Notice of 30-Day Period for Public Comment

Dear Sir or Madam,

The purpose of this letter is to notify you that a draft of the Back Creek Watershed Total Maximum Daily Load (TMDL) report is available for public comment and to invite you to review the report on the IDEM website. The 30-day public comment period for the Draft TMDL report will begin on January 2, 2024, and will end on February 2, 2024. The draft TMDL report for the Black Creek Watershed will be posted on IDEM's website at:

https://www.in.gov/idem/nps/resources/total-maximum-daily-load-reports/black-creek-watershed/

At the stakeholder meeting, the Indiana Department of Environmental Management (IDEM) provided an overview of the draft TMDL report and provided an opportunity for public comments. The stakeholder meeting was held on **November 14, 2023, at 6:00 PM EDT** at:

Linton Public Library
95 S.E. 1st Street
Linton, IN, 47441

A hard copy of the report can also be requested in writing. **All comments must be in writing and postmarked, emailed, or faxed by close of business (5:00 p.m.) on February 2, 2024.** Written comments and requests for a hard copy of the report can be sent to:

JD Sparks
MC65-44 SHADELAND
100 North Senate Avenue
Indianapolis, IN 46204-2251

Comments can be emailed to: JDsparks@idem.IN.gov or faxed to: (317) 308-3219.

If you have questions regarding this stakeholder meeting, please contact JD Sparks at (317) 308-3378. If you know of anyone else who might be interested in this meeting, please pass on this information. IDEM looks forward to your continued input to complete these TMDLs.

Sincerely,

Kristen Arnold

Kristen Arnold, Section Chief
Watershed Planning and Restoration Section
Office of Water Quality

To learn more about watersheds, TMDLs, and nonpoint source pollution, visit www.watersheds.in.gov

Total Maximum Daily Load Report for the Black Creek Watershed

Draft TMDL

December 20, 2023

Prepared for: U.S. Environmental Protection Agency Region 5

Prepared by: Indiana Department of Environmental Management

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Executive Summary

The Black Creek watershed (HUC 0512020206) is located in southwestern Indiana and drains an area of approximately 132 square miles. The watershed originates in the western portion of Greene County and eastern portion of Sullivan County and flows south, where it ultimately empties into the White River in Knox County. Land use throughout the watershed is predominantly agriculture with forested areas being the second most abundant land use type.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) List of Impaired Waters. 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 waste load 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:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

This TMDL has been developed to address *E. coli*, biotic communities, nutrients, and dissolved oxygen impairments in the Black Creek watershed, in accordance with the TMDL Program Priority Framework. Parameters chosen for TMDL development include *E. coli,* total suspended solids (TSS), and total phosphorus (TP). TSS will be used as a surrogate to address impaired biotic communities (IBC), and TP will be used as a surrogate to address nutrients and dissolved oxygen impairments. These parameters will be referred to cumulatively in this report as "pollutants."

The Black Creek watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, IDEM 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 in conjunction with the IDEM sampling and TMDL development for streams impaired for *E. coli*, biological communities, nutrients, and dissolved oxygen.

After the Indiana Department of Environmental Management (IDEM) identifies a waterbody as not supporting a designated use or having 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 each waterbody using new sampling data and to examine the watershed as a whole. The reassessment data help IDEM identify the area of concern for TMDL development. As a result of the reassessment of the Black Creek watershed, the pollutants and the impaired segments for which TMDLs were developed differ from those appearing on the 2022 Section 303(d) List because sampling performed by IDEM in 2021 and 2022 generated new water quality data that were not available at the time the 2022 Section 303(d) List was developed.

Both historical and recent data were used for the TMDL analysis. Surveys of the Black Creek watershed have been conducted as far back as 1985, when IDEM performed fish tissue monitoring. Fixed station monitoring has been conducted in the watershed since 1992 and more extensive surveys of the watershed were conducted in 2000, 2005, 2010, 2011, and 2017 by both the probabilistic and targeted monitoring programs.

Sampling data were collected at 23 sampling sites from November 2021 to October 2022 by IDEM for the TMDL analysis. The data indicate that 22 of the sample sites violated one or more of the Indiana Water Quality Standards (327 IAC 2).

Potential sources of biotic impairment, *E. coli*, nutrients, and low dissolved oxygen levels in the watershed include both regulated point sources and nonpoint sources. Point sources including wastewater treatment plants (WWTPs) and Public Water Supply (PWS) facilities that discharge wastewater, surface coal mining operations, and stormwater permitted construction activities are regulated through the National Pollutant Discharge Elimination System (NPDES). Nonpoint sources such as unregulated urban stormwater, agricultural run-off, wildlife, confined feeding operations (CFOs), pasture animals with access to streams, and faulty and failing septic systems are also potential sources.

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 Black Creek watershed, subwatersheds with the greatest areas of cash crop have the highest average *E. coli* counts. Being a very rural watershed, other factors such as failing septic systems or illegal straight pipes could be affecting subwatersheds that also tend to experience lower 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 Black Creek watershed, TP TMDLs were developed for Calico Slash Ditch and Buck Creek subwatersheds to address nutrient impairments. Calico Slash Ditch was impaired with low dissolved oxygen which was also addressed by a TP TMDL. It is possible that field run-off in this subwatershed is contributing to elevated phosphorus loads, resulting in lower dissolved oxygen. However, other factors could also explain the correlation, such as upstream loading, failing septic systems, impeded flow, tillage practices, or point source contributions. Low dissolved oxygen levels can also be correlated with elevated levels of TSS by reducing light availability to aquatic plants.

Various subwatersheds in the Black Creek watershed have IBC. Biological communities include fish and aquatic macroinvertebrates, such as insects, snails, or crayfish. 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 is 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 Black Creek watershed, high TSS has been identified as a pollutant 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 Black Creek watershed TMDL includes these allocations, which are presented for each of the 12-digit hydrologic unit code (HUC) subwatersheds containing impairments.

There are six NPDES permitted facilities located in the Black Creek watershed. These facilities include two wastewater treatment facilities, a public water supply facility, a privately owned petroleum product terminal, and two surface coal mining operations. Most of the time effluent from permitted facilities meets water quality standards and/or targets.

There are several types of documented and suspected nonpoint sources located in the Black Creek watershed, including unregulated livestock operations with direct access to streams, agricultural row crop land use, straight pipes, leaking or failing septic systems, wildlife, and erosion. Of these, agricultural row crop land use, livestock operations, and erosion are found most often in subwatersheds with elevated levels of *E. coli*, TSS, and TP. 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 a greater focus on implementation activities. These areas throughout the Black Creek watershed are referred to as critical conditions. It also provides recommendations on the types of implementation activities, including best management practices (BMPs), that key implementation partners in the Black Creek watershed can consider to achieve the pollutant load reductions calculated for each subwatershed. Table 1 presents potential critical areas which can be used to recommend BMPs identified as having a high likely degree of effectiveness to achieve the *E. coli*, TSS, and TP load reductions allocated to sources in each subwatershed. The critical condition for each TMDL is identified as the flow condition requiring the largest percent reduction based on a 90th percentile concentration of observed water quality data in each subwatershed and flow regime combination. A more detailed explanation of critical conditions can be found in Section 5.2.

Table 1: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition (Reduction Needed)				
		High	Moist	Mid-Range	Dry	Low
E. coli (MPN/100mL)	Headwaters Black Creek (051202020601)	97%	91%	88%	90%	93%
	Buck Creek (051202020602)	99%	80%	87%	90%	32%
	Brewer Ditch (051202020603)	98%	16%	71%	63%	--
	Calico Slash Ditch (051202020604)	98%	62%	88%	71%	86%

Parameter	Subwatershed (HUC)	Critical Condition (Reduction Needed)				
		High	Moist	Mid-Range	Dry	Low
	Singer Ditch (051202020605)	98%	28%	73%	77%	35%
Total Phosphorus (mg/L)	Buck Creek (051202020602)	--	--	--	9%	28%
	Calico Slash Ditch (051202020604)	37%	--	--	--	--
Total Suspended Solids (mg/L)	Headwaters Black Creek (051202020601)	96%	98%	96%	98%	99%
	Buck Creek (051202020602)	81%	92%	95%	95%	97%
	Brewer Ditch (051202020603)	98%	98%	97%	98%	99%
	Calico Slash Ditch (051202020604)	88%	94%	96%	96%	97%
	Singer Ditch (051202020605)	93%	96%	97%	97%	98%

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:

A kickoff public meeting was held in Linton, IN on September 14, 2021, to introduce the project and solicit public input. IDEM explained the TMDL process and presented initial information regarding the Black Creek watershed. Questions were answered from the public, and information was solicited from stakeholders in the area.

On September 8, 2022, IDEM worked with the Greene County Soil and Water Conservation District (SWCD) to host a water monitoring demonstration. The event was held in a public campground in Dugger, IN off Goodman Road east of CR 1500 W intersection. IDEM staff were on-site to explain and/or give demonstrations on their process for collecting water chemistry, fish (through electrofishing techniques), and macroinvertebrates. Results were discussed for the 2021-2022 IDEM sampling of the watershed. The details of the partnership between the Greene County SWCD and IDEM were detailed as well.

On April 5, 2023, a notice was posted to the Indiana Register to inform stakeholders of new impairments discovered during the 2021-2022 watershed characterization study in the Black Creek watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2024 303(d) List of Impaired Waters. Public comments were solicited through May 20, 2023. IDEM received no comments regarding the notice.

On November 14, 2023, a draft TMDL public meeting was held in the watershed at Linton Public Library 95 S.E. 1st Street, Linton, IN, 47441. The draft findings of the TMDL were presented at the meeting and the public had the opportunity to ask questions and provide information to be included in the final TMDL report. A representative from the Greene County SWCD was in attendance and presented information on the progress of the watershed management plan. A public comment period was from January 2, 2024, to February 2, 2024.

1.0 INTRODUCTION

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

The Black Creek watershed TMDL was prioritized to be completed at this time based on local interest from the Greene County Soil and Water Conservation District (SWCD) in addressing water quality, IDEM 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 in conjunction with the IDEM sampling and TMDL development for streams impaired for *E. coli*, biological communities, nutrients, and dissolved oxygen.

The Black Creek watershed (HUC 0512020206), shown in Figure 1, is located in southwestern Indiana and drains an area of approximately 132 square miles. The watershed originates in the western portion of Greene County and eastern portion of Sullivan County and flows south, where it ultimately empties into the White River in Knox County. Land use throughout the watershed is predominantly agriculture with forested areas being the second most abundant land use type. There are no public water supply intakes in the Black Creek watershed.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop TMDLs for waterbodies placed on the Section 303(d) List of Impaired Waters. U.S. EPA defines a TMDL as the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources, and a margin of safety (MOS) that addressed the uncertainty in the analysis.

The overall goals and objectives of the TMDL study for the Black Creek watershed are to:

- 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) that are impaired.
- 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 critical flow conditions 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. EPA 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 U.S. EPA's nine minimum elements under the CWA Section 319 Nonpoint Source Program, as well as the additional requirements under IDEM's WMP Checklist.

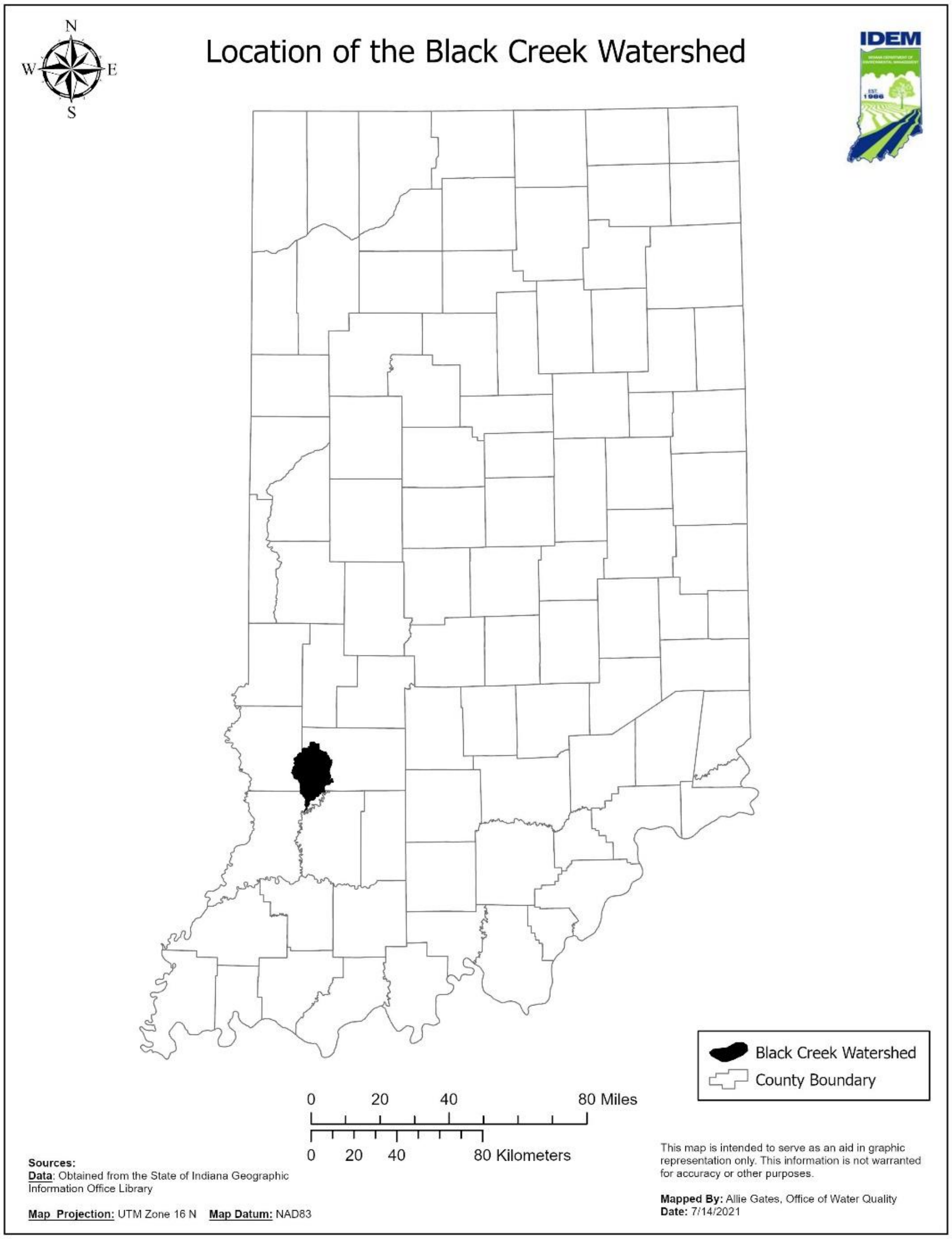

Figure 1: Location of the Black Creek Watershed

1.1 Water Quality Standards

Under the 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 Black Creek watershed TMDLs focus on protecting the designated aquatic life support 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 ("free from…") that apply to all surface waters. Numeric criteria for *E. coli* and Dissolved Oxygen and narrative criteria for IBC were used as the basis of the Black Creek watershed TMDLs.
>
> **Antidegradation** policies provide protection of existing uses and extra protection for high-quality or unique waters.

The water quality standards in Indiana pertaining to *E. coli*, nutrients, and IBC ("the impairments") are described below.

1.1.1 *E. coli*

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 colony forming units (CFU) in 100 milliliters of water (CFU/100 mL) or most probable number (MPN/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).]

1.1.2 Nutrients

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 through a process 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 bio-criteria 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(a)(1)(E)

(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(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(a)(1)(E)

1.1.3 Biological Communities

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)].

