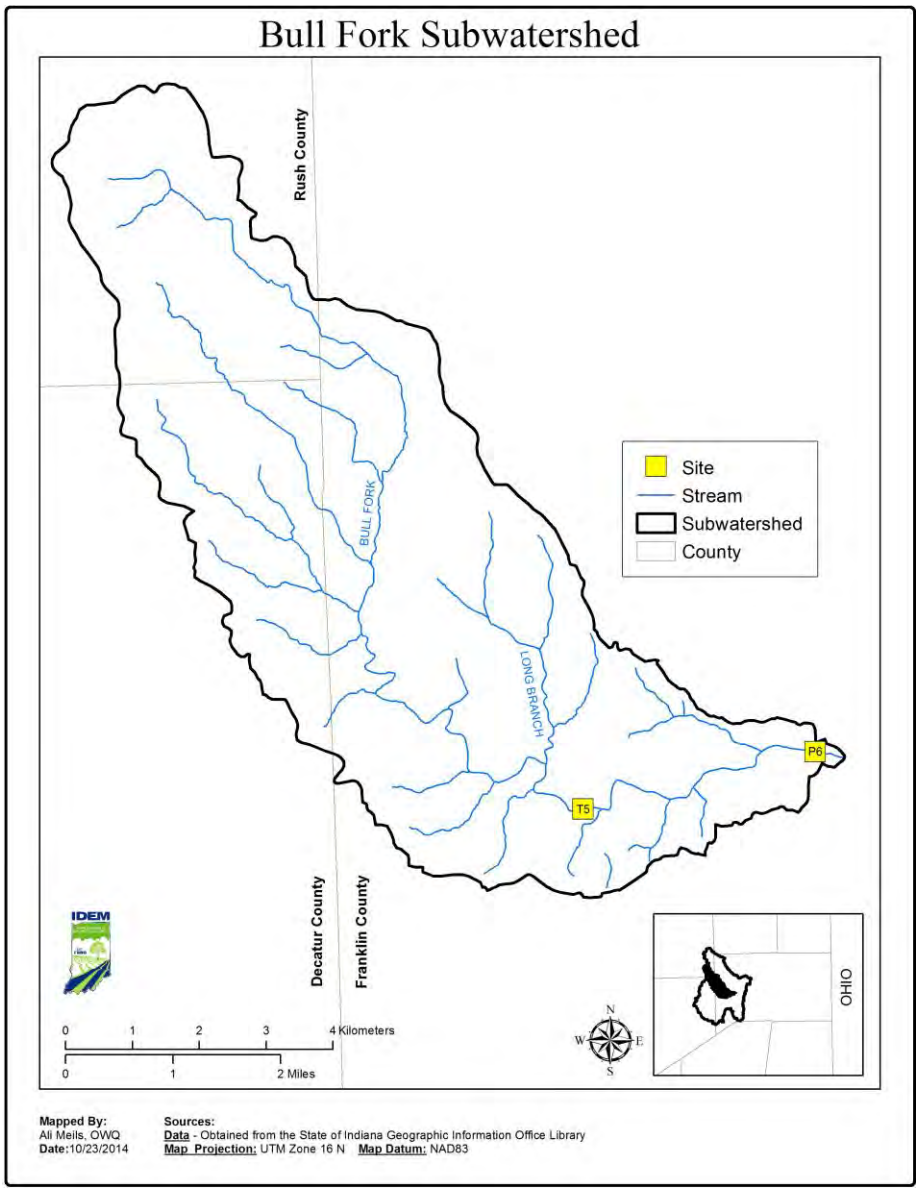


**Figure 72. Sampling Stations in Bull Fork Subwatershed**

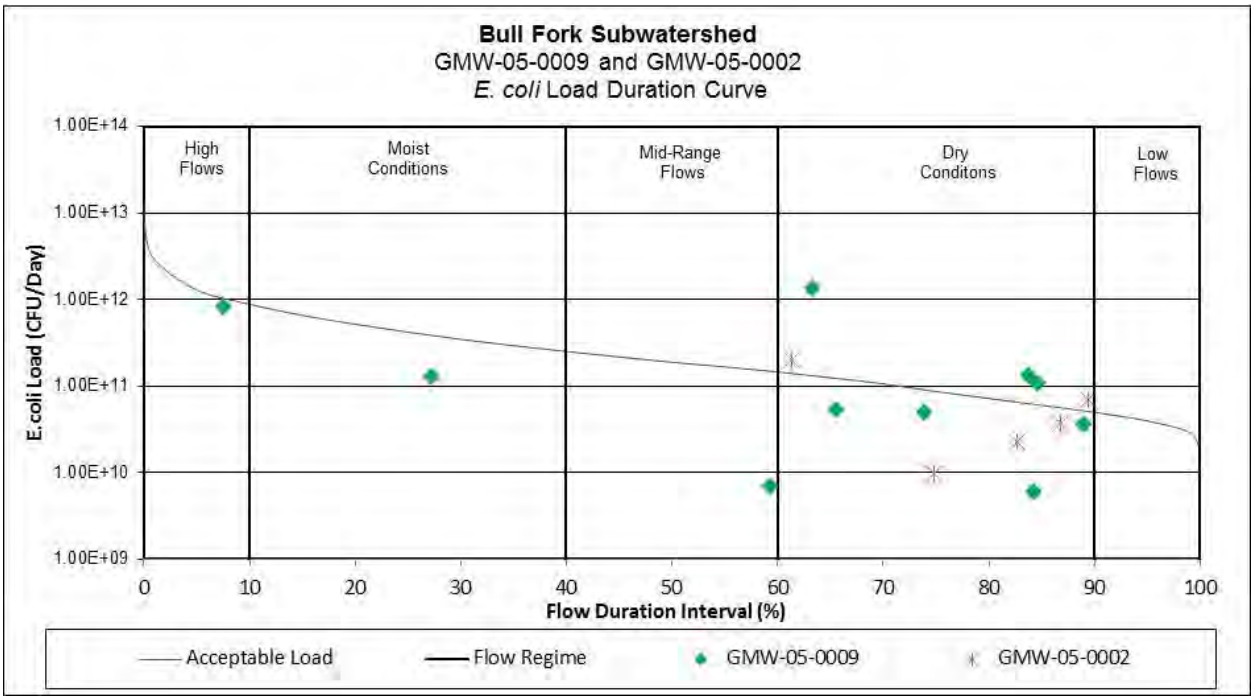


**Figure 73. Load Duration Curve for Most Representative Site in the Bull Fork Subwatershed**

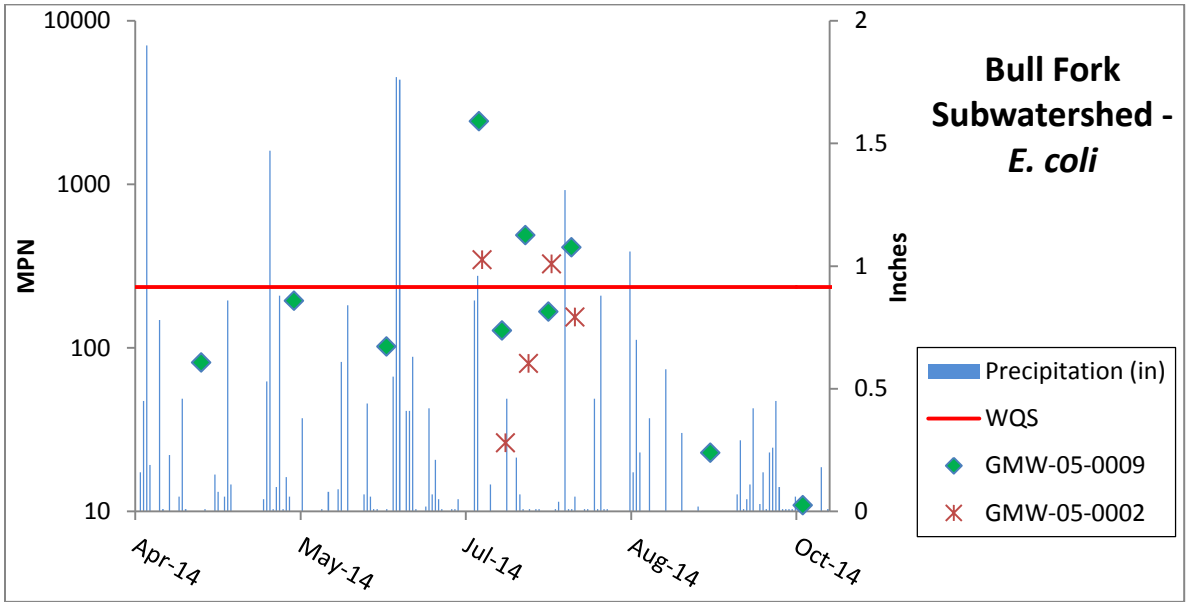


**Figure 74. Graph of Precipitation and *E. coli* Data in the Bull Fork Subwatershed**

The Bull Fork subwatershed drains approximately 46 square miles. The Bull Fork subwatershed drains into the mainstem of Salt Creek. The land use is primarily agriculture (28%) followed by forested land (55%) and hay and pasture land (12%). There are no permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. The Town of Buena Vista within the watershed yet it represents only a very small portion of the drainage. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types make up nearly a third of this subwatershed. The majority of the

HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are small patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 12 percent pasture land which indicates the potential for numerous smaller animal farms. The total number of animal units in this area (78 animals/square mile) which is the second lowest concentration when compared to other subwatersheds in Salt Creek. There are approximately 43 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 33 stream miles impaired for *E. coli* and 6 stream miles with impaired biological communities listed on the 2016 List of Impaired Waters.

There are two sites located in this subwatershed, both of which are located on Bull Fork. Site GMW-05-0009 (T5) is the upstream site along Bull Fork. It is located just downstream from the confluence with Long Branch at Bullfork Road. The downstream site, GMW-05-0002 (P6), is located at the pour point of the subwatershed also at Bullfork Road. This stream reach is impaired for *E. coli* and dissolved oxygen based on a 2002 sample in the headwaters of Bull Fork. In 2013 and 2014 DO was sampled 21 times between the two sites located on this stream and there were no WQS violations. This stream reach will be delisted for dissolved oxygen in the 2016 303(d) list of impaired waters. However the headwaters of Bull Fork will remain impaired for DO since there was no data collected in that location to show an improvement.

In 2009, there was an E. coli only sample collected just upstream of site T5 and the geometric mean was 360.62 MPN with 4/5 samples exceeding the single sample maximum. After the 2014 sampling, site T5 had a geometric mean was 400.07 MPN and site P6 had a geometric mean of 129.33 MPN. While the *E. coli* levels are still in violation of the Indiana WQS, there is dilution occurring in a downstream direction. Agricultural land use dominates the headwaters of the subwatershed and could be contributing to higher levels of *E. coli* in the headwaters. The fish community IBI score at site T5 was 52 which is considered good and the habitat score was 65 which is considered good. The macroinvertebrate community mIBI score was 44 which is considered fair and the habitat score was 67 which is considered good. Downstream at site P6 the fish community IBI score at site T5 was 42 which is considered fair and the habitat score was 64 which is considered good. The macroinvertebrate community mIBI score was 40 which is considered fair and the habitat score was 57 which is considered good.

In 2009 there were two LARE sites (5 and 6) located on this stream. The results of that study showed low DO during base flow and high TP, high nitrogen and high TSS during storm flow. The study determined this subwatershed has high nutrient loadings and defined nutrients as the primary pollutant in this stream. While IDEM data did not collect any nutrient samples in violation of water quality targets, IDEM did not capture any storm events as targeted by LARE studies. The riparian area around the stream transitions in a downstream direction to a more forested buffer. The steep slopes, agricultural lands in the headwaters, land application of animal manure, unsewered communities and leaky septic systems in limited use soils may be contributing to high levels of *E.coli* and nutrients in the subwatershed.

### 11.3.4 Little Salt Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Little Salt Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 90 provides a summary of the Little Salt Creek subwatershed, including segment AUIDs, drainage area, sampling sites, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations

**Table 90. Summary of Little Salt Creek Subwatershed Characteristics**

| **Little Salt Creek (050800030504)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 25.13 | | | | | |
| **TMDL Sample Sites:** GMW-05-0015 (T8), GMW-05-0008 (T9), GMW-05-0001 (P1) | | | | | |
| **Listed Segments:** ING0354_02, ING0354_T1002, ING0354_T1003, ING0354_T1004 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **574.2** | **187.69** | **84.05** | **38.60** | **17.71** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **518.23** | **169.39** | **75.84** | **34.87** | **16.02** |
| ***Margin Of Safety (MOS) (5%)*** | **28.7** | **9.38** | **4.20** | **1.93** | **0.89** |
| ***Future Growth (5%)*** | **27.3** | **8.9** | **4.0** | **1.8** | **0.8** |
| | | | | | |

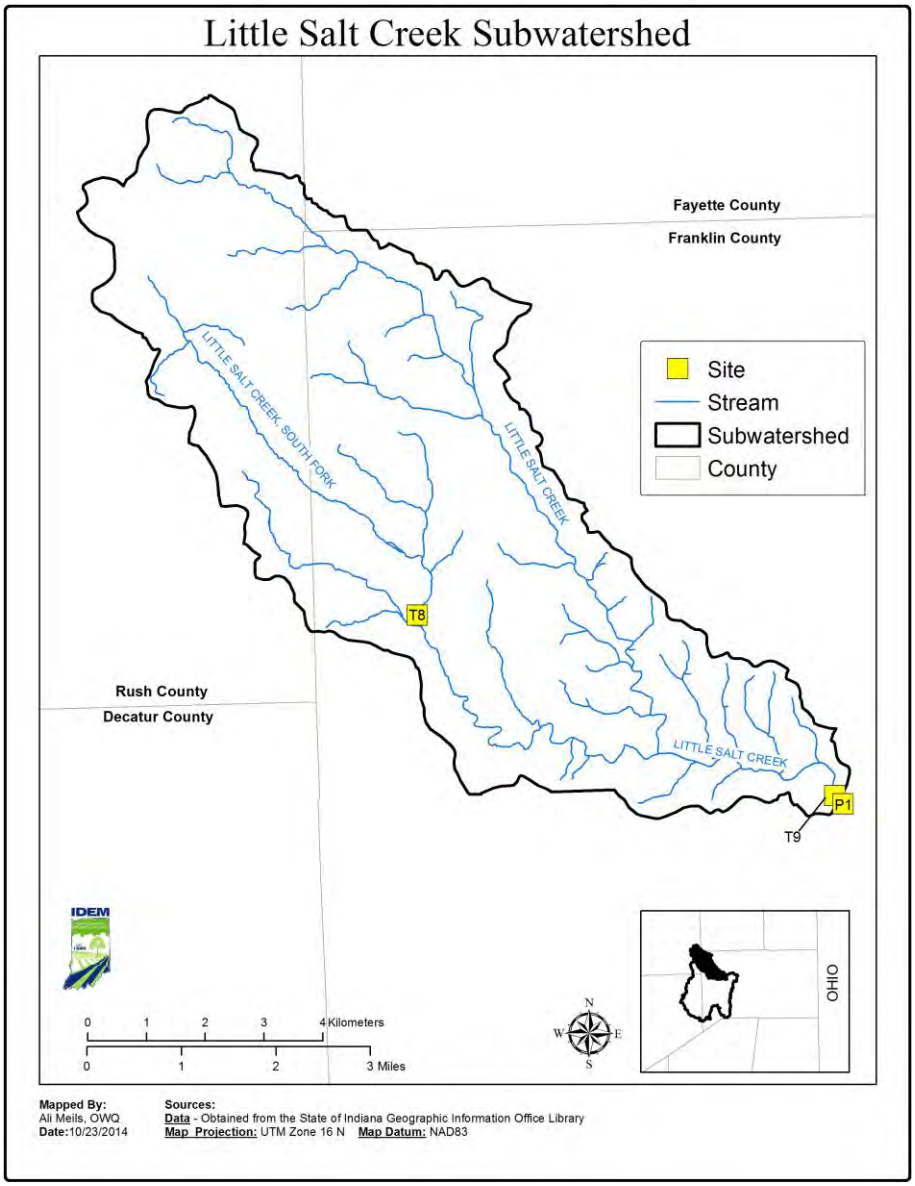


**Figure 75. Sampling Stations in Little Salt Creek Subwatershed**

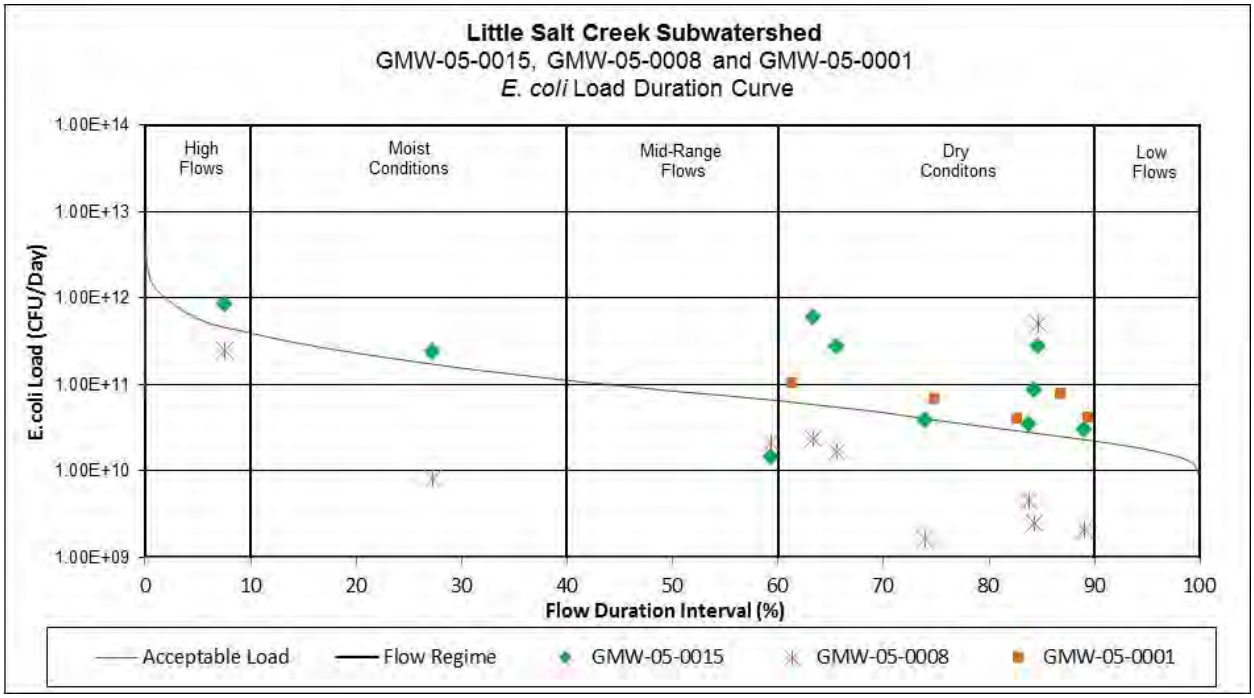


**Figure 76. Load Duration Curve for Most Representative Site in the Little Salt Creek Subwatershed**

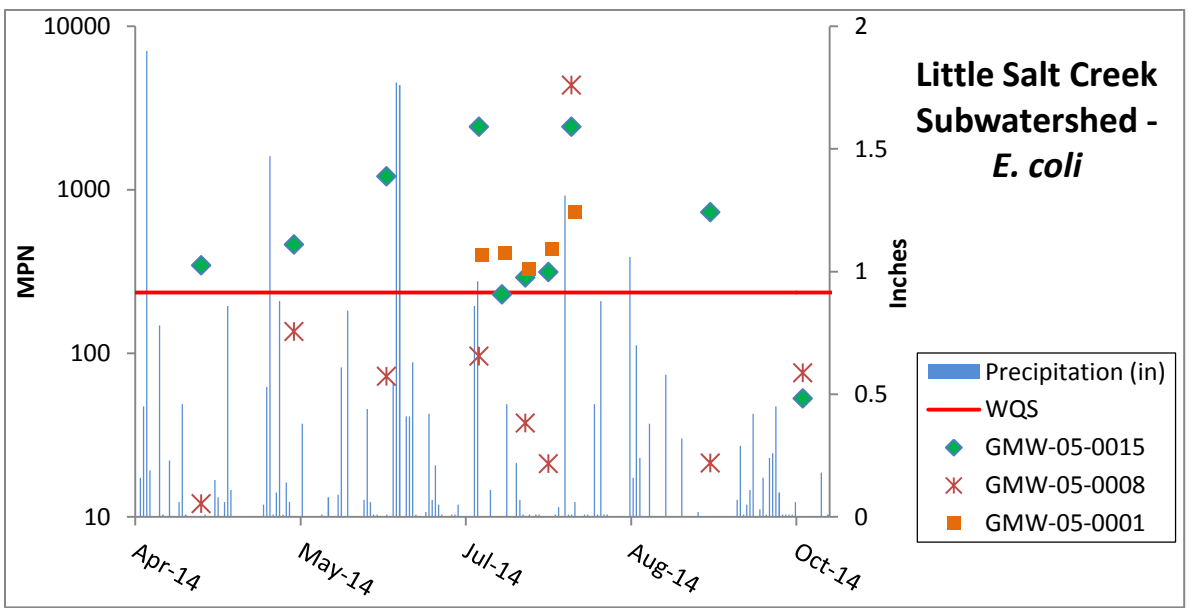


**Figure 77. Graph of Precipitation and *E. coli* Data in the Little Salt Creek Subwatershed**

The Little Salt Creek subwatershed drains approximately 25 square miles. The Little Salt Creek subwatershed drains into the mainstem of Salt Creek. The land use is primarily agriculture (36%) followed by forested land (48%) and hay and pasture land (11%). There are no permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. The Town of Andersonville is within the watershed yet it represents approximately 5 percent of the drainage. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types make up nearly a third of this subwatershed. The

majority of the HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are small patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 11 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (89 animals/square mile) which is median concentration when compared to other subwatersheds in Salt Creek. There are approximately 56 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 41 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

There are three sites located in this subwatershed, two located on Little Salt Creek GMW-05-0001 (P1) and GMW-05-008 (T9) and one located on South Fork Little Salt Creek GMW-05-0015 (T8) located in the middle of the South Fork Little Salt Creek. In 2014 this watershed was sampled 29 times between the three sites the *E.coli* WQS were violated. This stream reach will remain listed for *E.coli* in the 2016 303(d) list of impaired waters.

In 2009 a site was sampled for E. coli only and the geometric mean was 95.38 MPN with 1/5 samples exceeding the single sample max. In 2014 there were two samples taken from T9 and P1 which are located at the pour point of this subwatershed, downstream of the confluence with ING0354_T1003. The geometric mean for T9 was 79.40 MPN and there was 1/10 samples in exceedance of the single sample max. In 2014 there was another site P1 located in close proximity to site T9 and the geometric mean was 441.52 MPN with 5/5 samples in exceedance of the single sample max. The geometric means from site T9 and P1 were taken one day apart for five consecutive weeks. There was a historical site sampled in 2002 and the E. coli geometric mean was 30.65 MPN. The fish community IBI score for site T9 was 38 (fair) and the QHEI was 60 (good). The macro community mIBI score was 42 (fair) and the QHEI was 61 (good). The fish community IBI score for site P1 was 42 (fair) and the QHEI was 79 (excellent). The macro community mIBI score was 42 (fair) and the QHEI was 58 (good). The historical site in close proximity was sampled in 1994 with macro score of 4.8 and QHEI of 70 and again in 2004 with an mIBI score of 34 and a QHEI of 54. In 2009 there were also two LARE sites (8 and 10) located on this AUID. The results indicated that this subwatershed has high loads of sediment.

In 2009 site T8 had a geometric mean of 136.73 MPN, with 0/5 exceeding the single sample max. In 2014 this same site was sampled and the geometric mean was 656.17 MPN with 8/10 samples exceeding the single sample max. The fish community IBI score for site T8 was 44 (fair) and the QHEI was 72 (excellent). The macro community mIBI score was 46 (good) and the QHEI was 66 (good). No other chemical impairments but the TSS was > 30 mg/L in July which is more than the WQ target.

The land use is primarily steep forested lands with wide riparian buffers surrounding the stream. However further upstream the land use is dominantly agriculture with little to no riparian buffers. Small clusters of homes are also present along US 52. T9 (2014): Geometric mean of 79 cfu/100 mL. 0019 (2009): 95 cfu/100 mL. P1(2014): 442 cfu/100 mL. T9 and P1 were sampled a day apart with results geometric means that are drastically different. No weather events happened during the sampling period to explain the differing results. These results suggest consistent loadings and a specific cause has not been identified.

### 11.3.5 Fremont Branch Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Fremont Branch subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 91 provides a summary of the Fremont Branch subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli* and TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TSS concentrations.

**Table 91. Summary of Fremont Branch Subwatershed Characteristics**

| **Fremont Branch (050800030505)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 117.36 | | | | | |
| **TMDL Sample Sites:** GMW-05-0012 (T7), GMW-05-0010 (T10) | | | | | |
| **Listed Segments:** ING0355_01, ING0355_T1001, ING0355_T1002, ING0355_T1003, ING0355_T1004 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **569.60** | **186.50** | **83.80** | **38.70** | **18.0** |
| ***Wasteload Allocation (WLA): Total*** | **1.33** | **1.33** | **1.33** | **1.33** | **1.33** |
| **Oldenburg WTTP (IN0023973) 0.15 MGD** | **1.33** | **1.33** | **1.33** | **1.33** | **1.33** |
| ***Load Allocation (LA)*** | **513.65** | **167.86** | **74.27** | **33.67** | **14.87** |
| ***Margin Of Safety (MOS) (5%)*** | **28.5** | **9.3** | **4.2** | **1.9** | **0.9** |
| ***Future Growth (5%)*** | **27.1** | **8.9** | **4.0** | **1.8** | **0.9** |
| | | | | | |
| **Drainage Area (sq. mi.):** 117.36 | | | | | |
| **TMDL Sample Sites:** GMW-05-0010 (T10) | | | | | |
| **Listed Segments:** ING0355_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **TSS TMDL (lbs/day)** | **62849.4** | **20542.81** | **9199.05** | **4224.84** | **1938.00** |
| ***Wasteload Allocation (WLA): Total*** | **1.07** | **0.35** | **N/A** | **N/A** | **N/A** |
| ***Construction Activities (0.0021 sq. mi.)*** | **1.07** | **0.35** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **56720.50** | **18539.54** | **8302.09** | **3812.90** | **1749** |
| ***Margin Of Safety (MOS) (5%)*** | **3142.5** | **1027.14** | **459.95** | **211.24** | **96.90** |
| ***Future Growth (5%)*** | **2985.3** | **975.8** | **437.0** | **200.7** | **92.1** |
| | | | | | |

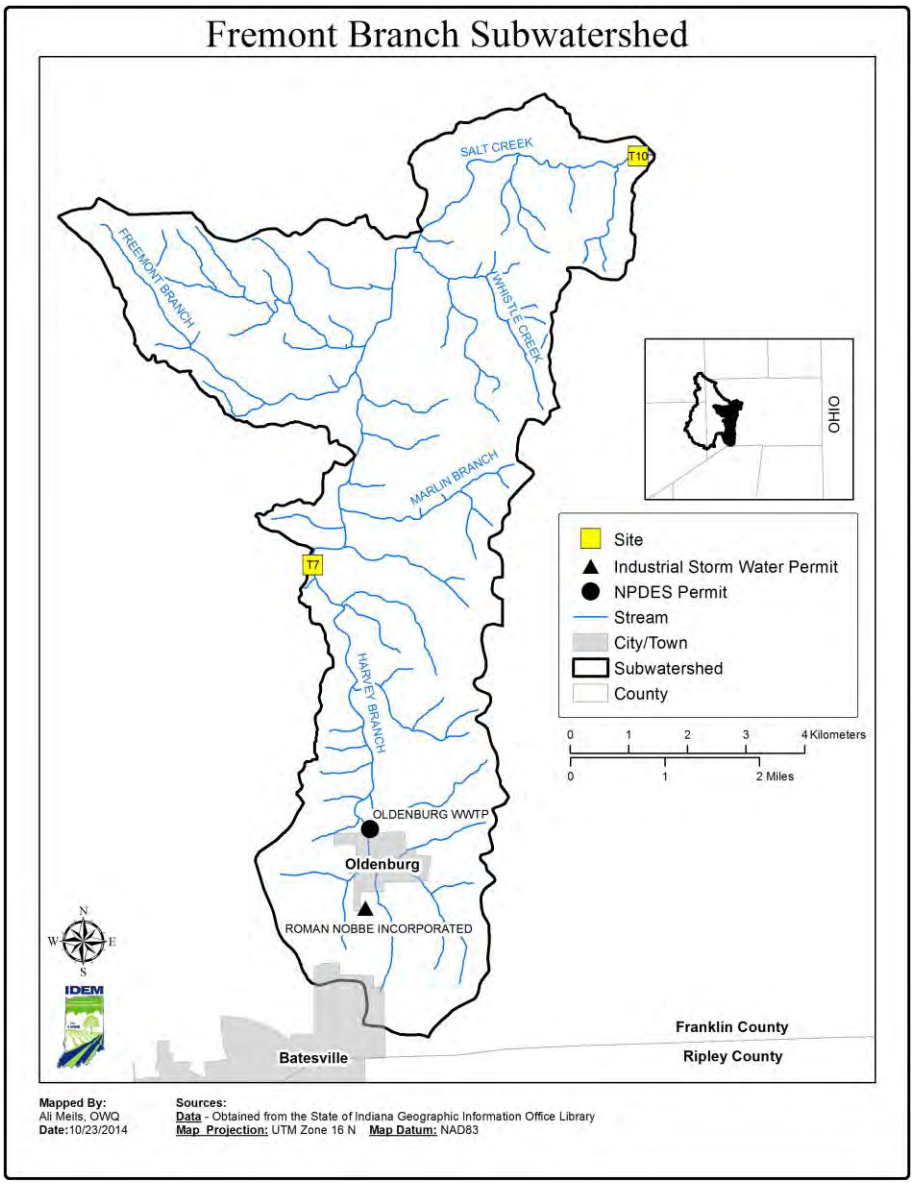


**Figure 78. Sampling Stations in Fremont Branch Subwatershed**

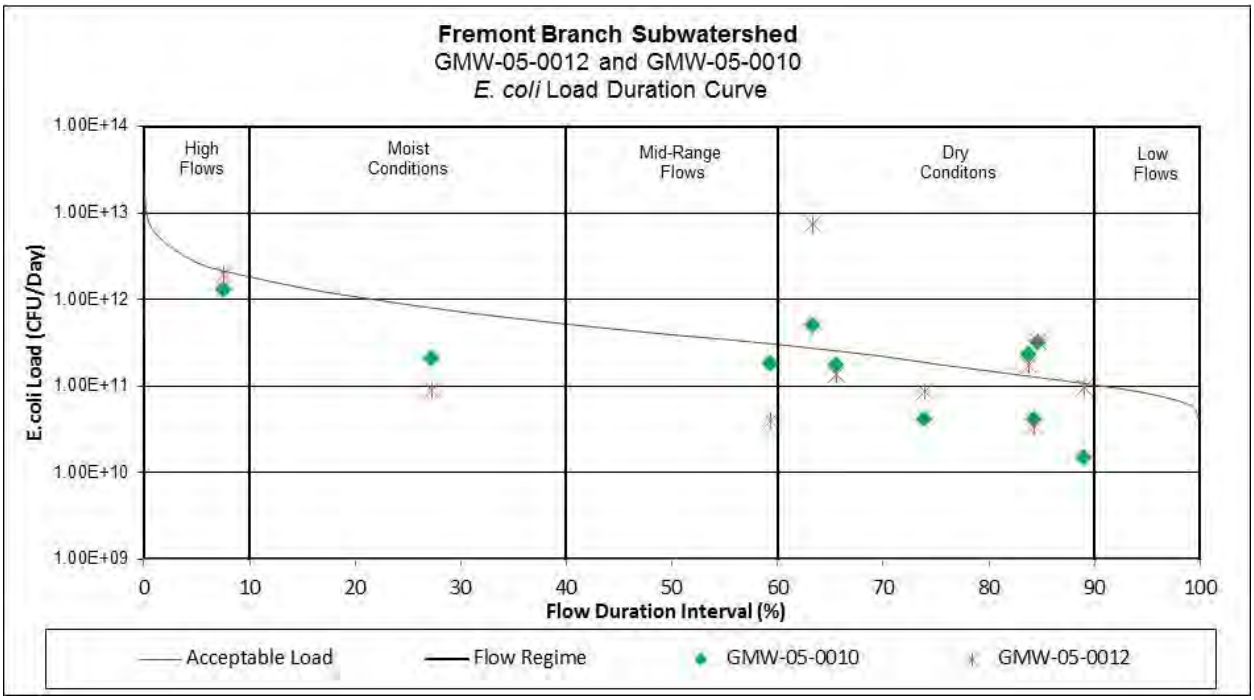


**Figure 79. Load Duration Curve *E. coli* in the Fremont Branch Subwatershed**

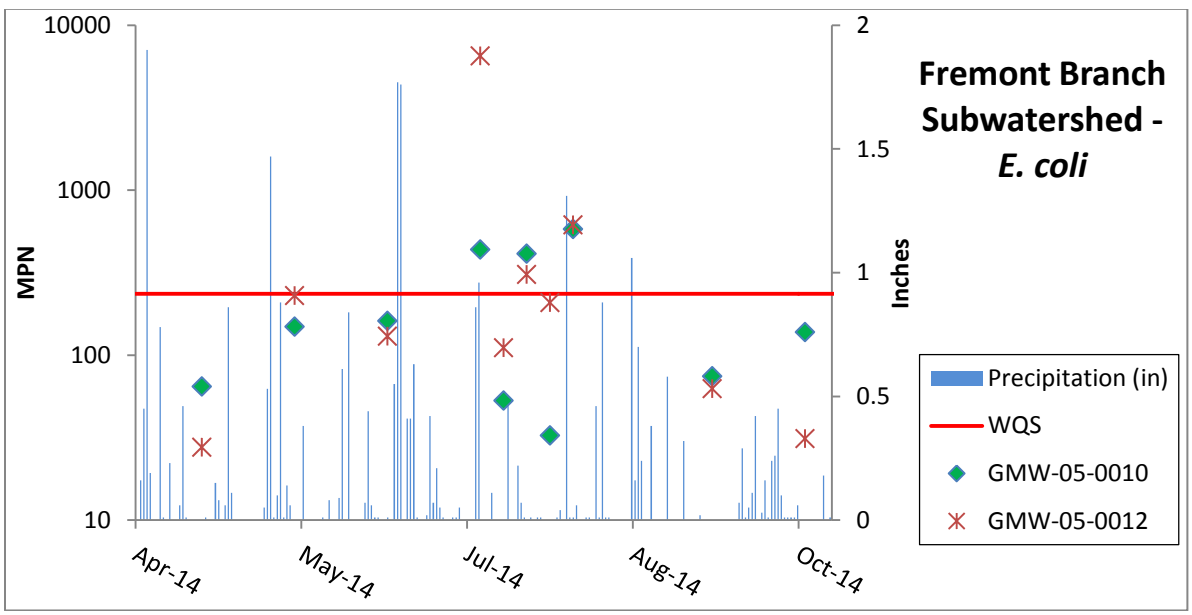


**Figure 80. Graph of Precipitation and *E. coli* Data in the Fremont Branch Subwatershed**

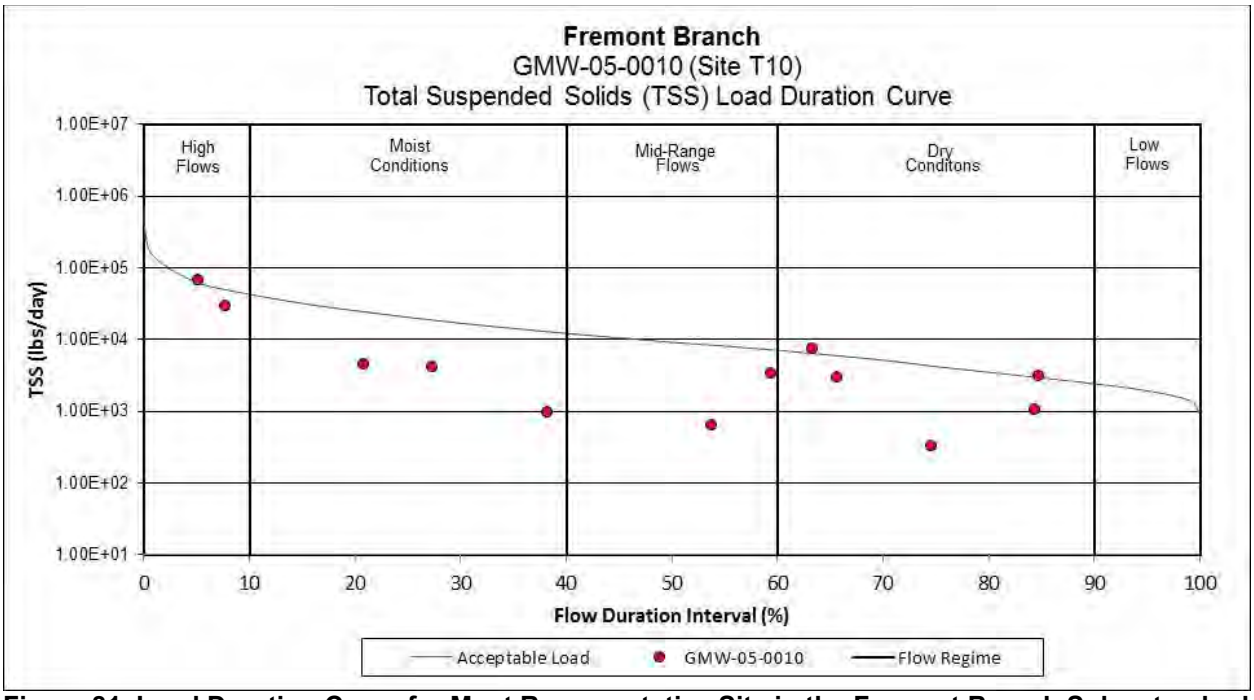


**Figure 81. Load Duration Curve for Most Representative Site in the Fremont Branch Subwatershed**

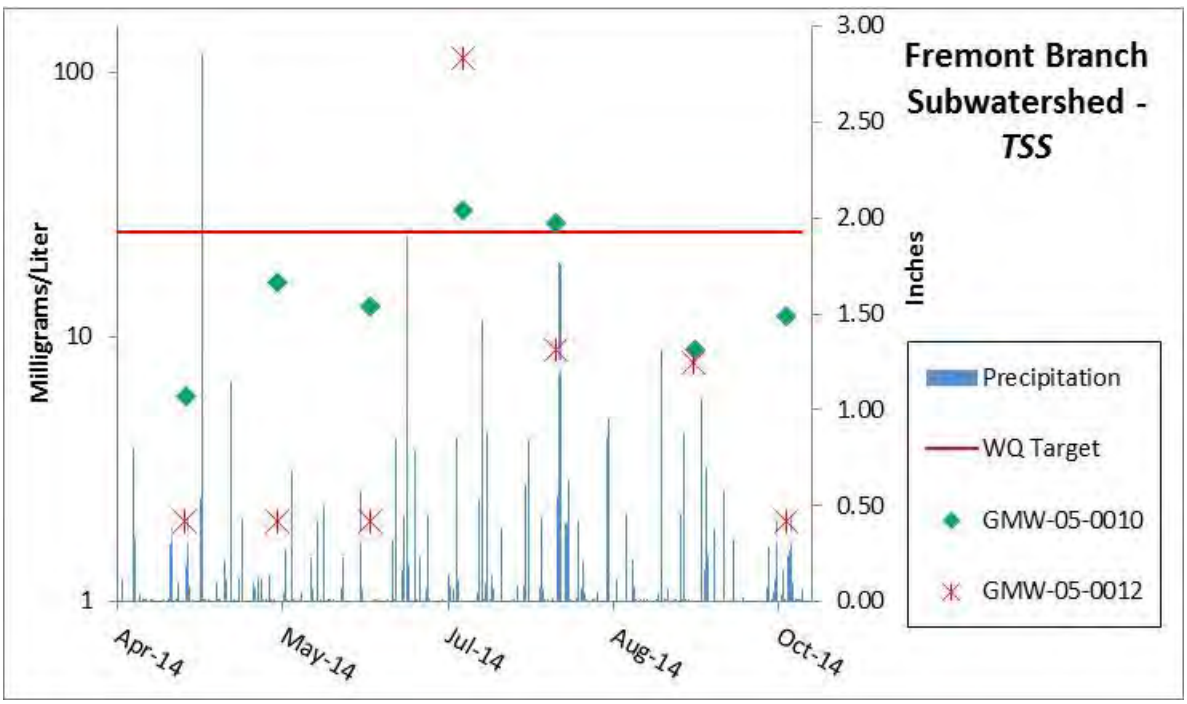


**Figure 82. Graph of Precipitation and TSS Data in the Fremont Branch Subwatershed**

The Fremont Branch subwatershed drains approximately 117 square miles. The Fremont Branch subwatershed drains into the mainstem of Salt Creek. The land use is primarily forested (67%) followed by hay and pasture (14%) and agricultural land (14%). There is one permitted facilities in the subwatershed Oldenburg. Oldenburg has had compliance issues in the past and continued compliance with the NPDES permit is necessary for meeting WQS. Oldenburg also has a sanitary sewer overflow

which is not permitted to discharge and will continue to be monitored for discharge by IDEM. There is one confined animal feeding operation (CAFO) and one confined feeding operation (CFO) in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a source for the Fremont Branch subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types make up nearly a third of this subwatershed. The majority of the HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are small patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. There are approximately 64 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 35 stream miles impaired for *E. coli* and 10 stream miles impaired for TSS listed on the 2016 List of Impaired Waters.

Site GMW-05-0012 (T7) is located on Harvey Branch. This site T7 had a geometric mean of 489.42 MPN with 3/10 samples exceeding the single sample max. In 1997 this AUID was sampled just downstream and the biological fish IBI = 48 (good), QHEI = 80 (excellent). In 2014 the fish community IBI score for site T7 was 44 (fair) and the QHEI was 61 (good). The macro community mIBI score was 34 (poor) and the QHEI was 61 (good). From the site collected upstream in 2009 the data shows there are heavy loads of nutrients coming downstream. The data collected in 2014 did not show any nutrient exceedances. This study does not indicate this was a priority area for management. The surrounding land use is a mixture of forested and agricultural land.

Site GMW-05-0010 (T10) is located on Salt Creek and is the pour point for this subwatershed. T10 was sampled in 2002 and the E. coli geometric mean was ~72 MPN. In 2014 this same site was sampled and the geometric mean was 177.69 MPN with 3/10 samples exceeding the single sample max. The fish community IBI score for site T10 was 44 (fair) and the QHEI was 55 (good). The macro community mIBI score was 44 (fair) and the QHEI was 57 (good). There is a 1994 historical macroinvertebrate site upstream on this AUID and the macro score was 2.6 with QHEI of 70. This is the mainstem Salt Creek and all other subwatersheds are contributing loads. Given the higher levels of E. coli in some of the other subwatersheds this is a major factor in the elevated levels of E. coli. The geometric mean decreases in a downstream direction from site T7 to T10. In 2009 LARE site 15 is located at the same location as T10. The study showed there were high TP (0.41 mg/L) and high TSS (97 mg/L) during storm flows. The study identified the lower portion of this watershed as having high sediment loadings. The land use is primarily forest in the downstream portion. Small clusters of homes exist along SR229, other than that is it fairly rural. Wide riparian buffers exist and help filter out pollutants.

### 11.3.6 Headwaters Pipe Creek

Load duration curves and precipitation graphs were created for all the sampling sites in the Headwaters Pipe Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 92 provides a summary of the Headwaters Pipe Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 92. Summary of Headwaters Pipe Creek Subwatershed Characteristics**

| **Headwaters of Pipe Creek (050800030601)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 18.28 | | | | | |
| **TMDL Sample Sites:** GMW-06-0014 (T17), GMW060-0027 (T18) | | | | | |
| **Listed Segments:** ING0361_02, ING0361_T1003, ING0361_T1004, ING0361_T1005, ING0361_T1006, ING0361_T1006A, ING0361_T1007, ING0361_T1008, ING0361_T1009 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 – 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **417.70** | **136.53** | **61.14** | **28.08** | **12.88** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **376.97** | **123.22** | **55.18** | **25.37** | **11.64** |
| ***Margin Of Safety (MOS) (5%)*** | **20.9** | **6.83** | **3.06** | **1.40** | **0.64** |
| ***Future Growth (5%)*** | **19.8** | **6.5** | **2.9** | **1.3** | **0.6** |
| | | | | | |

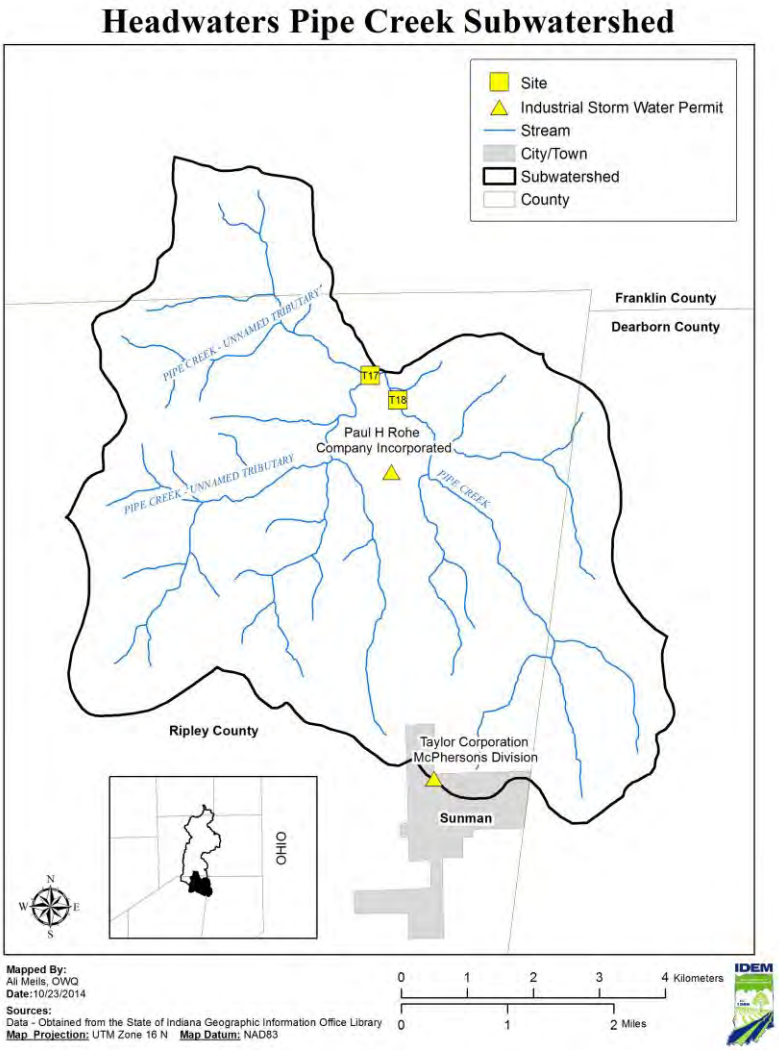


**Figure 83. Sampling Stations in Headwaters Pipe Creek Subwatershed**

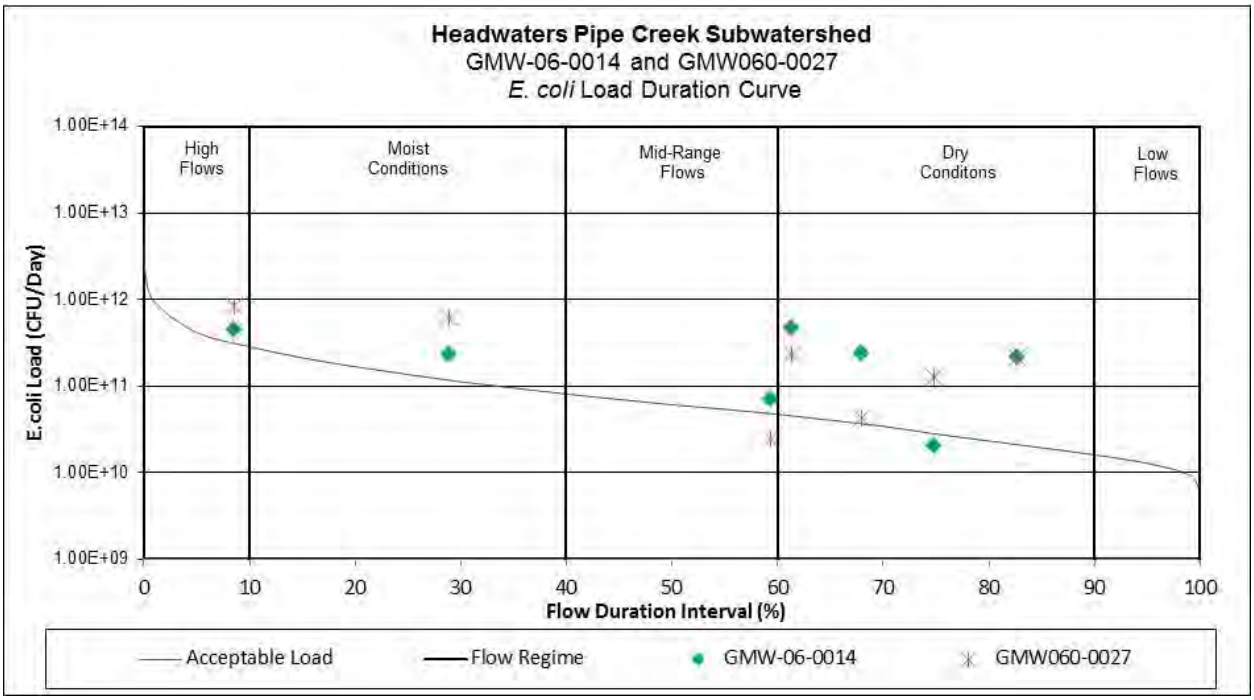


**Figure 84. Load Duration Curve for Most Representative Site in the Headwaters Pipe Creek Subwatershed**

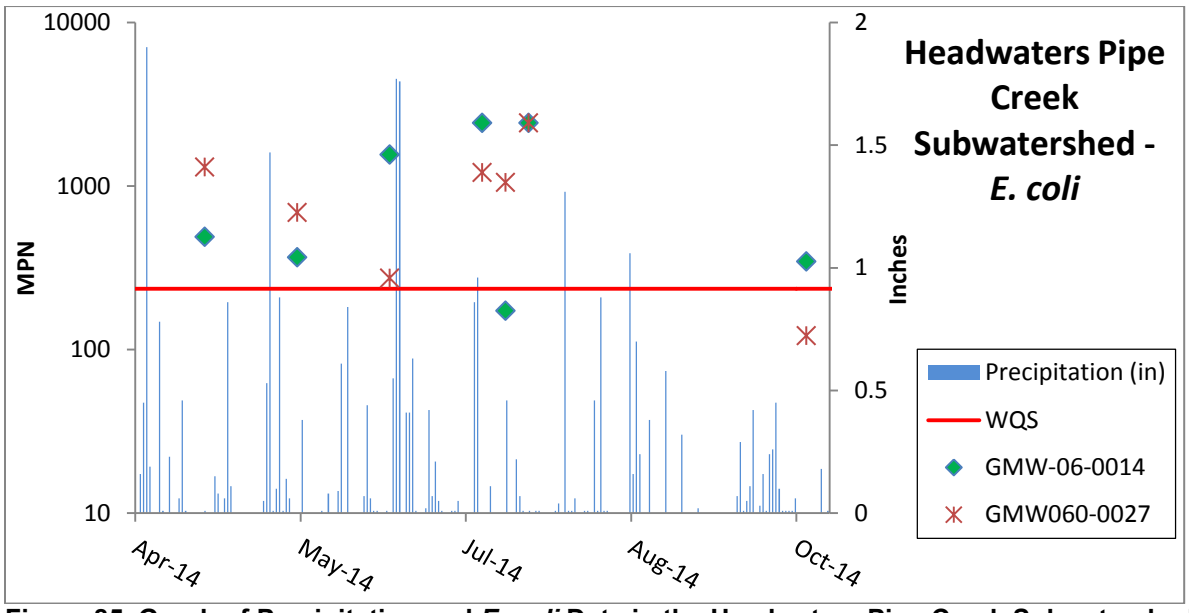


**Figure 85. Graph of Precipitation and *E. coli* Data in the Headwaters Pipe Creek Subwatershed**

The Headwaters Pipe Creek subwatershed drains approximately 18 square miles. The Headwaters Pipe Creek subwatershed drains into the mainstem of Pipe Creek. The land use is primarily forested (37%) followed by agricultural land (34%) hay and pasture (21%). There are no permitted facilities in the subwatershed. There are no confined animal feeding operation (CAFO) and one confined feeding operation (CFO) in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a source for the Headwaters Pipe Creek subwatershed. The majority of the subwatershed is rural, with a small portion in Sunman, indicating homes pump to on-site septic systems. Based on the

septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of steep gradient at the headwaters and more rolling hills toward the mouth of the watershed. Highly erodible soil types make up the majority of this subwatershed. The HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. Small patches on the edges of the watershed have been identified as having hydric soil types. These areas could be potential areas for wetland restoration. There are small wetland areas There are approximately 40 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 37 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

Site GMW-060-0027 (T18) is located Pipe Creek Road on Pipe Creek. The geometric mean value for Site 9 is 210 MPN/100mL. In 2009 this site was sampled for E. coli only and the geometric mean was 260.07 MPN with 3/5 exceeding the single sample max. In 2014 this same site (T18) was sampled. The geometric mean could not be calculated because the site went dry during the 5 weeks of sampling. However there were 6/7 sampling events where the results were in exceedance of the single sample max. Three of those samples were >1000 MPN. In 2014 the fish community IBI score for site T18 was 38 (fair) and the QHEI was 50 (fair). The macro community mIBI score was 38 (fair) and the QHEI was 49 (fair). This site went dry in August and September. The DO results never went below 4 mg/L while sampling however, while there was water in the stream, the DO was 4.5-6 mg/L from July through October. These low DO levels could be putting stress on the biological communities. Based on the small drainage area and high gradient this stream going dry in the summer months is likely a natural condition. As the stream is going dry and isolated pooling occurs low dissolved oxygen levels are likely as the results indicate. The geometric in 2009 was 260 cfu/100 mL, No GM in 2014 because stream went dry (2/7), but results violate 10% rule indicating impairment.

Site GMW-060-0014 (T17) is located Unnamed Tributary of Pipe Creek Road on St. Marys Road. In 2009 this site was sampled for E. coli only and the geometric mean was 260.07 MPN with 3/5 exceeding the single sample max. In 2014 this same site (T18) was sampled. The geometric mean could not be calculated because the site went dry during the 5 weeks of sampling. However there were 6/7 sampling events where the results were in exceedance of the single sample max. Three of those samples were >1000 MPN. In 2014 the fish community IBI score for site T18 was 38 (fair) and the QHEI was 50 (fair). The macro community mIBI score was 38 (fair) and the QHEI was 49 (fair). This site went dry in August and September. The DO results never went below 4 mg/L while sampling however, while there was water in the stream, the DO was 4.5-6 mg/L from July through October. These low DO levels could be putting stress on the biological communities. Based on the small drainage area and high gradient this stream going dry in the summer months is likely a natural condition. As the stream is going dry and isolated pooling occurs low dissolved oxygen levels are likely as the results indicate. The geometric in 2009 was 260 cfu/100 mL, there was no geometric mean in 2014 because stream went dry (2/7), but results violate 10% rule indicating impairment.

Individual results were pretty high. Land use is predominately agricultural fields throughout this watershed. Possible sources are CFOs in nearby watershed that land apply also pasture land where animals have direct or near access to water. Sparse rural population on septic systems. Penntown an unsewered community is also located in this watershed.

### 11.3.7 Clear Fork Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Clear Fork subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 93 provides a summary of the Clear Fork subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 93. Summary of Clear Fork Subwatershed Characteristics**

| **Clear Fork (050800030602)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 13.30 | | | | | |
| **TMDL Sample Sites:** GMW-06-0013 (T15) | | | | | |
| **Listed Segments:** ING0362_02A, ING0362_T1002, ING0362_T1003, ING0362_T1004 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **303.9** | **99.33** | **44.48** | **20.43** | **9.37** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **274.27** | **89.65** | **40.16** | **18.41** | **8.50** |
| ***Margin Of Safety (MOS) (5%)*** | **15.2** | **4.97** | **2.22** | **1.02** | **0.47** |
| ***Future Growth (5%)*** | **14.4** | **4.7** | **2.1** | **1.0** | **0.4** |
| | | | | | |

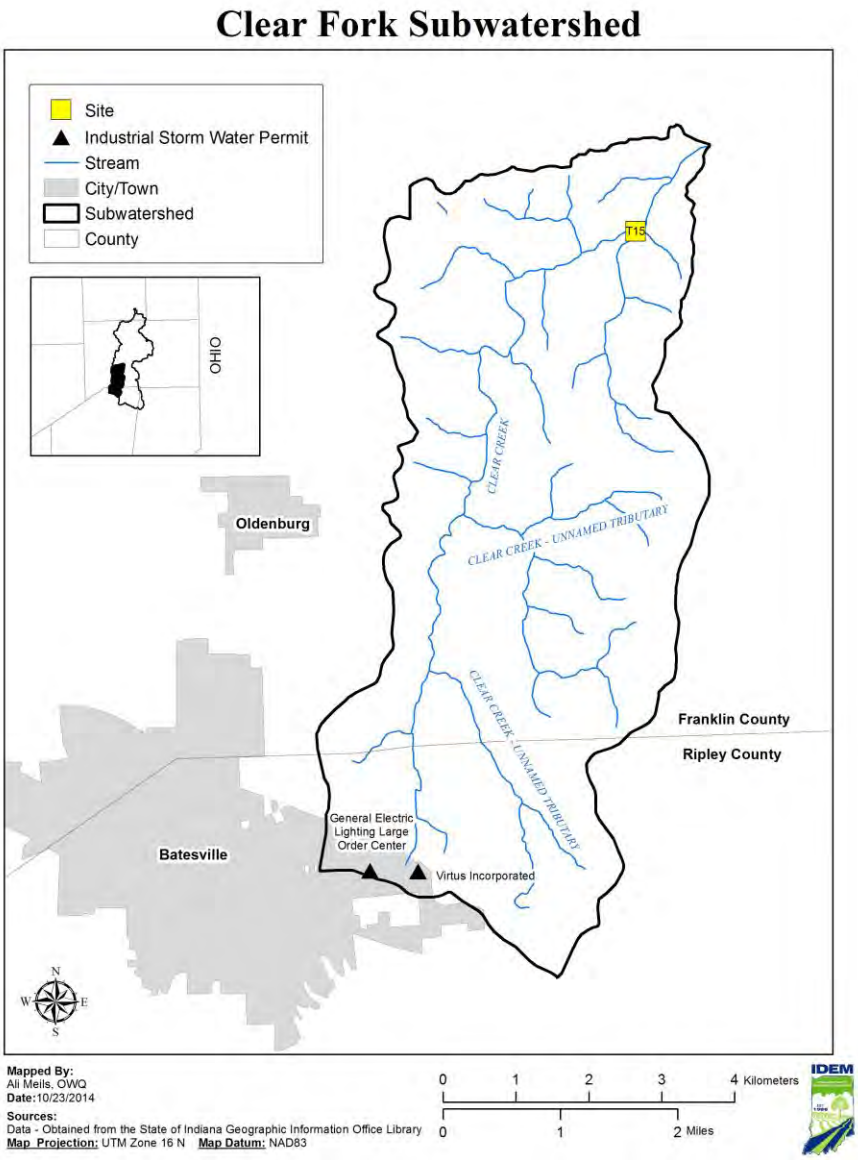


**Figure 86. Sampling Stations in Clear Fork Subwatershed**

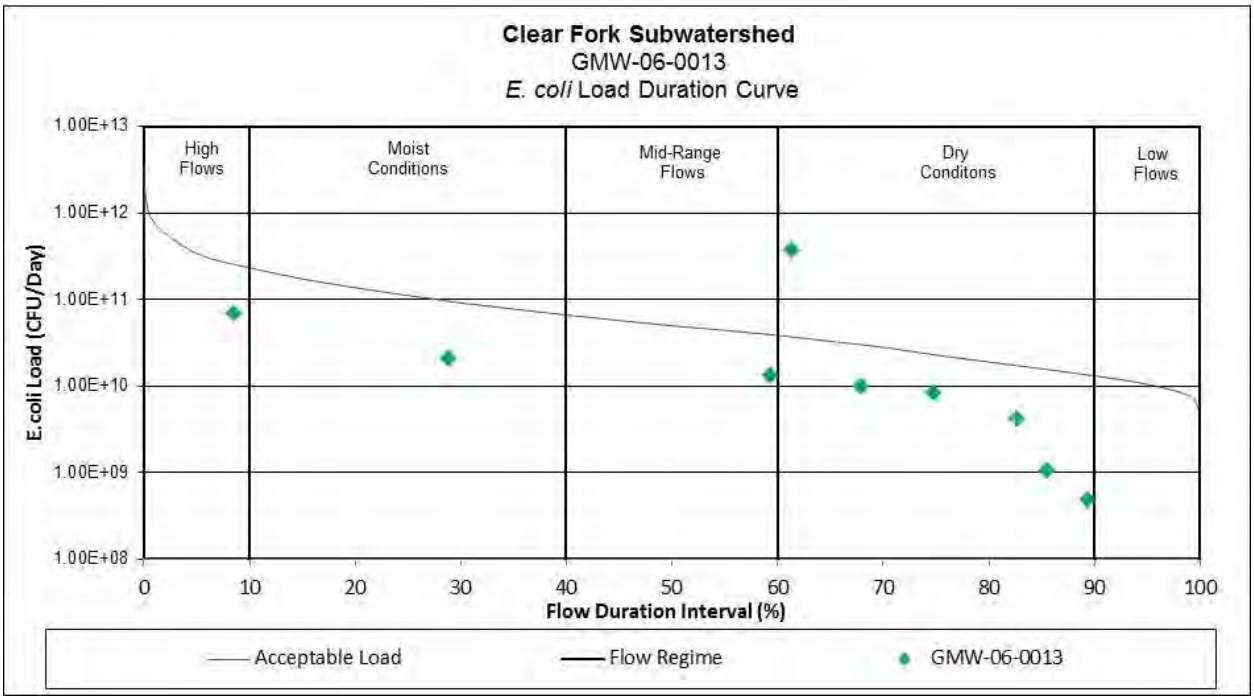


**Figure 87. Load Duration Curve for Most Representative Site in the Clear Fork Subwatershed**

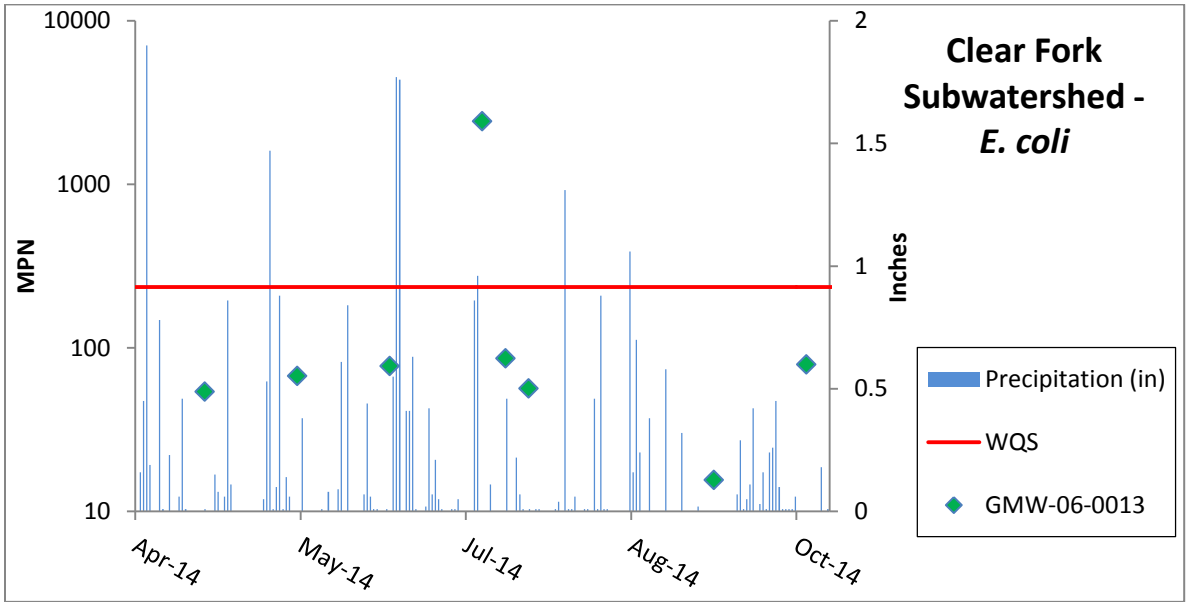


**Figure 88. Graph of Precipitation and *E. coli* Data in the Clear Fork Subwatershed**

The Clear Fork subwatershed drains approximately 13 square miles. The Clear Fork subwatershed drains into the mainstem of Pipe Creek. The land use is primarily forested (47%) followed by agricultural land (26%) hay and pasture (20%). There are no permitted facilities in the subwatershed. There are no confined animal feeding operation (CAFO) and one confined feeding operation (CFO) in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a source for the Clear Fork subwatershed. The majority of the subwatershed is rural, with a small portion in Batesville, indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to

ensure proper function and capacity. The landscape in the area consists of rolling hills. Highly erodible soil types make up the majority of this subwatershed. The HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. Small patches on the edges of the watershed near the headwaters have been identified as having hydric soil types. These areas could be potential areas for wetland restoration. There are small wetland areas throughout the watershed. There are approximately 33 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 15 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

Site GMW-060-00113 (T1) is located Schwegman Road on Clear Creek. In 2009 there was an E. coli only sample taken and the geometric mean was 291.17 MPN with 3/5 samples exceeding the single sample max. In 2014 the sample location was downstream on the segment and the geometric mean could not be calculated because the stream went dry in August. Only 1/9 sample was above the single sample max. In 2014 the fish community IBI score for site T15 was 46 (fair) and the QHEI was 57 (good). The macro community mIBI score was 40 (fair) and the QHEI was 59 (good). The WQ Target for TSS was exceeded one time in July but this appears to be related to a precipitation event, which indicates this stream is susceptible to large sediment loads during heavy rainfall events. The land use is primarily agriculture in the headwater portion of the stream and becomes heavily forested in the downstream portion of the subwatershed. Since the sample in 2009 was located further upstream and had higher E. coli results, the heavily forested downstream tributaries likely help dilute the concentration of pollutants. Since the 2009 samples indicated an impairment this stream segment will be impaired. There is also one CFO hog farm in the drainage, a portion of Batesville, and two storm water permits (Virtus – mattress pads and GE –trucking station).

Exceedance occurred after a rain event, all other results very low indicating event-driven. NPS is the likely source. Possible sources are CFOs in nearby watershed that land apply also pasture land where animals have direct or near access to water. Sparse rural population on septic systems. The outskirts of Batesville, IN (sewered) are located in the watershed. Some clusters of unsewered homes in the watershed septic systems a likely source.

### 11.3.8 Duck Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Duck Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 94 provides a summary of the Duck Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 94. Summary of Duck Creek Subwatershed Characteristics**

| **Duck Creek (050800030603)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 21.65 | | | | | |
| **TMDL Sample Sites:** GMW-06-0019 (T12) | | | | | |
| **Listed Segments:** ING0363_01, ING0363_02, ING0363_T1001, ING0363_T1002, ING0363_T1003, ING0363_T1004, ING0363_T1005, ING0363_T1006, ING0363_T1007, ING0363_T1008, ING0363_T1009, ING0363_T1010 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **494.7** | **161.7** | **72.41** | **33.25** | **15.25** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **446.47** | **145.93** | **65.39** | **29.99** | **13.79** |
| ***Margin Of Safety (MOS) (5%)*** | **24.7** | **8.08** | **3.62** | **1.66** | **0.76** |
| ***Future Growth (5%)*** | **23.5** | **7.7** | **3.4** | **1.6** | **0.7** |
| | | | | | |

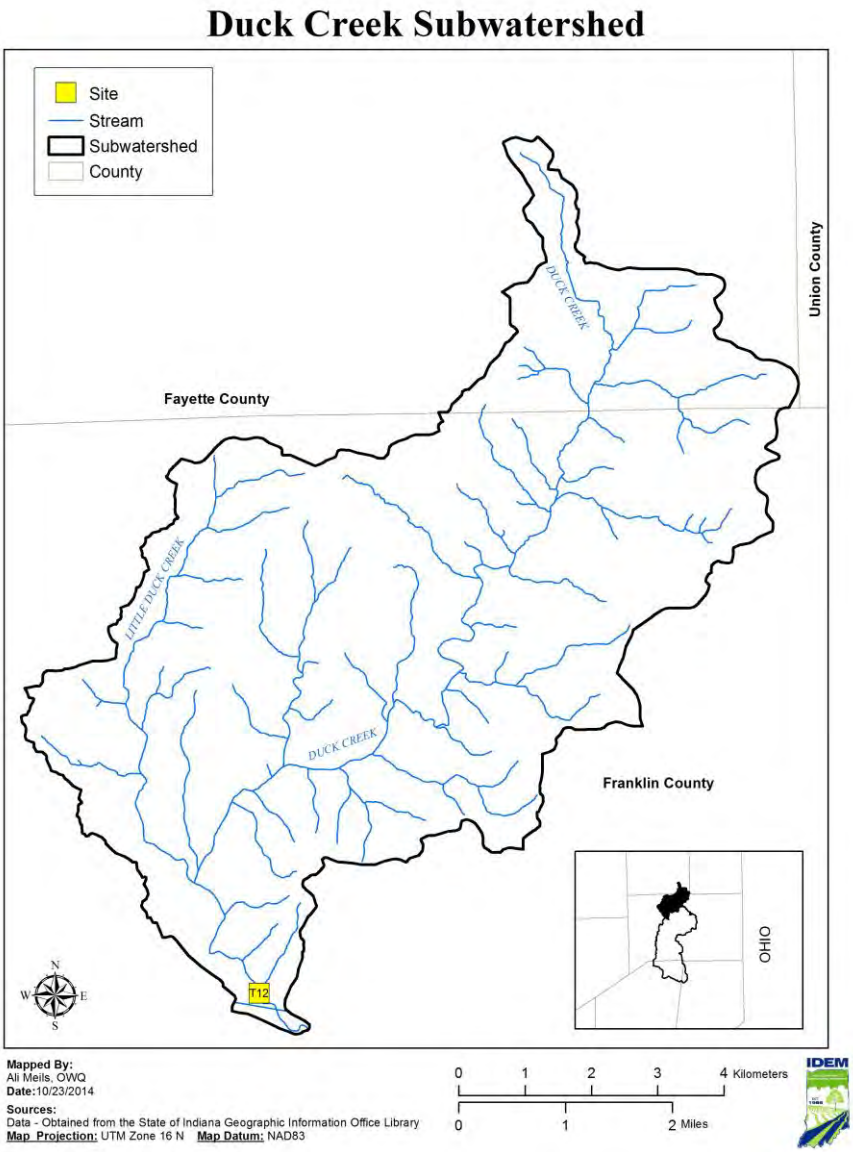


**Figure 89. Sampling Stations in Duck Creek Subwatershed**

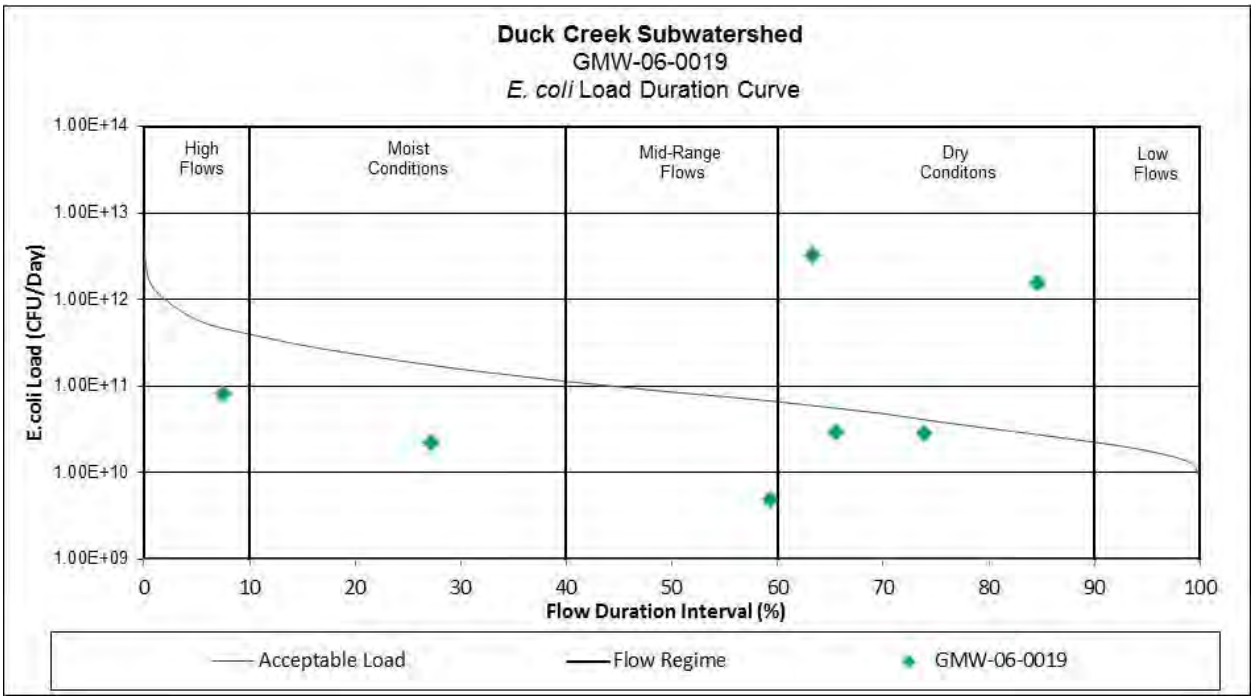


**Figure 90. Load Duration Curve for Most Representative Site in the Duck Creek Subwatershed**

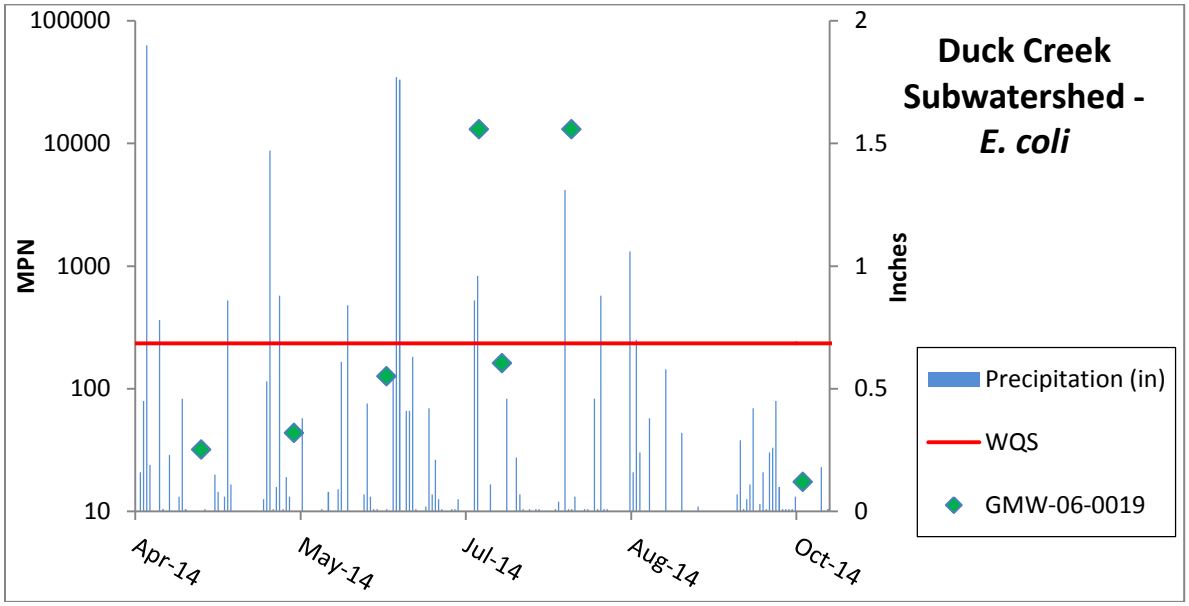


**Figure 91. Graph of Precipitation and *E. coli* Data in the Duck Creek Subwatershed**

The Duck Creek subwatershed drains approximately 22 square miles. The Duck Creek subwatershed runs mainstem of Whitewater River. The land use is primarily forested (62%) followed by agricultural land 20%) hay and pasture (12%). There are no permitted facilities in the subwatershed. There is no confined animal feeding operation (CAFO) and one confined feeding operation (CFO) partially in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a source for the Duck Creek subwatershed. The majority of the subwatershed is forested with wide riparian buffers but the Town of Metamora is at the pour point of the watershed. In the forested rural areas homes with pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very

limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape high gradient with steep hills. Highly erodible soil types make up the majority of this subwatershed. The HEL lands are located in the headwater portion of the subwatershed, which is dominated by agriculture uses. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. Small patches of areas in the extreme headwaters of the watershed have been identified as having hydric soil types. These areas could be potential areas for wetland restoration. There are small wetland areas throughout the watershed. There are approximately 54 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 54 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

Site GMW-060-0019 (T12) is located US 52 on Duck Creek. This watershed was sampled in 2002 and the geometric mean was 62.46 MPN. In 2014 this watershed was sampled further downstream at site T12 and
there were 2/7 samples that exceeded the single sample max. Both of those samples had extremely high levels of E. coli (>12000 MPN). This stream went dry during the summer months and the geometric mean was not able to be collected, nor were the biological communities.
Field staff also observed that just downstream of site T12 the Whitewater Canal aquaduct crosses over the stream and it was leaking. It was noted that large amounts of sediment were entering the stream through the aquaduct. Two times during the 2014 sampling the TP target was exceeded (0.569 and 0.309 mg/L) and the TSS target was exceeded (768 and 286 mg/L). There was no other supporting biological data to determine if there is a nutrient problem but the data results indicate high levels of TP and extremely high levels of sediment entering the stream during rain events.
T12 is located at the pour point of the subwatershed in the Town of Metamora before it enters the Whitewater River. There may be some urban influences since the site is located in a populated area. Based on the extremely high levels of E. coli entering the stream and the lack of data upstream to pinpoint the bacteria sources, the E. coli impairment will be extrapolated to all contributing tributaries.
The subwatershed is predominantly forested with wide riparian buffers along the stream. The landscape Is high gradient with steep hillsides. Agriculture us the dominant land use the headwaters, there is one CFO that is partially in the drainage, the Town of Metamora and the Town of Blooming Grove (unsewered) are in the drainage. SR 1 goes through the subwatershed and there are small clusters of homes along the highway.