IBCs are not a source of impairment but a symptom of other sources. To address these impairments in the Black Creek watershed, TSS has been identified as a pollutant for TMDL development. IDEM has not yet adopted numeric water quality criteria for 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(a)(1)(E)*
>
> *(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(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(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.”*

Biological assessments for streams are based on the sampling and evaluation of either the fish communities, the benthic aquatic macroinvertebrate communities, or both. Indices of biotic integrity (IBI) for fish and macroinvertebrate (mIBI) assessment scores, or both, were calculated and compared to regionally calibrated models. In evaluating fish communities, streams rating as “poor” or worse are classified as non-supporting for aquatic life uses. For benthic aquatic macroinvertebrate communities, individual sites are compared to a statewide calibration at the lowest practical level of identification. All sites at or above background for the calibration are considered to be supporting aquatic life uses. Those sites rated as moderately or severely impaired in the calibration are considered to be non-supporting. Waters with identified impairments to one or more biological communities are considered not supporting aquatic life use. The biological thresholds Indiana uses to make use attainment decisions are shown in Table 2 to provide greater context for understanding the range of biological conditions that is considered either fully supporting or impaired.

IDEM’s aquatic life use assessments are never based solely on habitat evaluations. However, habitat evaluations are used as supporting information in conjunction with biological data to determine aquatic life use support. Such evaluations, which take into consideration a variety of habitat characteristics as well as stream size, help IDEM to determine the extent to which habitat conditions may be influencing the ability of biological communities to thrive. If habitat is determined to be driving IBC impairment and no other pollutants that might be contributing to the impairment have been identified, the IBC may not be considered for inclusion on IDEM’s 303(d) List of Impaired Waters (Category 5). In such cases, the waterbody is instead placed in Category 4C for the biological impairment.

Table 2: Black Creek Watershed Aquatic Life Use Support Criteria for Biological Communities

Biotic Index Score and Associated Assessment Decision	Integrity Class	Corresponding Integrity Class Score	Attributes
Fish community Index of Biotic Integrity (IBI) Scores (Range of possible scores is 0-60)			
Fully Supporting IBI ≥ 36 Indicates Full Support	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 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	12-22	At least one species present, tolerant species dominant
	No Organisms	0	No fish captured during sampling.
Benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) Scores Multihabitat (MHAB) Methods (Range of possible scores is 0-60)			
Fully Supporting mIBI ≥ 36 Indicates Full Support	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 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	12-22	At least one species present, tolerant species dominant
	No Organisms	0	No macroinvertebrates captured during sampling.

1.2 Water Quality Targets

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 Black Creek watershed TMDL are presented below.

1.2.1 *E. coli* TMDLs

The target value used for the Black Creek watershed TMDL was based on the 235 CFU/100 mL single sample maximum component of the water quality standard (i.e., daily loading capacities were calculated by multiplying flows by 235 counts/100 mL). The U.S. EPA report, "An Approach for Using Load Duration Curves in the Development of TMDLs" describes how the monthly geometric mean (125 counts/100mL) is likely to be met when the single sample maximum value (235 counts/100mL) is used to develop the loading capacity (U.S. EPA, 2007). The process calculates the daily maximum bacteria value that is possible to observe and still attain the monthly geometric mean. If the single sample maximum is set as a never-to-be surpassed value then it becomes the maximum value that can be observed, and all other bacteria values would have to be less than the maximum.

1.2.2 IBC and DO TMDLs

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

Total Phosphorus

Although Indiana has not yet adopted numeric water quality criteria for TP, IDEM has identified the following TP benchmark of 0.3 mg/L that are used to assess potential nutrient impairments. This TP benchmark was based on IDEM's best professional judgement as well as elements of U.S. EPA's nationwide 1986 Quality Criteria for Waters (also known as the Gold Book). The TP value (0.30 mg/L) was used as the TMDL target during the development of the Black Creek watershed TMDL. IDEM has determined that meeting this target will result in achieving the narrative criteria by improving water quality and promoting a well-balanced aquatic community. TP is limited and interpreted as a monthly average in NPDES permits. Monitoring data, reviewed by IDEM during the TMDL development process, indicated that when WWTPs were in compliance with their individual monthly permit limit for phosphorus (1.0 mg/L), the in-stream target for phosphorus (0.30 mg/L) was typically met. As such, WWTPs were given WLAs based on their 1.0 mg/L permit limitation.

Total Suspended Solids (TSS)

Although Indiana has not yet adopted numeric water quality criteria for TSS, IDEM has identified a target value based on IDEM's NPDES permitting process. A target of 30.0 mg/L for TSS has been identified as a permit limit for NPDES facilities. A target value of 30.0 mg/L TSS was therefore used as the TSS TMDL target value to ensure consistency with IDEM's NPDES permitting process. 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.

Prior to watershed characterization sampling and development of the Black Creek watershed TMDL, only two subwatersheds in Black Creek watershed had IBC impairments (Calico Slash Ditch and Brewer Ditch). 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 of Impaired Waters means that IDEM's monitoring data show one or both 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 Black Creek watershed, TSS has been identified as a pollutant for TMDL development.

One subwatershed (Calico Slash Ditches) in the Black Creek watershed has a dissolved oxygen impairment. Dissolved oxygen is not a source of impairment but a symptom of other sources. To address this impairment in the Black Creek watershed phosphorus has been identified as a pollutant for TMDL development.

Table 3 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 Black Creek watershed.

Table 3: Target Values Used for Development of the Black Creek Watershed TMDLs

Parameter	Target Value
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 235 counts/100 mL (single sample maximum)

1.3 Listing Information

1.3.1 Understanding Subwatersheds and Assessment Units

This section presents information concerning IDEM's segmentation process as it applies to the Black Creek watershed. IDEM identifies the Black 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) (IDEM, 2010). Figure 2 shows the 12-digit HUCs located in the Black Creek watershed.

Within each 12-digit HUC subwatershed, IDEM has identified several AUIDs, which represent individual stream segments. Through the process of segmenting waterbodies 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, 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 4 and Table 9 contain the AUIDs in the subwatersheds of the Black Creek watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.

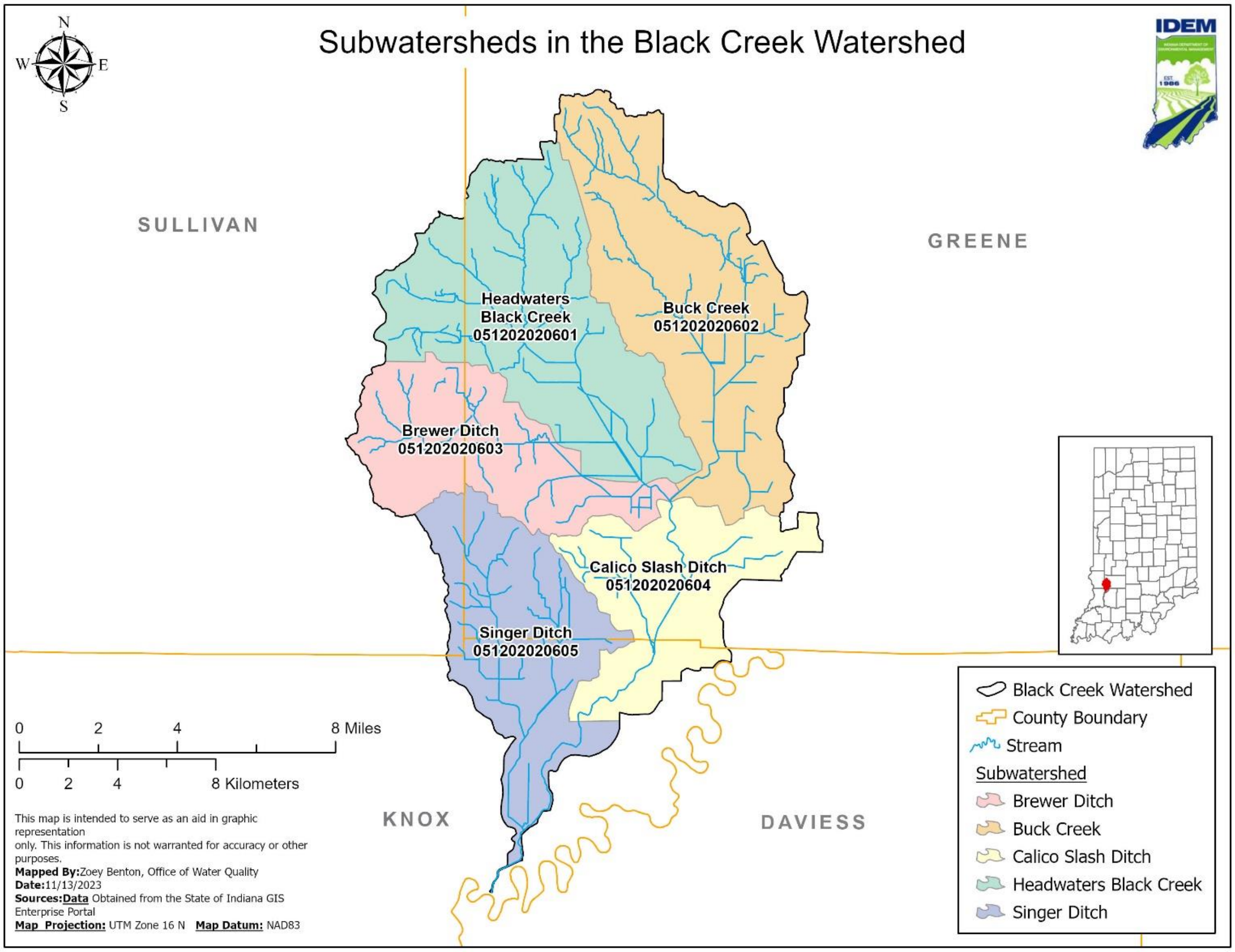

Figure 2: Subwatersheds (12-Digit HUCs) in the Black Creek Watershed

1.3.2 Understanding 303(d) Listing Information

There are a number of existing impairments in the Black Creek watershed from the approved 2022 303(d) List of Impaired Waters (Table 4). These listings and causes of impairment have been adjusted as a result of reassessment data collected at 23 sampling locations in the watershed. Within the Black Creek watershed a total of 18 assessment unit IDs (AUIDs) will be cited as impaired for *E. coli*, 13 AUIDs cited as impaired for IBC, 3 for sulfate, 2 for nutrients, and 1 for dissolved oxygen on Indiana's 2024 303(d) List of Impaired Waters (Table 4). These impaired segments account for approximately 135 miles. Table 4 presents listing information for the Black Creek watershed, including a comparison of the updated listings with the 2024 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Black Creek watershed are available in Appendix B.

Below is an inventory assessment of the available biological and chemistry data for the Black Creek watershed.

Table 4: Section 303(d) List Information for the Black Creek for 2022 and 2024

Name of Subwatershed	Current AUID	Length (mi)	2022 Section 303(d) Listed Impairment	Updated Impairments to be listed 2024 303(d)
Headwaters Black Creek 051202020601	INW0261_03	5.66		*E. coli*, IBC
	INW0261_T1007	7.76		
	INW0261_T1006	3.07		*E. coli*, IBC
	INW0261_T1005	1.82		
	INW0261_T1008	1.88		
	INW0261_T1011	1.19		
	INW0261_01	12.57		*E. coli*, IBC
	INW0261_T1003	5.19		
	INW0261_T1009	6.40		*E. coli*, Sulfate
	INW02P1073_00	0.08		
	INW02P1110_00	0.37		
	INW02P1114_00	0.45		
	INW02P1113_00	0.17		
	INW0261_T1009A	2.04		
	INW02P1119_00	0.69		
	INW0261_T1010	1.74		
	INW02P1125_00	0.52		
	INW02P1098_00	0.41		
	INW0261_T1010A	2.98		
	INW02P1124_00	0.27		
Buck Creek 051202020602	INW0262_03	3.72		*E. coli*
	INW0262_T1002	4.93		
	INW0262_T1004	7.16		*E. coli*, IBC
	INW0262_T1003	20.58	*E. coli*	*E. coli*, IBC
	INW0262_04	9.12		*E. coli*, Nutrients
	INW0262_05	5.42		*E. coli*
Brewer Ditch 051202020603	INW0263_01	0.87	IBC	*E. coli*, IBC
	INW0263_T1009	2.26		
	INW0263_T1006	7.74		E.coli, IBC
	INW0263_T1004	1.79		
	INW0263_T1003	2.90		
	INW0263_T1008	2.83		
	INW0263_T1007	2.61		IBC, Sulfate
	INW0263_T1007B	0.28		
	INW02P1097_00	1.29		
	INW0263_T1007A	0.58		
	INW0263_T1010	1.14		
	INW02P1092_00	0.39		
	INW0263_T1005	6.83	IBC	
Calico Slash Ditch	INW0264_05	0.94	*E. coli*, IBC	*E. coli*
	INW0264_04	2.38	*E. coli*	*E. coli*, IBC

Name of Subwatershed	Current AUID	Length (mi)	2022 Section 303(d) Listed Impairment	Updated Impairments to be listed 2024 303(d)
051202020604	INW0264_T1002	9.10		DO, Nutrients
	INW0264_03	1.81	*E. coli*	*E. coli*
	INW0264_T1001	4.58		
	INW0264_02	2.45	*E. coli*	*E. coli*, IBC
Singer Ditch 051202020605	INW0265_03	2.09	*E. coli*	*E. coli*
	INW0265_02	3.90	*E. coli*	
	INW0265_T1004	4.39	*E. coli*	*E. coli*, IBC
	INW0265_T1002	13.45	*E. coli*	IBC
	INW0265_T1003	13.10	*E. coli*	*E. coli*, IBC, Sulfate
	INW02P1150_00	0.78		
	INW0265_T1003B	2.68	*E. coli*	
	INW0265_T1003A	1.72	*E. coli*	

Understanding Table 4:

Column 1: Name of 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 Watershed Management Plan (WMP) Checklist defines as a subwatershed for the purposes of watershed management planning.

Column 2: Current AUID. Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2022 Section 303(d) listing assessment process.

Column 3: Length (mi). Provides the length in miles of the associated AUID.

Column 4: 2020 Section 303(d) Listed Impairment. Identifies the cause of impairment associated with the 2022 Section 303(d) listing.

Column 5: Updated Impairments to be listed 2024 303(d). Provides the updated causes of impairment if new data and information are available.