### 11.3.9 Walnut Fork Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Walnut Fork subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 95 provides a summary of the Walnut Fork subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 95. Summary of Walnut Fork Subwatershed Characteristics**

| **Walnut Fork (050800030604)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 56.54 | | | | | |
| **TMDL Sample Sites:** GMW-06-0015 (T14), GMW-06-0020 (T16), GMW-06-0006 (P10) | | | | | |
| **Listed Segments:** ING0364_01, ING0364_02, ING0364_T1001, ING0364_T1002, ING0364_T1003 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **570.3** | **186.4** | **83.5** | **38.3** | **17.6** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **514.72** | **168.24** | **75.30** | **34.62** | **15.91** |
| ***Margin Of Safety (MOS) (5%)*** | **28.5** | **9.3** | **4.2** | **1.9** | **0.9** |
| ***Future Growth (5%)*** | **27.1** | **8.9** | **4.0** | **1.8** | **0.8** |
| | | | | | |

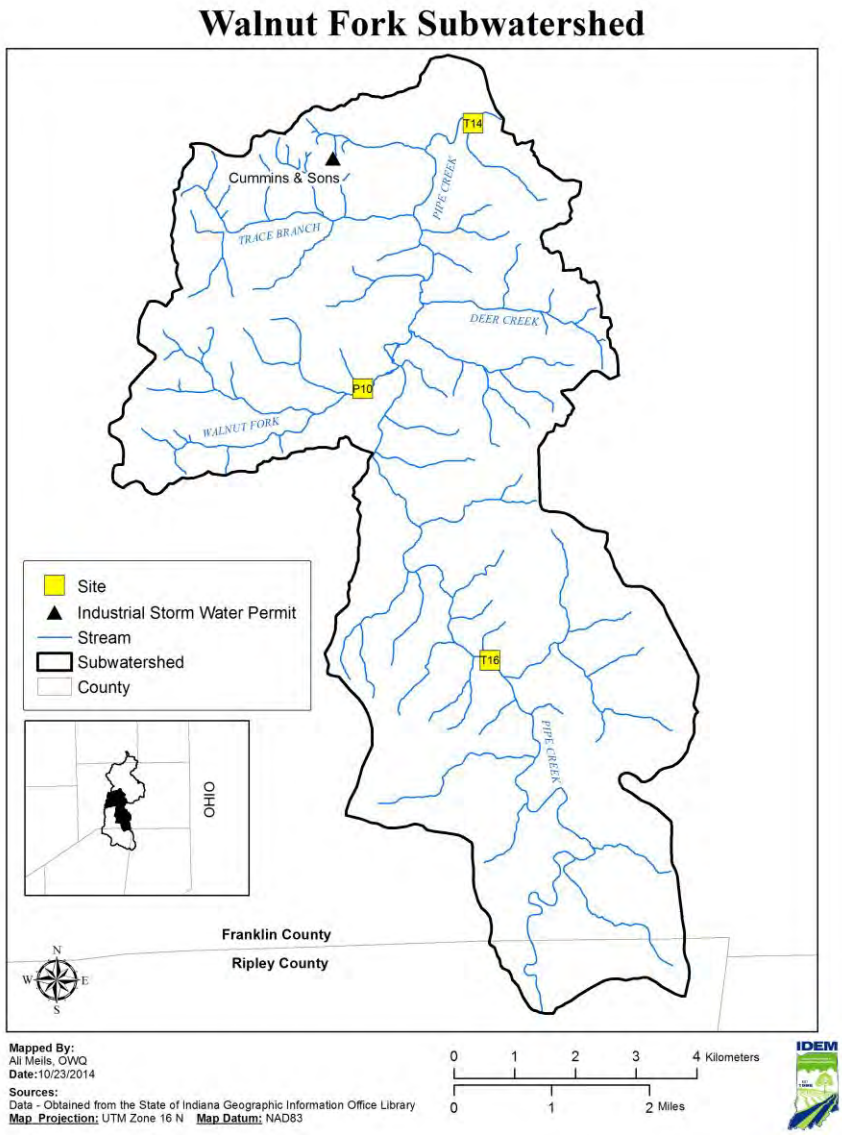


**Figure 92. Sampling Stations in Walnut Fork Subwatershed**

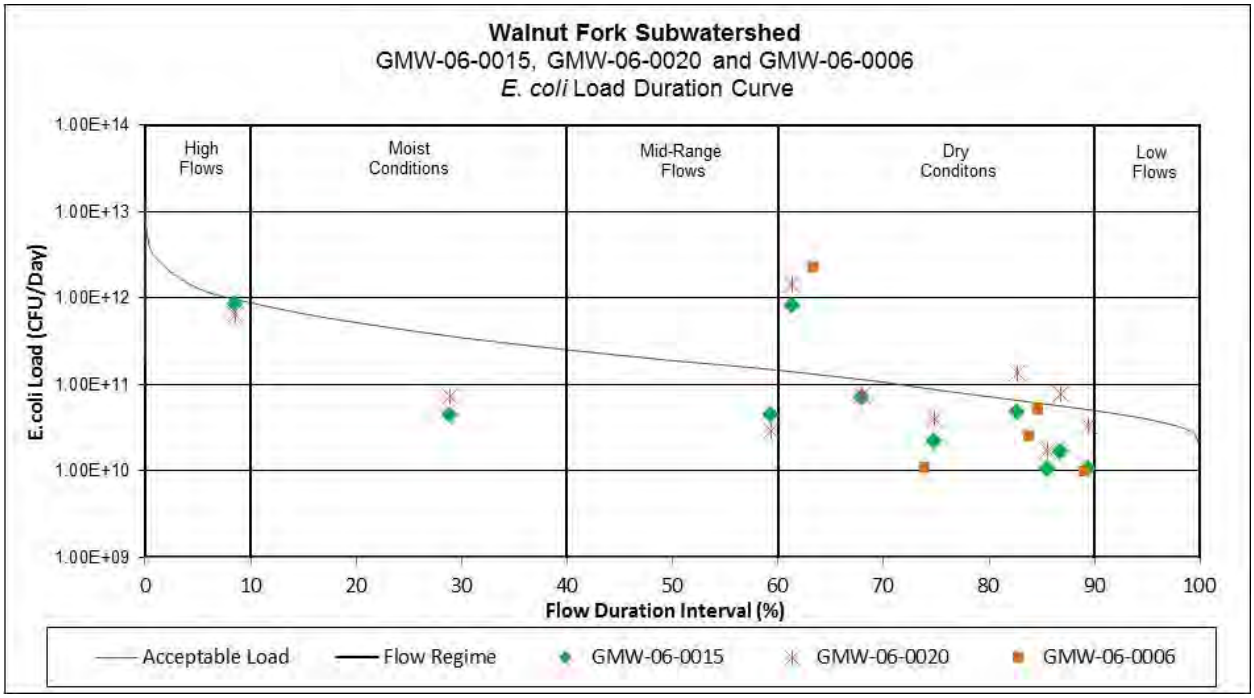


**Figure 93. Load Duration Curve for Most Representative Site in the Walnut Fork Subwatershed**

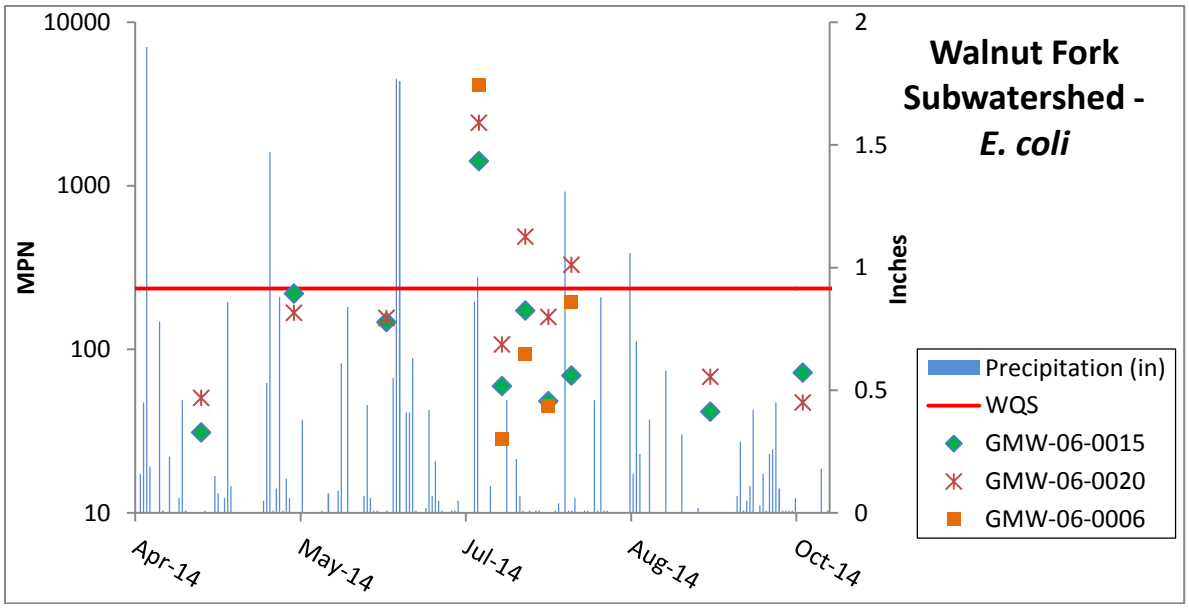


**Figure 94. Graph of Precipitation and *E. coli* Data in the Walnut Fork Subwatershed**

The Walnut Fork subwatershed drains approximately 57 square miles. The Walnut Fork subwatershed runs mainstem of Whitewater River. The land use is primarily forested (72%) followed by hay and pasture (13%) agricultural land (11%). There are no permitted facilities in the subwatershed. There is no confined animal feeding operation (CAFO) and two confined feeding operation (CFO) partially in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a source for the Duck Creek subwatershed. The majority of the subwatershed is forested but the Towns St. Joe and Pepperton are in this watershed. In the forested rural areas homes with pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and

inspections of septic systems in the area is important to ensure proper function and capacity. The landscape is high gradient with steep hills. Highly erodible soil types make up the very little of this subwatershed. It is mainly around the streams. These soil types can contribute to sediment loss from agricultural lands and stream banks, as well as, lands from the high gradient slopes. Small patches of areas in the extreme headwaters of the watershed have been identified as having hydric soil types. These areas could be potential areas for wetland restoration. There are very few wetland areas throughout the watershed. There are approximately 54 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 76 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

Site GMW-060-0015 (T14) is located at Silver Creek Road on an Pipe Creek. In 1994 macroinvertebrates were sampled on this stream and the score was 3.4 with QHEI of 68 (good). In 2002 E. coli was sampled at this site and the geometric mean was 94.76 MPN. This AUID was sampled (T14) at the pour point of the subwatershed in 2014 and the geometric mean was 136.81 MPN with 1/10 samples exceeding the single sample max. The E. coli data suggest the high levels of E. coli are driven by rainfall events, as it only exceeded the single sample max one time and it occurred when the TSS was also elevated. The data from other sites tells us there are elevated levels flowing into the stream from upstream, the Headwaters Pipe Creek subwatershed and the Walnut Fork tributary. The land use is almost entirely forested surrounding this watershed and the E. coli geometric mean was only slightly elevated. In 2014, the fish IBI score was 46 (good) and the QHEI was 58 (good) and the macro mIBI score was 40 (fair) and the QHEI was 43 (fair). This site located in lower part of watershed where land use is largely forested. One sample exceeded suggesting event driven nonpoint sources.

Site GMW-060-0025 (T16) is located at St. Marys Road on Pipe Creek. This stream was sampled in 2007 and the geometric mean was 167.57 MPN with 2/5 in exceedance of the single sample maximum. In 2014 the E. coli geometric mean was 365.49 MPN with 3/10 samples exceeding the single sample max. Results from upstream site T17 indicate there are high levels of E. coli flowing into the subwatershed there is still a good percentage of agricultural lands, two CFO hog farms and the Town of St. Marys (unsewered) that could be impacting the stream. Forested land exists around the streams as you work downstream and eventually becomes predominant. There was also one DO reading from 2007 <4 mg/L. In 2002, the fish IBI score was 52 (good) and the QHEI was 57 (good). In 2007, the fish IBI score was 48 (good) and the QHEI was 78 (excellent) and the macro mIBI score was 42 (fair) and the QHEI was 79 (excellent). In 2014, the fish IBI score was 48 (good) and the QHEI was 66 (good) and the macro mIBI score was 42 (fair) and the QHEI was 55 (good). GM 365 cfu/100 mL. Two CFO hog farms in upper drainage w/high percentage of agricultural fields and pasture.

Site GMW-06-0006 (P10) is located on Walnut Fork Road on Walnut Fork. The E. coli in 2007 had a geometric mean of 141.05 MPN with 2/5 samples exceeding the single sample max. In 2014, the geometric mean was 156.6 with 1/5 samples exceeding the single sample max. In 2014, the fish IBI score was 40 (fair) and the QHEI was 55 (good) and the macro mIBI score was 46 (good) and the QHEI was 51 (fair). The land use is dominated by forested lands. Wide forested riparian buffers along steep sloping terrain. There are a few agricultural fields in the extreme headwaters and a small portion of the Town of Peppertown (unsewered) is within the drainage.

### 11.3.10 Yellow Bank Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Yellow Bank Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 96 provides a summary of the Yellow Bank Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli* and TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TSS concentrations.

**Table 96. Summary of Yellow Bank Creek Subwatershed Characteristics**

| **Yellow Bank Creek (050800030605)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 842.10 | | | | | |
| **TMDL Sample Sites:** GMW-06-0022 (T13), GMW-06-0012 (T19), GMW-06-0002 (P3), GMW-06-0003 (P4), GMW-06-0004 (P5), GMW-06-0005 (P9) | | | | | |
| **Listed Segments:** ING0365_02, ING0365_01, ING0365_T1003 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90 – 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **931.67** | **303.27** | **134.77** | **60.89** | **26.92** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **842.11** | **274.98** | **123.44** | **55.96** | **25.31** |
| ***Margin Of Safety (MOS) (5%)*** | **46.08** | **14.66** | **6.24** | **2.54** | **0.84** |
| ***Future Growth (5%)*** | **43.75** | **13.90** | **5.90** | **2.39** | **0.77** |
| | | | | | |
| **TMDL Sample Sites:** GMW-06-0012 (T19), GMW-06-0002 (P3), GMW-06-0004 (P5), GMW-06-0005 (P9) | | | | | |
| **Listed Segments:** ING0365_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90 – 100 %** |
| **TSS TMDL (lbs/day)** | **450904.2** | **147381.57** | **65997.28** | **30310.55** | **13903.92** |
| ***Wasteload Allocation (WLA): Total*** | **13.59** | **4.45** | **N/A** | **N/A** | **N/A** |
| **Storm Water – Owens Corning (INR700015)** | **12.47** | **4.08** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **406927.43** | **133007.42** | **59562.52** | **27355.22** | **12548.33** |
| ***Margin Of Safety (MOS) (5%)*** | **22545.2** | **7369.08** | **3299.86** | **1515.53** | **695.20** |
| ***Future Growth (5%)*** | **21417.9** | **7000.6** | **3134.9** | **1439.8** | **660.4** |
| | | | | | |

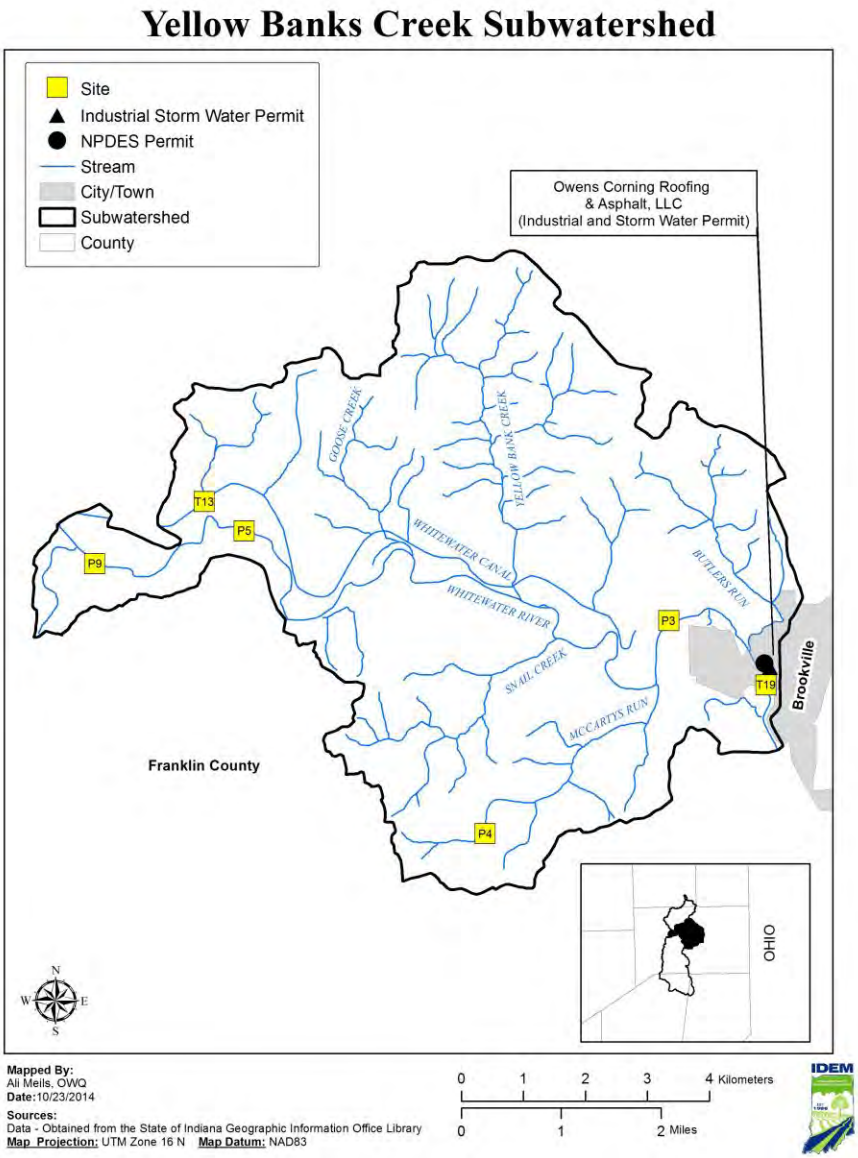


**Figure 95. Sampling Stations in Yellow Banks Creek Subwatershed**

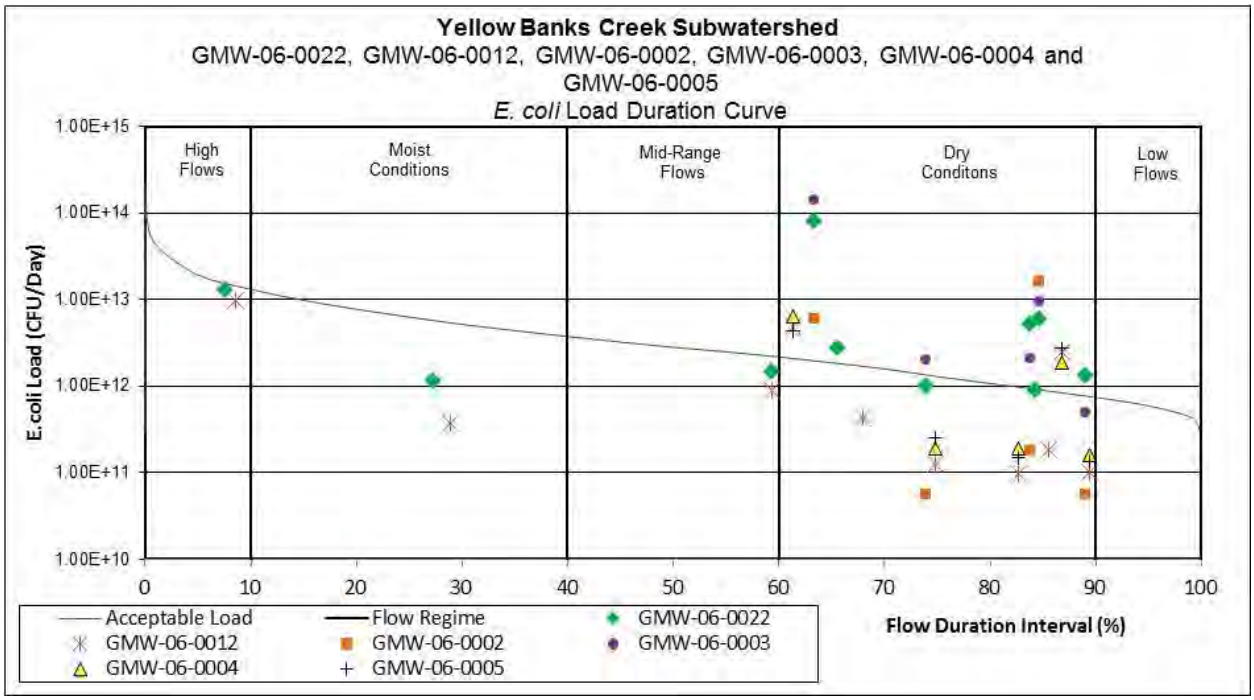


**Figure 96. Load Duration Curve for *E. coli* in the Yellow Banks Creek Subwatershed**

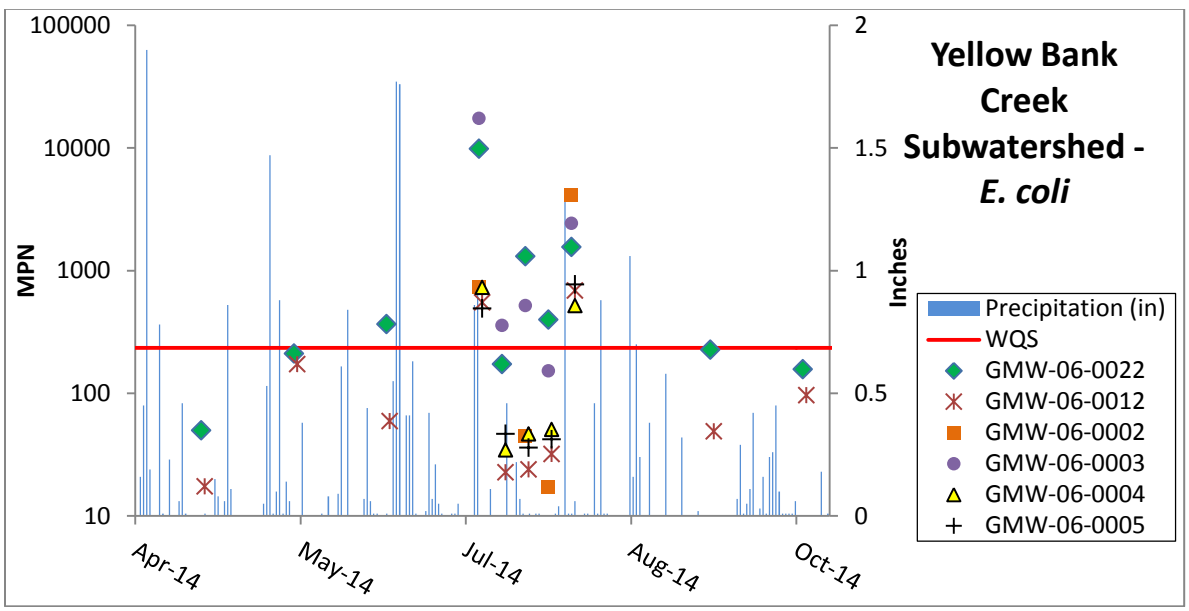


**Figure 97. Graph of Precipitation and *E. coli* Data in the Yellow Bank Creek Subwatershed**

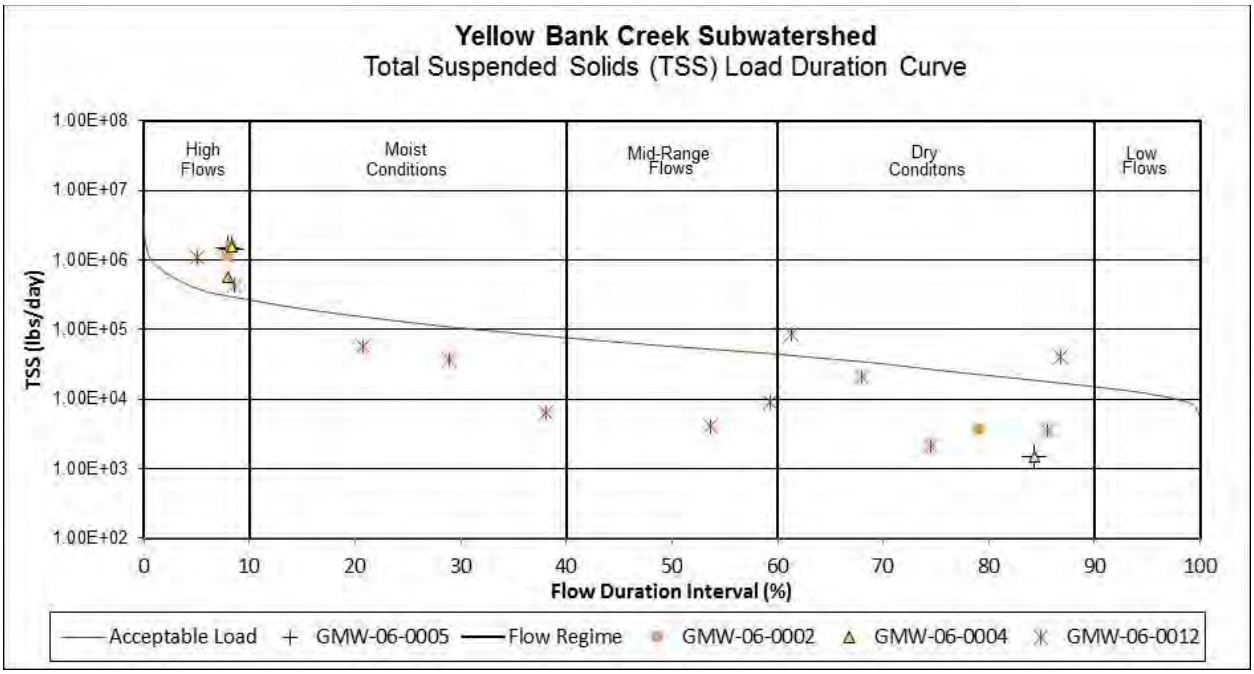


**Figure 98. Load Duration Curve for TSS in the Yellow Banks Creek Subwatershed**

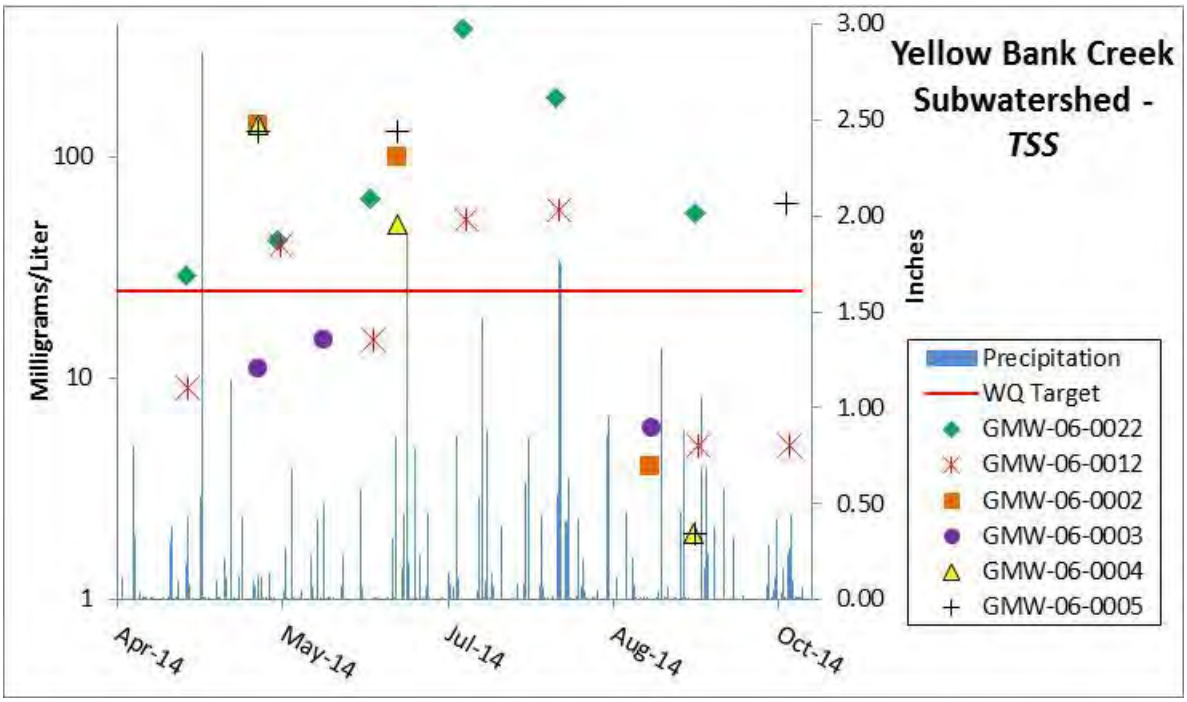


**Figure 99. Graph of Precipitation and TSS Data in the Yellow Bank Creek Subwatershed**

The Yellow Bank Creek subwatershed drains approximately 842 square miles. The Yellow Bank Creek subwatershed runs into mainstem of Whitewater River. The land use is primarily forested (68%) followed by hay and pasture (13%) agricultural land (12%). There are no permitted facilities in the subwatershed. There is no confined animal feeding operation (CAFO) and one confined feeding operation (CFO) partially in the subwatershed. These permits are no discharge permits and as long as the permittee complies with the current discharge regulation and land applies septage as permitted they should not be a

source for the Yellow Bank Creek subwatershed. The majority of the subwatershed is forested but the Brookville is in this watershed. In the forested rural areas homes with pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic system in the area is important to ensure proper function and capacity. The landscape is high gradient with steep hills. Highly erodible soil types make up the very little of this subwatershed, it is mainly around the streams. These soil types can contribute to sediment loss from agricultural lands and stream banks, as well as, lands from the high gradient slopes. Almost no hydric soil types have been identified within this watershed. These areas could be potential areas for wetland restoration. There are very few wetland areas throughout the watershed. There are approximately 52 miles of stream in the subwatershed. Based on IDEM data collected in 2014 there will be 32 stream miles impaired for E. coli listed on the 2016 List of Impaired Waters.

There are four sites GMW-06-0012 (T19) St. Marys Road, GMW-06-0002 (P3) St. Marys Road, GMW-06-0004 (P5) Silver Creek Road, GMW-06-0005 (P9) Penninton road all are located on the Whitewater River mainstem in this subwatershed. The stream is currently impaired for PCBs. This watershed was sampled in 2002 and the fish IBI = 54, QHEI = 77 and macro score = 5.2, QHEI = 77. Working downstream there was another site sampled in 2002 and the fish IBI = 50, QHEI = 75 and the macro score = 6, QHEI = 75. Continuing downstream there were another two sites sampled at the same location. The site in 1997 had a fish IBI = 50, QHEI = 81 and in 2002 the fish IBI = 52, QHEI = 77 and macro score = 6, QHEI = 77. Even further downstream there were two sites sampled in 2007 and the fish IBI = 50, 52 QHEI = 78,85 and macro mIBI = 44, 42 QHEI = 58, 75. In 1994 there was another site sampled very close to site T19 and the macro score was 4, QHEI = 87.

In 2007 there was a site sampled for E. coli and the geometric mean was 43.28 MPN, 66.29 MPN. In 1994 there was another site sampled very close to site T19 and the macro score was 4, QHEI = 87. In 2014 there were four sites sampled along this watershed. Entering the mainstem are Salt Creek(T10) = 177.69 , West Fork Whitewater River (T11) = 81.42 MPN , Duck Creek (T12) = >12000 MPN during rain events , and Pipe Creek (T14) = 136.81 MPN. Working in a downstream direction the 2014 E. coli results are P9 = 121.35 MPN, P5 = 124.85 MPN, P3 = 117.51 MPN, and T19 = 91.55 MPN. 2014 biological community scores working in a downstream direction are P9 fish IBI = 54, QHEI = 80 and macro mIBI = 44, QHEI = 71, P5 fish IBI = 54, QHEI = 82 and macro mIBI = 42, QHEI = 70, P3 fish IBI = 48 QHEI = 71 and macro mIBI = 44, QHEI = 64, T19 fish IBI = 54, QHEI = 78 and macro mIBI = 36, QHEI = 69. Land use is dominated by steep forested land mixed with small pockets of agriculture. Most of your agricultural lands are in the extreme headwater areas or in the flood plain where the land flattens out. This mainstem flows from Metamora to Brookville. It is mostly forested and rural in between the two Towns but there could be some urban impacts downstream towards Brookville given the amount of impervious surface.

Site GMW-060-0022 (T13) is located at Park Avenue on whitewater Canal. Both these AUIDs are on the Whitewater canal. The canal does not follow normal drainage patterns so a small portion of the canal flows through the Duck Creek subwatershed. The canal at one point is raised via an aquaduct and flows over Duck Creek. This aquaduct was seen leaking into Duck Creek containing heavy loads of sediment. The Whitewater canal begins in Laurel Indiana where a low head dam pumps water from the river into the canal. The canal is currently impaired for E. coli based on a sample collected in 2002 with a geometric mean of 478.93 MPN. In 2014 the E. coli geometric mean was 1062.58 MPN with 5/10 samples exceeding the single sample max. In 2014, the fish IBI score was 16 (very poor) and the QHEI was 25 (very poor) and the macro mIBI score was 36 (fair) and the QHEI was 24 (very poor). The TP target was exceeded one time in July with a 0.5 mg/L result. The TSS target was exceeded 6/7 times with the highest concentration at 380 mg/L. High levels of sediment in the water can negatively impact biological communities. The very poor habitat indicated by the QHEIs is also contributing to poor biological communities. The canal flows through the Town of Metamora and it is also used to power a grain mill in

Metamora. The canal does not fit the natural drainage of most watersheds so it is difficult to determine drainage area and contributing nonpoint sources. Previously impaired based on data collected in 2002. Recent data indicates impairment persists. Geometric mean of 1063 cfu/100 mL. The Canal starts in Laurel, IN (sewered) where there is a lowhead dam that may be restricting fish movement. There are no buffer, knee deep muck. Possibly tile drains draining ag land but no readily apparent source.

Site GMW-060-0003 (P4) is located on St. Mary Road on McCarty S Run. In 2014 the E. coli geometric mean was 1031.54 MPN with 4/5 samples exceeding the single sample max. In 2014, the fish IBI score was 22 (very poor) and the QHEI was 67 (good) and the macro mIBI score was 38 (fair) and the QHEI was 63 (poor). This is a small headwater stream with steep forested terrain. The site is surrounded by wide forested riparian buffers. There are small clusters of homes in the drainage area. Geometric mean of 1,031 cfu/100 mL. Site located in extreme headwaters of the watershed and is mostly forested. Results suggest septic's are most likely source due to continuously high results suggesting consistent loads.

### 11.3.11 Headwaters Blue Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Headwaters Blue Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 97 provides a summary of the Headwaters Blue Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 97. Summary of Headwaters Blue Creek Subwatershed Characteristics**

| **Headwaters of Blue Creek (050800030801)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 18.31 | | | | | |
| **TMDL Sample Sites:** GMW-08-0022 (T24), GMW-08-0014 (T23), GMW-08-0001 (P2) | | | | | |
| **Listed Segments:** ING0381_01 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 – 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90-100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **418.40** | **136.75** | **61.24** | **28.12** | **12.90** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **377.59** | **123.42** | **55.28** | **25.42** | **11.66** |
| ***Margin Of Safety (MOS) (5%)*** | **20.9** | **6.84** | **3.06** | **1.41** | **0.65** |
| ***Future Growth (5%)*** | **19.9** | **6.5** | **2.9** | **1.3** | **0.6** |
| | | | | | |

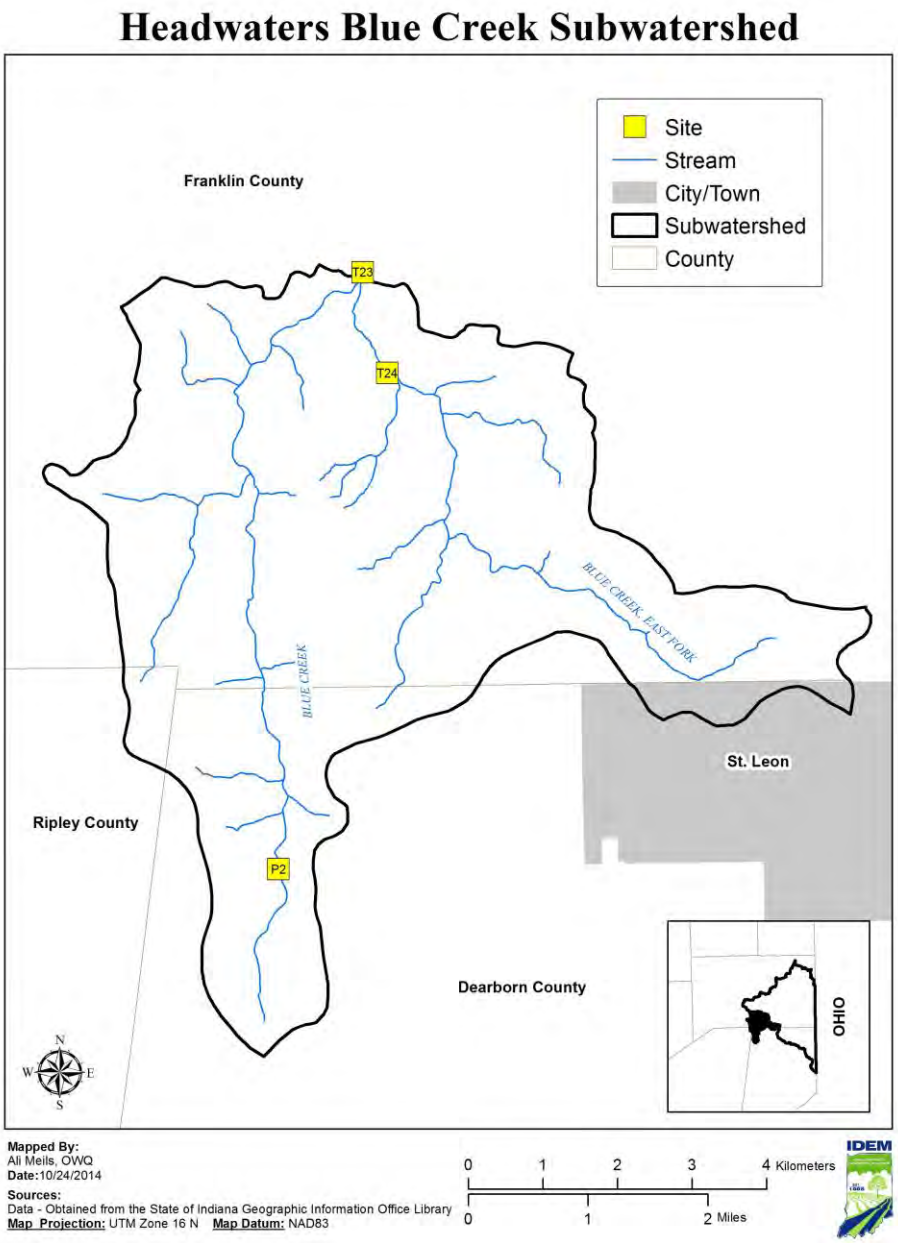


**Figure 100. Sampling Stations in Headwaters Blue Creek Subwatershed**

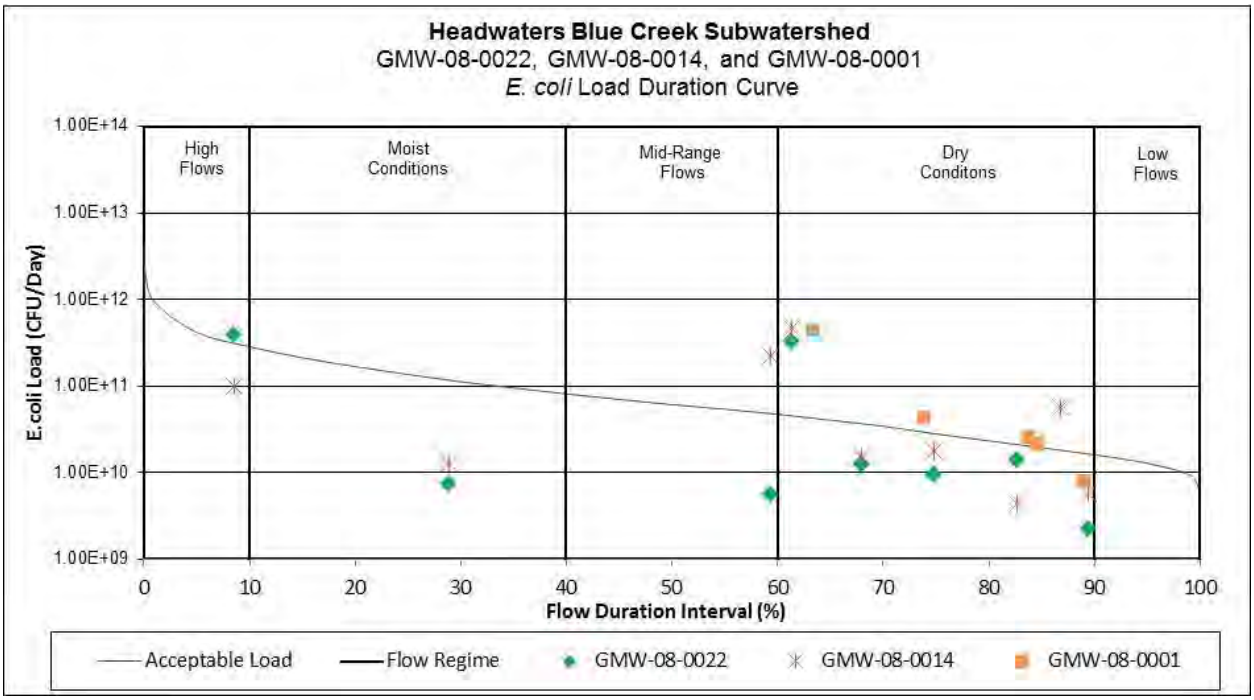


**Figure 101. Load Duration Curve for Most Representative Site in the Headwaters Blue Creek Subwatershed**

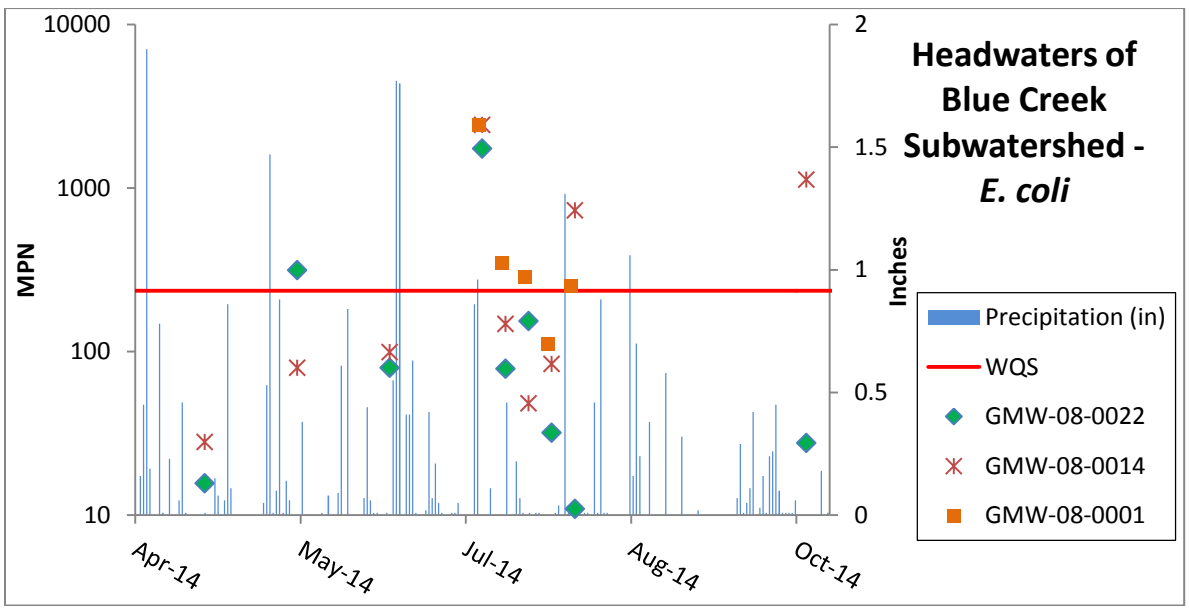


**Figure 102. Graph of Precipitation and *E. coli* Data in the Headwaters of Blue Creek Subwatershed**

The Headwaters of Blue Creek drain approximately 18 square miles. The land use is primarily forested land (50%) followed by agriculture (31%) and hay and pasture land (14%). A portion of the Town of St. Leon is located in the subwatershed. Since there is little development in this subwatershed the majority of homes pump to on-site septic systems. Based on the septic suitability of the soil, almost the entire subwatershed is classified as very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the stream channels. Highly erodible soil types make up the majority of this subwatershed. These soil types can contribute to sediment loss from agricultural

lands, as well as, lands from the high gradient slopes. There are large areas in the extreme headwaters identified as having hydric soil types. These areas could be potential areas for wetland restoration. While there are no permitted NPDES facilities in the subwatershed there is one confined feeding operation, as well as, numerous small animal farms. The total number of animal units in this area (83 animals/square mile) is the highest in the Whitewater River watershed. There are approximately 29 miles of stream in the subwatershed. According to the Draft 2012 List of Impaired Waters there are no impaired stream segments in the subwatershed. There had also been no historical samples collected in the subwatershed. Based on IDEM data collected in 2009, 2013 and 2014 there will be 14 stream miles impaired for *E. coli* in the subwatershed.

In September and October of 2009 IDEM collected data from a site (GMW080-0045) along East Fork Blue Creek at Blue Creek Road. *E. coli* and hydrolab chemistry readings were sampled once per week for five weeks at this site. The *E. coli* geometric mean at this site was 85.78 MPN/100mL which is below the Indiana water quality standard of (125 MPN/100mL). This site was resampled in 2014 as part of the watershed characterization study. This site in 2014 was T24 (GMW-08-0022). The *E.coli* sampled in July and August resulted in a geometric mean of 93.64 MPN/100mL which is also below the WQS. *E. coli* was sampled ten times from April through October and exceeded the WQS two times (May and July). The sampling exceedance in May was during high flow conditions and was slightly over the WQS. The exceedance in July was significant and occurred during dry flow conditions but followed a 1 inch rain event. The data results for this site shows the stream regularly has low levels of *E. coli* across several years but is susceptible to high loads of *E. coli* from run-off following rainfall events. The steep slopes and agricultural lands in the headwaters may be contributing to the high levels of *E.coli*. In 2013 and 2014 water chemistry, fish and aquatic insects were also collected at this site. There were no significant water chemistry violations. The fish community IBI score was 41 which is considered fair and the habitat score was 64 which is considered good. The macroinvertebrate community IBI score was 40 which is considered fair and the habitat score was 64 which is considered good.

Site P2 (GMW-08-0001) on Blue Creek was sampled as part of the IDEM probabilistic sampling program. The site is located close to the origin of Blue Creek. In 2014, the *E. coli* geometric mean was 366.17 MPN/100mL which is slightly above the Indiana water quality standard. In 2014 *E. coli* was sampled five times in July and August and exceeded the WQS four times. According to the load duration curve and precipitation graphs (Appendix B) all sites were sampled during dry, low flow conditions. The highest concentrations can be attributed to rainfall events but high levels of *E. coli* remained constant throughout sampling. This stream is uncharacteristic of the subwatershed and is surrounded by agricultural land use with little to no riparian buffers along the stream. The precipitation graph for this site shows the stream is susceptible to high loads of *E. coli* from run-off but there may also be contributions from failing septic systems. The overuse of manure application to agricultural fields or the mishandling of animal waste could also contribute to high levels of bacteria in the stream. In 2014 water chemistry, fish and aquatic insects were also collected at this site. There were dissolved oxygen violations at all ten sampling events. The fish community IBI score was 32 which is considered poor and is considered not to be fully supporting for aquatic life. The habitat score was 62 which is considered good and means the habitat exists to support a healthy fish community. Dissolved oxygen is essential for the survival of aquatic organisms. When dissolved oxygen drops below 5mg/L, aquatic life is put under stress and since dissolved oxygen was never recorded above 4mg/L it is a likely candidate for the poor biological communities. It was also recorded that a beaver dam exists just upstream of the bridge at this site. This could be restricting flow and contributing to the low dissolved oxygen. The macroinvertebrate community IBI score was 28 which is considered poor and the habitat score was 46 which is considered fair.

Site GMW-08-0014 which is site T23 is not within the Headwaters of Blue Creek watershed boundary but it represents the pour point the subwatershed. The site is located just downstream of the confluence between East Fork Blue Creek and mainstem Blue Creek. The site is located on Blue Creek at Blue Creek

Road. This site was sampled in 2009 for *E. coli* only and again in 2013 and 2014 for *E. coli*, water chemistry, and biological communities. In 2009 the *E. coli* geometric mean was collected in September and October and was below the WQS at 30.80 MPN/100mL. In 2014 the geometric mean was collected in July and August and was slightly higher (253.44 MPN/100mL) than the WQS. Based on the load duration curve, samples were high during the midrange and dry flow regimes and exceeded the single sample maximum of 235 MPN/100mL three out of ten times. Two of the exceedances can be attributed to rainfall events which suggest the subwatershed is susceptible to high bacteria loads from runoff. Total suspended solids were also above the TMDL target (30 mg/L) during the August sampling event. The fish community IBI score was 45 which is considered good and the habitat score was 56 which is considered fair. The macroinvertebrate community IBI score was 36 which is considered fair and the habitat score was 58 which is considered good. Excessive algae growing on rocks in stream was also observed during several site visits which can be caused by excessive nutrient loading. Overall the majority of the streams have wide forested riparian areas which are ideal for filtering out pollutants and reducing runoff. The topography contains some steep gradients that naturally erode and cause fast transportation of runoff during rainfall events. There is heavier agricultural land uses with narrow riparian areas in the headwater areas, as seen in site P2, but the stream recovers as it moves downstream. Further investigation may be needed to identify causes of low dissolved oxygen in the headwaters of Blue River.

### 11.3.12 Wolf Creek – Blue Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Wolf Creek-Blue Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 98 provides a summary of the Wolf Creek-Blue Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 98. Summary of Wolf Creek-Blue Creek Subwatershed Characteristics**

| **Wolf Creek-Blue Creek (050800030802)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 32.85 | | | | | |
| **TMDL Sample Sites:** GMW-08-0026 (T21), GMW080-0003 (T22), GMW-08-0014 (T23) | | | | | |
| **Listed Segments:** ING0382_01, ING0382_02 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **332.24** | **108.59** | **48.63** | **22.33** | **10.24** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **299.84** | **98.01** | **43.89** | **20.16** | **9.24** |
| ***Margin Of Safety (MOS) (5%)*** | **16.61** | **5.43** | **2.43** | **1.12** | **0.51** |
| ***Future Growth (5%)*** | **15.78** | **5.16** | **2.31** | **1.06** | **0.49** |

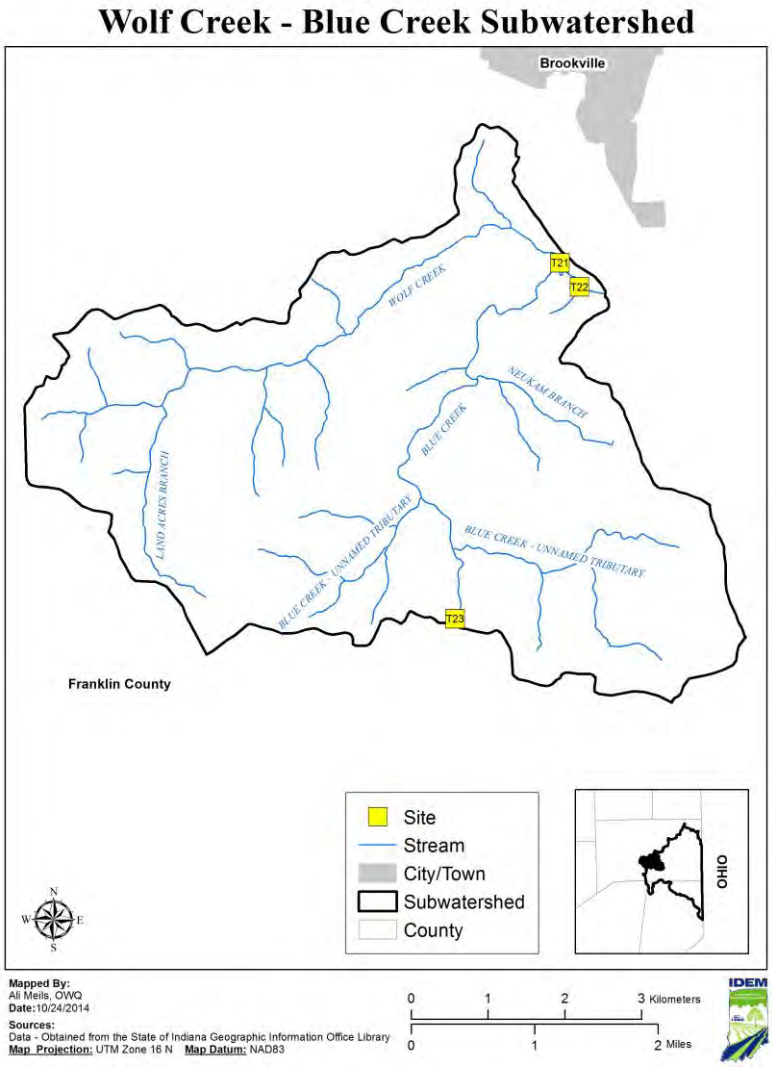


**Figure 103. Sampling Stations in Wolf Creek – Blue Creek Subwatershed**

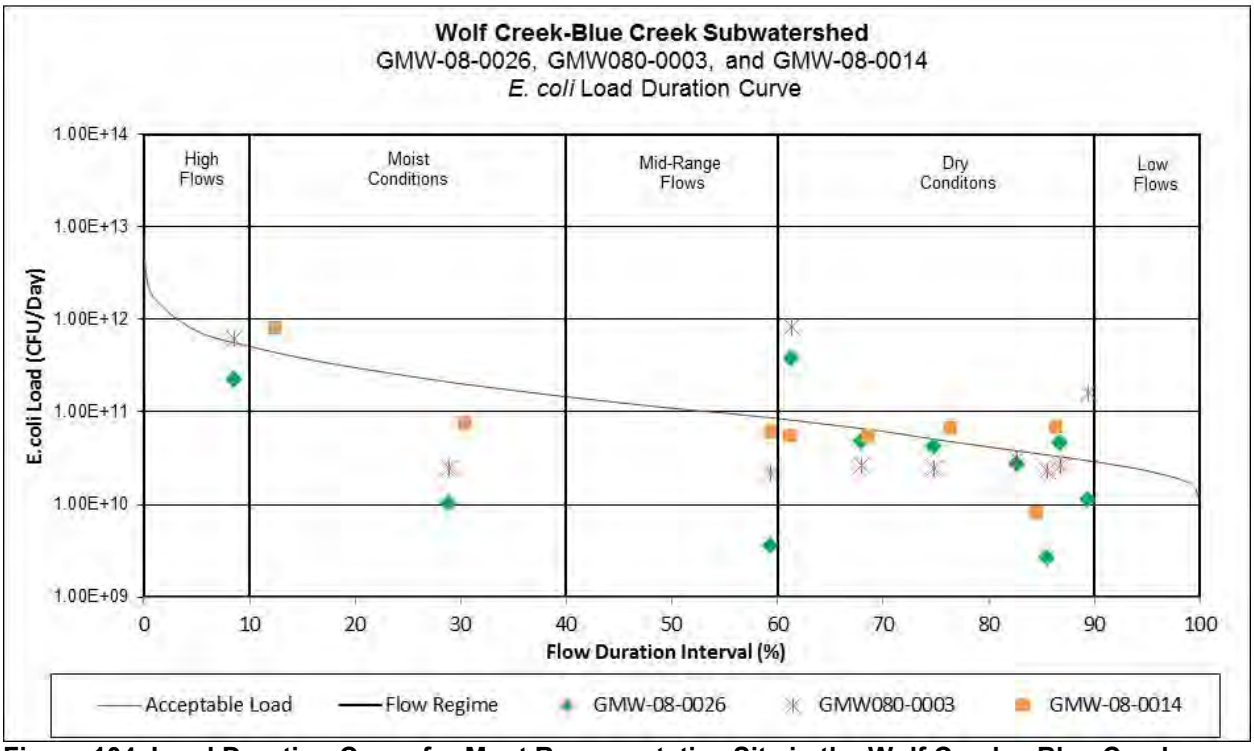


**Figure 104. Load Duration Curve for Most Representative Site in the Wolf Creek – Blue Creek Subwatershed**

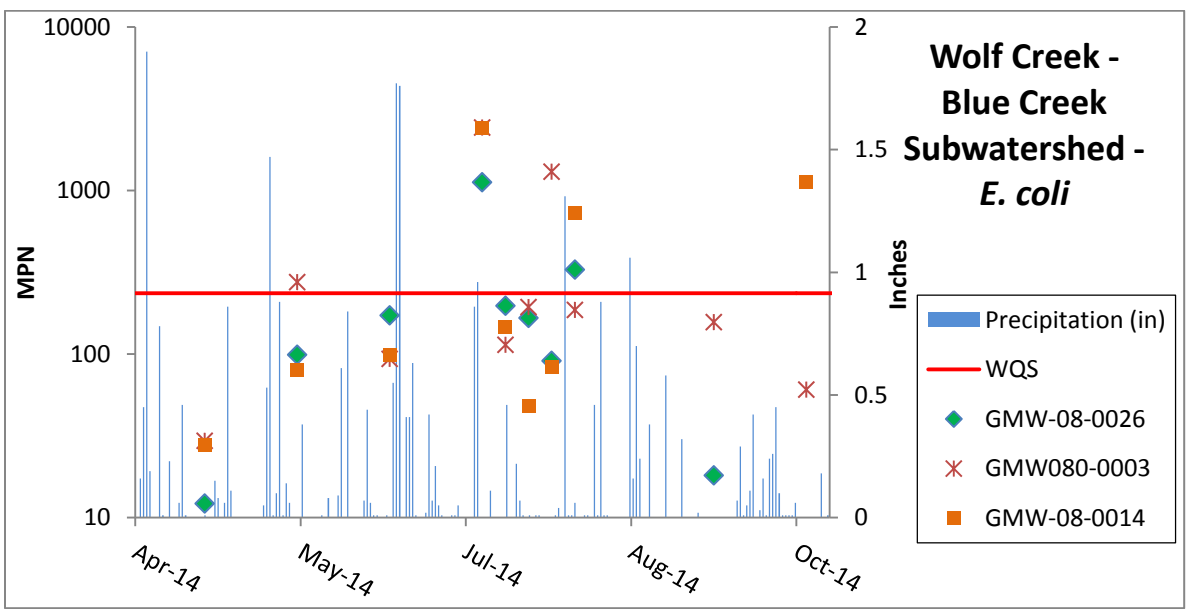


**Figure 105. Graph of Precipitation and *E. coli* Data Site in the Wolf Creek – Blue Creek Subwatershed**

The Wolf Creek subwatershed drains approximately 15 square miles. The Wolf Creek subwatershed drains into the mainstem of the Whitewater River through Blue Creek. The land use is primarily forest (63%) followed by agriculture (17%) and hay and pasture land (16%). There are no permitted facilities in the subwatershed. While the Town of Oak Forest is within this watershed, the majority of the subwatershed is rural indicating homes pump to on-site

septic systems. The land use is primarily steep forested lands that make up the valleys of both Wolf and Blue creek. However in the upland plains the land use is dominantly agriculture. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of agricultural fields in the headwaters and becomes steeper towards the base of the subwatershed. Highly erodible soil types are found in the hillsides that drain into creek and make up much of the eastern portion of the subwatershed. While much of these areas are forested agricultural practice is occurring in some erodible areas. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There is a small area in the south eastern portion of the watershed where hydric soils exits. This area could be potential areas for wetland restoration. The land use is comprised of 16 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (59 animals/square mile) is just above median concentration when compared to other subwatersheds in the Whitewater River subwatershed. There are approximately 29 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 12 stream miles impaired for *E. coli*, and 5 miles of IBC impairment listed on the 2016 List of Impaired Waters.

There are three sites located in this subwatershed, two located on Blue Creek GMW-08-0014 (T23) and GMW080-0003 (T22) and one located on Wolf Creek GMW-08-0026 (T21). The mainstem Blue Creek is currently impaired for E. coli. A 2007 probabilistic site was sampled downstream of site T23 and had a geometric mean of 23.97 MPN. Site T23 had a geometric mean in 2009 of 30.79 MPN and the geometric mean collected at the same site in 2014 was 253.44 MPN. The site had DO readings in July and August near 4 mg/L but not below. The field notes recorded that there was pooling and very low flow, which is likely a natural condition during hot, dry summer months. These low DO readings could negatively impact the biological communities. Site T22 is located at the pour point of the subwatershed. The geometric mean from a sample taken at this site in 2002 was 515.19 MPN which is what caused the initial impairment. In 2014, the geometric mean at site T22 was 418.71 MPN with 3/10 sites in exceedance of the single sample maximum. T21 is currently impaired for E. coli based on the site sampled on the Blue Creek in 2002. Since that time the stream reaches have been resegmented. The site, T21, located on this stream had a geometric mean of 255.39 MPN, having only exceeded the single sample maximum 2/10 times.

The fish community IBI score for site T23 was 42 (fair) and the QHEI was 56 (good). The macro community mIBI score was 36 (fair) and the QHEI was 58 (good). The biological communities at a site downstream (GMW080-0036) sampled in 2007 had a fish IBI = 48 (good) QHEI = 78. The fish community IBI score for site T22 was 48 (good) and the QHEI was 52 (fair). The macro community mIBI score was 34 (poor) and the QHEI was 63 (good). There was no biological community sampled at this site in 2002. The fish community IBI score for site T21 was 38 (fair) and the QHEI was 64 (good). The macro community mIBI score was 36 (fair) and the QHEI was 62 (good). While both T23 and T22 are located on the same AUID site T22 represents the condition of this particular AUID. Site T23 represents the condition of the Headwaters Blue Creek subwatershed. This is why the sample results from site T22 were used in the IBC impairment.
While both T23 and T22 are located on the same AUID site T22 represents the condition of this particular AUID. Site T23 represents the condition of the Headwaters Blue Creek subwatershed. This is why the sample results from site T22 were used in the IBC impairment.

### 11.3.13 Big Cedar Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Big Cedar Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 99 provides a summary of the Big Cedar Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 99. Summary of Big Cedar Creek Subwatershed Characteristics**

| **Big Cedar Creek (050800030803)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 29.61 | | | | | |
| **TMDL Sample Sites:** GMW-08-0016 (T26), GMW-08-0024 (T27) | | | | | |
| **Listed Segments:** ING0383_01, ING0383_02, ING0383_T1003, ING0383_T1004, ING0383_T1005 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 - 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **676.7** | **221.24** | **99.13** | **45.58** | **20.96** |
| ***Wasteload Allocation (WLA): Total*** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** |
| **Big Cedar Mobile Home Park WWTP (IN0037168) 0.0108 MGD** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** |
| ***Load Allocation (LA)*** | **610.61** | **199.58** | **89.37** | **41** | **18.81** |
| ***Margin Of Safety (MOS) (5%)*** | **33.8** | **11.06** | **4.96** | **2.28** | **1.05** |
| ***Future Growth (5%)*** | **32.1** | **10.5** | **4.7** | **2.2** | **1.0** |

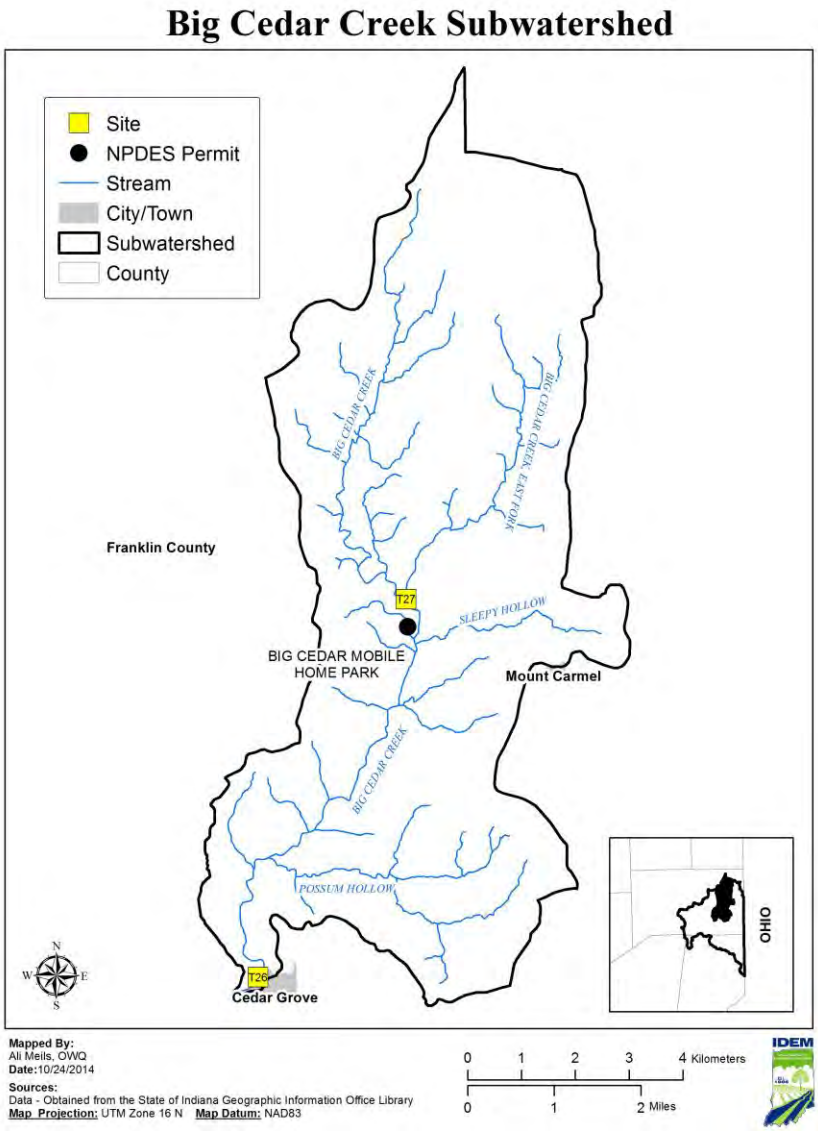


**Figure 106. Sampling Stations in Big Cedar Creek Subwatershed**

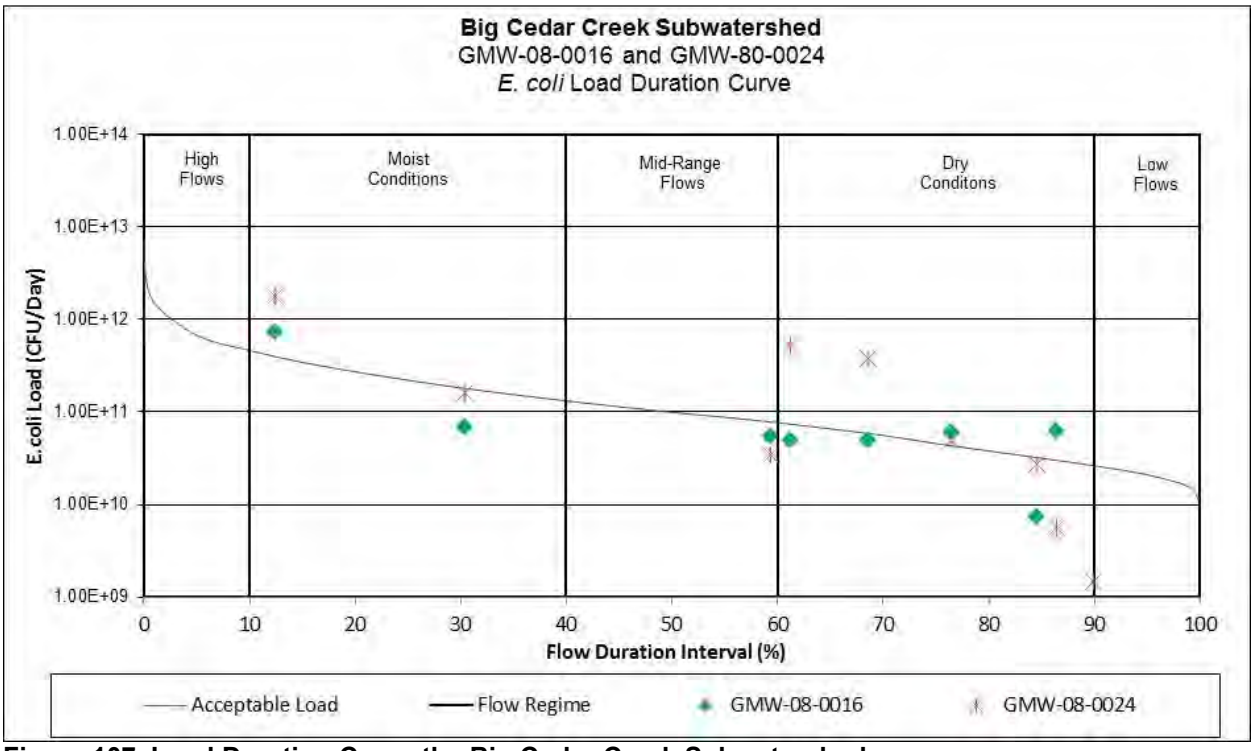


**Figure 107. Load Duration Curve the Big Cedar Creek Subwatershed**

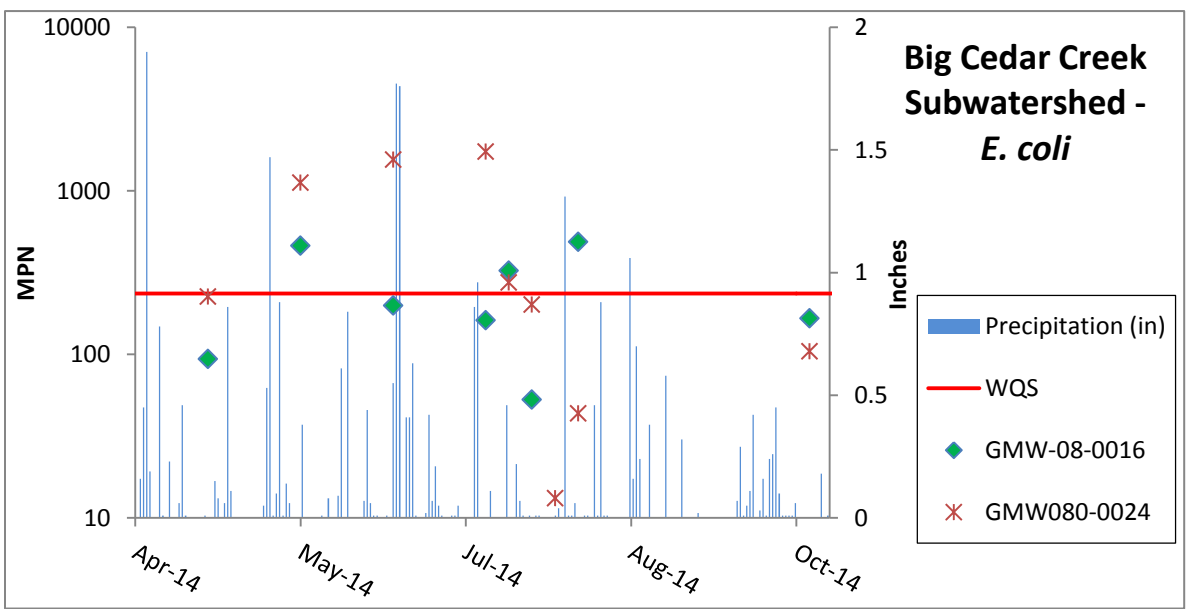


**Figure 108. Graph of Precipitation and *E. coli* Data in the Big Cedar Creek Subwatershed**

The Big Cedar Creek subwatershed drains approximately 27 square miles. The Big Cedar Creek subwatershed drains into the mainstem of the Whitewater River. The land use is primarily agriculture (50%) followed by forested land (17%) and hay and pasture land (11%). There are one permitted facilities in the subwatershed, the Big Cedar Mobile Home Park WWTP. The subwatershed is rural indicating homes pump to on-site septic systems. There are no incorporated towns within the subwatershed. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and

capacity. The landscape in the area consists of gentle rolling hills in the headwaters and becomes steeper towards the base of the subwatershed. The land use is primarily agricultural in the headwaters, with pasture land and forested areas making up the hills in the southern portion of the subwatershed. Highly erodible soil types make up nearly half of this subwatershed. The majority of the HEL lands are located in the southern portion of the subwatershed, which is characterized by wooded hillsides. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are small area in the northern portion of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 11 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (55 animals/square mile) which is median concentration when compared to other subwatersheds in Salt Creek. There are approximately 52 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 40 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

There are two sites located in this subwatershed, both located on Big Cedar Creek GMW-08-0016 (T26) and GMW-08-0024 (T27). Site T26 was previously impaired for E. coli based on historical samples collected in 2002 and the geometric mean was 169.92 MPN with only 1/5 in exceedance of the single sample maximum. In 2014 there was no geometric mean because the site went dry. There were 3/8 in exceedance of the single sample maximum and that is > 10% which means this site will remain impaired for E. coli. The nitrogen was high Jan - May although they were not in exceedance of WQ targets. This could indicate manure spreading on frozen ground or potentially the only point source in the subwatershed which is Big Cedar Mobile Home Park. They were in significant noncompliance from 2009-2011 and their most recent enforcement action was in Nov. 2013. Eight informal enforcement actions and one formal action violations include DO, TSS, Chlorine, Ammonia, CBOD, and E. coli. Site T27 was sampled in 2014 and the E. coli geometric mean was 140.74 MPN and 4/8 samples were in exceedance of the single sample maximum. In 2009, this stream was sampled farther upstream and the geometric mean was 1060.20MPN. In addition, there were high levels of nutrients in 2014 from April - June although the levels were not above the WQ target.

The fish community IBI score for site T26 was 42 (fair) and the QHEI was 59 (good). The macro community mIBI score was 38 (fair) and the QHEI was 61 (good). The biological scores indicate there has been degradation in the fish community over the last 12 years. The fish community IBI score for site T27 was 40 (fair) and the QHEI was 68 (good). The macro community mIBI score was 42 (fair) and the QHEI was 58 (good).

### 11.3.14 Little Cedar Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Little Cedar Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 100 provides a summary of the Little Cedar Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli,* nutrient, and TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli,* nutrient, and TSS concentrations.