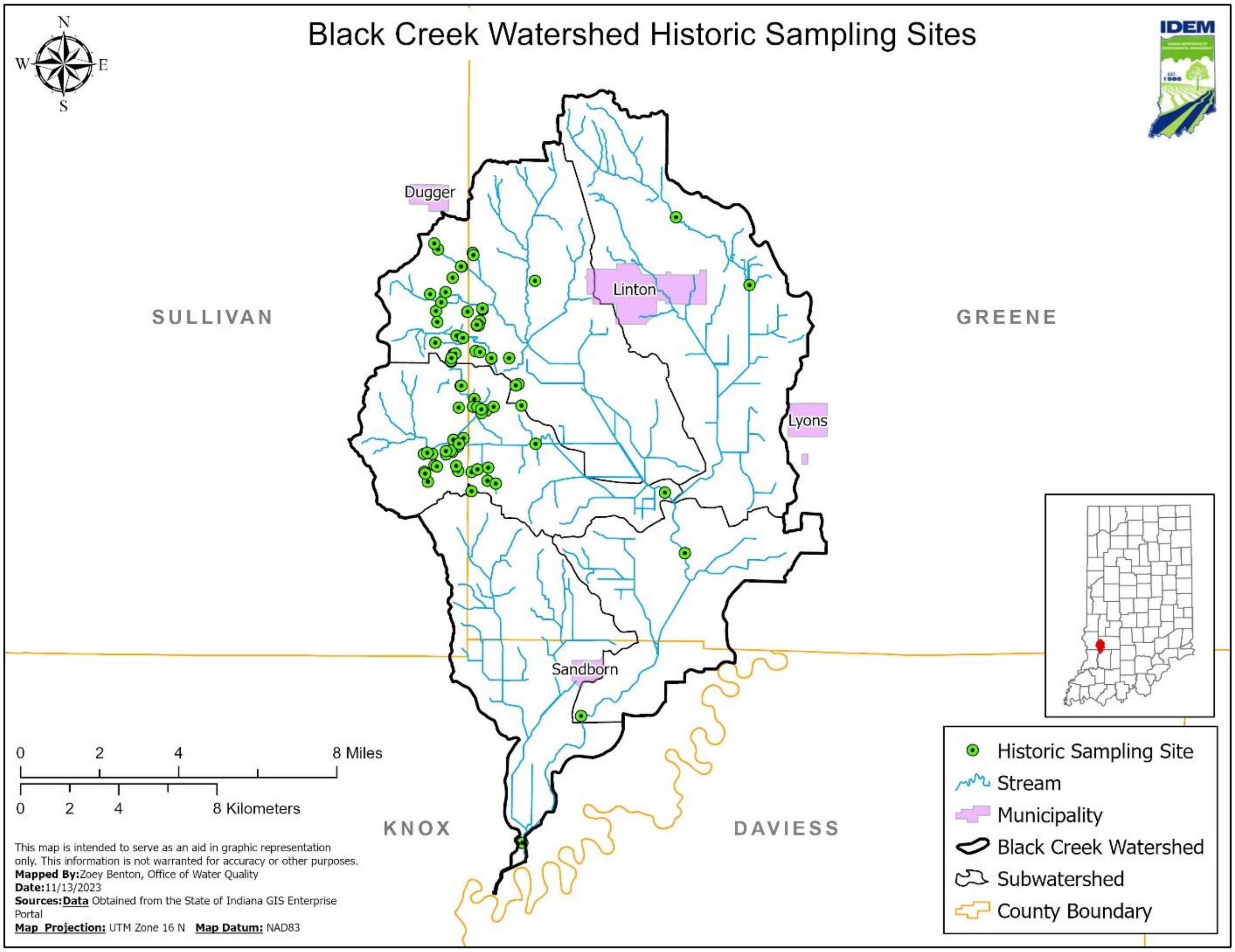

Figure 3: Location of Historical Sampling Sites in the Black Creek Watershed

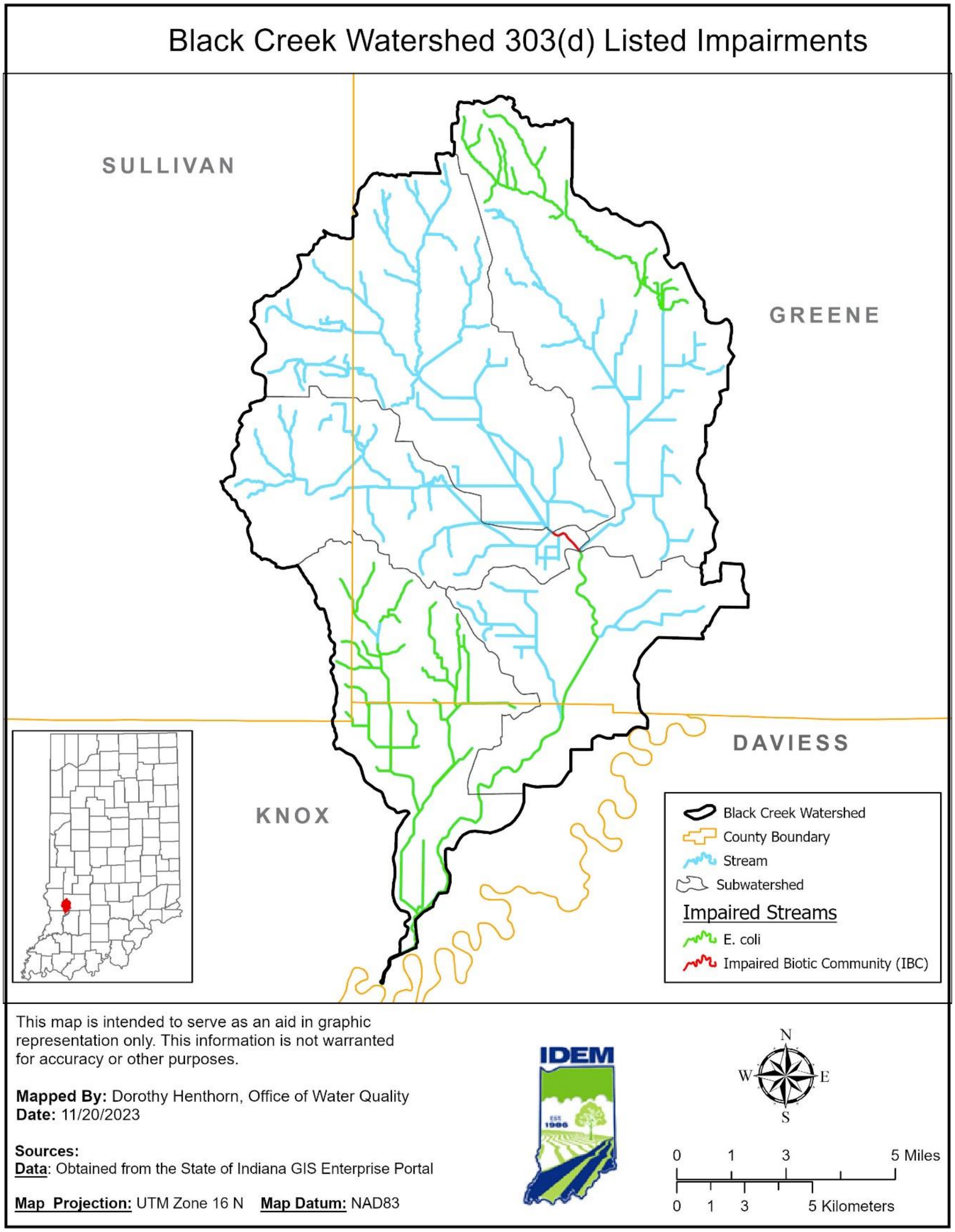

Figure 4: Streams Listed on the 2022 Section 303(d) List of Impaired Waters in the Black Creek Watershed

1.4 Water Quality Data

This section of the TMDL report contains a brief characterization of the Black Creek watershed water quality information that was collected in development of this TMDL. 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.

1.4.1 Water Quality Data

Data collected by IDEM from November 2021 through October 2022 were used for the TMDL analysis. Twenty-three sites were sampled for pathogens, water chemistry, and biological data in the Black Creek watershed. Table 5 and Figure 5 show the sampling site locations and information. 1.4.2 E*. coli* Data

Table 6 summarizes the pathogen data, and Table 7 summarizes the water chemistry data within the Black Creek watershed in addition to the maximum concentrations at all impaired sites along with the reduction needed to meet the TMDL.

The percent reductions were calculated as follows:

$$\%\ \text{Reduction} = \frac{(\text{Observed Concentration} - \text{Target Value or WQS})}{\text{Observed Concentration}} \text{ x } 100$$

Appendix A shows the individual sample results and summaries of all the water quality data for all 23 monitoring sites.

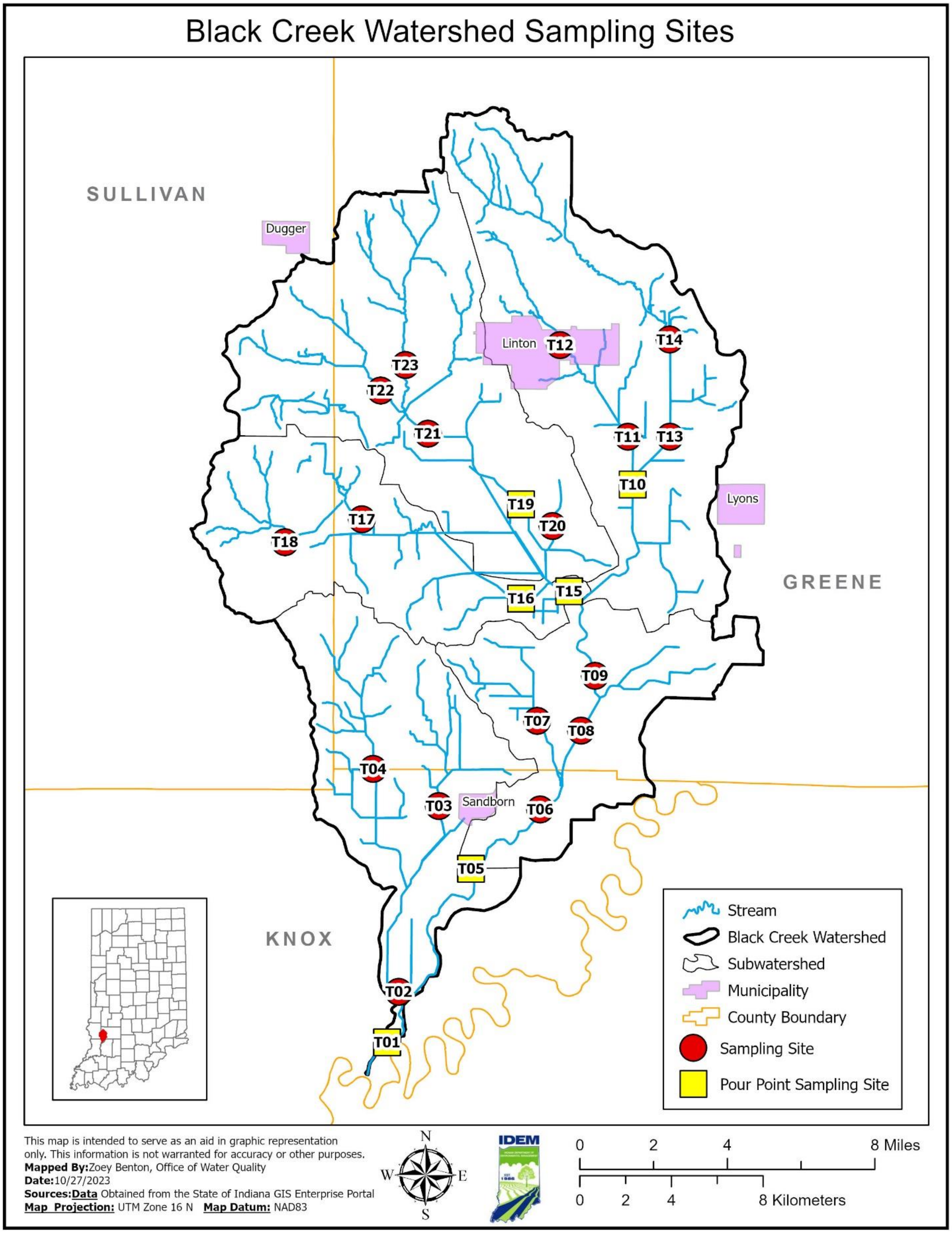

Figure 5: 2021-2022 Sampling Locations for the Black Creek Watershed Characterization Study

Table 5: Black Creek Sampling Site Information

Site #	EPA Site ID	IDEM Station ID	Stream Name	Road Name	AUID
T01	22T-001	WWL-06-0130	Black Creek	Unnamed Farm Lane	INW0265_03
T02	22T-002	WWL-06-0131	Singer Ditch	Koening Road	INW0265_T1004
T03	22T-003	WWL-06-0151	Hill Ditch	Grandview Drive	INW0265_T1002
T04	22T-004	WWL-06-0133	Singer Ditch	County Line Road	INW0265_T1003
T05	22T-005	WWL-06-0134	Black Creek	SR 58	INW0264_05
T06	22T-006	WWL-06-0135	Black Creek	Jericho Road	INW0264_04
T07	22T-007	WWL-06-0136	Calico Slash Ditch	CR 700 S	INW0264_T1002
T08	22T-008	WWL-06-0137	Black Creek	CR 1075 W	INW0264_03
T09	22T-009	WWL-06-0138	Black Creek	CR 610 S	INW0264_02
T10	22T-010	WWL-06-0152	Beehunter Ditch	CR 200 S	INW0262_03
T11	22T-011	WWL-06-0140	Beehunter Ditch	CR 100 S	INW0262_04
T12	22T-012	WWL-06-0141	Tributary of Beehunter Ditch	SR 54	INW0262_05
T13	22T-013	WWL-06-0142	Buck Creek	CR 100 S	INW0262_T1004
T14	22T-014	WWL-06-0143	Buck Creek	Buck Creek Road	INW0262_T1003
T15	22T-015	WWL060-0001	Black Creek Ditch	CR 1100 W	INW0263_01
T16	22T-016	WWL-06-0144	Brewer Ditch	CR 1200 W	INW0263_T1006
T17	22T-017	WWL-06-0145	Tributary of Brewer Ditch	CR 1500 W	INW0263_T1007
T18	22T-018	WWL-06-0121	Spencer Creek	SR 159	INW0263_T1005
T19	22T-019	WWL-06-0146	Black Creek	CR 1200 W	INW0261_03
T20	22T-020	WWL-06-0147	Tributary of Black Creek	CR 300 S	INW0261_T1006
T21	22T-021	WWL-06-0148	Black Creek	CR 1400 W	INW0261_03
T22	22T-022	WWL-06-0149	Tributary of Black Creek	CR 1500 W	INW0261_T1009
T23	22T-023	WWL-06-0150	Black Creek	CR 50 N	INW0261_01

Understanding Table 5:

Column 1: Site #. Lists the site number that corresponds to the site location in Figure 5.

Column 2: EPA Site ID. Provides the EPA assigned site number.

Column 3: IDEM Station ID. Provides the IDEM assigned site number.

Column 4: Stream Name. Identifies the stream name that the site is located on.

Column 5: Road Name. Identifies the road name that the site is located on.

Column 6: AUID. Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2022 Section 303(d) listing assessment process.