**Table 100. Summary of Little Cedar Creek Subwatershed Characteristics**

| **Little Cedar Creek (050800030804)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 1284.04 | | | | | |
| **TMDL Sample Sites:** GMW-08-0015 (T25), GMW-08-0013 (P7) | | | | | |
| **Listed Segments:** ING0384_01, ING0384_T1001, ING0384_T1003 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 - 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **612.80** | **201.20** | **90.83** | **42.44** | **20.19** |
| ***Wasteload Allocation (WLA): Total*** | **1.33** | **1.33** | **1.33** | **1.33** | **1.33** |
| **Sperry and Rice Mfg. Co. (IN0001473) 0.15 MGD** | **1.33** | **1.33** | **1.33** | **1.33** | **1.33** |
| ***Load Allocation (LA)*** | **551.71** | **180.24** | **80.65** | **36.96** | **16.89** |
| ***Margin Of Safety (MOS) (5%)*** | **30.64** | **10.06** | **4.54** | **2.12** | **1.01** |
| ***Future Growth (5%)*** | **29.11** | **9.56** | **4.31** | **2.02** | **0.96** |
| | | | | | |
| **Drainage Area (sq. mi.):** 1284.04 | | | | | |
| **TMDL Sample Sites:** GMW-08-0015 (T25), GMW-08-0013 (P7) | | | | | |
| **Listed Segments:** ING0384_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 – 90 %** | **90 – 100 %** |
| **TSS TMDL (pounds/day)** | **688,077.06** | **224,903.39** | **100,711.45** | **46,253.72** | **21,217.30** |
| ***Wasteload Allocation (WLA): Total*** | **1.17** | **0.38** | **N/A** | **N/A** | **N/A** |
| ***Construction Activities (0.0023 sq. mi.)*** | **1.17** | **0.38** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **620988.38** | **202974.93** | **90,892.09** | **41743.98** | **19148.62** |
| ***Margin Of Safety (MOS) (5%)*** | **34,403.85** | **11,245.17** | **5,035.57** | **2,312.69** | **1,060.87** |
| ***Future Growth (5%)*** | **32,683.66** | **10,682.91** | **4,783.79** | **2,197.05** | **1,007.82** |

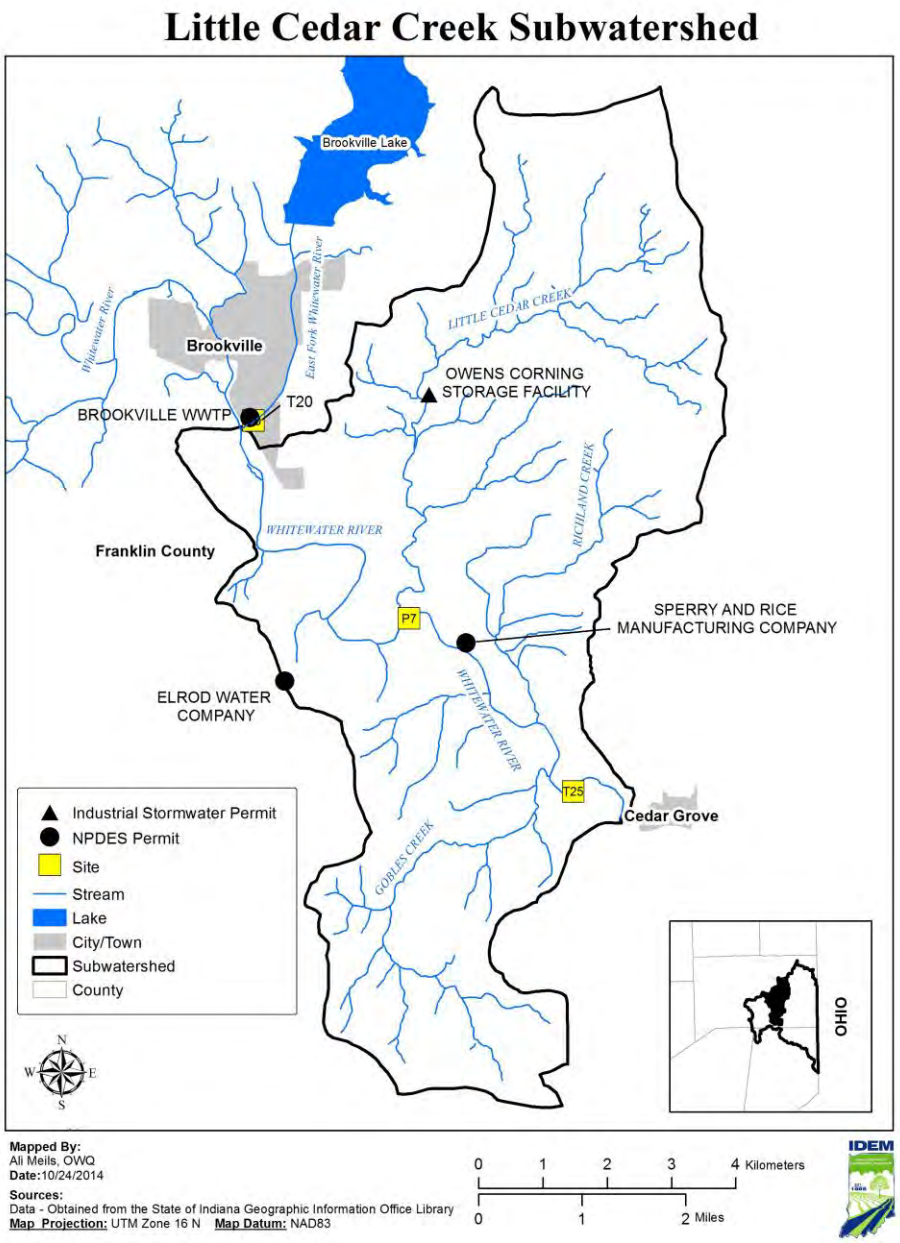


**Figure 109. Sampling Stations in Little Cedar Creek Subwatershed**

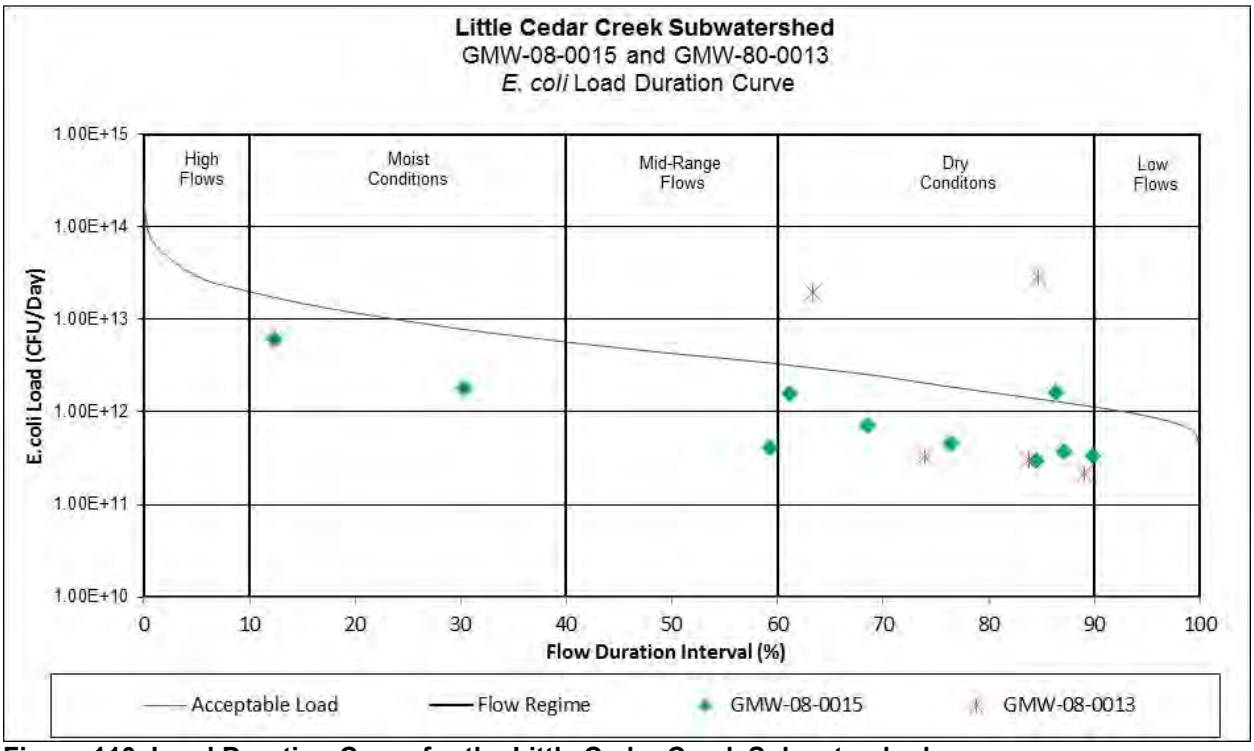


**Figure 110. Load Duration Curve for the Little Cedar Creek Subwatershed**

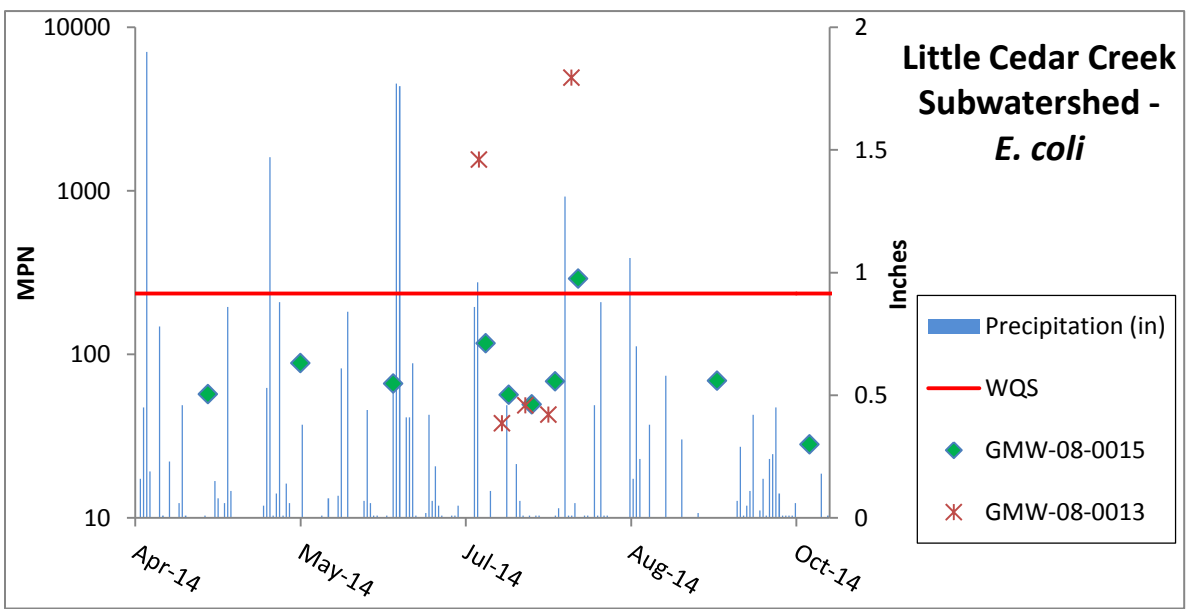


**Figure 111. Graph of Precipitation and *E. coli* Data in the Little Cedar Creek Subwatershed**

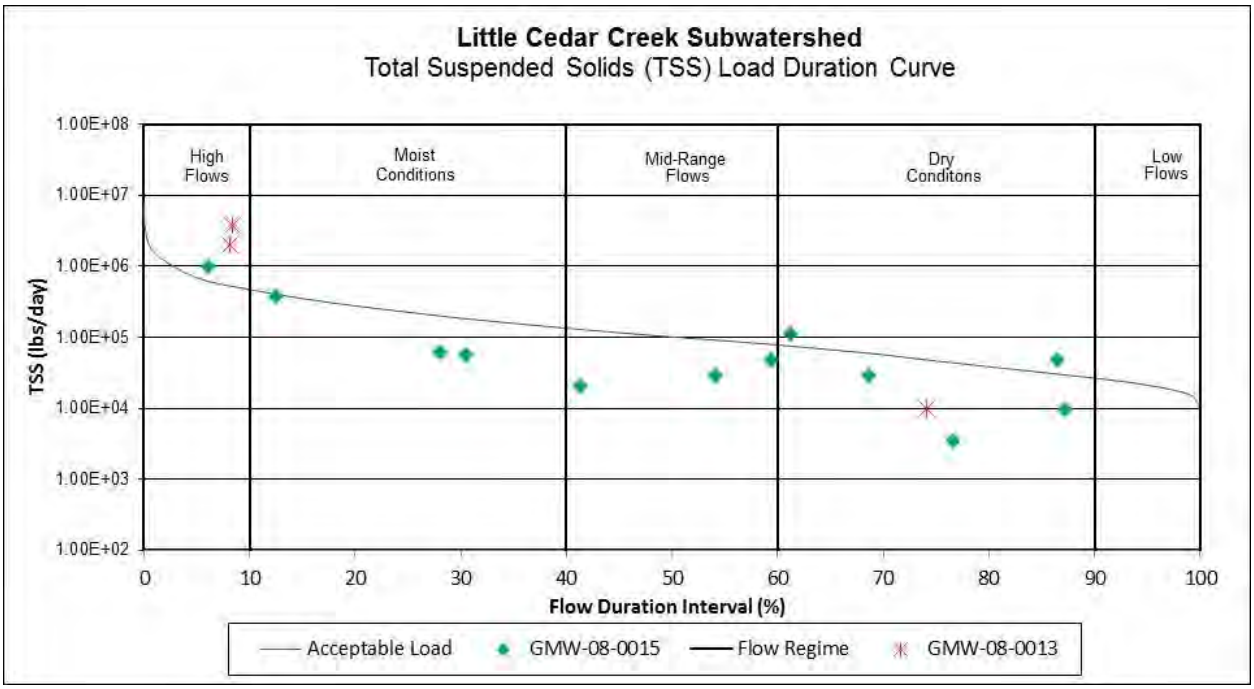


**Figure 112. Load Duration Curve for TSS in the Little Cedar Creek Subwatershed**

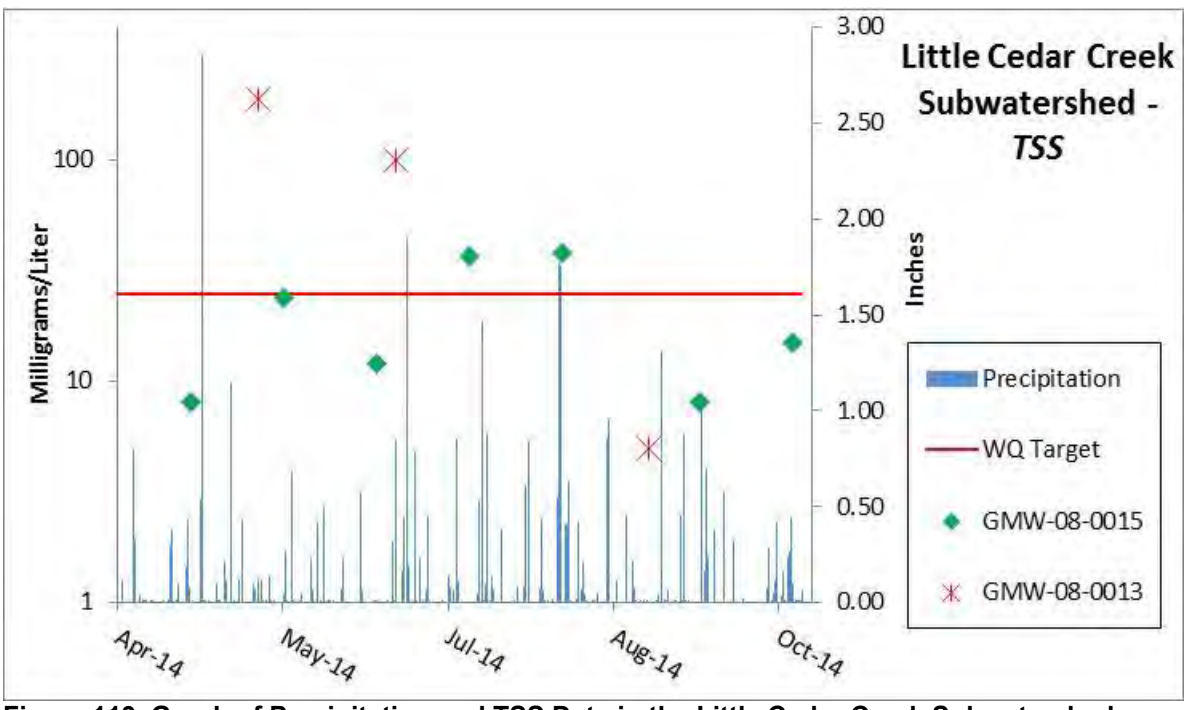


**Figure 113. Graph of Precipitation and TSS Data in the Little Cedar Creek Subwatershed**

The Little Cedar Creek subwatershed drains approximately 27 square miles. The Little Cedar Creek subwatershed drains into the mainstem of the Whitewater River. The land use is primarily forest (45%) followed by agriculture (27%) and hay and pasture land (19%). There are two permitted facilities in the subwatershed, Sperry and Rick Mfg. Co. and Elrod Water Company. The subwatershed is rural indicating homes pump to on-site septic systems. While no incorporated towns lie in the subwatershed, the southern growth of Brookeville does spread into this area. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to

ensure proper function and capacity. The landscape in the area consists of the flat upland plains which have steep drainages as they flow into the Whitewater valley. The land use is predominantly agricultural in the upland and whitewater valley portions of the subwatershed with steep forested areas connecting the two. Riparian zones are wide along these drainages but reduced in many areas along the mainstem of the river. Development is limited in the watershed with interspersed housing a farming operations.
Highly erodible soil types make up most land in this watershed apart from the flat uplands in the north. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are areas in the south and east of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 19 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (62 animals/square mile) which is a higher concentration when compared to other subwatersheds in the Whitewater river. There are approximately 63 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 45 stream miles impaired for *E. coli,* and 25 miles for D.O. listed on the 2016 List of Impaired Waters.

There are two sites located in this subwatershed, both are located on the Whitewater River, GMW-08-0015 (T25) and GMW-08-00013 (P7). This AUID is currently impaired for DO and E. coli. There are no DO violations for site P7, T25 or any of the contributing tributaries we have sampled (T22, T20. T19). The DO impairment should be removed. Original DO impairment was from a 2007 sample on Little Cedar Creek (AUID ING0384_T1001). Since 2007 the streams have been reindexed. We know the geometric means of what is coming into the subwatershed by site T19 (~91 MPN), T20 (~51MPN), and T22 (~418 MPN). In 2002 an E. coli geometric mean of 101 MPN was taken just downstream of site T19. Site P7 is located at the confluence with Little Cedar Creek. The 2014 geometric mean for site P7 227.04 MPN with 2/5 samples exceeding the single sample maximum. Farther downstream, at the base of the subwatershed is site T25 with a geometric mean of 91.73 MPN with 1/10 samples exceeding the single sample maximum. In 2007 a geometric mean of 55.33 MPN was collected at a similar location to T25. There are a number of tributaries entering the mainstrem between the sites which could be diluting the bacteria.

There are historical sites located as the Whitewater River enters the subwatershed and the biological scores were macro mIBI = 6.2 (1994) and 5.4 (1997) both with excellent QHEI scores. In 1994 near site T25 the mIBI = 4 and QHEI = 88. In 1997 near site T25 the mIBI = 5.4 and QHEI = 88 and in 2007 near site T25 the mIBI = 42 and QHEI = 80. The fish IBI at that site in 2007 was 52 and the QHEI = 84.The fish community IBI score for site T25 was 56 (excellent) and the QHEI was 82 (excellent). The macro community mIBI score was 36 (fair) and the QHEI was 77 (excellent). The fish community IBI score for site P7 was 44 (fair) and the QHEI was 83 (excellent). The macro community mIBI score was 36 (fair) and the QHEI was 56 (fair). In 1997 there was fish community sampled just downstream of site P7 and the fish IBI = 38 (fair) and the QHEI = 70 (excellent).

The Sperry and Rice Manufacturing Company and Elrod Water Company are point sources in the watershed. Sperry and Rice is a rubber and sponge manufacturing company and they have been in noncompliance 7/12 quarters and have had 9 informal enforcement actions in the last five years. The only violations recorded have been for DO in 2012. There is one CFO hog farm and a portion of the Town of Stavetown and Palestine that drain into the river or its tributaries.
Whitewater River in this WS is currently indexed as one AUID (ING0384_01) this reach needs to be split at Little Cedar Creek to more accurately capture the potential influences of Brookeville on the upper end of Whitewater River in this WS which would likely not have as great an impact, if any, at its lower end given flow conditions and its overall length. Once reindexed, ING0384_01 will represent the US reach, and ING0384_02 will represent the DS reach. Results for this reach are from a site located midway in the WS and indicate impairment to the upper half of Whitewater River in this WS w/a GM of 227 cfu/100 mL. Results for site 0015 on this lower reach indicate FS w/a GM of 92 cfu/100 mL.

### 11.3.15 Blackburn Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Blackburn Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 101 provides a summary of the Blackburn Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated TSS concentrations.

**Table 101. Summary of Blackburn Creek Subwatershed Characteristics**

| **Blackburn Creek (050800030805)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 1330.85 | | | | | |
| **Listed Segments:** ING0385_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 - 40 %** | **40 - 60 %** | **60 – 90 %** | **90 - 100 %** |
| **TSS TMDL (pounds/day)** | **713,279.98** | **233,221.19** | **104,501.81** | **48,058.80** | **22,109.68** |
| **Wasteload Allocation (WLA): Total** | **201.24** | **161.83** | **142.68** | **142.68** | **142.68** |
| **St. Leon WWTP (IN0058408) 0.57 MGD** | **142.68** | **142.68** | **142.68** | **142.68** | **142.68** |
| **Construction Activities (0.003 sq. mi.)** | **1.53** | **0.50** | **N/A** | **N/A** | **N/A** |
| **Storm Water – Rudicil Sand & Gravel (INR00R073)** | **57.03** | **18.65** | **N/A** | **N/A** | **N/A** |
| **Load Allocation (LA)** | **643391.27** | **210320.30** | **94312.88** | **43373.07** | **19953.98** |
| **Margin Of Safety (MOS) (5%)** | **35,664.00** | **11,661.06** | **5,225.09** | **2,402.94** | **1,105.48** |
| **Future Growth (5%)** | **33,880.80** | **11,078.01** | **4,963.84** | **2,282.79** | **1,050.21** |

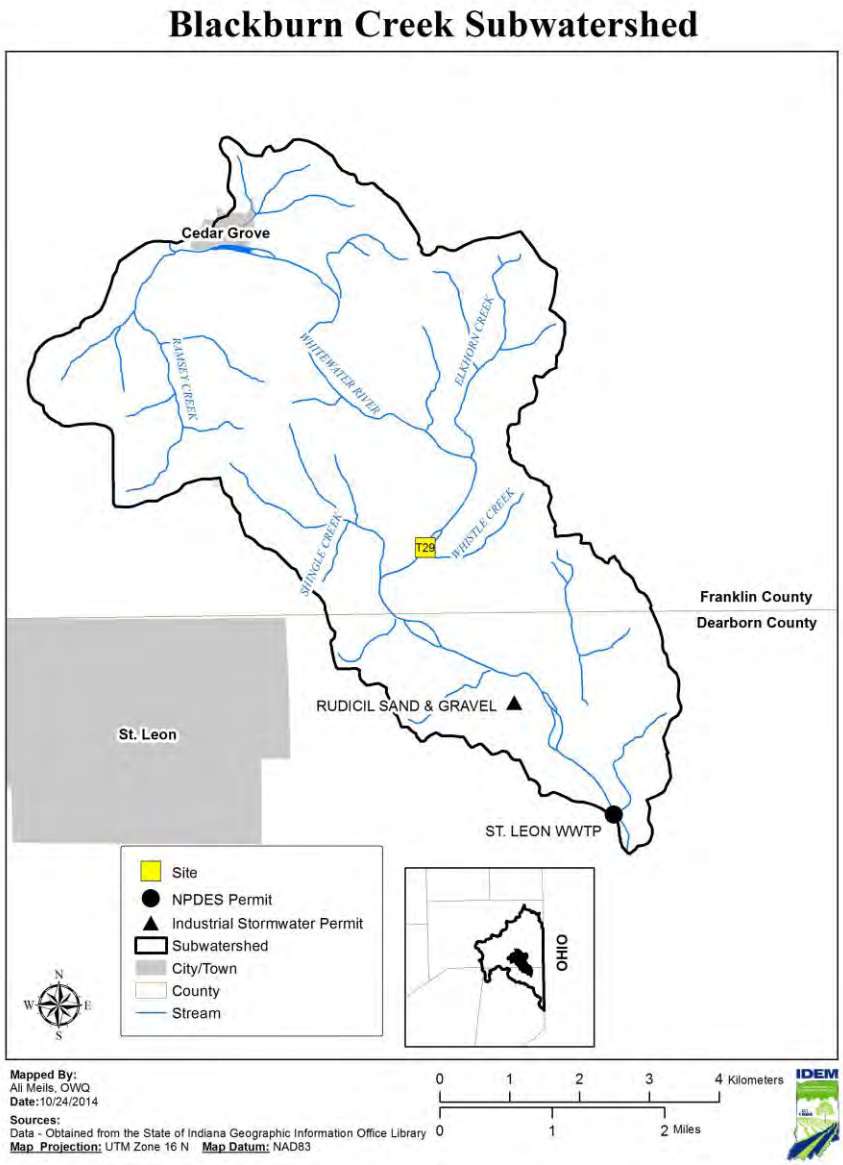


**Figure 114. Sampling Stations in Blackburn Creek Subwatershed**

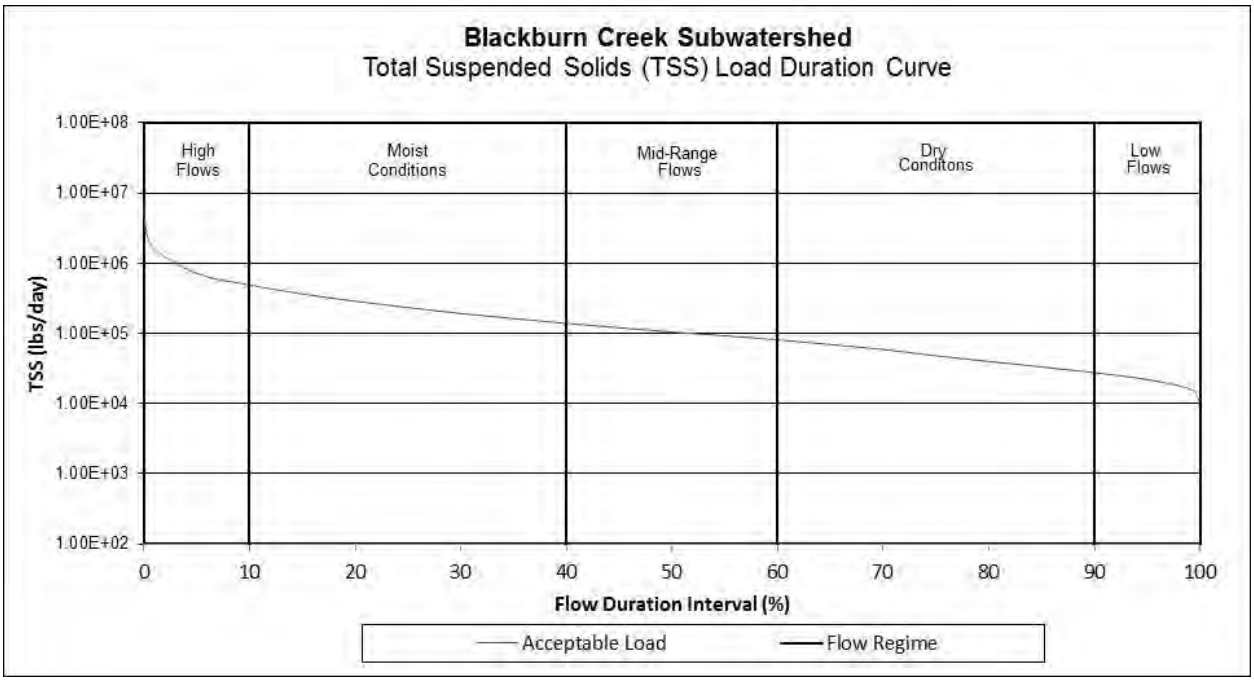


**Figure 115. Load Duration Curve for TSS in the Blackburn Creek Subwatershed**

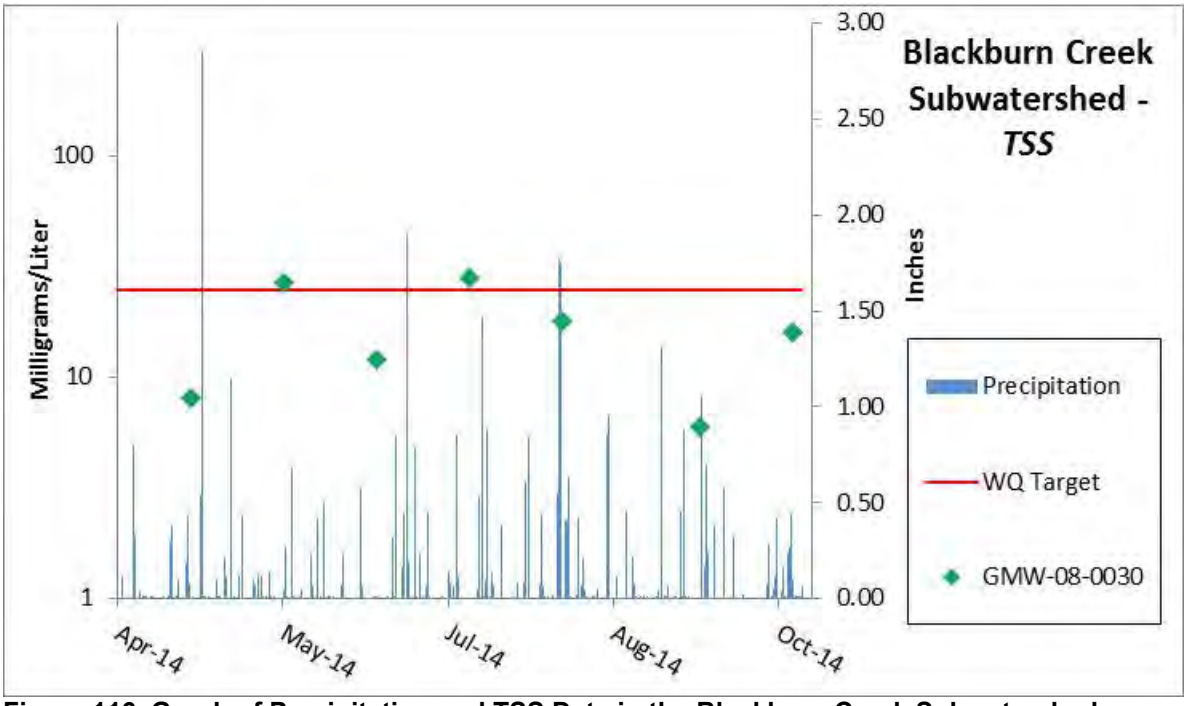


**Figure 116. Graph of Precipitation and TSS Data in the Blackburn Creek Subwatershed**

The Blackburn Creek subwatershed drains approximately 17 square miles. Blackburn Creek subwatershed drains into the mainstem of the Whitewater river. The land use is primarily forest (61%) followed by hay and pasture (19%) and Agriculture (11%). There are two permitted facilities in the subwatershed, St. Leon wastewater treatment plant and Rudicil Sand and Gravel. The majority of the subwatershed is rural

indicating homes pump to on-site septic systems. The small towns of Cedar Grove and New Trenton are within the watershed along U.S. 52. This subwatershed has one CFO hog farm, runoff from the towns of Cedar Grove and New Trenton, some agricultural lands but primarily steep sloping forested lands. There is one sand and gravel quarry with a SW permit. The St. Leon WWTP also discharges at the pour point of this watershed. According to the Dearborn Co. Health Dept. there are two home sewage problem clusters identified that may be impacting this stream (Longnecker Road community with ~ 40 houses and Chappalow Ridge Rd ~40 houses). Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of the flat plain of the Whitewater valley and its steep hillsides on either side of the river. Highly erodible soil types make up the valley walls of this subwatershed. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There is little to no patches of the subwatershed identified as having hydric soil types. The land use is comprised of 19 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (49 animals/square mile) which is median concentration when compared to other subwatersheds in Whitewater River. There are approximately 38 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 11 stream miles impaired for PCB in fish tissue listed on the 2016 List of Impaired Waters.

There is one site located in this subwatershed, two located on the Whitewater River GMW-08-0030 (T29). This AUID is currently impaired for PCBs and Mercury. We know that entering this subwatershed we have loads from site T25 (geometric mean ~91 MPN) and site T26 (3/8 exceeded). There are historical samples located on this stream reach. One of the sites is a fixed station (GMW080-0001) from which there have been samples taken since 1991, none of which have caused an impairment. In 2002, as site at the pour point of the AUID had a geometric mean of ~95. In 2007, there were two probabilistic sites on this AUID and the E. coli results had geometric means of 51.62 and 46.98 MPN. In 2014, site T29 had a geometric mean of 74.82 MPN.

In 2007, biological communities scored the following on this AUID: fish IBI = 50 and 48 (good) QHEI = 86 and 82 (excellent) and macro mIBI = 38 and 42 (fair) QHEI = 83 and 73 (excellent). In 2104 he fish community IBI score for site T29 was 50 (Good) and the QHEI was 82 (Excellent). The 2014 macro community mIBI score was 34 (poor) and the QHEI was 73 (excellent).

### 11.3.16 Johnson Fork Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Johnson Fork subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 102 provides a summary of the Johnson Fork subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli* and TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TSS concentrations.

**Table 102. Summary of Johnson Fork Subwatershed Characteristics**

| **Johnson Fork (050800030806)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 1363.73 | | | | | |
| **TMDL Sample Sites:** GMW-08-0019 (T28), GMW-08-0018 (T30), GMW-08-0003 (P8), GMW-08-0005 (P11) | | | | | |
| **Listed Segments:** ING0386_02, ING0386_T1001, ING0386_T1002, ING0386_T1006, ING0386_T1006A, ING0386_T1007, ING0386_T1008 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **914.15** | **302.21** | **138.13** | **66.18** | **33.10** |
| ***Wasteload Allocation (WLA): Total*** | **2.03** | **0.67** | **N/A** | **N/A** | **N/A** |
| **MS4 – Hamilton Co., OH (1GQ00034*BG) 0.0771 sq. mi.** | **2.03** | **0.67** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **823.02** | **272.74** | **124.66** | **59.73** | **29.88** |
| ***Margin Of Safety (MOS) (5%)*** | **45.71** | **15.11** | **6.91** | **3.31** | **1.66** |
| ***Future Growth (5%)*** | **43.42** | **14.35** | **6.56** | **3.14** | **1.57** |
| | | | | | |
| **Drainage Area (sq. mi.):** 1363.73 | | | | | |
| **Listed Segments:** ING0386_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **TSS TMDL (pounds/day)** | **730,780.45** | **238,861.33** | **106,961.80** | **49,124.31** | **22,534.09** |
| **Wasteload Allocation (WLA): Total** | **5.50** | **1.80** | **N/A** | **N/A** | **N/A** |
| **Construction Activities (0.0108 sq. mi.)** | **5.50** | **1.80** | **N/A** | **N/A** | **N/A** |
| **Load Allocation (LA)** | **659523.86** | **215,570.55** | **96533.02** | **44334.69** | **20,337.01** |
| **Margin Of Safety (MOS) (5%)** | **36,539.02** | **11,943.07** | **5,348.09** | **2,456.22** | **1,126.70** |
| **Future Growth (5%)** | **34,712.07** | **11,345.91** | **5,080.69** | **2,333.40** | **1,070.37** |

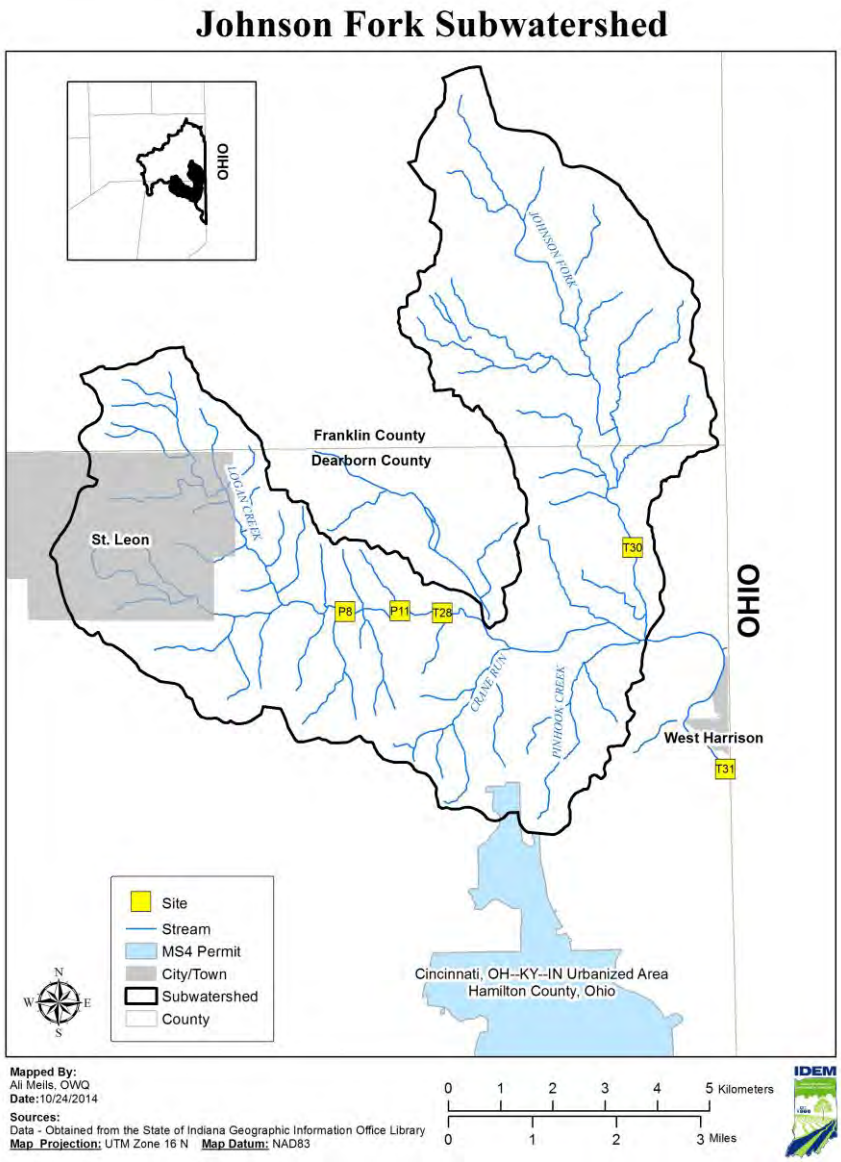


**Figure 117. Sampling Stations in Johnson Fork Subwatershed**

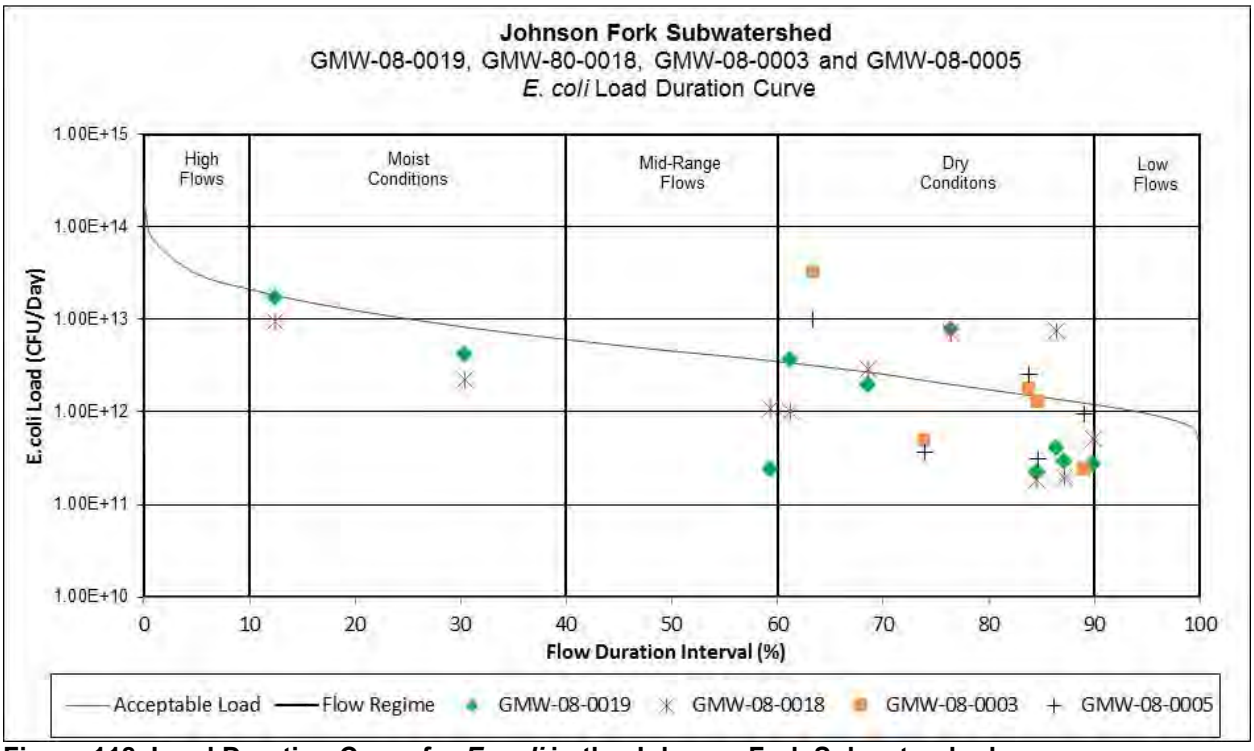


**Figure 118. Load Duration Curve for *E. coli* in the Johnson Fork Subwatershed**

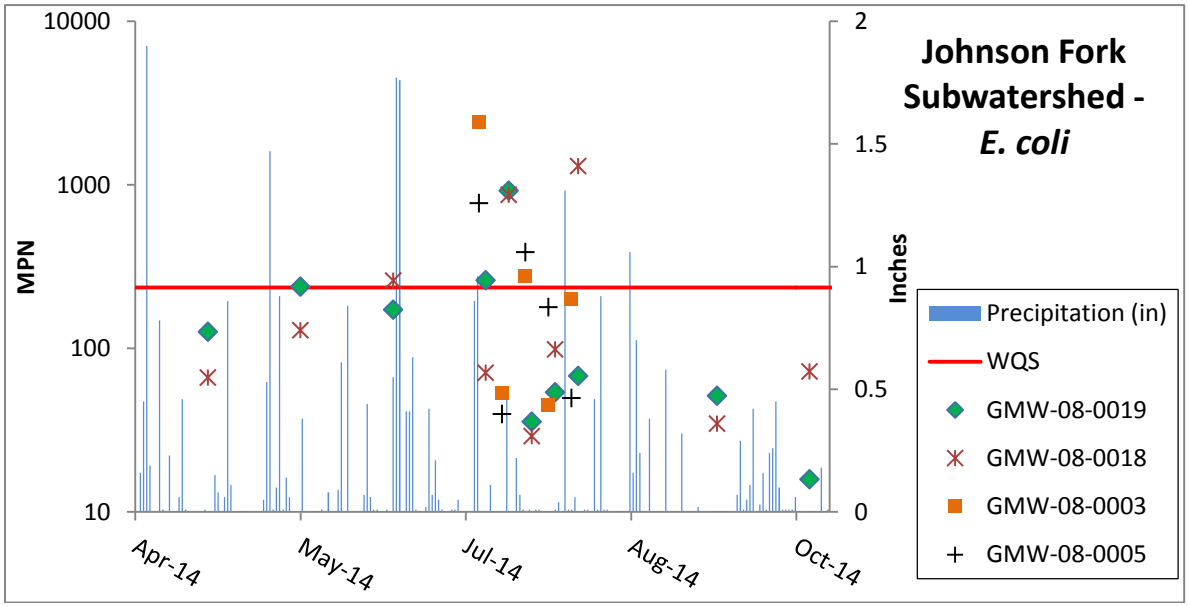


**Figure 119. Graph of Precipitation and *E. coli* Data in the Johnson Fork Subwatershed**

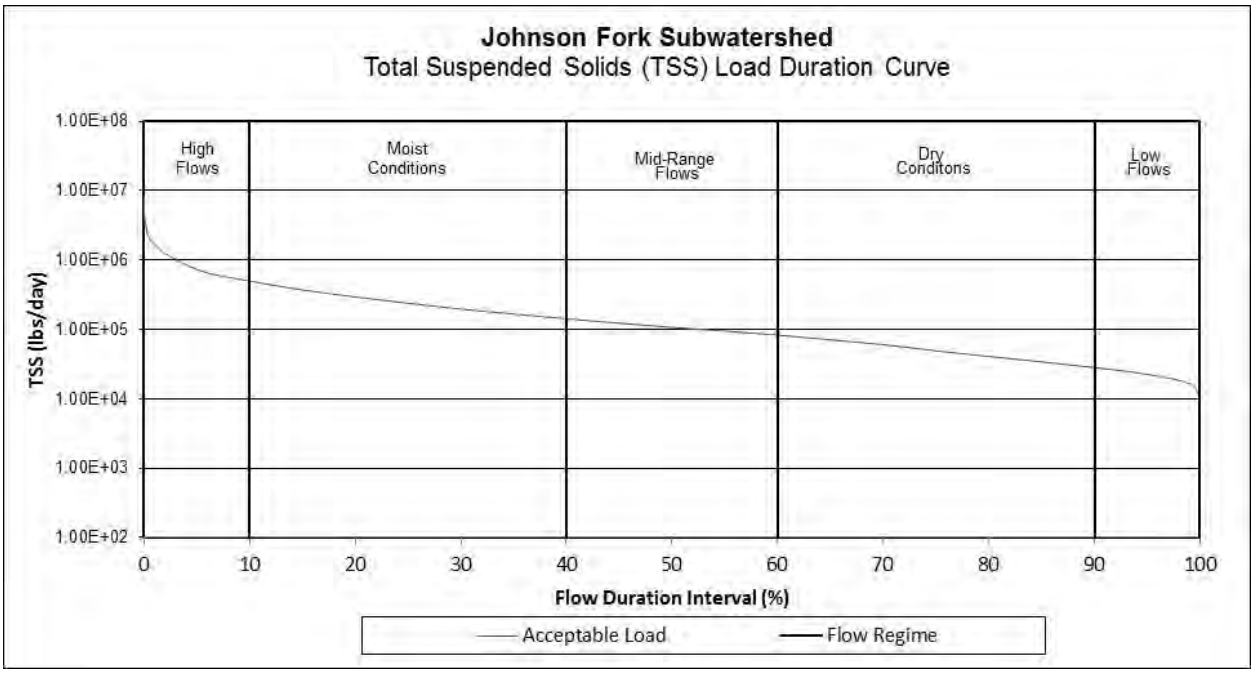


**Figure 120. Load Duration Curve for *TSS* in the Johnson Fork Subwatershed**

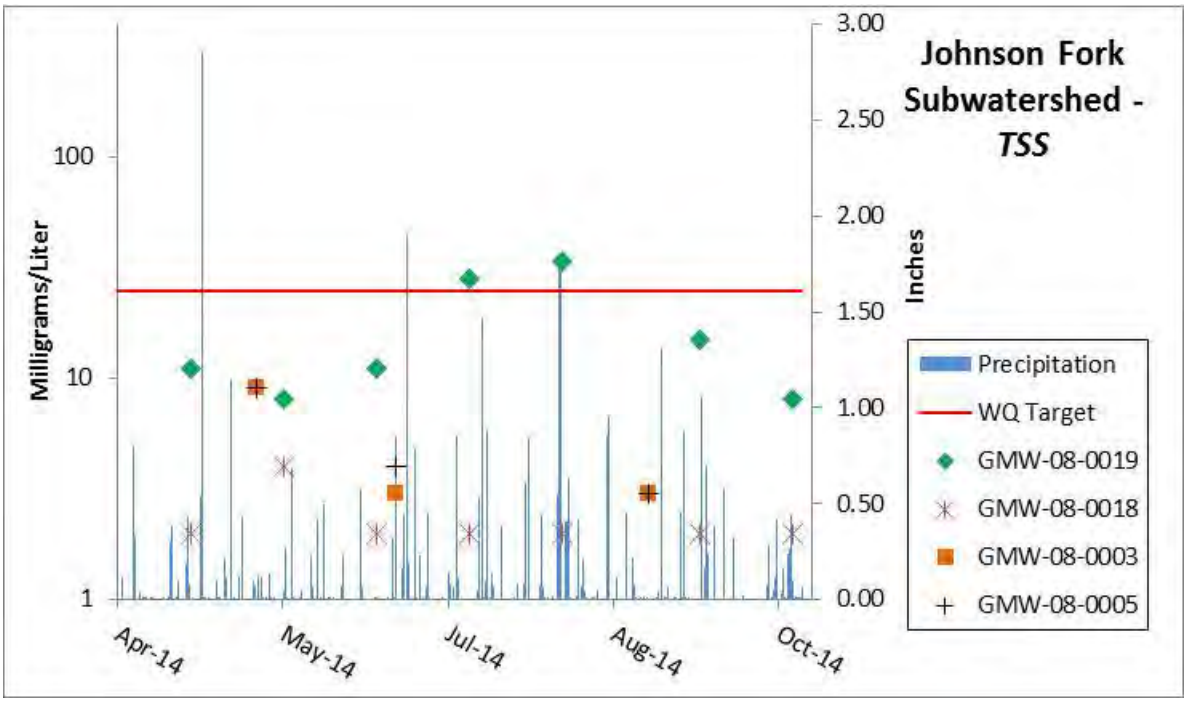


**Figure 121. Graph of Precipitation and TSS Data in the Johnson Fork Subwatershed**

The Johnson Fork subwatershed drains approximately 33 square miles. The Johnson Fork subwatershed drains through the mainstem of Whitewater. The land use is primarily forest (55%) followed by hay and pasture land (29%) and agriculture (8%). There are no permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. The Town of St. Leon has part of its incorporated area within the watershed, developed land represents seven percent of land use in the watershed. The land use is primarily steep forested lands with wide riparian buffers

surrounding the stream. Small crop fields do occur in the whitewater valley, however most agriculture in the watershed is pasture based. Small housing developments exist near St. Leon, Logan, and Rockdale. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of high gradient headwaters that join the mainstem of the Whitewater river in its valley. Highly erodible soil types make up nearly this entire subwatershed outside of the whitewater valley. The majority of the HEL lands are located in the headwater portion of the subwatershed, which is primarily forested. There are few patches of the subwatershed identified as having hydric soil types, these are mostly along the main stem of the river. These areas could be potential areas for wetland restoration. The land use is comprised of 29 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (38 animals/square mile) which is a lower concentration when compared to other subwatersheds in the Whitewater River Watershed. There are approximately 77 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 54 stream miles impaired for *E. coli,* 32 miles for D.O., and 26 miles of Mercury and PCB impairment listed on the 2016 List of Impaired Waters.

There are four sites located in this subwatershed, three located on Logan Creek; GMW-08-0019 (P28), GMW-08-0003 (P8), GMW-08-0005 (P11), and one located on Johnson Fork GMW-08-0018 (T30). Logan Creek is currently impaired for E. coli, PCBs and Hg. E. coli was collected at a site in 2002 and the geometric mean was ~334 MPN. The E. coli results were: P8 geometric mean = 200.4 MPN, P11 geometric mean = 159.99 MPN and T28 geometric mean = 125.35 MPN. The E. coli concentration is decreasing as you move downstream which suggests the sources for higher E. coli values are located upstream. In July, August and October the DO results were below the 4 mg/L WQS at site T28. There were no DO violations at the two sites upstream. The low DO would also impact the health of the biological communities. According to the Dearborn Co. Health Dept. there is a home sewage problem cluster identified that may be impacting this stream (Chappalow Ridge Rd ~40 houses) and the Health Dept. also estimated that 50% of the septic systems are failing in Dearborn County. This stream has runoff coming from St. Leon. The land use is primarily steep forested terrain with housing clusters as you move between St. Leon and the Ohio border. The City of Cincinnati is just across the state line so this part of the watershed is more heavily populated. The Logan creek segment was previously impaired for E. coli and DO based on a sample collected in 2007. In 2007 the E. coli geometric mean was ~413 MPN and there were 2/7 DO readings < 4 mg/L. This stream has since been reindexed and the original sample falls on a different AUID. In 2009 a site (GMW080-0048) was sampled on this AUID for E. coli only and the geometric mean was 482.21 (5/5 samples exceeded the single sample maximum). In 2014 E. coli was taken at this same site and the geometric mean was 187.04 MPN (3/10 exceeded the single sample max). Both years of sampling indicate the stream is still impaired for E. coli. There were no DO violations in 2009 or 2014 to support a DO impairment. There are several Towns that run off into the stream including: Sharptown, Drewersburg, and Rockdale. According to the Dearborn Co. Health Dept. there are several home sewage problem clusters identified that may be impacting this stream. Those are the Old US 52 area with approximately 30 houses and approximately 12 businesses and the Longnecker Road community with approximately 40 houses.

The fish community IBI score for site T28 was 36 (fair) and the QHEI was 47 (fair). The macro community mIBI score was 38 (fair) and the QHEI was 45 (fair). The fish community IBI score for site P8 was 54 (excellent) and the QHEI was 67 (excellent). The macro community mIBI score was 36 (poor) and the QHEI was 55 (Good). The fish community IBI score for site P11 was 48 (good) and the QHEI was 72 (excellent). The macro community mIBI score was 32 (poor) and the QHEI was 64 (Good). Another site was sampled further downstream on Logan Creek in 2002 and had a fish IBI score of 48 and a QHEI score of 64. The field notes for fish community sampling at site T28 indicated there was an oil sheen on the water's surface. This may have impacted the biological communities at this site. Five out of

six biological communities passed but stream will still be impaired. The fish community IBI score for site T30 was 46 (good) and the QHEI was 61 (good). The macro community mIBI score was 42 (fair) and the QHEI was 59 (good).

### 11.3.17 Headwaters Dry Fork Whitewater River Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Headwaters Dry Fork Whitewater River subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 103 provides a summary of the Headwaters Dry Fork Whitewater River subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 103. Summary of Headwaters Dry Fork Whitewater River Subwatershed Characteristics**

| **Headwaters of Dry Fork Whitewater River (050800030807)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 14.01 | | | | | |
| **TMDL Sample Sites:** GMW-08-0020 (T33) | | | | | |
| **Listed Segments:** ING0387_02 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 - 40 %** | **40 - 60 %** | **60 – 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **320.1** | **104.64** | **46.86** | **21.52** | **9.87** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **288.91** | **94.43** | **42.31** | **19.44** | **8.88** |
| ***Margin Of Safety (MOS) (5%)*** | **16.0** | **5.23** | **2.34** | **1.08** | **0.49** |
| ***Future Growth (5%)*** | **15.2** | **5.0** | **2.2** | **1.0** | **0.5** |
| | | | | | |

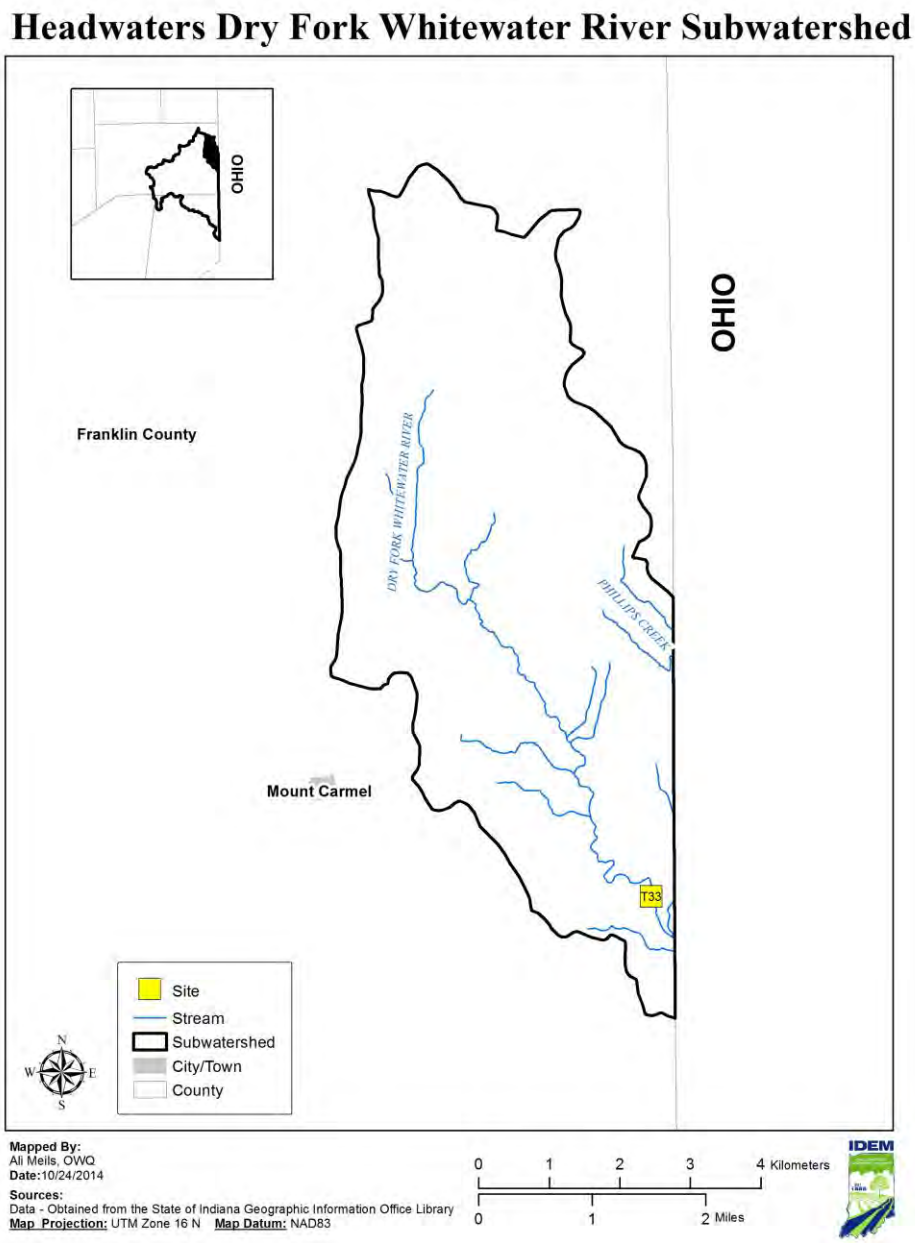


**Figure 122. Sampling Stations in Headwaters Dry Fork Whitewater River Subwatershed**

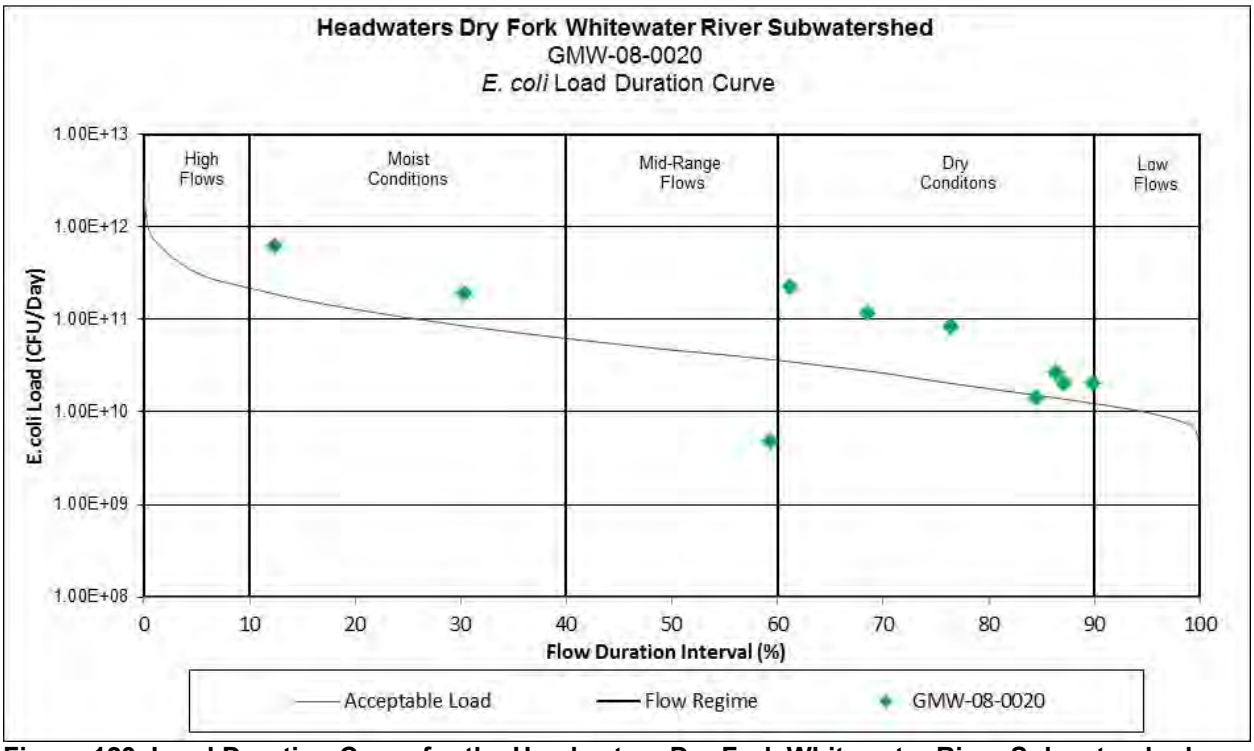


**Figure 123. Load Duration Curve for the Headwaters Dry Fork Whitewater River Subwatershed**

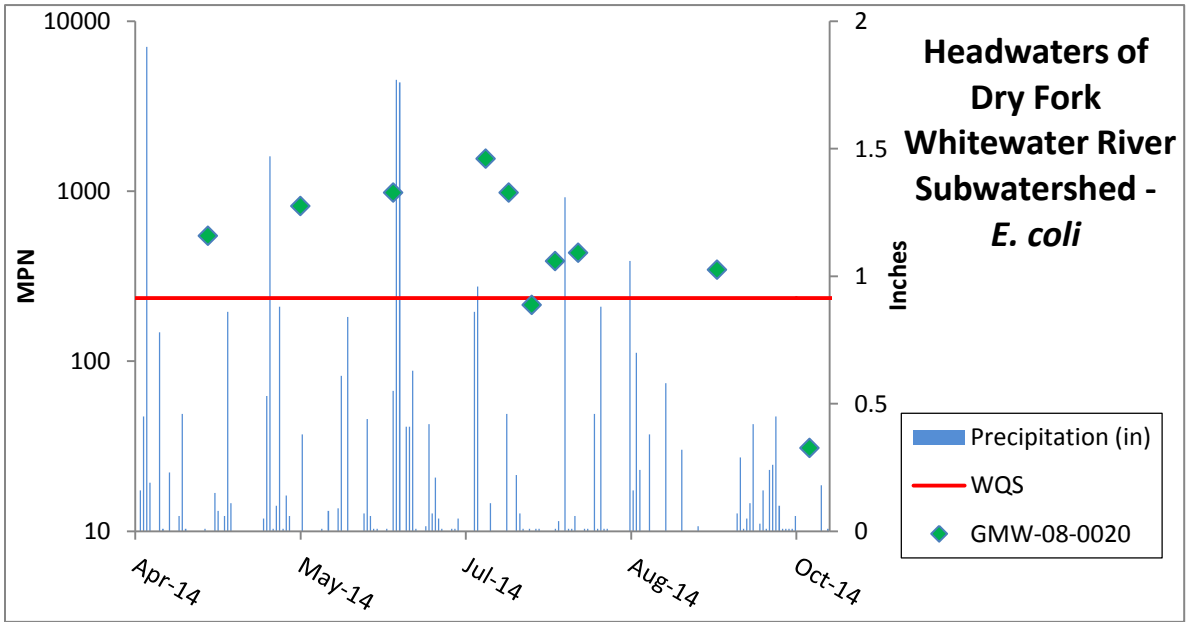


**Figure 124. Graph of Precipitation and *E. coli* Data in the Headwaters Dry Fork Whitewater River Subwatershed**

The Headwaters Dry Fork Whitewater River subwatershed drains approximately 14 square miles. The Headwaters Dry Fork Whitewater River subwatershed drains through Ohio into Dry Fork creek and the Whitewater River. The land use is primarily agriculture (72%) followed by hay and pasture land (13%) and forest (10%). There are no permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There are no municipalities within the watershed. Mount Carmel Elementary School WWTP has been a point source in the extreme headwaters

but they no longer discharge and no longer have a permit. Pollutant sources could be coming from the land use which is dominantly agriculture, manure spreading, faulty septic systems and runoff from the Town of Mount Carmel. Mt. Carmel Elementary School used to have a permit but put in an onsite mound system. The school is likely not impacting the impairment based on this and location in the extreme headwaters. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is more level that what is typically found in the watershed leading to its agricultural intensity in in contrast to much of the overall watershed. Highly erodible soil types are present in a small capacity in this subwatershed, with the majority of the HEL lands located on the sloping lands near waterways. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. Though dominated by agricultural uses many tributaries are buffered and the main stem riparian area is forested along much of its course .There are small patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 13 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (55 animals/square mile) which is median concentration when compared to other subwatersheds in the Whitewater River Watershed. There are approximately 17 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 14 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

There is one sites located in this subwatershed, located on the Dry Fork Whitewater River GMW-08-0020 (T33). The 2014 samples resulted in 7/10 E. coli concentrations were in exceedance of the single sample maximum. The geometric mean was 478.15 MPN. Nitrogen levels were moderately high from April - June but not in exceedance of the IN WQ target. The stream is currently listed as impaired for E. coli and will remain impaired. In 2007 this same site was sampled in the IDEM probabilistic program and the E. coli geometric mean was 250.60 MPN. While TP was not in exceedance of the WQ target in 2014, the 2007 results indicate that TP was greater than the WQ target (0.3 mg/L) 2/3 samples (0.24, 0.32, 1.2 mg/L). In addition the DO results from 2007 were close to the 4 mg/L WQS 4/11 times (4.09, 4.22, 4.07, 4.07 mg/L), and > 13 2/11 times. While the TP and DO did not occur on the same day to warrant a nutrient impairment, data suggests there are high levels of nutrients in the stream.

The fish community IBI score for site T33 was 48 (good) and the QHEI was 63 (good). The macro community mIBI score was 28 (poor) and the QHEI was 61 (good). The biological communities collected in 2007 were: fish IBI = 38 (fair) QHEI = 62 (good) and macro mIBI = 38 (fair) QHEI 54 (good). The high levels of nutrients and DO extremes could be a source of stress on the biological communities.

### 11.3.18 Howard Creek

Load duration curves and precipitation graphs were created for all the sampling sites in the Howard Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 104 provides a summary of the Howard Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for *E. coli*. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* concentrations.

**Table 104. Summary of Howard Creek Subwatershed Characteristics**

| **Howard Creek (050800030808)** | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 10.05 | | | | | |
| **TMDL Sample Sites:** GMW-08-0027 (T32) | | | | | |
| **Listed Segments:** ING0388_01, ING0388_T1005, ING0388_T1007 | | | | | |
| **Flow Regime TMDL analysis *E. coli* (billions of bacteria/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **Bacteria TMDL (billions of bacteria/day)** | **229.6** | **75.06** | **33.61** | **15.44** | **7.08** |
| ***Wasteload Allocation (WLA): Total*** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| ***Load Allocation (LA)*** | **207.25** | **67.74** | **30.33** | **13.97** | **6.43** |
| ***Margin Of Safety (MOS) (5%)*** | **11.5** | **3.75** | **1.68** | **0.77** | **0.35** |
| ***Future Growth (5%)*** | **10.9** | **3.6** | **1.6** | **0.7** | **0.3** |
| | | | | | |

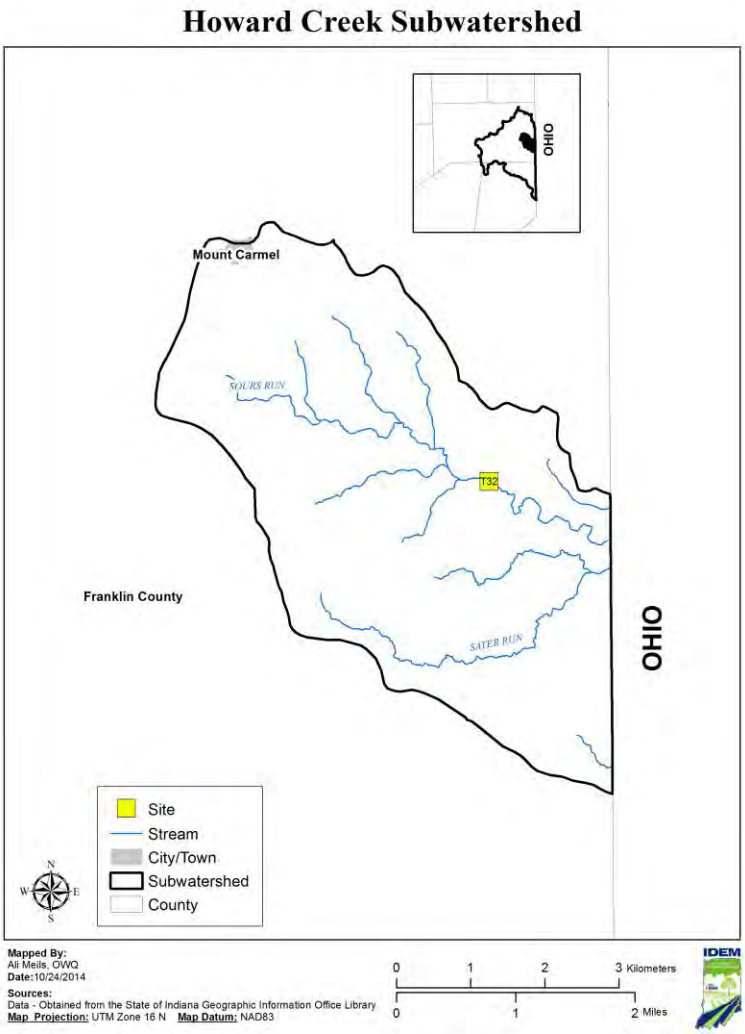


**Figure 125. Sampling Stations in Howard Creek Subwatershed**

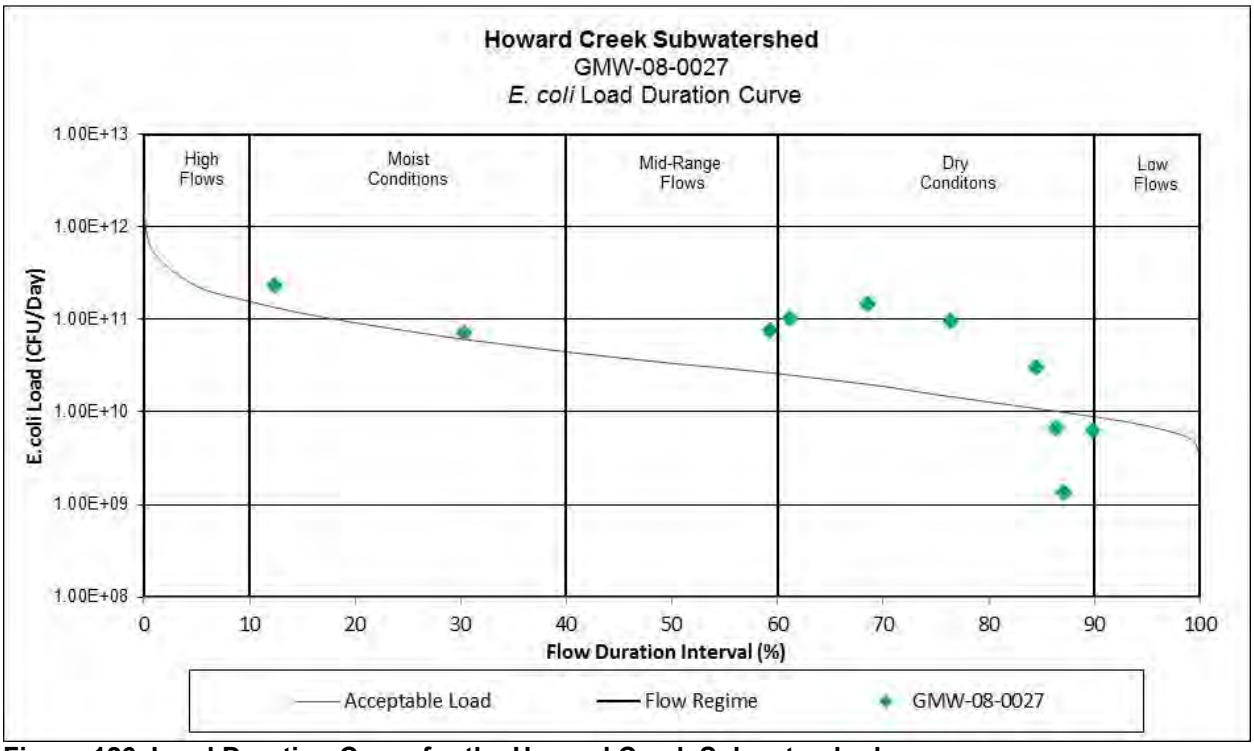


**Figure 126. Load Duration Curve for the Howard Creek Subwatershed**

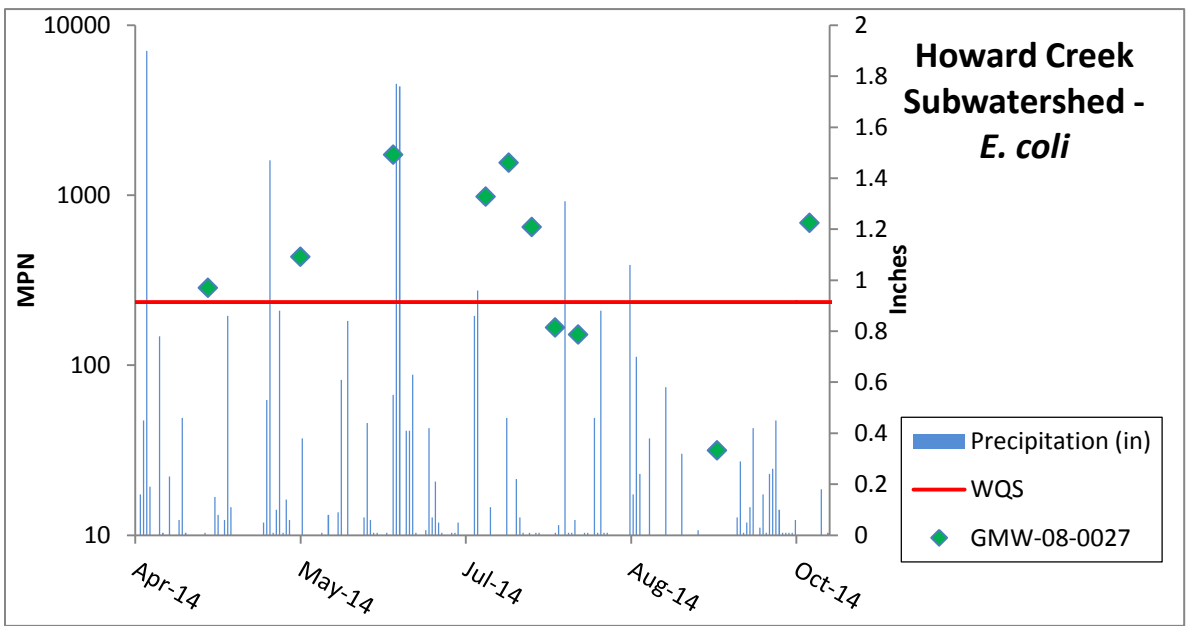


**Figure 127. Graph of Precipitation and *E. coli* Data in the Howard Creek Subwatershed**

The Howard Creek subwatershed drains approximately 10 square miles. The Howard Creek subwatershed drains through Ohio into Dry Fork creek and the Whitewater River. The land use is primarily agriculture (59%) followed by hay and pasture land (22%) and forest (12%). There is one permitted facilities in the subwatershed, the Mount Carmel Elementary School. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. The small village of Mount Carmel is the only Municipality in the subwatershed. The high levels of nutrients and DO extremes could be a source of stress on the biological communities. Mount Carmel Elementary School WWTP has been a

point source in the extreme headwaters but they no longer discharge and no longer have a permit. Pollutant sources could be coming from the land use which is dominantly agriculture, manure spreading, faulty septic systems and runoff from the Town of Mount Carmel. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area consists of relatively flat land making up the upland of the watershed with depressions where the creek drains into Ohio. Highly erodible soil types make up nearly a third of this subwatershed. The majority of the HEL lands are located near the waterways in the small valleys they have carved. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There are many isolated patches of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 22 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (55 animals/square mile) which is median concentration when compared to other subwatersheds in Salt Creek. There are approximately 16 miles of stream in the subwatershed. Based on IDEM data collected in 2013 and 2014 there will be 16 stream miles impaired for *E. coli* listed on the 2016 List of Impaired Waters.

There are one sites located in this subwatershed, Located on GMW-08-0027 (T32). The 2014 samples resulted in 7/10 E. coli concentrations were in exceedance of the single sample maximum. The geometric mean was 478.15 MPN. Nitrogen levels were moderately high from April - June but not in exceedance of the IN WQ target. The stream is currently listed as impaired for E. coli and will remain impaired. In 2007 this same site was sampled in the IDEM probabilistic program and the E. coli geometric mean was 250.60 MPN. While TP was not in exceedance of the WQ target in 2014, the 2007 results indicate that TP was greater than the WQ target (0.3 mg/L) 2/3 samples (0.24, 0.32, 1.2 mg/L). In addition the DO results from 2007 were close to the 4 mg/L WQS 4/11 times (4.09, 4.22, 4.07, 4.07 mg/L), and > 13 2/11 times. While the TP and DO did not occur on the same day to warrant a nutrient impairment, data suggests there are high levels of nutrients in the stream.

The fish community IBI score for site T32 was 38 (fair) and the QHEI was 58 (good). The macro community mIBI score was 36 (fair) and the QHEI was 56 (good). The biological communities collected in 2007 were: fish IBI = 38 (fair) QHEI = 62 (good) and macro mIBI = 38 (fair) QHEI 54 (good). The high levels of nutrients and DO extremes could be a source of stress on the biological communities.

### 11.3.19 Lee Creek Subwatershed

There is only a small portion of Lee Creek subwatershed located in Indiana before flowing east into Ohio. There were no sampling sites in the Lee Creek subwatershed. With little information and only a small portion of the drainage in Indiana it is difficult to characterize the area.