1.4.2 *E. coli* Data

Table 6: Summary of Pathogen Data in Black Creek by Subwatershed

Subwatershed	Site #	IDEM Station ID	AUID	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		5-week Geomean (#/100 mL)	*E. coli* Percent Reduction Based on Geomean (125/100mL)	Single Sample Maximum (SSM) (#/100 mL)	*E. coli* Percent Reduction Based on SSM (#/100 mL)
						125	235				
Headwaters Black Creek	T19	WWL-06-0146	INW0261_03	4/18/22-10/18/22	11	27	27	406.9	69.3	3,890	94.0
	T20	WWL-06-0147	INW0261_T1006	4/19/22-10/18/22	11	0	18	56.2	0	>2,419.6	90.1
	T21	WWL-06-0148	INW0261_03	4/18/22-10/17/22	11	9	36	259.02	51.7	>2,419.6	90.3
	T22	WWL-06-0149	INW0261_T1009	4/18/22-10/17/22	11	36	27	252.2	50.4	>2,419.6	90.3
	T23	WWL-06-0150	INW0261_01	4/18/22-10/17/22	11	0	63	875.8	85.7	3,880	93.94
Buck Creek	T10	WWL-06-0152	INW0262_03	6/16/20-10/14/20	11	9	81	2054.2	93.9	19,560	98.80
	T11	WWL-06-0140	INW0262_04	4/19/22-10/18/22	11	18	72	1113.8	88.8	1,986.3	88.2
	T12	WWL-06-0141	INW0262_05	4/19/22-10/18/22	11	0	81	969.1	87.1	>2,419.6	90.3
	T13	WWL-06-0142	INW0262_T1004	4/19/22-10/18/22	11	27	45	448.5	72.1	9,340	97.5
	T14	WWL-06-0143	INW0262_T1003	4/19/22-10/18/22	11	9	63	801.1	84.4	27,550	99.2
Brewer Ditch	T15	WWL060-0001	INW0263_01	4/19/22-10/18/22	11	18	54	507.2	75.4	5,280	95.6
	T16	WWL-06-0144	INW0263_T1006	4/19/22-10/18/22	11	27	45	390.3	68.0	6,500	96.4
	T17	WWL-06-0145	INW0263_T1007	4/18/22-10/17/22	11	18	9	52.4	0	307.6	23.6

Subwatershed	Site #	IDEM Station ID	AUID	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		5-week Geomean (#/100 mL)	*E. coli* Percent Reduction Based on Geomean (125/100mL)	Single Sample Maximum (SSM) (#/100 mL)	*E. coli* Percent Reduction Based on SSM (#/100 mL)
						125	235				
	T18	WWL-06-0121	INW0263_T1005	4/18/22-10/17/22	11	9	18	43.21	0	1,732.9	86.4
Calico Slash Ditch	T05	WWL-06-0134	INW0264_05	4/20/22-10/19/22	11	36	54	615.7	79.7	4,100	94.3
	T06	WWL-06-0135	INW0264_04	4/20/22-10/19/22	11	27	54	613.4	79.6	4,880	95.2
	T07	WWL-06-0136	INW0264_T1002	4/20/22-9/20/22	11	0	27	19.67	0	1,986.3	88.2
	T08	WWL-06-0137	INW0264_03	4/19/22-10/19/22	11	18	63	625.4	80.0	4,170	94.4
	T09	WWL-06-0138	INW0264_02	4/19/22-10/19/22	11	45	45	827.4	84.9	6,240	96.2
Singer Ditch	T01	WWL-06-0130	INW0265_03	August	11	18	63	601.8	79.2	5,540	95.76
	T02	WWL-06-0131	INW0265_T1004	August	11	45	9	151.2	17.3	770.1	69.5
	T03	WWL-06-0151	INW0265_T1002	4/20/22-10/19/22	11	18	9	74.0	0	770.1	69.5
	T04	WWL-06-0133	INW0265_T1003	4/20/22-10/19/22	11	18	36	136.9	8.7	816.4	71.2

ND = No Data

Understanding 1.4.2 E. coli Data

Table 6: Pathogen data for the Black Creek watershed indicated the following:

Reductions of 94 percent or greater are needed to meet the TMDL target values for *E. coli* in Headwaters Black Creek.

Reductions of 99 percent or greater are needed to meet the TMDL target values for *E. coli* in Buck Creek.

Reductions of 96 percent or greater are needed to meet the TMDL target values for *E. coli* in Brewer Ditch.

Reductions of 96 percent or greater are needed to meet the TMDL target values for *E. coli* in Calico Slash Ditch.

Reductions of 96 percent or greater are needed to meet the TMDL target values for *E. coli* in Singer Ditch.

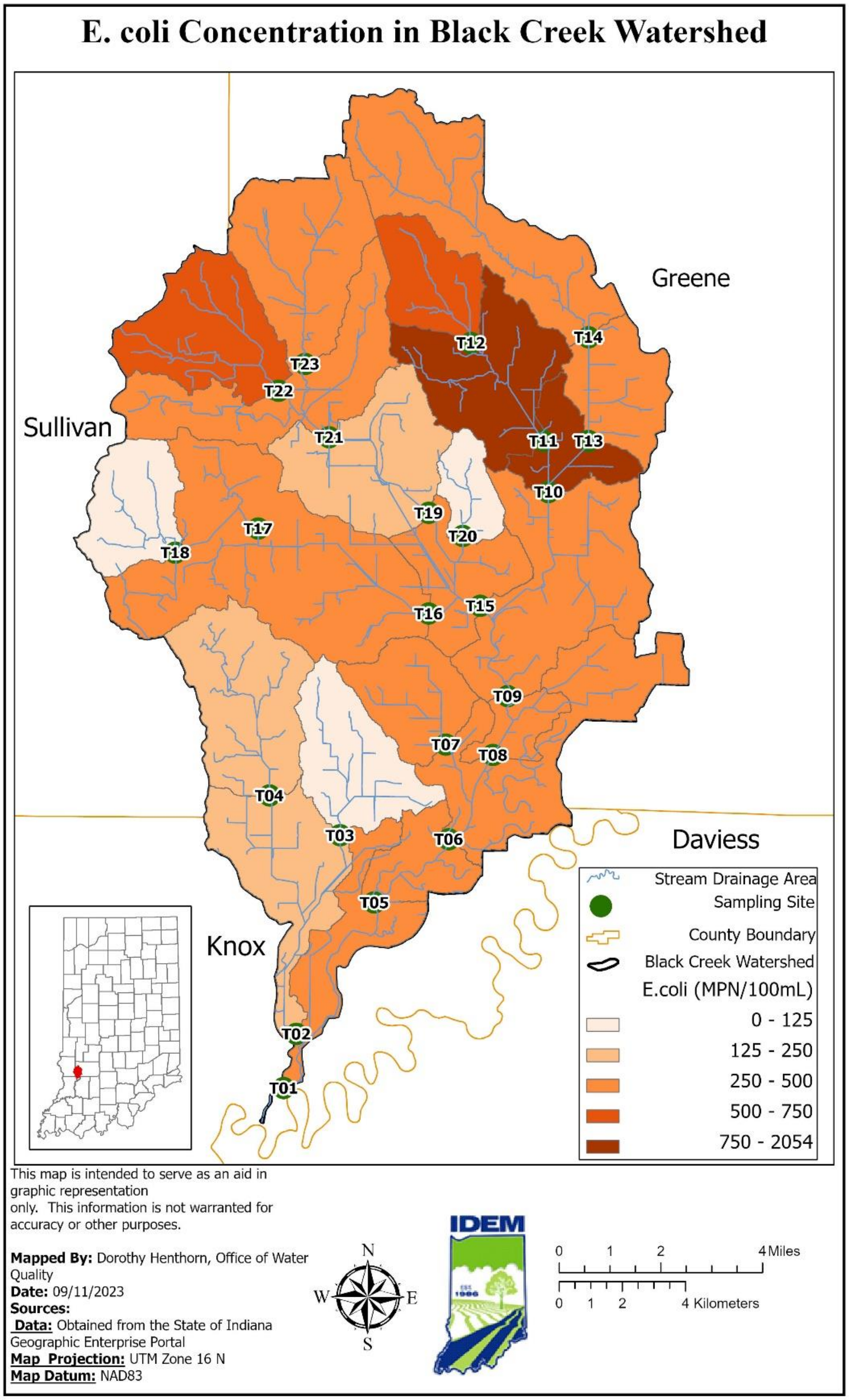

Figure 6: *E. coli* concentrations based on 5-week geometric mean (MPN/100mL) and sampling site drainage areas for 2021 and 2022. Values over 125 MPN/100mL are not meeting the current water quality standard for *E. coli*.

Table 7: Summary of Chemistry Data in Black Creek Watershed for Nutrients, Total Suspended Solids, and Dissolved Oxygen

Subwatershed	Site #	IDEM Station ID	AUID	Total Phosphorus Single Sample Maximum (mg/L)	Total Phosphorus % Reduction	Total Suspended Solids Single Sample Maximum (mg/L)	Total Suspended Solids % Reduction	Dissolved Oxygen Single Sample Minimum (mg/L)	Dissolved Oxygen % Below WQS
Headwaters Black Creek	T19	WWL-06-0146	INW0261_03	0.13	NA	175	82.9	5.17	NA
	T20	WWL-06-0147	INW0261_T1006	0.25	NA	23.8	NA	4.56	NA
	T21	WWL-06-0148	INW0261_03	0.092	NA	25.6	NA	6.59	NA
	T22	WWL-06-0149	INW0261_T1009	0.058	NA	15.2	NA	6.67	NA
	T23	WWL-06-0150	INW0261_01	0.13	NA	17.8	NA	7.17	NA
Buck Creek	T10	WWL-06-0152	INW0262_03	0.33	9.09	234	87.2	6	NA
	T11	WWL-06-0140	INW0262_04	0.54	44.4	76	60.5	3.96	1.0
	T12	WWL-06-0141	INW0262_05	0.29	NA	44	31.8	6.49	NA
	T13	WWL-06-0142	INW0262_T1004	0.21	NA	118	74.6	7.29	NA
	T14	WWL-06-0143	INW0262_T1003	0.29	NA	146	79.5	7.16	NA
Brewer Ditch	T15	WWL060-0001	INW0263_01	0.34	11.8	218	86.2	4.43	NA
	T16	WWL-06-0144	INW0263_T1006	0.27	NA	158	81.0	5.87	NA
	T17	WWL-06-0145	INW0263_T1007	<0.05	NA	38	21.1	7.03	NA
	T18	WWL-06-0121	INW0263_T1005	.05	NA	36	16.7	7.02	NA
Calico Slash Ditch	T05	WWL-06-0134	INW0264_05	0.84	NA	856	96.5	5.18	NA
	T06	WWL-06-0135	INW0264_04	0.31	3.2	245	87.8	5.41	NA
	T07	WWL-06-0136	INW0264_T1002	0.55	45.5	60	50.0	3.73	6.8
	T08	WWL-06-0137	INW0264_03	0.26	NA	91.8	67.3	5.36	NA
	T09	WWL-06-0138	INW0264_02	0.31	3.2	164	81.7	5.16	NA
Singer Ditch	T01	WWL-06-0130	INW0265_03	1.1	72.7	1,220	97.5	5.49	NA
	T02	WWL-06-0131	INW0265_T1004	0.23	NA	78.6	61.8	4.98	NA
	T03	WWL-06-0151	INW0265_T1002	0.22	NA	38.5	22.1	3.77	5.6

Subwatershed	Site #	IDEM Station ID	AUID	Total Phosphorus Single Sample Maximum (mg/L)	Total Phosphorus % Reduction	Total Suspended Solids Single Sample Maximum (mg/L)	Total Suspended Solids % Reduction	Dissolved Oxygen Single Sample Minimum (mg/L)	Dissolved Oxygen % Below WQS
	T04	WWL-06-0133	INW0265_T1003	0.17	NA	64.3	53.3	6.03	NA

Understanding Table 7: Water chemistry data for the Black Creek watershed indicated the following:

Reductions of 83 percent or greater are needed to meet the TMDL target values for TSS in Headwaters Black Creek.

Reductions of 87 percent or greater are needed to meet the TMDL target values for TSS in Buck Creek.

Reductions of 86 percent or greater are needed to meet the TMDL target values for TSS in of Brewer Ditch.

Reductions of 97 percent or greater are needed to meet the TMDL target values for TSS in Calico Slash Ditch.

Reductions of 98 percent or greater are needed to meet the TMDL target values for TSS in Singer Ditch.

Reductions of 44 percent or greater are needed to meet the TMDL target values for TP in Buck Creek.

Reductions of 46 percent or greater are needed to meet the TMDL target values for TP in Calico Slash Ditch.

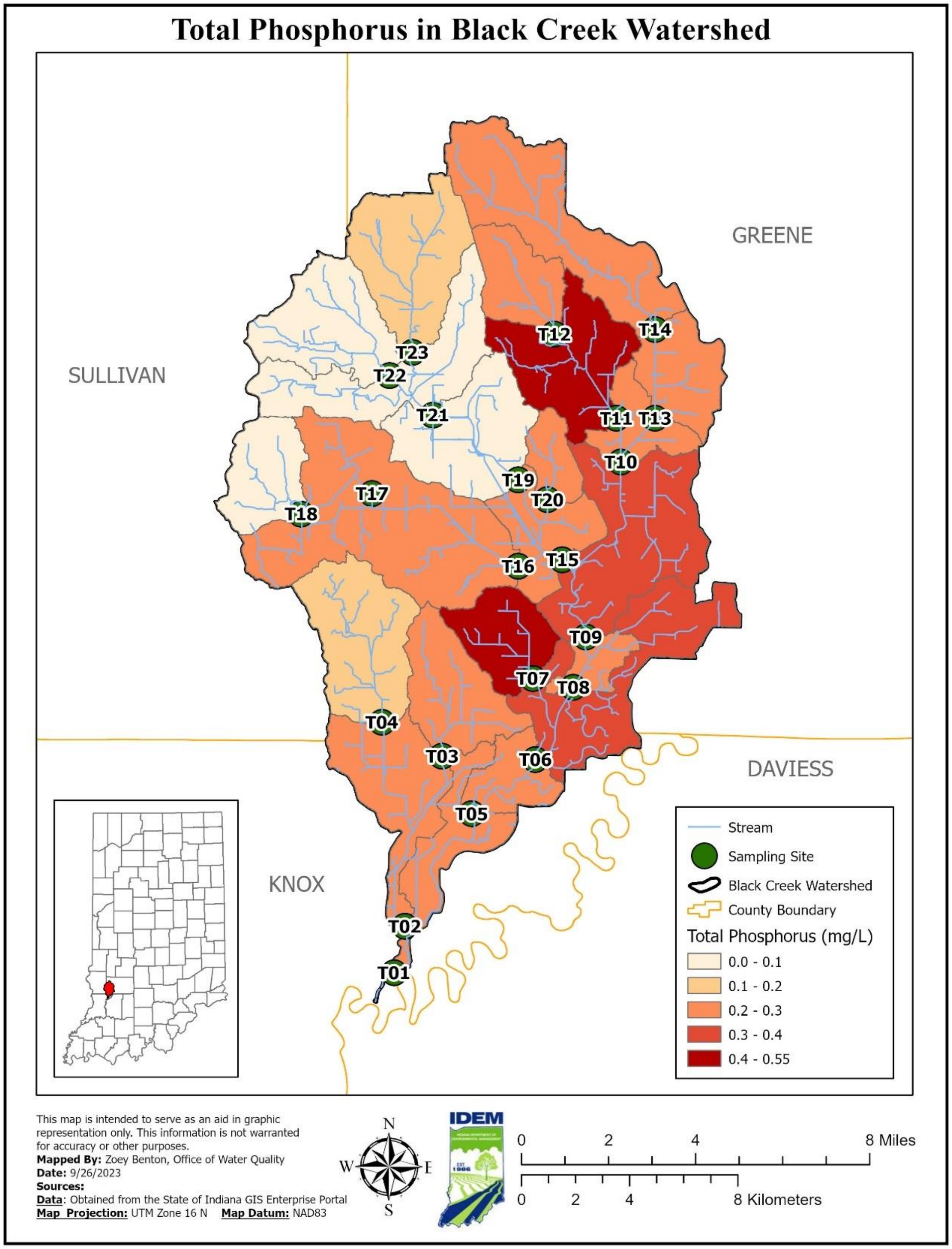

Figure 7: TP concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2021 and 2022. Values over 0.30 mg/L are not meeting the water quality target value for TP.

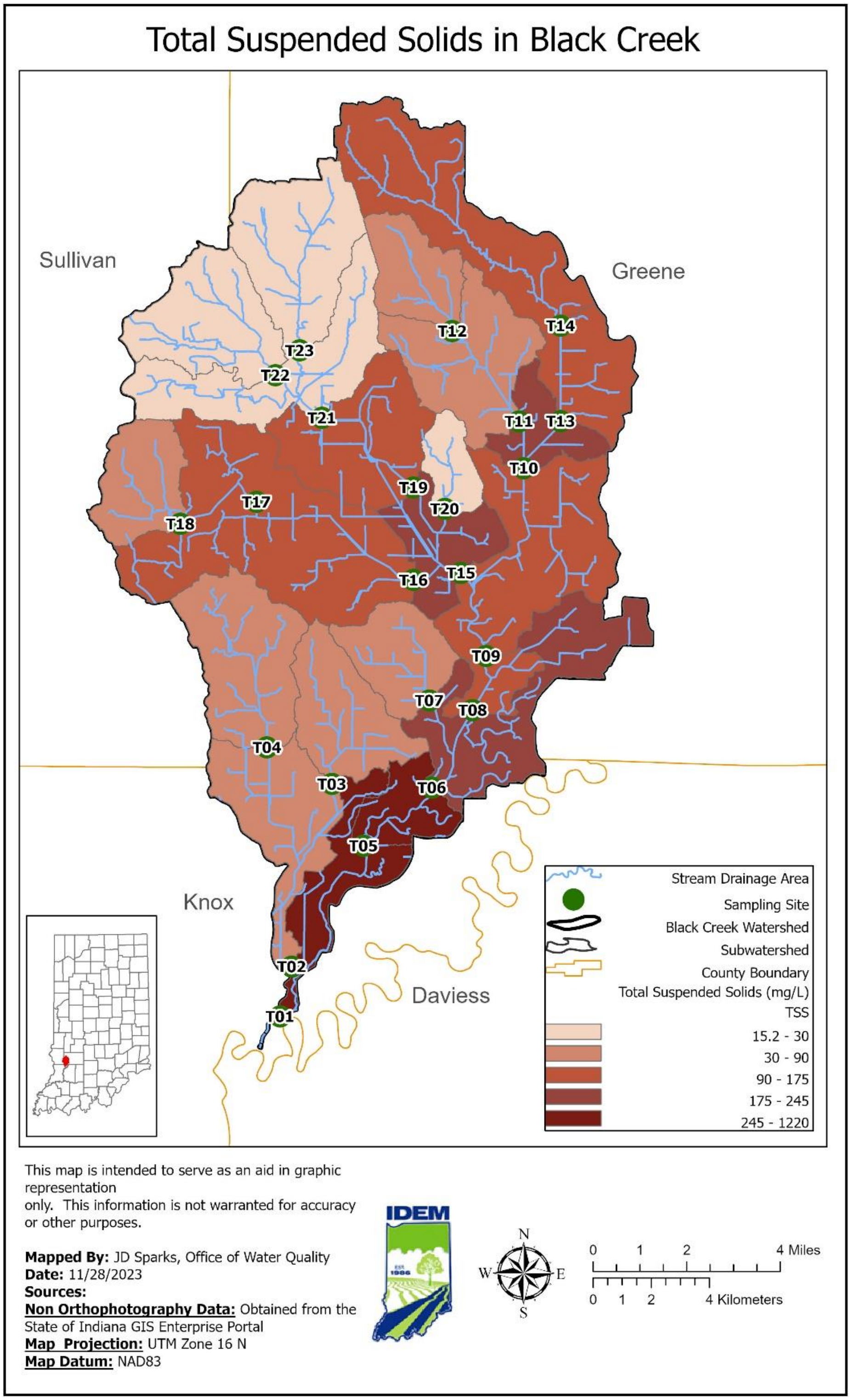

Figure 8: TSS concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2021 and 2022. Values over 30 mg/L are not meeting the water quality target value for TSS.

1.4.4 Biological Data

Sampling performed by IDEM in July and August 2022 documented widespread biological impairments in the Black Creek watershed as summarized in Table 8. Fish and macroinvertebrate community sampling took place at 23 sample sites in the Black Creek watershed. Sampling data indicate that the overall biological integrity of the Black Creek watershed was fair. Sampling resulted in 14 of the 23 sites failing established criteria for aquatic life support for fish and/or macroinvertebrates.

Through the TMDL efforts, IDEM has identified several potential reasons for the widespread impairments. 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. TP can cause excessive plant production resulting in increased turbidity, decreased dissolved oxygen levels, and cause greater fluctuations in diurnal dissolved oxygen and pH levels resulting in lower stream diversity. Attaining the TSS target value shown in Table 3 will address the causes of IBC impairments.

Table 8: Impaired Biotic Community Stream Segments in the Black Creek Watershed Identified During July/August 2022 Sampling

Subwatershed	Stream Name	Site #	IDEM Station ID	Score	Integrity Class	QHEI	Score	Integrity Class	QHEI
				mIBI	mIBI	mIBI	IBI	IBI	IBI
Headwaters Black Creek	Black Creek	T19	WWL-06-0146	32	Poor	38	16	Very Poor	41
	Tributary of Black Creek	T20	WWL-06-0147	30	Poor	24	44	Fair	37
	Black Creek	T21	WWL-06-0148	30	Poor	37	40	Fair	42
	Tributary of Black Creek	T22	WWL-06-0149	36	Fair	42	38	Fair	54
	Black Creek	T23	WWL-06-0150	32	Poor	42	20	Very Poor	41
Buck Creek	Beehunter Ditch	T10	WWL-06-0152	38	Fair	31	36, 42	Fair	38, 35
	Beehunter Ditch	T11	WWL-06-0140	40, 44	Poor	34, 35	42	Fair	36
	Tributary of Beehunter Ditch	T12	WWL-06-0141	44	Fair	46	36	Fair	54
	Buck Creek	T13	WWL-06-0142	30	Poor	33	42	Fair	54
	Buck Creek	T14	WWL-06-0143	42	Fair	53	30	Poor	51
Brewer Ditch	Black Creek Ditch	T15	WWL060-0001	40	Fair	39	18	Very Poor	38
	Brewer Ditch	T16	WWL-06-0144	32, 34	Poor	44, 35	32	Poor	49
	Tributary of Brewer Ditch	T17	WWL-06-0145	30	Poor	27	28	Poor	24
	Spencer Creek	T18	WWL-06-0121	36	Fair	27	42	Fair	54

Subwatershed	Stream Name	Site #	IDEM Station ID	Score mIBI	Integrity Class mIBI	QHEI mIBI	Score IBI	Integrity Class IBI	QHEI IBI
Calico Slash Ditch	Black Creek	T05	WWL-06-0134	42, 34	Fair	53, 43	40	Fair	55
	Black Creek	T06	WWL-06-0135	36	Fair	42	18	Very Poor	41
	Calico Slash Ditch	T07	WWL-06-0136	38	Fair	19	44	Fair	17
	Black Creek	T08	WWL-06-0137	36	Fair	22	38	Fair	19
	Black Creek	T09	WWL-06-0138	34	Poor	31	16	Very Poor	31
Singer Ditch	Black Creek	T01	WWL-06-0130	36	Fair	44	42	Fair	48
	Singer Ditch	T02	WWL-06-0131	40	Fair	38	32	Poor	40
	Hill Ditch	T03	WWL-06-0151	34	Poor	20	44, 46	Good	23, 29
	Singer Ditch	T04	WWL-06-0133	34	Poor	21	34, 34	Poor	26, 32

Notes: IBI = Index of Biotic Integrity for fish community, mIBI = Index of Biotic Integrity for macroinvertebrate community, QHEI = Qualitative Habitat Evaluation Index. Scores were calculated using IDEM's Procedures for Completing the Qualitative Habitat Evaluation Index Technical Standard Operating Procedure (IDEM, 2023).

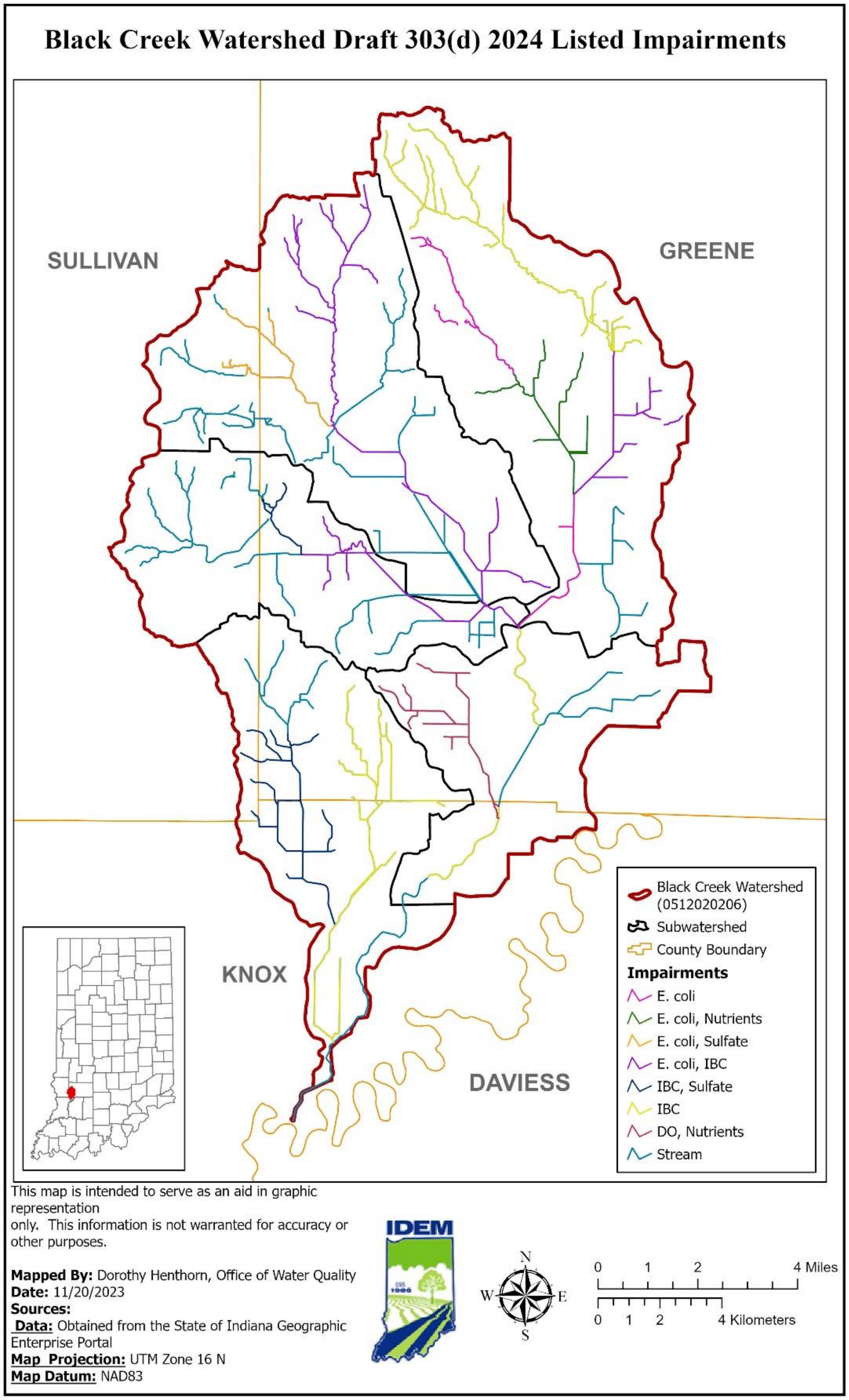

Figure 9: Streams to be listed on the Draft 2024 Section 303(d) List of Impaired Waters in the Black Creek Watershed

2.0 DESCRIPTION OF THE WATERSHED AND SOURCE ASSESSMENT

This section of the TMDL report contains a brief characterization of the Black Creek watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to the 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.

As discussed in Section 1.3.1, the Black Creek watershed contains five 12-digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include:

Headwaters Black Creek (051202020601)

Buck Creek (051202020602)

Brewer Ditch (051202020603)

Calico Slash Ditch (051202020604)

Singer Ditch (051202020605)

The following table contains the names of the five subwatersheds of the Black Creek watershed and their associated drainage area.

Table 9: Black Creek Subwatershed Drainage Areas

Name of Subwatershed	12-digit HUC	Area Within Watershed (sq. miles)	Percent of Watershed Area	Drainage Area (sq miles)	Percent of Total Drainage Area
Headwaters Black Creek	051202020601	34.48	26.1%	34.48	25.5%
Buck Creek	051202020602	35.02	26.5%	35.02	25.9%
Brewer Ditch	051202020603	19.99	15.1%	54.47	40.3%
Calico Slash Ditch	051202020604	19.48	14.3%	108.97	80.6%
Singer Ditch	051202020605	23.36	17.7%	132.33	100%

Understanding Table 9: Land area helps IDEM to define the pollutant load reductions needed for each AU in each 12-digit HUC subwatershed that comprises the Black Creek watershed. Information in each column is as follows:

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

Column 2: 12-digit HUC. Identifies the subwatersheds 12-digit HUC.

Column 3: Area Within Watershed. Provides the area of each subwatershed within the overall watershed in square miles.

Column 4: Percent of Watershed Area. Indicates the percent of land area of each subwatershed, providing a relative understanding of the portions of each subwatershed compared to the overall Black Creek watershed.

Column 5: Drainage Area. Quantifies the area the specific subwatershed drains in square miles.

Column 6: Percent of Total Drainage Area. Indicates the percent of the total drainage area, providing a relative understanding of the portion of the subwatershed in the overall Black Creek watershed.

IDEM bases load calculations on the drainage area for each of the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations found in Sections 3.0 and 4.0 of this report. This table will help watershed stakeholders look at the smaller subwatersheds within the Black 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.

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 confined feeding operations (which are places where animals are confined and fed); and illicitly connected “straight pipe” discharges of household waste. Permitted point sources are regulated through the National Pollutant Discharge Elimination System (NPDES).

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, run-off from lawn fertilizer applications, pet waste, and other sources. In rural areas, nonpoint sources can include run-off from cropland, pastures and animal feeding operations, and inputs from streambank erosion, leaking, failing or straight-piped septic systems, and wildlife.

2.1 Land Use

Land use patterns provide important clues to the potential sources of impairments in a watershed. Land use information for the Black Creek watershed is available from the National Agricultural Statistics Service (NASS) 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 circa 2020 Figure 10 displays the spatial distribution of the land uses and the data are summarized in Table 10. Additionally, Table 11 displays the breakdown of land uses within each of the five subwatersheds.

Land use in the Black Creek watershed is primarily agriculture, comprising 44 percent of the Black Creek watershed. Corn and soybean crops are not typically associated with high *E. coli* loads unless they have been fertilized with manure. Approximately 29 percent of the land is forest. Pasture/hay represents 12 percent of the watershed and could indicate the presence of animal feedlots which can be significant sources of *E. coli*, TSS, and/or nutrients. The remaining land categories represent less than 15 percent of the total land area.

The Black Creek watershed has a diverse network of streams. Tributaries include Spencer Creek, Buck Creek, and Singer Ditch among others. The watershed is unique in being influenced heavily by being the lowest drainage point for the East Fork White River. Forested areas are more pronounced in the northwestern portions of the watershed Greene-Sullivan State Forest. Urban areas are limited primarily to the central northern portions of the city of Linton, IN near the headwaters of Buck Creek. Waters drain to from the Singer Ditch subwatershed of Black Creek watershed and flow into the White River. There is at least one rare and endangered species residing in the Black Creek watershed. *Lithobates areolatus circulosus* (northern crawfish frog) can be found in the watershed at the Goose Pond Fish & Wildlife Area. This species breeds in seasonal to semi-permanent wetlands and fishless ponds meaning they are dependent upon the health of the aquatic system (IDNR, 2022). Additional information on state endangered, threatened and rare species can be found on the DNR website (https://www.in.gov/dnr/nature-preserves/heritage-data-center/endangered-plant-and-animal-species/county/).