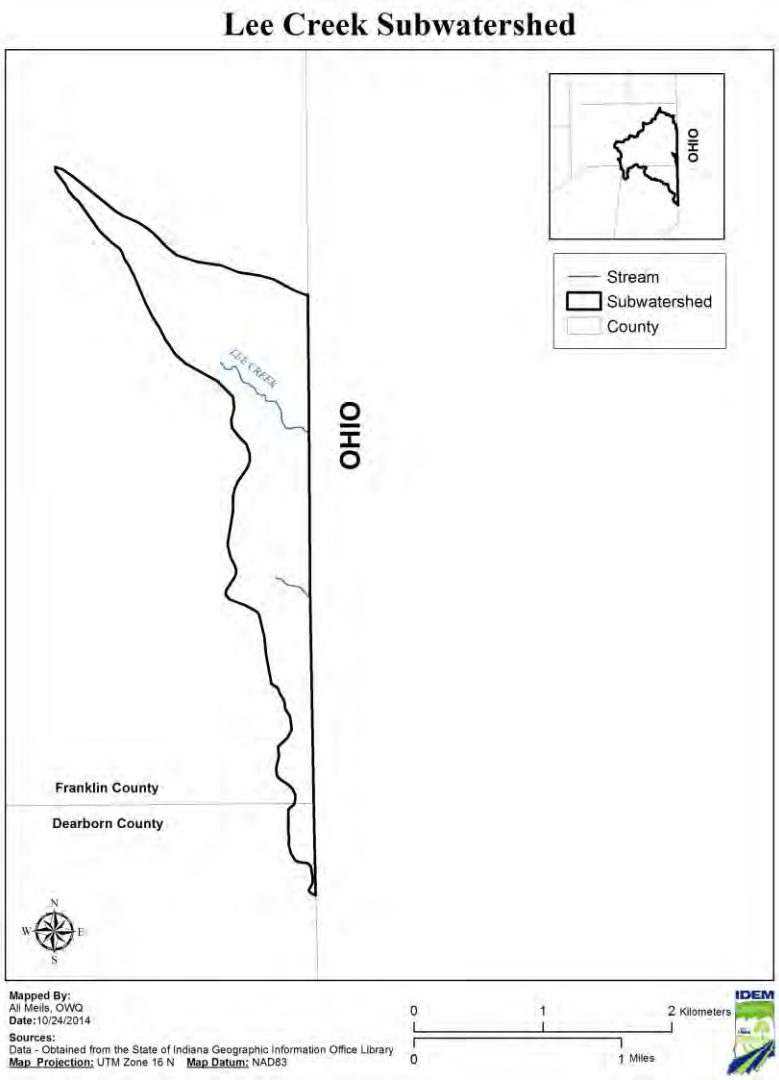


**Figure 128. Sampling Stations in Lee Creek Subwatershed**

### 11.3.20 Jameson Creek Subwatershed

Load duration curves and precipitation graphs were created for all the sampling sites in the Jameson Creek subwatershed. The figures below illustrate water quality standards violations during all flow ranges that occurred during sampling events. A discussion of key sampling sites in the subwatershed is included following the figures. Table 105 provides a summary of the Jameson Creek subwatershed, including segment AUIDs, drainage area, sampling sites, NPDES facilities, CFOs, as well as Load Allocations, Wasteload Allocations, Future Growth and Margin of Safety values for TSS. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated TSS concentrations.

**Table 105. Summary of Jameson Creek Subwatershed Characteristics**

| Jameson Creek (050800030810) | | | | | |
|---|---|---|---|---|---|
| **Drainage Area (sq. mi.):** 1374.94 | | | | | |
| **TMDL Sample Sites:** GMW-08-0021 (T31) | | | | | |
| **Listed Segments:** ING038A_01 | | | | | |
| **Flow Regime TMDL analysis TSS (pounds/day)** | **Very High Flows** | **Higher Flow Conditions** | **Normal Flows** | **Lower Flow Conditions** | **Low Flows** |
| **Duration Interval** | **0 - 10 %** | **10 – 40 %** | **40 - 60 %** | **60 - 90 %** | **90 - 100 %** |
| **TSS TMDL (pounds/day)** | **733994.6** | **239911.89** | **107432.24** | **49340.37** | **22633.20** |
| **Wasteload Allocation (WLA): Total** | **81.91** | **26.77** | **NA** | **NA** | **NA** |
| **MS4 – City of Harrison, OH (1GQ00034*BG) 0.1546 sq. mi.** | **78.70** | **25.72** | **NA** | **NA** | **NA** |
| **Storm Water – Wagner Auto Parts (INR00W108)** | **0.51** | **0.17** | **NA** | **NA** | **NA** |
| **Construction Activities (0.0053 sq. mi.)** | **2.7** | **0.88** | **NA** | **NA** | **NA** |
| **Load Allocation (LA)** | **662348.21** | **216493.71** | **96957.63** | **44529.65** | **20426.44** |
| **Margin Of Safety (MOS) (5%)** | **36699.7** | **11995.59** | **5371.61** | **2467.02** | **1131.66** |
| **Future Growth (5%)** | **34864.7** | **11395.8** | **5103.0** | **2343.7** | **1075.1** |

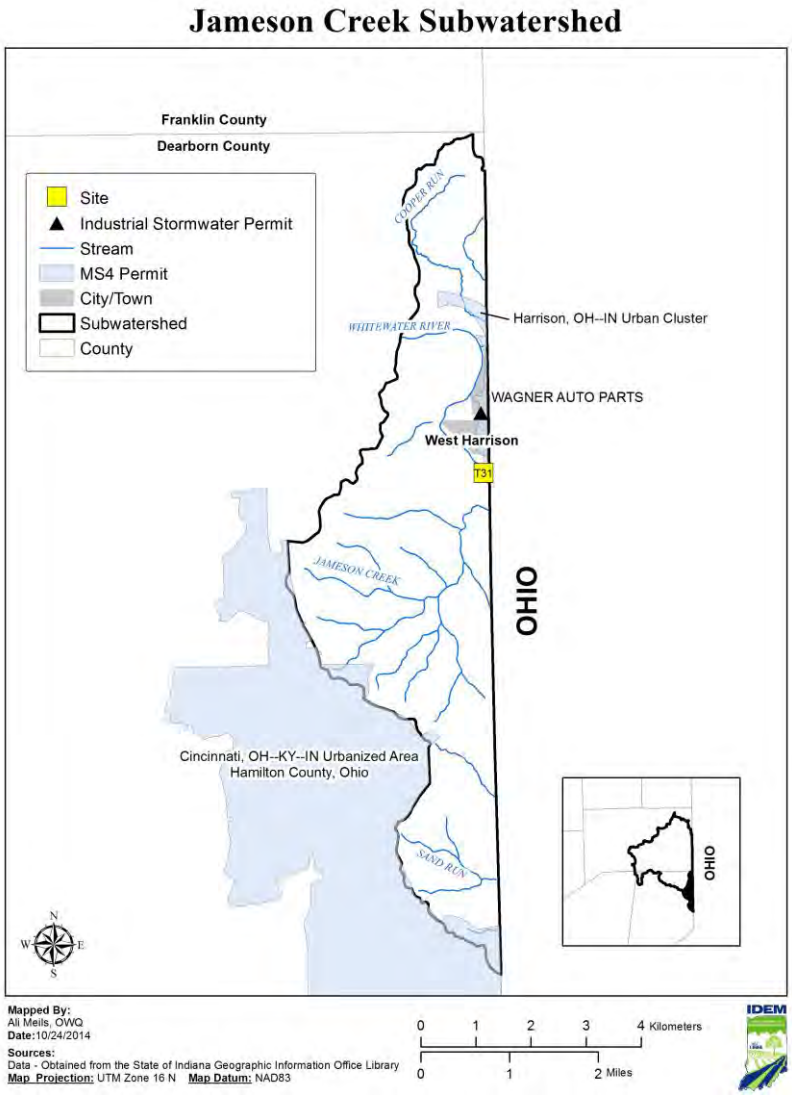


**Figure 129. Sampling Stations in Jameson Creek Subwatershed**

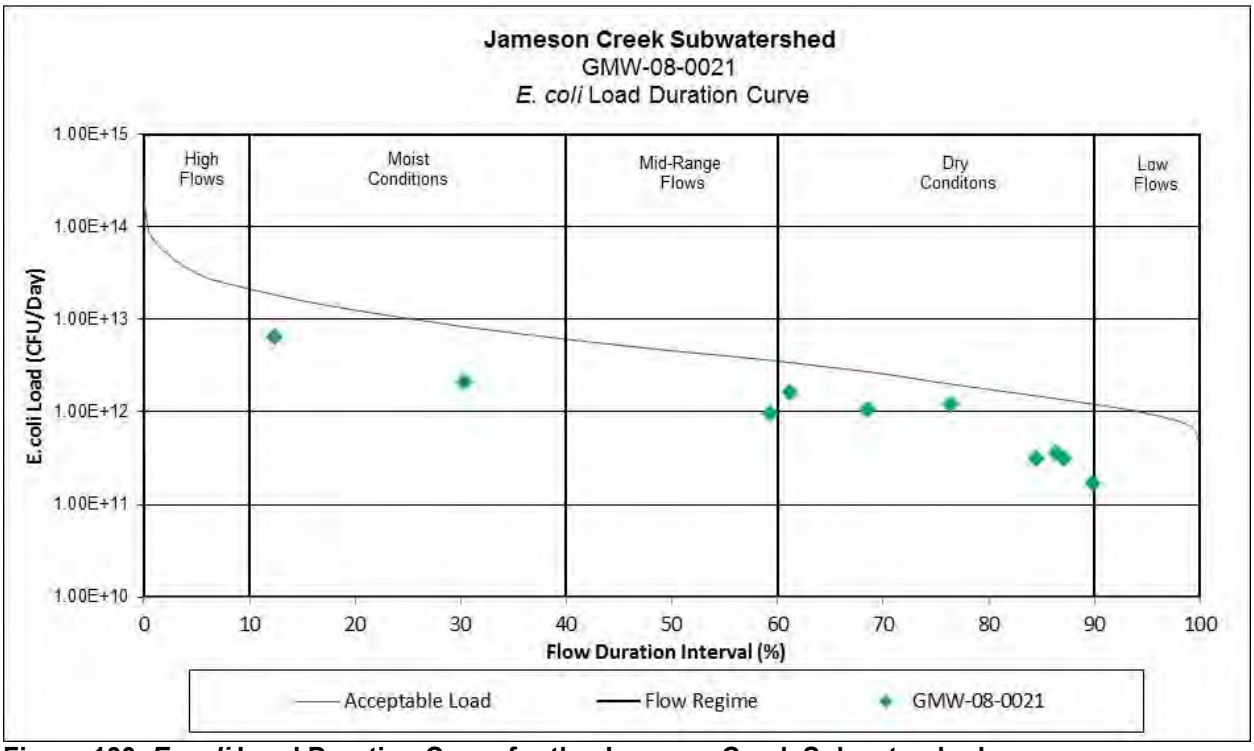


**Figure 130. *E. coli* Load Duration Curve for the Jameson Creek Subwatershed**

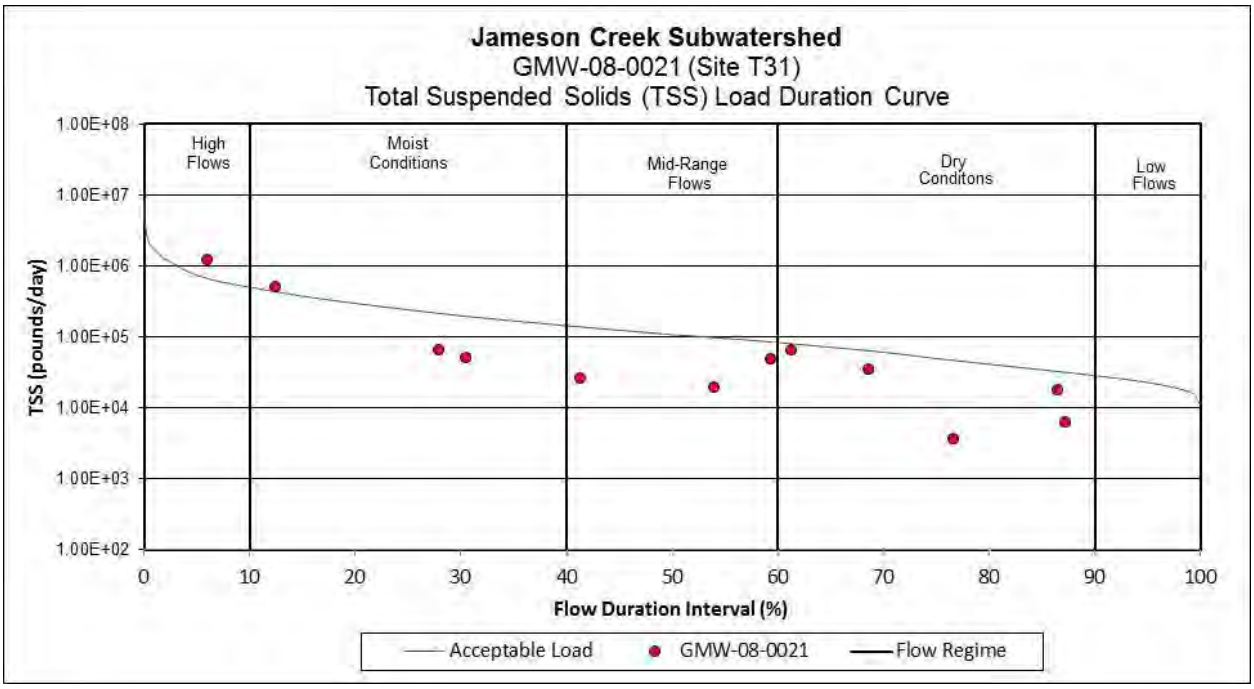


**Figure 131. TSS Load Duration Curve for the Jameson Creek Subwatershed**

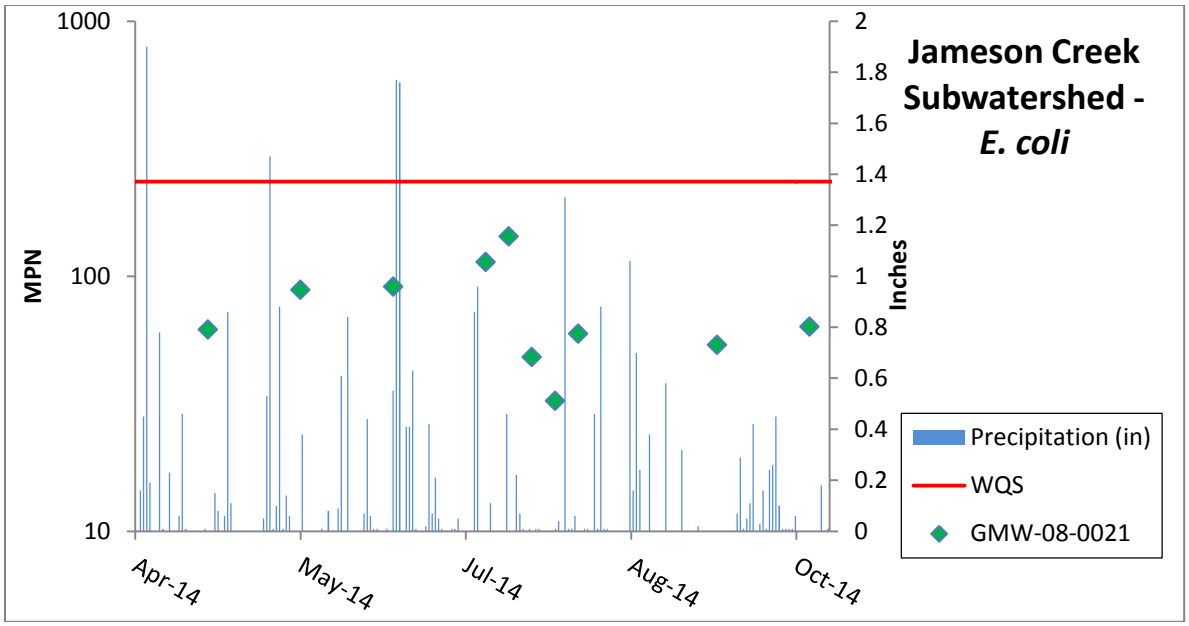


**Figure 132. Graph of Precipitation and *E. coli* Data in the Jameson Creek Subwatershed**

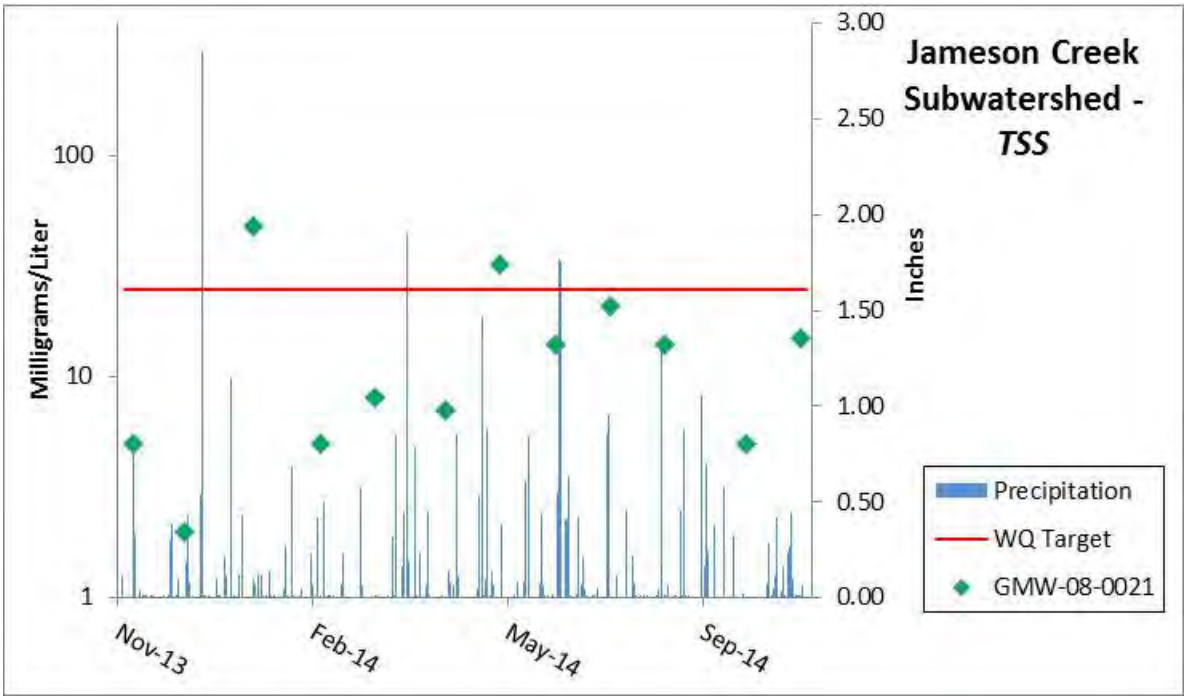


**Figure 133. Graph of Precipitation and TSS Data in the Jameson Creek Subwatershed**

The Jameson Creek subwatershed drains approximately 11 square miles. The Jameson Creek subwatershed drains into the mainstem of the Whitewater River. The land use is primarily Forested land (63%) followed by hay and pasture land (26%) and developed (8%). There are no permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. The Town of West Harrison is within the watershed yet it represents approximately 8 percent of the drainage. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and

capacity. The landscape in the area consists of Steeper drainages in the headwaters which reduces in slope as they flow to the mainstem. Highly erodible soil types make up nearly a two thirds of this subwatershed. The majority of the HEL lands are located in the headwater portion of the subwatershed, which is predominantly forested interspersed with pasture land. These soil types can contribute to sediment loss from agricultural lands, as well as, lands from the high gradient slopes. There no areas of the subwatershed identified as having hydric soil types. These areas could be potential areas for wetland restoration. The land use is comprised of 26 percent pasture land which indicates the potential for smaller animal farms. The total number of animal units in this area (27 animals/square mile) which is the lowest concentration when compared to other subwatersheds in the Whitewater river watershed. Based on IDEM data collected in 2013 and 2014 there are no impaired streams listed on the 2016 List of Impaired Waters.

There is one site located in this subwatershed, located on the mainstem Whitewater River GMW-08-0021 (T31). In 2009 this stream was sampled for E. coli only. The geometric mean was 94.64 MPN with 0/5 exceeding the single sample maximum. In 2014, the E. coli geometric mean was 68.52 MPN with 0/10 exceeding the single sample maximum. There are two historical sites located just upstream of site T31. The macro community in 1994 scored 4.2, QHEI= 81 and the macro score in 1997 was 5.6, QHEI = 83. In 2014, biological communities scored the following: fish IBI = 54 (excellent) QHEI = 75 (excellent) and macro mIBI = 34 (poor) QHEI = 65 (good). In January and May the TSS was greater than the WQ target but these were likely attributed to high flows. This site has a drainage area of 1370 sq. miles. The majority of the Southern Whitewater River watershed is forested with steep to rolling terrain. This particular AUID has a portion of the Greater Cincinnati MS4 contributing to the drainage, however a good portion of the drainage remains forested.

The fish community IBI score for site T31 was 54 (excellent) and the QHEI was 75 (excellent). The macro community mIBI score was 34 (poor) and the QHEI was 65 (good). This macro score is poor however based on biologist's best professional judgment this site will be fully supporting for aquatic communities.

# 12.0 ALLOCATIONS

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual WLAs for regulated sources and LAs for sources not directly regulated by a permit. In addition, the TMDL must include a MOS, either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

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

## 12.1 Margin of Safety (MOS)

Section 303(d) of the Clean Water Act and USEPA regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a MOS which takes into account any lack of knowledge concerning the relationship between limitations and water quality." USEPA guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS). This TMDL uses both an implicit and explicit MOS. An implicit MOS was used by applying a couple of conservative assumptions. A moderate explicit MOS has been applied by reserving five percent of the allowable load. five percent was considered an appropriate MOS based on the following considerations:

- The use of the load duration curve approach minimizes a great deal of uncertainty associated with the development of TMDLs because the calculation of the loading capacity is simply a function of flow multiplied by the target value. Most of the uncertainty is therefore associated with the estimated flows in each assessed segment which were based on extrapolating flows from the nearest downstream USGS gage.
- The *E. coli* TMDLs include an implicit MOS in that they were based on the geometric mean component of the standard rather than the single sample maximum standard. Using the single sample maximum standard would have resulted in larger loading capacities.
- An additional implicit MOS for *E. coli* is included because the load duration analysis does not address die-off of pathogens.
- The identified percent reduction required for IBC surrogate TMDLs are based on the highest sampled result of all of the monitoring sites within the HUC 12 watershed, relative to the standard. The use of the maximum sample result provides an implicit margin of safety.

## 12.2 Future Growth

The rate of future growth was estimated from population in Southern Whitewater River Watershed by the U.S. Census Bureau. Based on the comparison of the 2000 to 2010 census, the future growth was set as 5% in TMDL allocation.

## 12.3 Critical Conditions

The Clean Water Act requires that TMDLs take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. Through the load duration curve approach it has been determined that load reductions for the parameters of concern are needed for specific flow conditions; the critical conditions (the periods when the greatest reductions are required) vary by parameter and location and are summarized in Table 106. The critical condition is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical condition for control of continuous point source discharge is the drought stream flow. Point source pollution controls designed to meet water quality standards for draught flow conditions will ensure compliance with standards for all other conditions. The 7Q10 flow value is typically chosen as the critical condition for this situation. The 7Q10 flow value represents the 7-day low flow period that occurs on average every 10 years in a stream system. The critical condition for wet weather-driven sources may be a particular rainfall event, coupled with stream flow associated with that event. Nutrient sources arise from a mixture of continuous and wet weather-driven sources. Loading form failing septic systems is assumed to be relatively constant over time whereas agricultural runoff will be greatest during wet weather periods. The TMDL will therefore examine the combined impact of both continuous and wet-weather sources. The table indicates that critical conditions for most pollutants for most locations occur during multiple flows and therefore implementation of controls should be targeted for these conditions.

**Table 106. Critical Conditions for TMDL Parameters**

| Station ID | Parameter | Critical Condition | | | | |
|---|---|---|---|---|---|---|
| | | High | Moist | Mid-Range | Dry | Low Flow |
| GMW050-0023 | *E. coli* (counts/mL) | X | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0006 | *E. coli* (counts/mL) | X | | X | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0014 | *E. coli* (counts/mL) | X | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0011 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0007 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0003 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0009 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0002 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0015 | *E. coli* (counts/mL) | X | X | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0008 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0001 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0012 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-05-0010 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0014 | *E. coli* (counts/mL) | X | X | X | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |

| Station ID | Parameter | Critical Condition | | | | |
|---|---|---|---|---|---|---|
| | | High | Moist | Mid-Range | Dry | Low Flow |
| GMW060-0027 | *E. coli* (counts/mL) | X | X | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0013 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0019 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0015 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0020 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0006 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0022 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0012 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0002 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0003 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0004 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-06-0005 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0022 | *E. coli* (counts/mL) | X | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0001 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0026 | *E. coli* (counts/mL) | | | | X | |

| Station ID | Parameter | Critical Condition | | | | |
|---|---|---|---|---|---|---|
| | | High | Moist | Mid-Range | Dry | Low Flow |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW080-0003 | *E. coli* (counts/mL) | X | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0014 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0016 | *E. coli* (counts/mL) | | X | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0024 | *E. coli* (counts/mL) | | X | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0015 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0013 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0030 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0019 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0018 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0003 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0005 | *E. coli* (counts/mL) | | | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0021 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0020 | *E. coli* (counts/mL) | | X | | X | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-08-0027 | *E. coli* (counts/mL) | | X | X | X | |
| | Phosphorus, Total (mg/L) | | | | | |

| Station ID | Parameter | Critical Condition | | | | |
|---|---|---|---|---|---|---|
| | | High | Moist | Mid-Range | Dry | Low Flow |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-04-0018 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |
| GMW-07-0026 | *E. coli* (counts/mL) | | | | | |
| | Phosphorus, Total (mg/L) | | | | | |
| | Total Suspended Solids (mg/L) | | | | | |

## 12.4 Potential Priority Implementation Areas (PPIAs)

The information and the allocations presented provide the foundation necessary to identify subwatersheds that are in need of the most significant *E. coli*, nutrients and sediment reductions to achieve water quality standards in the Southern Whitewater River watershed. Using the PPIA rankings, watershed organizations will gain a better understanding of which subwatersheds require the most pollutant load reductions. This can assist in future efforts to identify critical areas in the Southern Whitewater River watershed for implementation. PPIAs differ from critical areas in that PPIAs focus on the information and data collected and analyzed through the TMDL development process for ranking purposes, whereas critical areas take into account other factors into consideration (e.g., political, social, economic) to help determine implementation feasibility that will affect progress toward pollutant load reductions and, ultimately, attainment of water quality standards.

In order to rank each subwatershed IDEM used EPA's Recovery Potential Screening Tool which is a technical method for comparing the relative restorability of large numbers of water bodies. This is a method that measures, for each water or watershed, several ecological, stressor, and social context indicators that are associated with the likelihood that a restoration effort may succeed. The user selects the indicators based on what is most appropriate to the waters being assessed and their surrounding communities, the availability of quality data, and the goals of the restoration effort. Measuring the same indicators on all waters allows for systematic, even-handed and information-based comparison. Calculating separate ecological, stressor, and social indices enables the user to consider each of these three classes of factors, individually or in combination. The ecological index score reflects overall condition and the capacity of the watershed to regain functionality, based on metrics related to natural watershed processes and structure. The stressor score reflects the pressures on watershed condition from several primary sources of pollutants and water quality impairments. The social context score includes many factors, such as community involvement, incentives, economics, governance, regulation and planning status that do not constitute watershed condition but often strongly influence the level of effort and complexity of making improvements. A Recovery Potential Integrated (RPI) score is calculated by combining these three indices. For more information on the Recovery Potential Screening process visit EPA's website: (http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/index.cfm)

### 12.4.1 Potential Priority Implementation Areas (PPIAs)

The information and the allocations presented provide the foundation necessary to identify subwatersheds that are in need of the most significant *E. coli*, nutrients, and TSS reductions to achieve water quality standards in the Southern Whitewater River watershed. Using the PPIA rankings, watershed organizations will gain a better understanding of which subwatersheds will show improvements with watershed planning activities. This can assist in future efforts to identify critical areas in the Southern Whitewater River watershed for implementation. PPIAs differ from critical areas in that PPIAs focus on the information and data collected and analyzed through the TMDL development process for ranking purposes, whereas critical areas take into account other factors (e.g., political, social, economic) to help determine implementation feasibility that will affect progress toward pollutant load reductions and, ultimately, attainment of water quality standards.

In order to rank each subwatershed IDEM used EPA's Recovery Potential Screening Tool (RPT) which is a technical method for comparing the relative restorability of large numbers of water bodies. This is a method that measures, for each water or watershed, several ecological, stressor, and social context indicators that are associated with the likelihood that a restoration effort may succeed. The user selects the indicators based on what is most appropriate to the waters being assessed and their surrounding communities, the availability of quality data, and the goals of the restoration effort. Measuring the same indicators on all waters allows for systematic, even-handed and information-based comparison. Calculating separate ecological, stressor, and social indices enables the user to consider each of these three classes of factors, individually or in combination. The ecological index score reflects overall condition and the capacity of the watershed to regain functionality, based on metrics related to natural watershed processes and structure. The stressor score reflects the pressures on watershed condition from several primary sources of pollutants and water quality impairments. The social context score includes many factors, such as community involvement, incentives, economics, governance, regulation and planning status that do not constitute watershed condition but often strongly influence the level of effort and complexity of making improvements. A Recovery Potential Integrated (RPI) score is calculated by combining these three indices. For more information on the Recovery Potential Screening process visit EPA's website: (http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/recovery/index.cfm)

**Table 107. PPIA Ranking for Subwatersheds in the Southern Whitewater River Watershed**

| Watershed | PPIA Ranking | Subwatershed | RPI Score | Ecological Rank | Stressor Rank | Social Rank |
|---|---|---|---|---|---|---|
| Salt Creek | 1 | Fremont Branch | 3.2 | 1 | 2 | 1 |
| | 2 | Bull Fork | 1.99 | 3 | 1 | 3 |
| | 3 | Little Salt Creek | 1.65 | 4 | 3 | 4 |
| | 4 | Righthand Fork Salt Creek | 1.57 | 2 | 5 | 2 |
| | 5 | Headwaters Salt Creek | 0.84 | 5 | 4 | 5 |
| | | | | | | |
| Pipe Creek | 1 | Yellow Bank Creek | 2.37 | 1 | 4 | 1 |
| | 2 | Walnut Fork | 1.87 | 2 | 2 | 4 |
| | 3 | Clear Fork | 1.74 | 3 | 3 | 3 |
| | 4 | Headwaters Pipe Creek | 1.31 | 4 | 5 | 2 |
| | 5 | Duck Creek | 1.31 | 5 | 1 | 5 |
| | | | | | | |
| Whitewater River | 1 | Jameson Creek | 5.07 | 4 | 1 | 1 |
| | 2 | Johnson Fork | 2.5 | 1 | 5 | 2 |
| | 3 | Blackburn Creek | 2.33 | 3 | 4 | 4 |
| | 4 | Little Cedar Creek | 2.15 | 2 | 9 | 3 |
| | 5 | Wolf Creek | 1.68 | 5 | 2 | 7 |
| | 6 | Big Cedar Creek | 1.45 | 6 | 3 | 6 |
| | 7 | Headwaters Blue Creek | 1.43 | 7 | 6 | 5 |
| | 8 | Howard Creek | 0.79 | 9 | 8 | 8 |
| | 9 | Headwaters Dry Fork Whitewater River | 0.76 | 8 | 7 | 9 |
| | 10 | Lee Creek | NA | NA | NA | NA |

**Table 108. Indicators Used in the Recovery Potential Calculator**

| Ecological Indicator | Stressor Indicator | Social Indicator |
|---|---|---|
| Percent Forested Land<br>Watershed Surface Area<br>Watershed Drainage Area<br>Fish IBI Score<br>Total QHEI Score<br>Stream Order (%2-4)<br>Slope of Land (mean) | Percent Agricultural Land<br>Number of Impairment Parameters<br>Percent Developed Land<br>Percent Stream Miles Impaired<br>Soil Erodability (mean)<br>Percent Agriculture in Riparian<br>Number of CFOs | Percent Managed Lands<br>Population Density<br>Jurisdictional Complexity<br>Number of Ecological Attributes<br>Drinking Water Source |

This information is important for watershed organizations in the process of identifying and selecting critical areas and implementation activities for the purposes of watershed management plan development. While PPIAs are not intended to dictate those critical areas for watershed organizations, IDEM recommends that watershed organizations take the PPIA rankings into consideration when selecting critical areas for purposes of watershed management planning.

## 13.0 PROTECTION MEASURES/RECOMMENDATION

The Southern Whitewater River watershed has several unique characteristics to take into account when discussing protection measures and recommendations in this section. The mainstem Whitewater River is classified as a DNR State Outstanding Water from Cambridge City to the Ohio State line. The variegate darter, a state endangered fish species, is also located within the watershed. The species distribution is restricted by the Ohio River downstream, which does not have the necessary habitat for the species, and by dams (Brookville Lake Dam and Laurel Feeder Dam) upstream. Based on the information above, this Section will discuss protection measures as described in the Indiana anti-degradation rule, the protective strategy calculated in this TMDL document, and future protection actions to take into consideration.

Historically Indiana's State Outstanding Waters were based on environmental and aesthetic interests. In 1993, the Natural Resources Commission revised the original listings and adopted the State Outstanding Waters as an official recognition of the resource values of these waters. The Whitewater River specifically is designated a State Outstanding Water because it has been identified as having statewide significance based on assessments, it has been identified by the state natural heritage programs as having outstanding ecological importance, the river is designated as a canoe/boating route, and it has been formally proposed for state protection.

The State's anti-degradation rule (327 IAC 2-1.3) requires streams that presently have conditions better than the proposed targets are maintained at those above par conditions. This rule applies to a proposed new or increased loading of a regulated pollutant to a surface water of the state that results from a deliberate activity subject to the Clean Water Act (CWA) including a change in process or operation that will result in a significant lowering of water quality. Any future discharge, new or increased loadings, to the water will require an anti-degradation demonstration to ensure the permit limits are protective of the water quality. The components of the anti-degradation demonstrations include, providing basic information about the discharge, showing that a discharge is necessary, outlining treatment alternatives, and indicating the social and economic benefit of discharges. The anti-degradation rule and the demonstration components work collectively to prevent future degradation to Whitewater River.

With no fixed numeric criterion, a major challenge to preparing a TMDL for sediment is development of a numeric target that can be used to derive a load capacity. Setting targets for surrogate measures of sediment load is a process that attempts to account for yields, delivery, transport, and deposition in both natural and potentially disturbed conditions. A surrogate is often selected for relative efficiency of measurement and because the effects on biological endpoints are better understood than general effects of higher sediment loads. As such, a concentration goal is used in a TMDL, providing a bridge over the uncertainty in the connection between sediment loading and support of beneficial uses (IDEQ, 2003). While effects of light penetration are usually associated solely with primary production, turbidity is also associated with elevated stress in fish, predatory efficiency, inducement of invertebrate drift, and suffocation of incubating embryos. TSS is perhaps the most direct measurement of sediment loads in the stream in terms of its effects on fish, macroinvertebrates, and the aquatic habitat. Historically, Indiana TMDLs for sediment have used a TSS target of 30 mg/L, based on the target for permitted facilities. Due to the presence of a State Endangered Species, the variegate darter, the TSS target has been lowered to the U.S. EPA recommended target of 25 mg/L (Waters, 1995). The variegate darter, *Etheostoma variatum*, typically occurs in swift, rubble-boulder-gravel riffles with some sand. Embedded substrates lack the interstitial spaces that allow intergravel flow and provide habitat and cover for benthic invertebrates and juvenile fish. Restricting the sediment load in the streams should help protect this specific habitat from being embedded with silt and other fine sediment, as well as, reduce the negative effects reduction of light penetration has on aquatic communities. The fish and macroinvertebrate assemblages are the living resources that should be protected through TMDL planning, and measurements of their condition should be integral to TMDL evaluation. Based on the 2014 IDEM sampling, the mainstem Whitewater River does not show signs of biological impairment, thus it may be assumed that environmental conditions are suitable and excessive sediments are not a problem. However, in order to implement a higher level of protection, TSS TMDLs were developed for all rivers and streams where the variegate darter has known distributions in the Southern Whitewater River project area to ensure the habitat remains suitable for the survival and fecundity of the endangered species.

In Indiana the variegate darter is found only in the Whitewater River drainage. The species distribution has been studied throughout the basin (Fisher, 2008) and has a very limited range. In addition to protecting the known rivers and tributaries supporting the variegate darter, expanding the range should also be discussed. The habitat requirements do not exist in the Ohio River, which prevents the species from moving downstream. The East Fork Whitewater River is impounded by Brookville Lake and this creates a large barrier preventing the upstream movement of the species along the East Fork Whitewater River. South of the Town of Laurel, in Franklin County, there is a low-head dam on the West Fork Whitewater River which functions as a feeder dam for the Whitewater Canal. This barrier restricts the species from expanding its range upstream along the West Fork Whitewater River. The necessary riffle habitat exists upstream of the dam in Laurel to support the endangered species, however without a functional fish passage for darters the species distribution is limited. After reviewing other fish species distribution maps from the IDNR and IDEM there are a number of other species restricted by the Laurel Feeder Dam. Those species distributions that end at the Laurel Feeder Dam include the longnose gar, eastern sand darter, smallmouth redhorse, brindled madtom, suckermouth minnow, brook silverside, freshwater drum, and the slenderhead darter.

A fourteen-mile section of the original Whitewater Canal is preserved from Laurel to Brookville as a state memorial. The canal currently powers a working grain mill and is a tourist site in the Town of Metamora. The Laurel Feeder Dam was built in the 1940s to provide water to the restored canal section in Metamora. The canal is a DNR State historical site and has great value in terms of tourism and the local economy. However, it is a barrier to the aquatic communities and restricts species ranges, specifically the endangered variegate darter. Just as in the 1940s engineered devices (dams) were used to raise the river

level to a useable depth to feed the canal, engineered devices in the 21st century should be explored to replace the 75 year old dam, while preserving the function of the Whitewater Canal. The removal of the Laurel Feeder Dam or the installation of a functional fish passage could expand the range of up to nine fish species and remove a barrier allowing canoeist's access to the West Fork Whitewater River in its entirety.

# 14.0 REASONABLE ASSURANCES/IMPLEMENTATION

This section of the Southern Whitewater River watershed TMDL focuses on implementation activities that have the potential to achieve the WLAs and LAs presented. The focus of this section is to identify and select the most appropriate structural and non-structural best management practices (BMPs) and control technologies to reduce pollutant loads from sources throughout the Southern Whitewater River watershed, particularly in the PPIAs identified. This section also addresses the programs that are available to facilitate implementation of structural and non-structural BMPs to achieve the allocations, as well as current ongoing activities in the Southern Whitewater River watershed at the local level that will play a key role in successful TMDL implementation.

To select appropriate BMPs and control technologies, it is important to review the significant sources in the Southern Whitewater River watershed.