Table 10: Land Use of the Black Creek Watershed

Land Use	**Watershed**		
	Area		**Percent**
	Acres	**Square Miles**	
Agricultural Land	37,354	58.37	44%
Developed Land	6,735	10.52	8%
Forested Land	24,712	38.61	29%
Hay/Pasture	10,588	16.54	12%
Open Water	4,505	7.04	5%
Shrub/Scrub	58	0.09	<1%
Wetlands	921	1.44	1%
Total	84,874	132.62	100%

Understanding Table 10: The predominant land use types in the Black Creek watershed can indicate potential sources of E. coli, TSS, and nutrient 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 stormwater events during high flow periods delivering E. coli, TSS, and nutrients to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute pollutants 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, TSS, and nutrient load reductions.

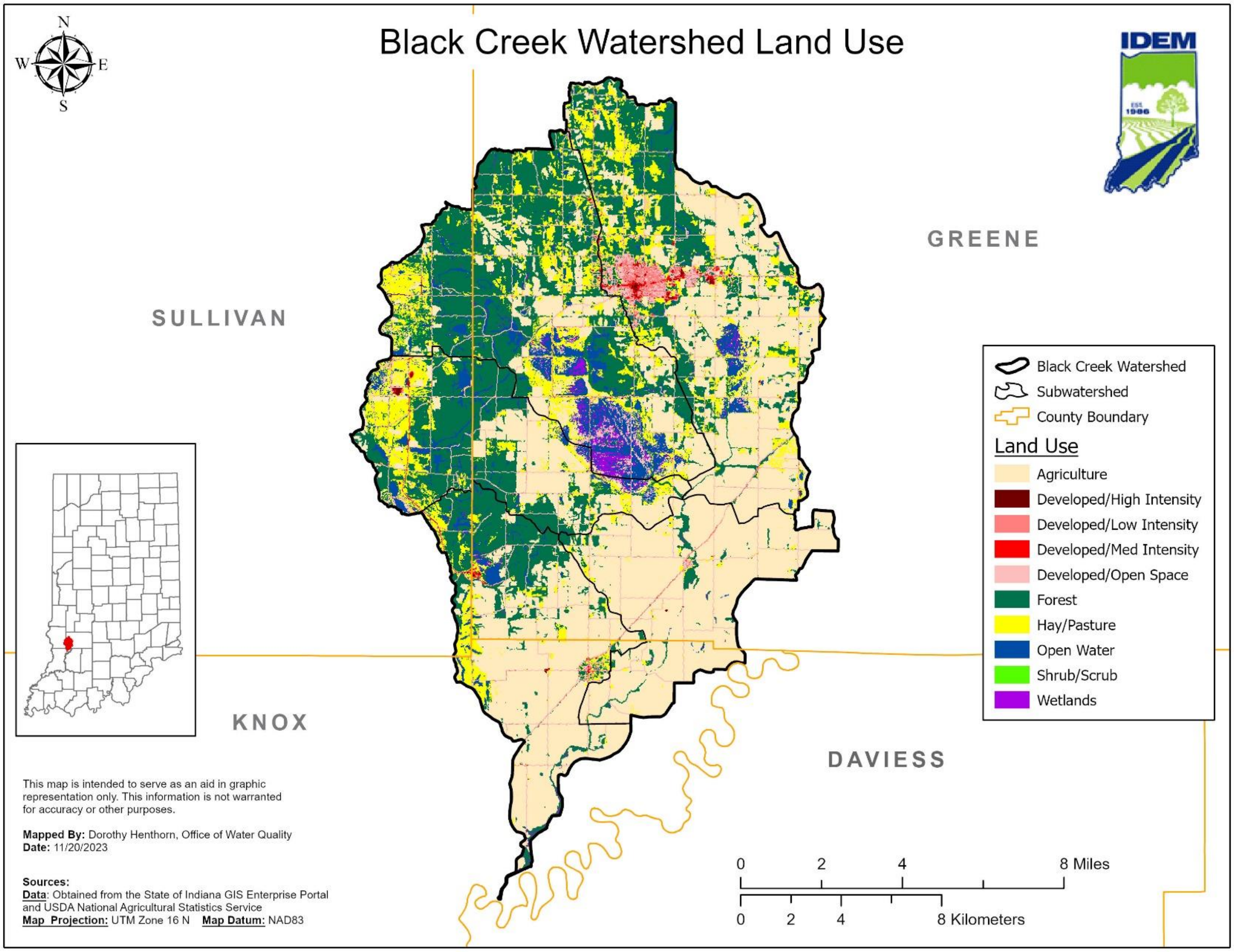

Figure 10: Land use in the Black Creek Watershed

Table 11: Land Use in the Black Creek Subwatersheds

Subwatershed	Area	Land Use							Total
		Agriculture	Developed	Forest	Hay/ Pasture	Open Water	Shrub/ Scrub	Wetlands	
Headwaters Black Creek (051202020601)	Acres	3,960	1,777	9,595	3,684	2,503	41	634	22,194
	Sq. Mi.	6.19	2.78	14.99	5.76	3.91	0.06	0.99	34.68
	Percent	18%	8%	43%	17%	11%	0%	3%	100%
Buck Creek (051202020602)	Acres	10,100	2,525	5,994	3,159	625	7	97	22,507
	Sq. Mi.	15.78	3.95	9.37	4.94	0.98	0.01	0.15	35.17
	Percent	45%	11%	27%	14%	3%	0%	0%	100%
Brewer Ditch (051202020603)	Acres	3,462	959	5,140	2,264	925	7	84	12,841
	Sq. Mi.	5.41	1.50	8.03	3.54	1.44	0.01	0.13	20.26
	Percent	27%	7%	40%	18%	7%	0%	1%	100%
Calico Slash Ditch (051202020604)	Acres	11,009	612	600	247	13	0	15	12,496
	Sq. Mi.	17.20	0.96	0.94	0.39	0.02	0.00	0.02	19.52
	Percent	88%	5%	5%	2%	0%	0%	0%	100%
Singer Ditch (051202020605)	Acres	8,879	852	3,469	1,257	452	4	91	15,004
	Sq. Mi.	13.87	1.33	5.42	1.96	0.71	0.01	0.14	23.44
	Percent	59%	6%	23%	8%	3%	0%	1%	100%

2.1.1 Cropland

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from fertilization with chemical (e.g., anhydrous ammonia) fertilizers, 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 (Patwardhan, 1997). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (Patwardhan, 1997). Data available from the National Agricultural Statistic Service (NASS) were downloaded to estimate crop acreage in the subwatersheds. The 2020 NASS statistics were used in the analysis as shown in Table 12 and displayed in Figure 11 (USDA, 2020).

Table 12: Major Cash Crop Acreage in the Black Creek Watershed

Subwatershed	Crop	Total Acreage	% of Subwatershed Cash Crop Acreage
Headwaters Black Creek (051202020601)	Corn	1,762	45%
	Soybean	2,184	55%
	Winter Wheat	3	<1%
	Total	3,949	100%
Buck Creek (051202020602)	Corn	4,438	44%
	Soybean	5,570	56%
	Winter Wheat	5	<1%
	Total	10,013	100%
Brewer Ditch (051202020603)	Corn	1,675	49%
	Soybean	1,752	51%
	Winter Wheat	22	<1%
	Total	3,449	100%
Calico Slash Ditch (051202020604)	Corn	4,996	47%
	Soybean	5,575	53%
	Winter Wheat	9	<1%
	Total	10,580	100%
Singer Ditch (051202020605)	Corn	4,796	55%
	Soybean	3,978	45%
	Winter Wheat	3	<1%
	Total	8,777	100%

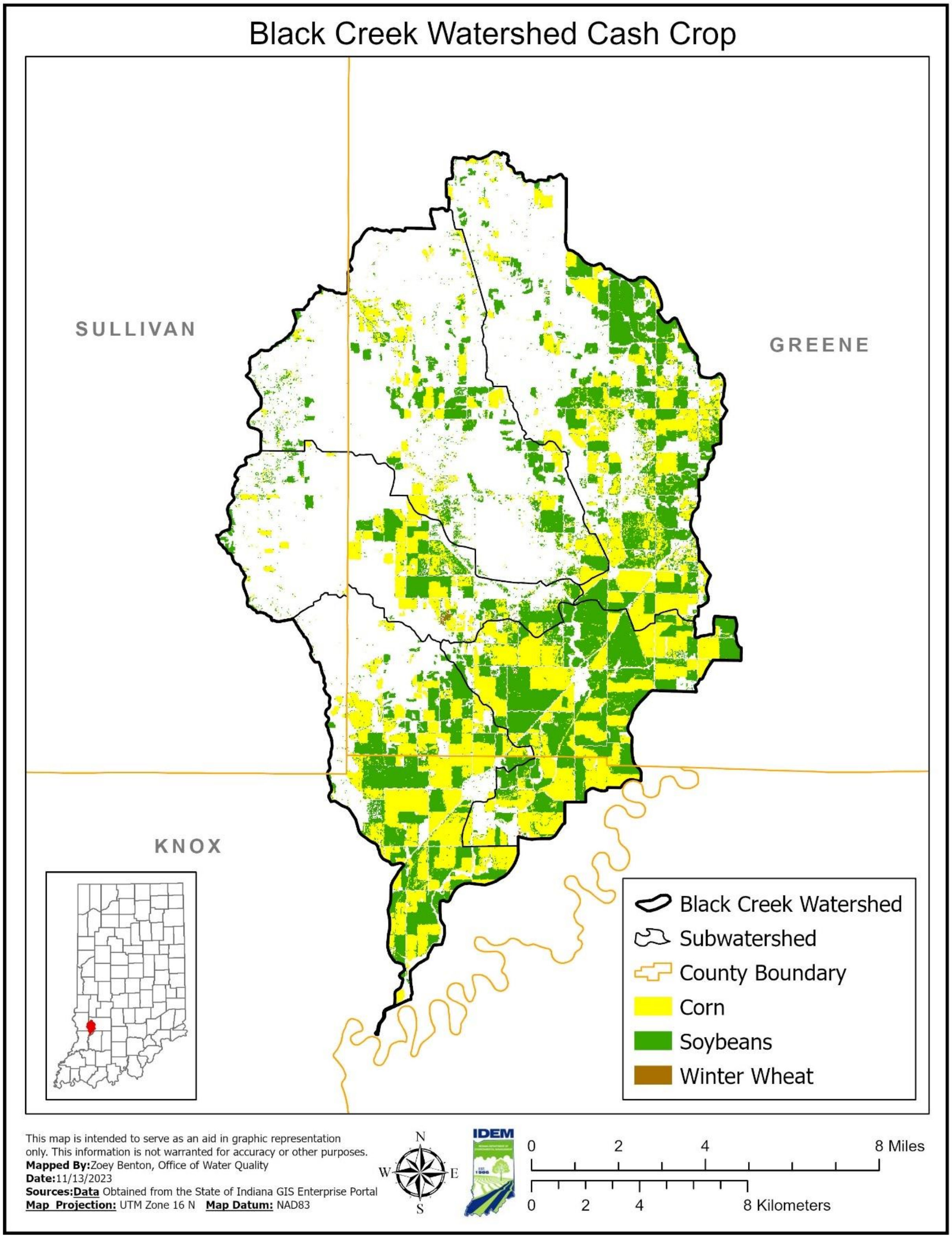

Figure 11: Cash Crop Acreage in the Black Creek Watershed

2.1.2 Hay/Pastureland

Run-off 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 run-off during a storm event.

Livestock are potential source of *E. coli*, nutrients, and TSS to streams, particularly when direct access is unrestricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. The amount of hay/pastureland across the landscape can be used to as an indicator for potential areas of higher densities from livestock. Information on permitted livestock facilities within the Black Creek watershed are presented in Figure 12 and Table 13.

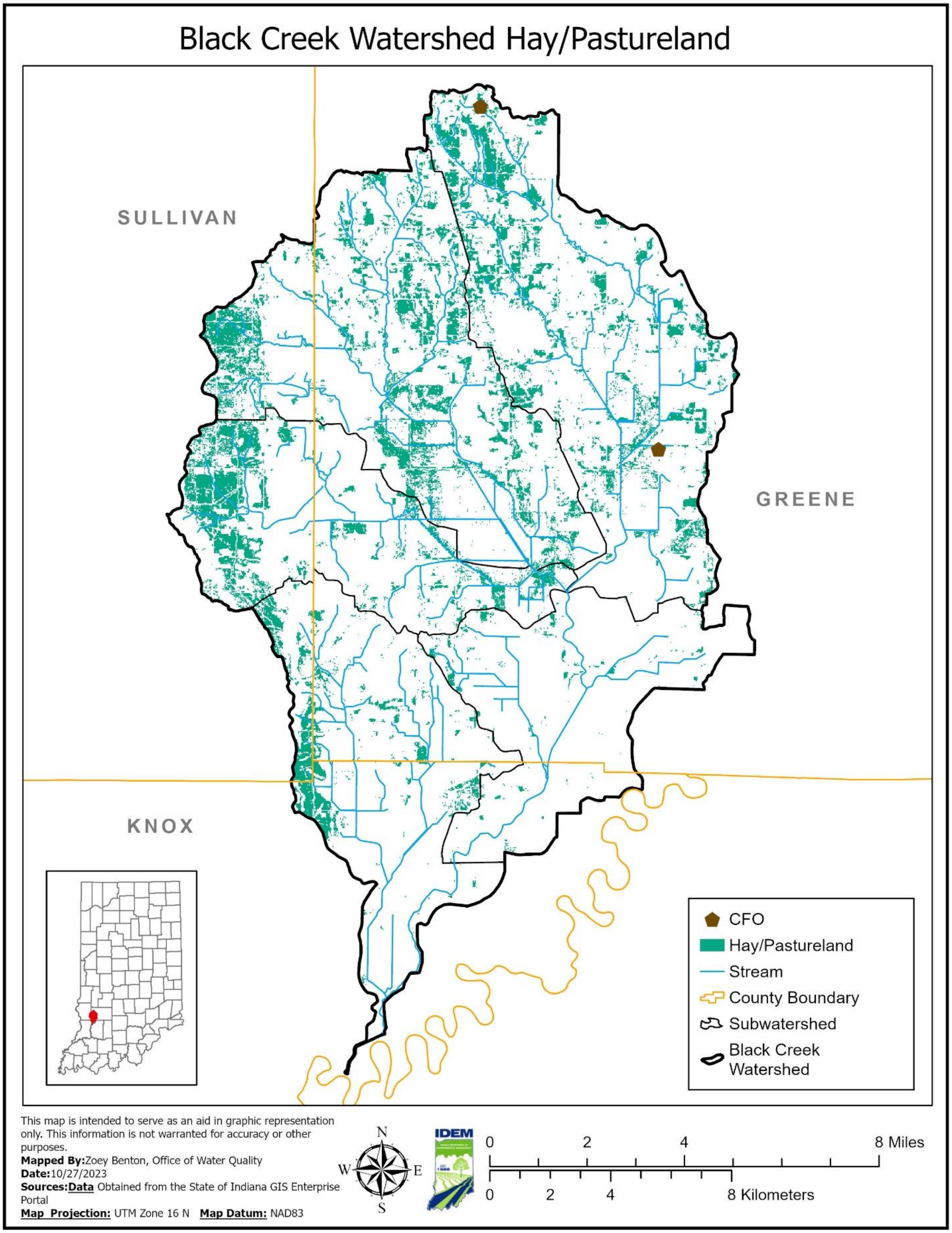

Figure 12: Grassland and Pastureland in the Black Creek Watershed with CFO locations.