Point Sources

- WWTPs
- Industrial facilities
- Regulated storm water sources
- SSOs
- Illicitly connected straight pipe systems
- Regulated construction sites

Nonpoint Sources

- Cropland
- Pastures and livestock operations
- CFOs
- Streambank erosion
- Onsite wastewater treatment systems
- Wildlife/domestic pets
- Urban nonpoint source runoff

## 14.1 Implementation Activity Options for Sources in the Southern Whitewater River Watershed

Keeping the list of significant sources in the Southern Whitewater River watershed in mind, it is possible to review the types of BMPs that are most appropriate for the *E. coli*, nutrients and sediment and the source type. **Error! Reference source not found.** provides a list of implementation activities that are potentially suitable for the Southern Whitewater River watershed based on the *E. coli*, nutrients and sediment and the types of sources. The implementation activities are a combination of structural and non-structural BMPs to achieve the assigned WLAs and LAs. IDEM recognizes that actions taken in any individual subwatershed may depend on a number of factors (including socioeconomic, political and ecological factors). The recommendations in **Error! Reference source not found.** are not intended to be prescriptive. Any number or combination of implementation activities might contribute to water quality improvement, whether applied at sites where the actual impairment was noted or other locations where sources contribute indirectly to the water quality impairment.

**Table 109. List of Potentially Suitable BMPs for the Southern Whitewater River Watershed**

| | Pollutant | | | Point Sources | | | Nonpoint Sources | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Implementation Activities** | **Bacteria** | **Nutrients** | **Sediment** | **WWTPs and Industrial Facilities** | **Regulated Stormwater Sources** | **Illicitly Connected "Straight Pipe" Systems** | **Cropland** | **Pastures and Livestock Operations** | **CFOs** | **Streambank Erosion** | **Onsite Wastewater Treatment Systems** | **Wildlife/Domestic Pets** | **Urban NPS Runoff** |
| Disinfection of primary effluent | X | | | X | | | | | | | | | |
| Biological nutrient removal | | X | | X | | | | | | | | | |
| Inspection and maintenance | X | X | X | X | X | | | | | | X | | X |
| Outreach and education and training | X | X | X | X | X | X | X | X | X | X | X | X | X |
| System replacement | X | X | | | | X | | | | | X | | |
| Conservation tillage/residue management | X | X | X | | | | X | | | | | | |
| Cover crops | X | X | X | | | | X | | | X | | | |
| Filter strips | X | X | X | | X | | X | X | X | X | | | |
| Grassed waterways | X | | X | | | | X | | X | X | | | |
| Riparian forested/herbaceous buffers | X | X | X | | | | X | X | X | X | | X | |
| Manure handling, storage, treatment, and disposal | X | X | | | | | | | X | | | | |
| Composting | X | X | | | X | | | | | | | | X |
| Alternative watering systems | X | | X | | | | | X | X | X | | | |
| Stream fencing (animal exclusion) | X | X | X | | | | | X | X | X | | | |
| Grazing land management | X | X | X | | | | | X | X | X | | | |
| Conservation easements | X | X | X | | | | | | | | | | |
| Two-stage ditches | | X | X | | | | | | | | | | |
| Rain barrel | | X | X | | X | | | | | | | | X |
| Rain garden | | X | X | | X | | | | | | | | X |
| Street rain garden | | X | X | | X | | | | | | | | X |
| Block bioretention | | X | X | | X | | | | | | | | X |

| Implementation Activities | Pollutant | | | Point Sources | | | Nonpoint Sources | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bacteria | Nutrients | Sediment | WWTPs and Industrial Facilities | Regulated Stormwater Sources | Illicitly Connected "Straight Pipe" Systems | Cropland | Pastures and Livestock Operations | CFOs | Streambank Erosion | Onsite Wastewater Treatment Systems | Wildlife/Domestic Pets | Urban NPS Runoff |
| Regional bioretention | | X | X | | X | | | | | | | | X |
| Porous pavement | | X | X | | X | | | | | | | | X |
| Green alley | | X | X | | | | | | | | | | |
| Green roof | | X | X | | X | | | | | | | | X |
| Dam modification or removal | | X | X | | | | | | | | | | |
| Levee or dike modification or removal | | X | X | | | | | | | | | | |
| Stormwater planning and management | X | X | X | X | X | | | | | X | X | X | X |
| Comprehensive Nutrient Management Plan | X | X | | | | | X | | X | | | | |
| Constructed Wetland | X | X | X | X | | X | X | | | | | X | |
| Critical Area Planting | | | X | | | | | X | | X | | | |
| Drainage Water Management | | X | | | | | X | | | | | | |
| Heavy Use Area Pad | X | | X | | | | | X | | | | | |
| Nutrient Management Plan | | X | | | | | X | | | X | | | |
| Terrace | | | X | | | | X | | | | | | |
| Sediment Basin | | X | X | | | | | | | | | | |
| Pasture and Hay Planting | X | X | X | | | | X | X | X | X | | X | |
| Streambank and Shoreline Protection | | | X | | | | X | X | X | X | | X | |
| Conservation Crop Rotation | X | X | X | | | | X | X | X | X | | | |
| Field Border | X | X | | | | | X | X | X | | | X | |
| Waste Treatment Lagoon | X | X | | | | | | X | X | | | | |

The information provided in **Error! Reference source not found.** assisted in the development of Table 110, which provides a more refined suite of recommended implementation activities targeted to the PPIAs identified.

Watershed stakeholders can use the implementation activities identified in Table 110 for each PPIA and select activities that are most feasible in the Southern Whitewater River watershed. This table can also help watershed stakeholders to identify implementation activities for critical areas that they select through the watershed management planning process.

**Table 110. Recommended Implementation Activities for the Salt Creek Watershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Fremont Branch (050800030505) | 1 | Outreach and education and training |
| | | Filter Strips |
| | | Grazing land management |
| Bull Fork (050800030503) | 2 | Filter Strips |
| | | Riparian forested/herbaceous buffers |

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| | | Grazing land management |
| Little Salt Creek (050800030504) | 3 | Cover crops |
| | | Riparian forested/herbaceous buffers |
| | | Grazing land management |
| Righthand Fork Salt Creek (050800030502) | 4 | Comprehensive Nutrient Management Plan |
| | | Conservation tillage/residue management |
| | | Heavy Use Area Pad |
| Headwaters Salt Creek (050800030501) | 5 | Comprehensive Nutrient Management Plan |
| | | Conservation tillage/residue management |
| | | Heavy Use Area Pad |

**Table 111. Recommended Implementation Activities for the Pipe Creek Watershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Yellow Bank Creek (050800030605) | 1 | Outreach and education and training |
| | | System replacement |
| | | Nutrient Management Plan |
| Walnut Fork (050800030604) | 2 | Outreach and education and training |
| | | Filter strips |
| | | Nutrient Management Plan |
| Clear Fork (050800030602) | 3 | Outreach and education and training |
| | | Conservation tillage/residue management |
| | | System replacement |
| Headwaters Pipe Creek (050800030601) | 4 | Outreach and education and training |
| | | Conservation tillage/residue management |
| | | System replacement |
| Duck Creek (050800030603) | 5 | Outreach and education and training |
| | | Nutrient Management Plan |
| | | Filter strips |

**Table 112. Recommended Implementation Activities for the Whitewater River Watershed**

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Jameson Creek (050800030810) | 1 | Not enough information to prioritize |
| Johnson Fork (050800030806) | 2 | Outreach and education and training |
| | | Riparian forested/herbaceous buffers |
| | | Constructed Wetland |
| Blackburn Creek (050800030805) | 3 | Outreach and education and training |
| | | Riparian forested/herbaceous buffers |
| | | Constructed Wetland |
| Little Cedar Creek (050800030804) | 4 | Riparian forested/herbaceous buffers |
| | | Outreach and education and training |
| | | Grazing land management |
| Wolf Creek (050800030802) | 5 | Riparian forested/herbaceous buffers |
| | | Outreach and education and training |
| | | Grazing land management |

| Subwatershed | PPIA Rank | Implementation Action |
|---|---|---|
| Big Cedar Creek (050800030803) | 6 | Outreach and education and training |
| | | Nutrient Management Plan |
| | | Filter strips |
| Headwaters Blue Creek (050800030801) | 7 | Manure handling, storage, treatment, and disposal |
| | | Outreach and education and training |
| | | Filter strips |
| Howard Creek (050800030808) | 8 | Manure handling, storage, treatment, and disposal |
| | | Nutrient Management Plan |
| | | Filter strips |
| Headwaters Dry Fork Whitewater River (050800030807) | 9 | Manure handling, storage, treatment, and disposal |
| | | Nutrient Management Plan |
| | | Filter strips |
| Lee Creek | 10 | Not enough information to prioritize |

## 14.2 Implementation Goals and Indicators

For each *E. coli*, nutrients and sediment in the Southern Whitewater River watershed, IDEM has identified broad goal statements and indicators. This information is to help watershed stakeholders determine how to track implementation progress over time and also provides the information necessary to complete a watershed management plan.

***E. coli* Goal Statement:** The waterbodies (or streams) in the Southern Whitewater River watershed should meet the 125 colonies/100 mL (geometric mean) TMDL target value.

***E. coli* Indicator:** Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the *E. coli* target value.

**Total Phosphorus Goal Statement:** The waterbodies (or streams) in the Southern Whitewater River watershed should meet the 0.30 mg/L TMDL total phosphorus target value.

**Total Phosphorus Indicator:** Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total phosphorus target value.

**Total Nitrogen Goal Statement:** The waterbodies (or streams) in the Southern Whitewater River watershed should meet the 10 mg/L TMDL total nitrogen target value.

**Total Nitrogen Indicator:** Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total nitrogen target value.

**Total Suspended Solids Goal Statement:** The waterbodies (or streams) in the Southern Whitewater River watershed should meet the 30 mg/L TMDL total suspended solids target value.

**Total Suspended Solids Indicator:** Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total suspended solids target value.

## 14.3 Summary of Programs

There are a number of federal, state, and local programs that either require or can assist with the implementation activities recommended for the Southern Whitewater River watershed in **Error! Reference source not found.** and Table 110. A description of these programs is provided in this section. The following section discusses how some of these programs relate to the various sources in the Southern Whitewater River watershed.

### 14.3.1 Federal Programs

#### 14.3.1.1 Clean Water Act Section 319(h) Grants

Section 319 of the federal Clean Water Act contains provisions for the control of nonpoint source pollution. The Section 319 program provides for various voluntary projects throughout the state to prevent water pollution and also provides for assessment and management plans related to waterbodies in Indiana impacted by NPS pollution. The Watershed Planning and Restoration Section within the Watershed Assessment and Planning Branch of the Office of Water Quality administers the Section 319 program for the NPS-related projects.

USEPA offers Clean Water Act Section 319(h) grant monies to the state on an annual basis. These grants must be used to fund projects that address nonpoint source pollution issues. Some projects which the Office of Water Quality has funded with this money in the past include developing and implementing Watershed Management Plans (WMPs), BMP demonstrations, data management, educational programs, modeling, stream restoration, and riparian buffer establishment. Projects are usually two to three years in length. Section 319(h) grants are intended to be used for project start-up, not as a continuous funding source. Units of government, nonprofit groups, and universities in the state that have expertise in nonpoint source pollution problems are invited to submit Section 319(h) proposals to the Office of Water Quality.

#### 14.3.1.2 Clean Water Action Section 205(j) Grants

Section 205(j) provides for planning activities relating to the improvement of water quality from nonpoint and point sources by making funding available to municipal and county governments, regional planning commissions, and other public organizations. For-profit entities, non-profit organizations, private associations, universities and individuals are not eligible for funding through Section 205(j). The CWA states that the grants are to be used for water quality management and planning, including, but not limited to:

- Identifying most cost effective and locally acceptable facility and non-point source measures to meet and maintain water quality standards;
- Developing an implementation plan to obtain state and local financial and regulatory commitments to implement measures developed under subparagraph A;
- Determining the nature, extent, and cause of water quality problems in various areas of the state.

The Section 205(j) program provides for projects that gather and map information on nonpoint and point source water pollution, develop recommendations for increasing the involvement of environmental and civic organizations in watershed planning and implementation activities, and develop watershed management plans.

#### 14.3.1.3 USDA's Conservation of Private Grazing Land Initiative (CPGL)

The Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. It is not a cost-share program. This technical assistance will offer opportunities for: better grazing land management; protecting soil from erosive wind and water; using more energy efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.

#### 14.3.1.4 USDA's Conservation Reserve Program (CRP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost-share funding is provided to establish the vegetative cover practices.

#### 14.3.1.5 USDA's Conservation Technical Assistance (CTA)

The purpose of the CTA program is to assist land users, communities, units of state and local government, and other Federal agencies in planning and implementing conservation systems. The purpose of the conservation systems is to reduce erosion, improve soil and water quality, improve and conserve wetlands, enhance fish and wildlife habitat, improve air quality, improve pasture and range condition, reduce upstream flooding, and improve woodlands.

One objective of the program is to assist individual land users, communities, conservation districts, and other units of State and local government and Federal agencies to meet their goals for resource stewardship and assist individuals in complying with State and local requirements. NRCS assistance to individuals is provided through conservation districts in accordance with the Memorandum of Understanding signed by the Secretary of Agriculture, the Governor of the State, and the conservation district. Assistance is provided to land users voluntarily applying conservation practices and to those who must comply with local or State laws and regulations.

Another objective is to provide assistance to agricultural producers to comply with the highly erodible land (HEL) and wetland (Swampbuster) provisions of the 1985 Food Security Act as amended by the Food, Agriculture, Conservation and Trade Act of 1990 (16 U.S.C. 3801 et. seq.), the Federal Agriculture Improvement and Reform Act of 1996, and wetlands requirements of Section 404 of the Clean Water Act. NRCS makes HEL and wetland determinations and helps land users develop and implement conservation plans to comply with the law. The program also provides technical assistance to participants in USDA cost-share and conservation incentive programs.

NRCS collects, analyzes, interprets, displays, and disseminates information about the condition and trends of the Nation's soil and other natural resources so that people can make good decisions about resource use and about public policies for resource conservation. They also develop effective science-based technologies for natural resource assessment, management, and conservation.

#### 14.3.1.6 USDA's Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan, which includes structural, vegetative, and land management practices on eligible land. Five to ten year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management.

Fifty percent of the funding available for the program is targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas.

#### 14.3.1.7 USDA's Small Watershed Program and Flood Prevention Program (WF 08 or FP 03)

The Small Watershed Program works through local government sponsors and helps participants solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, wetlands creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. Both technical and financial assistance are available.

#### 14.3.1.8 USDA's Watershed Surveys and Planning

The Watershed and Flood Prevention Act, P.L. 83-566, August 4, 1954, (16 U.S.C. 1001-1008) authorized this program. Prior to fiscal year 1996, small watershed planning activities and the cooperative river basin surveys and investigations authorized by Section 6 of the Act were operated as separate programs. The 1996 appropriations act combined the activities into a single program entitled the Watershed Surveys and Planning program. Activities under both programs are continuing under this authority.

The purpose of the program is to assist Federal, State, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources. Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries.

Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance. The focus of these plans is to identify solutions that use land treatment and non-structural measures to solve resource problems.

#### 14.3.1.9 USDA's Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. ACEP consolidated three former USDA programs – Wetland Reserve Program, Grassland Reserve Program, and Farm and Ranchland Protection Program. NRCS provides financial assistance to eligible partners for purchasing Agricultural

Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include Indian tribes, state and local governments and non-governmental organizations that have farmland or grassland protection programs.

NRCS also provides technical and financial assistance directly to private landowners and Indian tribes to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement. Through the wetland reserve enrollment options, NRCS may enroll eligible land through: Permanent Easements, 30-year Easements, Term Easements, or 30-year Contracts.

Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland and nonindustrial private forest land. NRCS will prioritize applications that protect agricultural uses and related conservation values of the land and those that maximize the protection of contiguous acres devoted to agricultural use. Land eligible for wetland reserve easements includes farmed or converted wetland that can be successfully and cost-effectively restored. NRCS will prioritize applications based the easement's potential for protecting and enhancing habitat for migratory birds and other wildlife.

#### 14.3.1.10 USDA's Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentives Program provides financial incentives to develop habitat for fish and wildlife on private lands. Participants agree to implement a wildlife habitat development plan and USDA agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. USDA and program participants enter into a cost-share agreement for wildlife habitat development. This agreement generally lasts a minimum of 10 years from the date that the contract is signed.

### 14.3.2 State Programs

#### 14.3.2.1 State Point Source Control Program

The purpose of the NPDES permit is to control the point source discharge of pollutants into the waters of the State such that the quality of the water of the State is maintained in accordance with applicable water quality standards. NPDES permit requirements ensure that the minimum amount of control is imposed upon any new or existing point source through the application of technology-based treatment requirements. Control of discharges from WWTPs, industrial facilities, storm water and CSOs consistent with WLAs is implemented through the NPDES program.

#### 14.3.2.2 State Nonpoint Source Control Program

The state's Nonpoint Source Program, administered by the IDEM Office of Water Quality's Watershed Planning and Restoration Section, focuses on the assessment and prevention of nonpoint source water pollution. The program also provides for education and outreach to improve the way land is managed. Through the use of federal funding for the installation of BMPs, the development of watershed management plans, and the implementation of watershed restoration pollution prevention activities, the program reaches out to citizens so that land is managed in such a way that less pollution is generated.

Nonpoint source projects funded through the Office of Water Quality are a combination of local, regional, and statewide efforts sponsored by various public and not-for-profit organizations. The emphasis of these projects has been on the local, voluntary implementation of nonpoint source water pollution controls. The Watershed Planning and Restoration Section administers the Section 319 funding for nonpoint source-related projects, as well as Section 205(j) grants.

To award 319 grants, Watershed Planning and Restoration Section staff review proposals for minimum 319(h) eligibility criteria and rank each proposal. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; strength of local partnerships; and competence/reliability of contracting agency. They then convene to discuss individual project merits and pool all rankings to arrive at final rankings for the projects. All proposals that rank above the funding target are included in the annual grant application to USEPA, with USEPA reserving the right to make final changes to the list. Actual funding depends on approval from USEPA and yearly congressional appropriations.

Section 205(j) projects are administered through grant agreements that define the tasks, schedule, and budget for the project. IDEM project manager's work closely with the project sponsors to help ensure that the project runs smoothly and the tasks of the grant agreement are fulfilled. Site visits are conducted at least quarterly to touch base on the project, provide guidance and technical assistance as needed, and to work with the grantee on any issues that arise to ensure a successful project closeout.

Hoosier Riverwatch, is a water quality monitoring initiative which aims to increase public awareness of water quality issues and concerns through hands-on training of volunteers in-stream monitoring and cleanup activities. Hoosier Riverwatch collaborates with agencies and volunteers to educate local communities about the relationship between land use and water quality and to provide water quality information to citizens and governmental agencies working to protect Indiana's rivers and streams.

#### 14.3.2.3 Indiana State Department of Agriculture Division of Soil Conservation

The Division of Soil Conservation's mission is to ensure the protection, wise use, and enhancement of Indiana's soil and water resources. The Division's employees are part of Indiana's Conservation Partnership, which includes the 92 soil and water conservation districts (SWCDs), the USDA Natural Resources Conservation Service, and the Purdue University Cooperative Extension Service. Working together, the partnership provides technical, educational, and financial assistance to citizens to solve erosion and sediment-related problems occurring on the land or impacting public waters.

The Division administers the Clean Water Indiana soil conservation and water quality protection program under guidelines established by the State Soil Conservation Board, primarily through the local SWCDs in direct service to land users. The Division staff includes field-based resource specialists who work closely with land users, assisting in the selection, design, and installation of practices to reduce soil erosion on agricultural land. The Storm water and Sediment Control Program works primarily with developers, contractors, realtors, property holders and others to address erosion and sediment concerns on non-agricultural lands, especially those undergoing development.

#### 14.3.2.4 Indiana Department of Natural Resources, Division of Fish and Wildlife

The Lake and River Enhancement (LARE) program utilizes a watershed approach to reduce nonpoint source sediment and nutrient pollution of Indiana's and adjacent states' surface waters to a level that meets or surpasses state water quality standards. To accomplish this goal, LARE provides technical and financial assistance to local entities for qualifying projects that improve and maintain water quality in public access lakes, rivers, and streams.

#### 14.3.2.5 State Revolving Fund (SRF) Loan Program

The SRF is a fixed rate, 20-year loan administered by the Indiana Finance Authority. The SRF provides low-interest loans to Indiana communities for projects that improve wastewater and drinking water

infrastructure. The Program's mission is to provide eligible entities with the lowest interest rates possible on the financing of such projects while protecting public health and the environment. SRF also funds non-point source projects that are tied to a wastewater loan. Any project where there is an existing pollution abatement need is eligible for SRF funding.

### 14.3.3 Funding Utilized by Local Stakeholders

Programs taking place at the local level are key to successful TMDL implementation. Partners are instrumental to bringing grant funding into the Southern Whitewater River watershed to support local protection and restoration projects. This section provides a brief summary of the local programs taking place in the Southern Whitewater River watershed that will help to reduce pollutant loads, as well as provide ancillary benefits to the Southern Whitewater River watershed.

The county funding information is based on information from the Indiana Conservation Partnership website. The dollar amounts were calculated using an area weighted approach to account for the Southern Whitewater River watershed area.

Dearborn County
Dearborn County has received the following funding to improve water quality in 2012 and 2013:
Clean Water Indiana (CWI) - $7,662
Wildlife Habitat Cost-Share Program (WHCP) - $89
Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP) - $197,496
Environmental Quality Incentives Program (EQIP) - $34,512
Game Bird Habitat Development Program (GDHP) - $276
Wildlife Habitat Incentive Program (WHIP) - $1,771
Local funding from non-state and non-federal sources - $43,165

In 2012 and 2013 the Dearborn County SWCD sponsored rain barrels, tumbling composters, a native plantings and a rain garden installations and the expense was cost shared.

Decatur County
Decatur County has received the following funding to improve water quality in 2012 and 2013:
CWI - $4,447
WHCP - $336
CRP/CREP - $59,669
EQIP - $90,607
WHIP - $1,086
Conservation Stewardship Program (CSP) - $2,099
Local funding from non-state and non-federal sources - $19,524

The Decatur County SWCD hosted a pond seminar to discuss the permitting process and regulations required by the county. Also discussed was site selection, construction, dealing with nuisance animals and aquatic weed controls and fish stocking.

The Decatur County SWCD hosted a forestry and wildlife field day in 2013. A small group of local residents learned about invasive species, forestry and wetland management and how to control nuisance animals.

Fayette County

Fayette County has received the following funding to improve water quality in 2012 and 2013:
CWI -$394
CRP\CREP - $13,548
EQIP - $2,521
WHIP - $78
CSP - $84
Local funding from non-state and non-federal sources - $671

Franklin County
Franklin County has received the following funding to improve water quality in 2012 and 2013:
CWI -$18,508
CRP\CREP - $470,299
EQIP - $127,249
Local funding from non-state and non-federal sources - $54,678

Ripley County
Ripley County has received the following funding to improve water quality in 2012 and 2013:
CWI -$1,122
CRP\CREP - $56,238
EQIP - $10,777
WHIP - $318
CSP - $2,000
WHCP - $34
GHDP - $35
Local funding from non-state and non-federal sources - $11,042

In addition, in 2013 the Ripley County SWCD teamed with the Regional No-Till Committee and held the 20th Annual No-Till Breakfast. Over 150 farmers and landowners attended to learn about new advancements in farming and possible weed problems in no-till fields. This event promotes conservation tillage and other conservation methods pertaining to soil health.

Rush County
Rush County has received the following funding to improve water quality in 2012 and 2013:
CWI -$613
CRP\CREP - $16,898
EQIP - $764
CSP - $4,624
Local funding from non-state and non-federal sources - $2,979

The Franklin County Soil and Water Conservation District received $138,600 from IDEM through a Section 319 grant to produce a WMP for the Whitewater River Watershed, HUC 0508000308. They have also received $92,400 in matched funds. The WMP will meet both the IDEM WMP checklist and OH EPA guidelines. An education and outreach program will also be conducted including newsletters to watershed stakeholders, press releases to the local media, public service announcement to local radio station(s), newspaper articles to the local media, a watershed brochure, watershed signs to increase watershed awareness, workshops to educate stakeholders on BMPs that reduce pollutant loading from urban and/or agricultural areas, field days to promote conservation practices. The watershed group will also hold two workshops to educate stakeholders about urban nonpoint pollution. Franklin County SWCD has received letters of commitment on the project from the following partners:

| Name of Partner | Type(s) of commitment to project success |
|---|---|

| | |
|---|---|
| Franklin Co SWCD | Provide information and input for the watershed project, assist with public outreach and educational programs and have a representative on the steering committee |
| Butler Co SWCD | Provide information and input for the watershed project, assist with public outreach and educational programs and have a representative on the steering committee |
| Hamilton Co SWCD | Provide information and input for the watershed project, assist with public outreach and educational programs and have a representative on the steering committee |
| OH-KY-IN Regional Council of Governments | Provide any data relevant to the watershed and assist in developing the management plan |
| Purdue Extension Service | Provide assistance in the educational and outreach efforts |
| Ohio State Extension | Provide assistance in the educational and outreach efforts |
| Oxbow, Inc | Provide assistance in awareness and education |
| County Health Departments | Assist in developing the management plan by providing information on problem areas and assist with educational efforts |
| Miami University, Stream Team and S. Dearborn Regional Sewer District | Assist in the water testing program for the watershed by assisting in the collection and/or analysis of samples |
| County and State Highway Departments | Assist in developing the management plan by providing information on problem erosion sites and assist with installing signage throughout the watershed |

## 14.4 Implementation Programs by Source

Previous sections identified a number of federal, state, and local programs that can support implementation of the recommended management or restoration activities for the Southern Whitewater River watershed (Table 110). Table 113 and the following sections identify which programs are relevant to the various sources in the Southern Whitewater River watershed.

**Table 113. Summary of Programs Relevant to Sources in the Southern Whitewater River Watershed**

| Source | State NPDES program | Local agencies/programs | Section 319 program | Section 205(j) program | ISDA Division of Soil Conservation | IDNR Division of Fish and Wildlife | USDA's Conservation of Private Grazing Land Initiative | USDA's Conservation Reserve Program | USDA's Conservation Technical Assistance | USDA's Environmental Quality Incentives Program | USDA's Small Watershed Program and Flood Prevention Program | USDA's Watershed Surveys and Planning | USDA's Wetlands Reserve Program | USDA's Wildlife Habitat Incentives Program |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWTPs and Industrial Facilities | X | | | X | | | | | | | | | | |
| CSOs | X | | | X | | | | | | | | | | |
| Regulated Stormwater Sources | X | | | X | | | | | | | | | | |
| Illicitly Connected "Straight Pipe" Systems | X | X | | X | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cropland | | X | X | X | X | X | | X | X | X | X | X | X | |
| Pastures and Livestock Operations | | X | X | X | X | X | X | X | X | X | X | X | | |
| CFOs | X | | | X | | X | | | | | | | | |
| Streambank Erosion | | X | X | X | X | X | X | | X | X | X | X | | |
| Onsite Wastewater Treatment Systems | | X | | X | | | | | | | | | | |
| Wildlife/Domestic Pets | X | X | X | | | | | | | | | | | |
| In-stream Habitat | X | X | X | | | | | | | | | | | X |

### 14.4.1 Point Source Programs

#### 14.4.1.1 WWTPs

Discharges from WWTPs are regulated under the NPDES program, with permits that authorize the discharge of substances at levels that meet the more stringent of technology- or water quality-based effluent limits. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

#### 14.4.1.2 Industrial facilities

As with discharges from WWTPs, industrial discharges are regulated under the NPDES program, with permits that authorize the discharge of substances at levels that meet the more stringent of technology- or water quality-based effluent limits. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

#### 14.4.1.3 Regulated storm water sources

Regulated MS4s are required to obtain permit covered under IDEM's MS4 general permit that requires a storm water management program (SWMP) to address six minimum control measures. There are two MS4s in the Southern Whitewater River watershed that have coverage under Ohio's MS4 permit program. The SWMPs for each of these MS4s describes best management practices implemented to fulfill the six minimum control measure requirements.

According to the 2013 Annual Report for the City of Harrison (1GQ00034*BG) the following activities support the implementation practices described in the SWMP.

1. Education and Outreach
    - An updated City webpage and creation of a new storm water brochure were completed in 2013.
    - Monthly storm water meeting are held to receive complaints. All areas of improvements are scheduled for construction.
2. Public Involvement and Participation:
    - Hold monthly storm water meetings where resident complaints will be documented and construction projects can be scheduled
    - Meetings are open to all residents, commercial and industrial businesses
3. Illicit Discharge Detection and Elimination:
    - Regular inspections of construction and city storm water controls
    - Keep an updated storm sewer system map
    - Conduct pretreatment inspections at all industrial facilities
    - Conducted dry-weather screenings of outfalls to identify any illicit discharges

4. Construction Site Runoff Control:
    - Performs inspections of erosion controls according to the City Ordinance 42-2007 and Codified Ordinance 1111
    - Perform inspections for document violations according to the planning and zoning code
5. Post-Construction Storm Water Management in New Development and Redevelopment:
    - Reduction of impervious surfaces using detention basins, dry wells and storm catch basins
    - Post construction reviews of site plans and inspection for proper drainage
    - Long term management requires home owner associations to maintain storm water facilities
6. Pollution Prevention/Good Housekeeping for Municipal Operations:
    - Provide weekly street sweepings, daily Fall leaf collections, and monthly yard waste collections. In 2013 1,431 miles were cleaned and 218 yards of trash were collected.
    - Make yard waste chipping available to residence
    - Road salt is used on primary streets and overpasses first. Secondary streets are plowed only.
    - Provide training to employees for pollution prevention measures
    - Inspect, repair and document storm water facilities
    - Performs maintenance on storm water structures when needed
    - Disposes of street sweepings to a nearby landfill
    - Future plans to reduce the amount of road salt used in winter months

According to the 2013 Annual Report for the City of Cincinnati (1GQ00046*BG) the following activities support the implementation practices described in the SWMP.

1. Education and Outreach
    - Update internet based education and outreach annually. This includes the Hamilton county Storm Water District website, the Hamilton County SWCD website and the Regional Storm Water Collaborative website, in addition to social media like Facebook, Twitter, You tube and Pinterest.
    - Provide content and programming for other respective media outlets
    - Development of new outreach brochures including storm water awareness property management and storm corridor awareness. These brochures along with others were distributed at 41 events, reaching 5,900 participants. Additional brochures reached thousands of residents in the eco-Safe Alternatives to Household Cleaners education pamphlet. Copies (250) of the Ohio Clean Boater flyer were distributed as well as 475 storm water door tags educating residents on impacts of dumping materials into storm drains.
    - Conduct classroom presentations and review and update curriculum as necessary as it relates to general awareness and stream and watershed awareness.
2. Public Involvement and Participation:
    - The MS4 received 271 storm water related nuisance complaints, 277 stream related complaints and 119 construction complaints.
    - Distribution of 390 soil fertility kits, three stream clean up kits and rain barrel/rain garden seminars.
    - Respond to citizen inquiries and track follow-up to evaluate program effectiveness.
3. Illicit Discharge Detection and Elimination:
    - Storm sewer mapping and maintaining the existing MS4 map.
    - Map drainage systems for government facilities and development project infrastructure.

- Keeping an updated map for BMPs installed.
- Map household sewage treatment systems and their connections to the MS4 according to the established protocol.
- Perform dry weather screenings and identify illicit discharges
- Routinely inspect businesses with pretreatment requirements, respond to storm water related complaints, respond to spills, inspect new storm and sanitary sewers and repair or replace malfunctioning home sewage treatment systems.

4. Construction Site Runoff Control:
   - Performs inspections of erosion
   - Review all applicable site plans
   - Issue Notices of Violation, stop work orders and legal action if necessary.
   - Respond to citizen inquiries related to construction sites.
5. Post-Construction Storm Water Management in New Development and Redevelopment:
   - Conduct enforcement actions as necessary
   - Post construction reviews of site plans and inspection for proper drainage
6. Pollution Prevention/Good Housekeeping for Municipal Operations:
   - Provide programs or demonstrations for rain barrels, rain gardens and pond clinics.
   - Incorporate storm water awareness messages into existing household hazardous waste and recycling opportunities
   - Develop a method for collecting and incorporating soil nutrient and pH information.
   - Conduct and track watershed protection activities, including trash clean-ups.
   - In 2014 the County plans to expand its County buffer, cover crop and tree program.
   - Implement stream signage activities including sign maintenance and new installations.
   - Provide hands on opportunities to riparian property owners to understand stream processes and water quality concerns.
   - Provide training to employees for pollution prevention measures
   - Implement appropriate techniques to minimize the application of road salt, pesticides, herbicides and fertilizer.
   - Develop sustainable capital improvement project program as a way to evaluate water quality issues within the districts permitted area.
   - Clean and repair drainage system as necessary

#### 14.4.1.4 Illegal straight pipes

Local health departments are responsible for locating and eliminating illicit discharges and illegal connections to the sewer system.

### 14.4.2 Nonpoint Sources Programs

#### 14.4.2.1 Cropland

Nonpoint source pollution from cropland areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of cropland BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)

- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs
- USDA's Conservation Reserve Program (CRP)
- USDA's Conservation Technical Assistance (CTA)
- USDA's Environmental Quality Incentives Program (EQIP)
- USDA's Small Watershed Program and Flood Prevention Program (WF 08 or FP 03)
- USDA's Watershed Surveys and Planning
- USDA's Wetlands Reserve Program (WRP)
- USDA's Wildlife Habitat Incentives Program (WHIP)

#### 14.4.2.2 Pastures and livestock operations

Nonpoint source pollution from pasture and livestock areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of pasture and grazing BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs
- USDA's Conservation of Private Grazing Land Initiative (CPGL)
- USDA's Conservation Reserve Program (CRP)
- USDA's Conservation Technical Assistance (CTA)
- USDA's Environmental Quality Incentives Program (EQIP)
- USDA's Small Watershed Program and Flood Prevention Program (WF 08 or FP 03)
- USDA's Watershed Surveys and Planning
- USDA's Wildlife Habitat Incentives Program (WHIP)

#### 14.4.2.3 CFOs

While CAFOs are regulated by federal law, CFOs are not. However, Indiana has CFO regulations 327 IAC 16, 327 IAC 15 that require that operations manage manure, litter, and process wastewater in a manner that "does not cause or contribute to an impairment of surface waters of the state." IDEM regulates CFOs under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 16, which implement the statute regulating CFOs, were effective on March 10, 2002. IDEM's Office of Land Quality administers the regulatory program, which includes permitting, compliance monitoring and enforcement activities.

#### 14.4.2.4 Streambank erosion

Streambank erosion can be the result of changes in the physical structure of the immediate bank from activities such as removal of riparian vegetation or frequent use by livestock, or it can be the result of increased flow volumes and velocities resulting from increased surface runoff throughout the upstream watershed. Therefore, streambank erosion might be addressed through BMPs and restoration targeted to the specific stream reach, and further degradation could be addressed through the use of BMPs implemented to address storm water issues throughout the watershed. Programs available to support

implementation of BMPs to address streambank erosion, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Soil Conservation
- USDA's Conservation Technical Assistance (CTA)
- USDA's Environmental Quality Incentives Program (EQIP)
- USDA's Small Watershed Program and Flood Prevention Program (WF 08 or FP 03)
- USDA's Watershed Surveys and Planning
- USDA's Wildlife Habitat Incentives Program (WHIP)
- Mitigation Funds

#### 14.4.2.5 Onsite wastewater treatment systems

Indiana State Department of Health (ISDH) Rule 410 IAC 6-8.1 outlines regulations for septic systems, including a series of regulatory constraints on the location and design of current septic systems in an effort to prevent system failures. The rule prohibits failing systems, requiring that:

- No system will contaminate ground water.
- No system will discharge untreated effluent to the surface.

#### 14.4.2.6 Wildlife/domestic pets

Addressing pollutant contributions from wildlife and domestic pets is typically done at the local level through education and outreach efforts. For wildlife, educational programs focus on proper maintenance of riparian areas and discouraging the public from feeding wildlife. For domestic pets, education programs focus on responsible pet waste maintenance (e.g., scoop the poop campaigns) coupled with local ordinances.

## 14.5 Potential Implementation Partners and Technical Assistance Resources

Agencies and organizations at the federal, state, and local levels will play a critical role in implementation to achieve the WLAs and LAs assigned under this TMDL. Table 114 identifies key potential implementation partners and the type of technical assistance they can provide to watershed stakeholders.

**Table 114. Potential Implementation Partners in the Southern Whitewater River Watershed**

| Potential Implementation Partner | Funding Source |
|---|---|
| **Federal** | |
| USDA | Conservation of Private Grazing Land Initiative (technical and education assistance only) |
| USDA | Conservation Reserve Program |
| USDA | Conservation Technical Assistance (technical assistance only) |
| USDA | Environmental Quality Incentives Program |
| USDA | Small Watershed Program and Flood Prevention Program |
| USDA | Watershed Surveys and Planning |

| Potential Implementation Partner | Funding Source |
|---|---|
| USDA | Wetlands Reserve Program |
| USDA | Wildlife Habitat Incentives Program |
| **State** | |
| ISDA | Division of Soil Conservation soil and water conservation districts |
| IDNR | Division of Fish and Wildlife Lake and River Enhancement program |
| IDEM | Section 319 program grants |
| IDEM | Section 205(j) program grants |
| **Local** | |
| | |
| | |

IDEM has compiled a matrix of public and private grants and other funding resources available to fund watershed implementation activities. The matrix is available on IDEM's website at http://www.in.gov/idem/nps/3439.htm .

# 15.0 PUBLIC PARTICIPATION

Public participation is an important and required component of the TMDL development process. The following public meetings were held in the watershed to discuss this project:

- Two TMDL public kickoff meetings were held on October 29, 2013. The first meeting was held at 2:00 PM (EST) at the Franklin County Government Center, 1010 Franklin Avenue, Brookville, IN 47012. The second kickoff meeting was held at 6:00 PM (EST) at the Batesville Middle School, 201 N. Mulberry Street, Batesville, IN 47006. IDEM described the TMDL program and provided a summary of the available data and the proposed sampling approach at both meetings.
- A Southern Whitewater River Monitoring Field Day was held on June 16, 2014 from 10:00 AM – 12:00 PM (EST). This event was held at the Brookville City Park along the East Fork Whitewater River. At this event, participants learned more about sampling methods from conducted by IDEM and Hoosier Riverwatch staff in the watershed. Field procedures for fish & macroinvertebrate collection, habitat assessment and water chemistry were demonstrated. Live wells and voucher specimens were on hand for observation.
- Draft TMDL public meetings will be held in the watershed on the August 6, 2015. The draft findings of the TMDL will be presented at these meetings and the public will have the opportunity ask questions and provide information to be included in the final TMDL report. A public comment period was from August 6- September 6, 2015.

# APPENDIX A. REASSESSMENT NOTES FOR THE SOUTHERN WHITEWATER RIVER WATERSHED TMDL

# APPENDIX B. SITE SPECIFIC PHOTOS, LOAD DURATION CURVES AND PRECIPITATION GRAPHS

# APPENDIX C. REFERENCES