2.1.3 Confined Feeding Operations (CFOs) and Animal Feeding Operations (AFOs)

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.
>
> Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over 50 percent of the lot or facility.
>
> The number of animals present meets the requirements for the state permitting action.

Feeding operations that are not classified as concentrated animal feeding operations (CAFOs) are known as confined feeding operations (CFOs) in Indiana. There are currently no CAFOs in the Black Creek watershed. Non-CAFO animal feeding operations identified as CFOs by IDEM are considered nonpoint sources by U.S. EPA. Indiana's CFOs have state issued permits 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 CAFOs and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012. It should be noted that there are currently no facilities in Indiana that have an NPDES permit under 327 IAC 15-16.

The animals raised in CFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure can then be applied to area fields as fertilizer. CFO owners can either apply manure to land they own or market and sell manure to other landowners per regulations outlined in 327 IAC 19-14. 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.

However, CFOs can be a potential source of *E. coli* due to the following:

> Improper application of manure can contaminate surface or groundwater.
>
> Manure over application or improper application can adversely impact soil productivity.

There are multiple AFOs in the Black Creek watershed and two permitted CFOs in the watershed, as shown below in Table 13 and in Figure 12. Manure used for land application in the Black Creek watershed may also originate from AFOs and CFOs in adjacent watersheds.

Table 13: CFOs in the Black Creek Watershed

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
Buck Creek	4962	Nathan & Lauren Red White & Blue Farm	Greene	Turkeys: 44,000
	3701	WIN Productions LLC	Greene	Finishers: 200 Sows: 2,192

2.2 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Figure 13 below displays the topography of the watershed. Information concerning the topography and geology within the Black Creek watershed is available from the Indiana Geological and Water Survey (IGWS). The Black Creek watershed originates in Greene County and travels southwest through Sullivan and Knox Counties, eventually discharging into the White River. The Black Creek Watershed is located in the Southern Hills and Lowlands physiographic region which is characterized by knolls and ridges with gorges and ridges to the south. It is unique in Indiana by not having been covered by glacial till.

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. Reservoirs in the state, such as Monroe Lake and Patoka Lake, are used for water supply in lieu of water wells in southern Indiana. The IGWS website contains information about the geology of Indiana (https://igws.indiana.edu/).

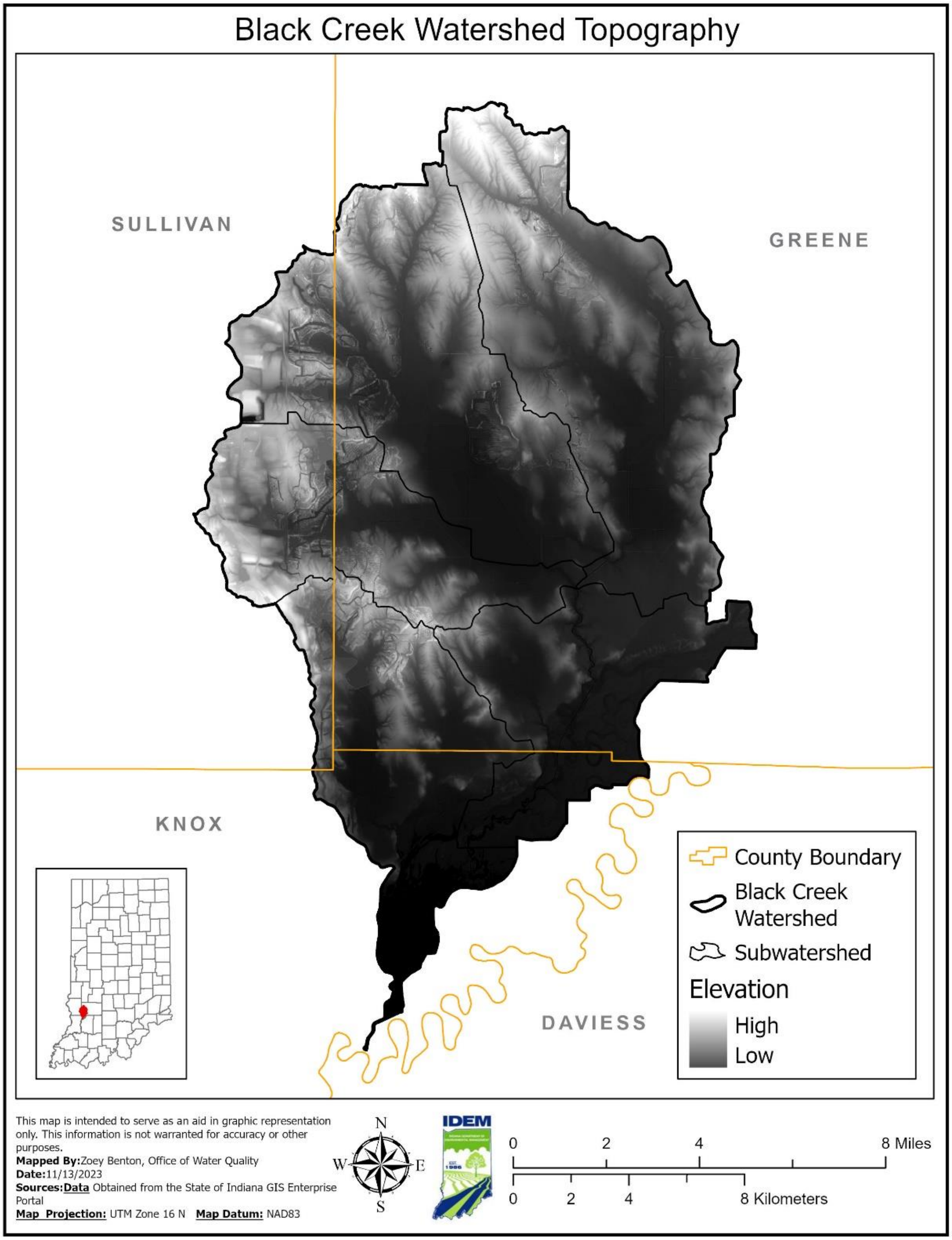

Figure 13: Topography of the Black Creek Watershed. Digital Elevation Data (DEM) was taken from the state of Indiana's Geographic Information Office (GIO).

2.2.1 Karst Geology

Karst regions are characterized by the presence of limestone or other soluble rocks, where drainage has been largely diverted into subsurface routes. The topography of such areas is dominated by sinkholes, sinking streams, large springs, and caves. Many subsurface drainage networks in this area are fed by surface streams that sink into caves or swallow holes. Activities that impact the surface water quality can thus be expected to affect groundwater as well. Due to the nature of conduit flow, impacts are likely to be ephemeral, and determination of exact directions of transport or affected conduits may be problematic in the absence of detailed dye-tracing studies. While the State of Indiana has performed dye-tracing studies in southern Indiana, none have been performed within the Black Creek watershed (Flemming et al., 1995). Figure 14 displays the location of the karst features of the watershed.

The Indiana Karst Conservancy is a 501(c)(3) non-profit organization dedicated to the preservation and conservation of Indiana's unique karst features. Unfortunately, many karst features are subject to incompatible or damaging uses. Most are on private land, occasionally with owners unaware of their significance or apathetic to their preservation. The IKC provides protection and awareness of karst features and the unique habitat they provide. For more information regarding the IKC, visit their website at https://ikc.caves.org/.

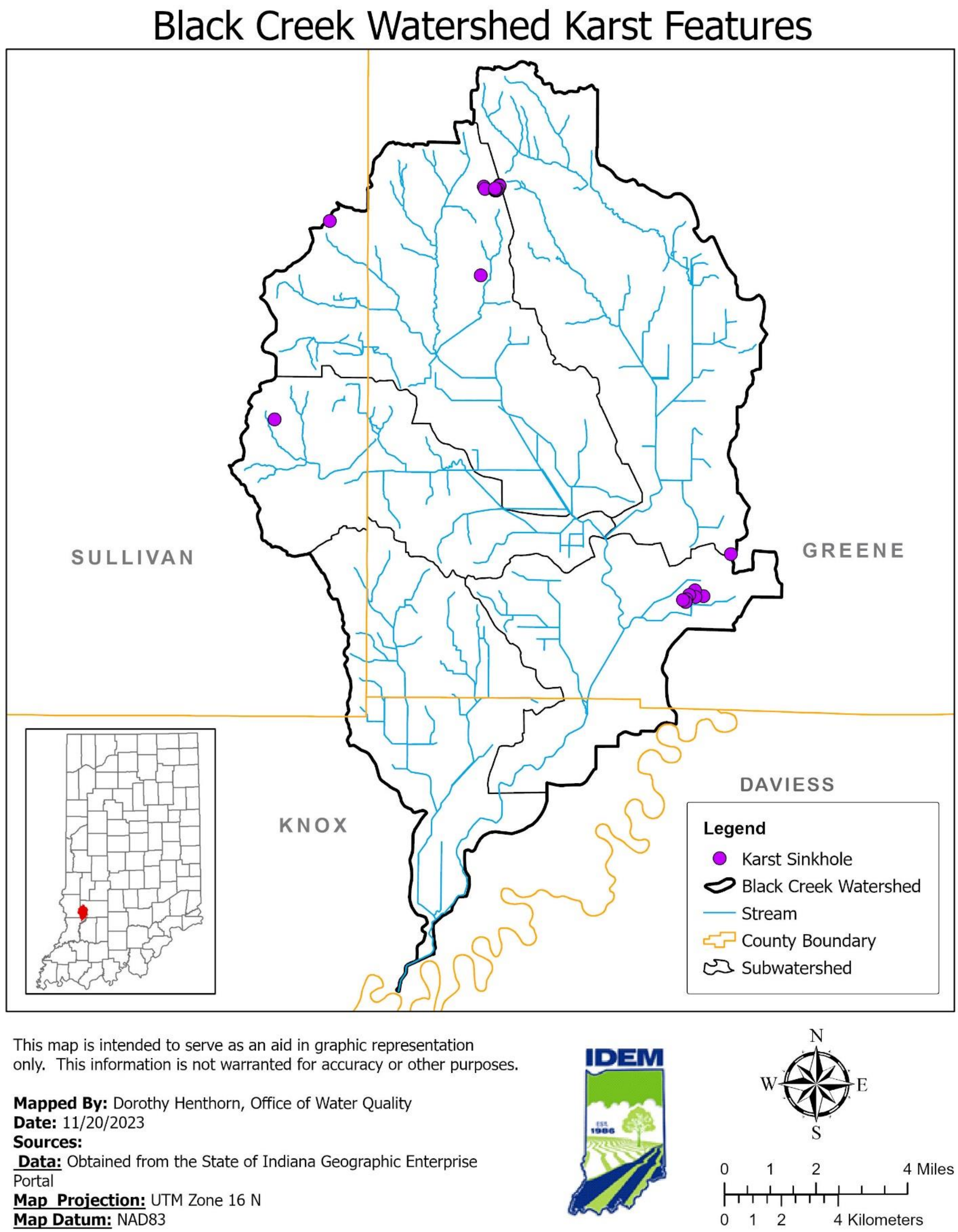

Figure 14: Karst Features in the Black Creek Watershed

2.3 Soils

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

2.3.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and run-off characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils, described in Table 14 (USDA, 2009). Data for the Black Creek watershed was obtained from the USDA 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 below in Figure 15 and Table 15.

The majority of the watershed is covered by category D soils (49 percent) followed by category C soils (29 percent), category B soils (14 percent), and category A soils (8percent). Category B soils are moderately deep and well drained, while Category C soils are finer and allow for slower infiltration. This means that regular flooding is likely not typical in much of this watershed but could potentially occur on occasion and transport pollutants across the landscape.

Of the soils identified as category D, 22 percent are specified as dual hydrologic group B/D, 53 percent are specified as dual hydrologic group C/D, and less than 1 percent are specified as dual hydrologic group A/D. Dual hydrologic groups are identified for certain wet soils that can be adequately drained. The first letter applies to the drained condition, and the second letter applies to the undrained, natural condition. Due to the watershed scale of this report, soils with dual hydrologic groups are classified as category D. However, a site-specific study should consider whether the site has been drained when soils with a dual hydrologic group are present.

Table 14: Hydrologic Soil Groups

Hydrologic Soils Group	Description
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little run-off.
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 run-off.

Understanding Table 14: 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 pollutant loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high pollutant loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of pollutants to streams.

Table 15: Hydrologic Soil Groups in the Black Creek Subwatersheds

Subwatershed	Hydrologic Soil Group			
	A	B	C	D
Headwaters Black Creek	3%	11%	38%	48%
Buck Creek	2%	15%	33.5%	50.5%
Brewer Ditch	1%	8%	37%	54%
Calico Slash Ditch	24%	16%	9%	51%
Singer Ditch	15%	19.6%	19.4%	46%

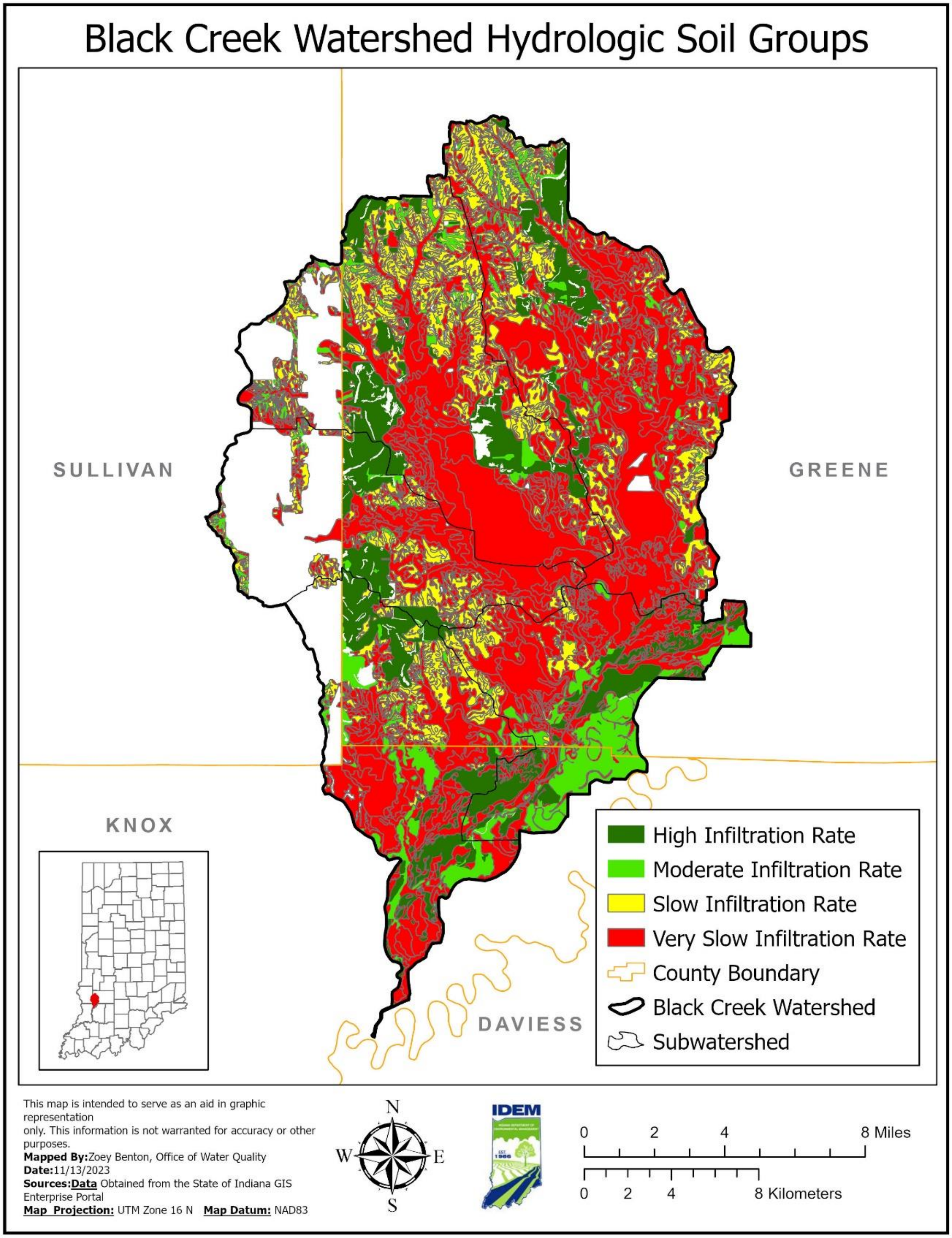

Figure 15: Hydrological Soil Groups in the Black Creek Watershed

2.3.2 Septic Tank Absorption Field 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. 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. 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 15 illustrates the hydrologic soil groups for the Black Creek subwatersheds.

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. Common soil type limitations which contribute to septic system 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 hydrogeological (inadequate soil filtration), there can be adverse effects to surface waters due to *E. coli* and nutrients (Horsley and Witten, 1996). Refer to Section 2.6.1 for additional information regarding septic systems within the Black Creek watershed.

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Black 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 85 percent of the Black 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 9 percent of the soils within the Black 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. Approximately 6 percent of the soils in the Black Creek watershed are designated “somewhat limited,” meaning that the soil type is suitable for septic systems.

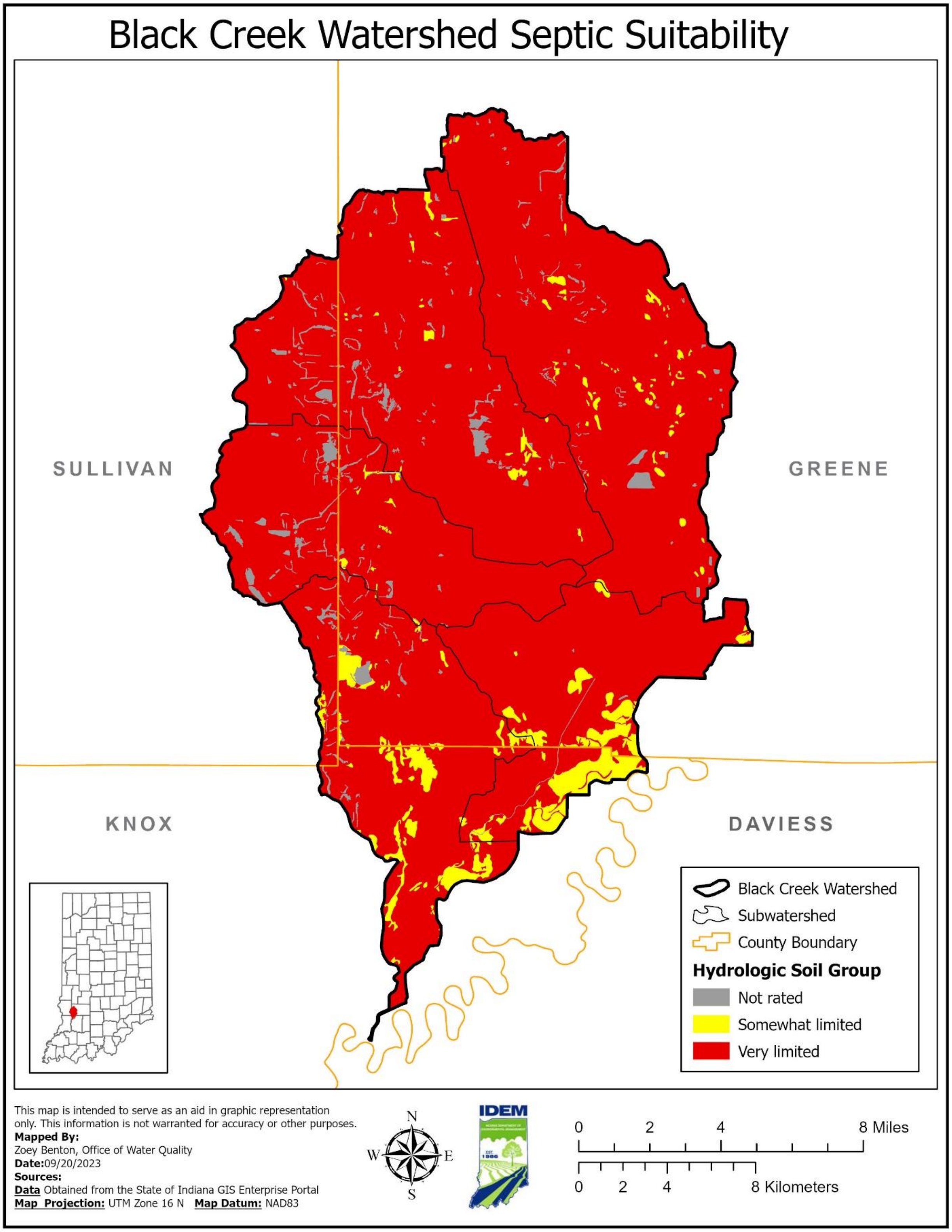

Figure 16: Suitability of Soils for Septic Systems in the Black Creek watershed

2.3.3 Soil Saturation and Wetlands

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 Black Creek watershed and are important in consideration of wetland restoration activities. Approximately 84,688 acres or 47 percent of the Black Creek watershed area contains soils that are considered hydric or have hydric inclusions. Table 16 includes a list of each map unit within the Black Creek watershed with a hydric rating greater than 0. Hydric ratings indicate the percentage of the map unit that meets the criteria for hydric soils. For example, map units with a hydric rating of 6 or less likely have small areas of hydric soils, and map units with a hydric rating of 95 or more have more significant coverage of hydric soils. Figure 15 displays the hydric ratings for each map unit within the Black Creek watershed. The Calico Slash Ditch subwatershed appears to have the most significant hydric soil coverage in the watershed. 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 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.

Table 16: Hydric Ratings for Map Units with Hydric Soils in the Black Creek Watershed

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
Headwaters Black Creek	AdB	Ade loamy fine sand, 2 to 6 percent slopes	3	28
	AnD	Alvin fine sandy loam, 12 to 18 percent slopes	3	549
	AnB	Alvin fine sandy loam, 12 to 18 percent slopes	3	2,016
	AnC	Alvin fine sandy loam, 6 to 12 percent slopes	3	837
	Ar	Armiesburg silty clay loam, rarely flooded	3	172
	Ay	Ayrshire fine sandy loam	3	768
	Bd	Birds silt loam, rarely flooded	100	117
	BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	3	87
	BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	3	1,323
	ChC	Chelsea loamy fine sand, 4 to 10 percent slopes	3	75
	ClF	Chetwynd loam, 25 to 50 percent slopes	3	9
	EkA	Elkinsville silt loam, 0 to 2 percent slopes	3	10
	ElA	Elston sandy loam, 0 to 3 percent slopes	3	279
	Hb	Haymond silt loam, rarely flooded	3	5

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	Hc	Haymond variant loamy sand, frequently flooded	2	5
	HeA	Henshaw silt loam, 0 to 2 percent slopes	3	16
	IvA	Iva silt loam, 0 to 2 percent slopes	5	5
	Kn	Kings silty clay	100	233
	Lo	Lomax loam, rarely flooded	2	70
	Ly	Lyles fine sandy loam	100	611
	No	Nolin silty clay loam, rarely flooded	2	57
	Pb	Patton silt loam	100	191
	Po	Petrolia silty clay loam, frequently flooded	100	835
	Ra	Ragsdale silt loam	100	388
	ReA	Reesville silt loam, 0 to 2 percent slopes	5	50
	Sc	Selma clay loam	100	362
	Sa	Selma loam	100	390
	SdA	Stockland sandy loam, 0 to 2 percent slopes	3	194
	Vn	Vincennes loam	100	182
	Wa	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	5	1,070
	Zp	Zipp silty clay, 0 to 2 percent slopes	95	134
	Zt	Zipp silty clay, frequently flooded	100	108
			Total Acreage:	**11,175**
Buck Creek	AnD	Alvin fine sandy loam, 12 to 18 percent slopes	**3**	101
	AnB	Alvin fine sandy loam, 2 to 6 percent slopes	3	1,272
	AnC	Alvin fine sandy loam, 6 to 12 percent slopes	3	391
	Ay	Ayrshire fine sandy loam	3	1,095
	Bd	Birds silt loam, rarely flooded	100	331
	BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	3	34
	BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	3	334
	ChC	Chelsea loamy fine sand, 4 to 10 percent slopes	3	10
	EkA	Elkinsville silt loam, 0 to 2 percent slopes	3	193
	HeA	Henshaw silt loam, 0 to 2 percent slopes	3	104
	IvA	Iva silt loam, 0 to 2 percent slopes	5	331
	Kn	Kings silty clay	100	46
	Ly	Lyles fine sandy loam	100	560

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	Pb	Patton silt loam	100	1,083
	Ra	Ragsdale silt loam	100	1,174
	ReA	Reesville silt loam, 0 to 2 percent slopes	5	1,687
	Vn	Vincennes loam	100	64
	Wa	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	5	2,464
	Zp	Zipp silty clay, 0 to 2 percent slopes	95	279
			Total Acreage:	**11,552**
Brewer Ditch	AnD	Alvin fine sandy loam, 12 to 18 percent slopes	3	249
	AnB	Alvin fine sandy loam, 2 to 6 percent slopes	3	1,693
	AnC	Alvin fine sandy loam, 6 to 12 percent slopes	3	430
	Ay	Ayrshire fine sandy loam	3	1,996
	AsA	Ayrshire fine sandy loam, 0 to 2 percent slopes	3	852
	AsB	Ayrshire fine sandy loam, 2 to 4 percent slopes	3	137
	AyA	Ayrshire loam, 0 to 2 percent slopes	3	37
	BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	3	22
	BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	3	775
	Kn	Kings silty clay	100	121
	Ly	Lyles fine sandy loam	100	1,498
	Ly	Lyles loam	100	657
	Pb	Patton silt loam	100	7
	Pc	Patton silty clay loam	100	508
	PrD2	Princeton fine sandy loam, 12 to 18 percent slopes, eroded	3	3
	PrB2	Princeton fine sandy loam, 2 to 6 percent slopes, eroded	3	445
	PrC2	Princeton fine sandy loam, 6 to 12 percent slopes, eroded	3	63
	Ra	Ragsdale silt loam	100	2,017
	ReA	Reesville silt loam, 0 to 2 percent slopes	5	2,157
	ReB2	Reesville silt loam, 2 to 5 percent slopes, eroded	5	283
	Rm	Rensselaer loam	100	314
	Sa	Selma loam	100	185
	Vo	Vincennes clay loam, gravelly substratum	100	3
	Vn	Vincennes loam	100	18

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	Wa	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	5	621
	Zp	Zipp silty clay, 0 to 2 percent slopes	95	42
			Total Acreage:	**15,134**
Calico Slash Ditch	AdB	Ade loamy fine sand, 2 to 6 percent slopes	3	137
	AnB	Alvin fine sandy loam, 2 to 6 percent slopes	3	37
	AnC	Alvin fine sandy loam, 6 to 12 percent slopes	3	8
	Ao	Ambraw sandy clay loam, rarely flooded	100	436
	Ar	Armiesburg silty clay loam, rarely flooded	3	989
	Ay	Ayrshire fine sandy loam	3	74
	Ay	Ayrshire sandy loam	3	396
	BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	3	172
	BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	3	13
	Bo	Bonnie silt loam, frequently flooded	100	245
	Br	Booker clay	100	3
	EkA	Elkinsville silt loam, 0 to 2 percent slopes	3	23
	ElA	Elston sandy loam, 0 to 3 percent slopes	3	159
	EnA	Elston loam, 0 to 2 percent slopes	3	578
	Ev	Evansville silt loam, rarely flooded	100	14
	Ha	Haymond silt loam, frequently flooded	6	0
	HdA	Henshaw silt loam, 1 to 3 percent slopes	3	239
	Kn	Kings silty clay	100	18
	Lo	Lomax loam, rarely flooded	2	181
	Ly	Lyles fine sandy loam	100	98
	MgA	McGary silt loam, 0 to 2 percent slopes	3	261
	Mo	Montgomery silty clay loam	97	727
	Ne	Newark loam, frequently flooded	6	36
	No	Nolin silty clay loam, rarely flooded	2	281
	Nr	Nolin silt loam, rarely flooded	3	162
	Pb	Patton silt loam	100	16
	Pc	Patton silty clay loam, 0 to 1 percent slopes	95	466

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	Pf	Peoga silt loam, 0 to 1 percent slopes	93	537
	Po	Petrolia silty clay loam, frequently flooded	100	245
	Ra	Ragsdale silt loam	100	0
	RaA	Reesville silt loam, 0 to 2 percent slopes	5	44
	Rb	Rensselaer sandy loam	100	374
	Rd	Rensselaer loam	100	169
	RmA	Roby sandy loam, 0 to 2 percent slopes	3	134
	Sc	Selma clay loam	100	120
	St	Stendal silt loam, frequently flooded	3	69
	VgA	Vigo silt loam, 0 to 2 percent slopes	3	405
	Vn	Vincennes loam	100	126
	Vo	Vincennes clay loam, gravelly substratum	100	220
	Wm	Wilhite silty clay, frequently flooded	100	179
	Zp	Zipp silty clay	100	615
	Zp	Zipp silty clay, 0 to 2 percent slopes	95	31
			Total Acreage:	9,037
Singer Ditch	AnB	Alvin fine sandy loam, 2 to 6 percent slopes	**3**	132
	AnC	Alvin fine sandy loam, 6 to 12 percent slopes	3	63
	Ay	Ayrshire fine sandy loam	3	689
	AsA	Ayrshire fine sandy loam, 0 to 2 percent slopes	3	97
	AsB	Ayrshire fine sandy loam, 2 to 4 percent slopes	3	8
	Bd	Birds silt loam, rarely flooded	100	210
	BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	3	3
	BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	3	13
	EkA	Elkinsville silt loam, 0 to 2 percent slopes	3	2
	Ha	Haymond silt loam, frequently flooded	6	8
	IvA	Iva silt loam, 0 to 2 percent slopes	5	1,213
	IvB2	Iva silt loam, 2 to 4 percent slopes, eroded	3	315
	Ly	Lyles fine sandy loam	100	115

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	Ly	Lyles loam	100	16
	Pb	Patton silt loam	100	645
	PrB2	Princeton fine sandy loam, 2 to 6 percent slopes, eroded	3	26
	PrC2	Princeton fine sandy loam, 6 to 12 percent slopes, eroded	3	16
	Ra	Ragsdale silt loam	100	823
	ReA	Reesville silt loam, 0 to 2 percent slopes	5	2,531
	ReB2	Reesville silt loam, 2 to 5 percent slopes, eroded	5	342
	Rm	Rensselaer loam	100	40
	Sn	Stendal silt loam	3	76
	VgA	Vigo silt loam, 0 to 2 percent slopes	3	120
	VgB2	Vigo silt loam, 2 to 4 percent slopes, eroded	3	14
	Wa	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	5	2,586
	Zp	Zipp silty clay, 0 to 2 percent slopes	95	322
			Total Acreage:	**10,425**

Understanding Table 17: Areas with the most acreage of hydric soils might contain opportunities for wetland restoration activities that could help address water quality impairments. The hydric rating indicates the percentage of the map unit with hydric soils. Map units with a hydric rating of 100 have 100% hydric soils.

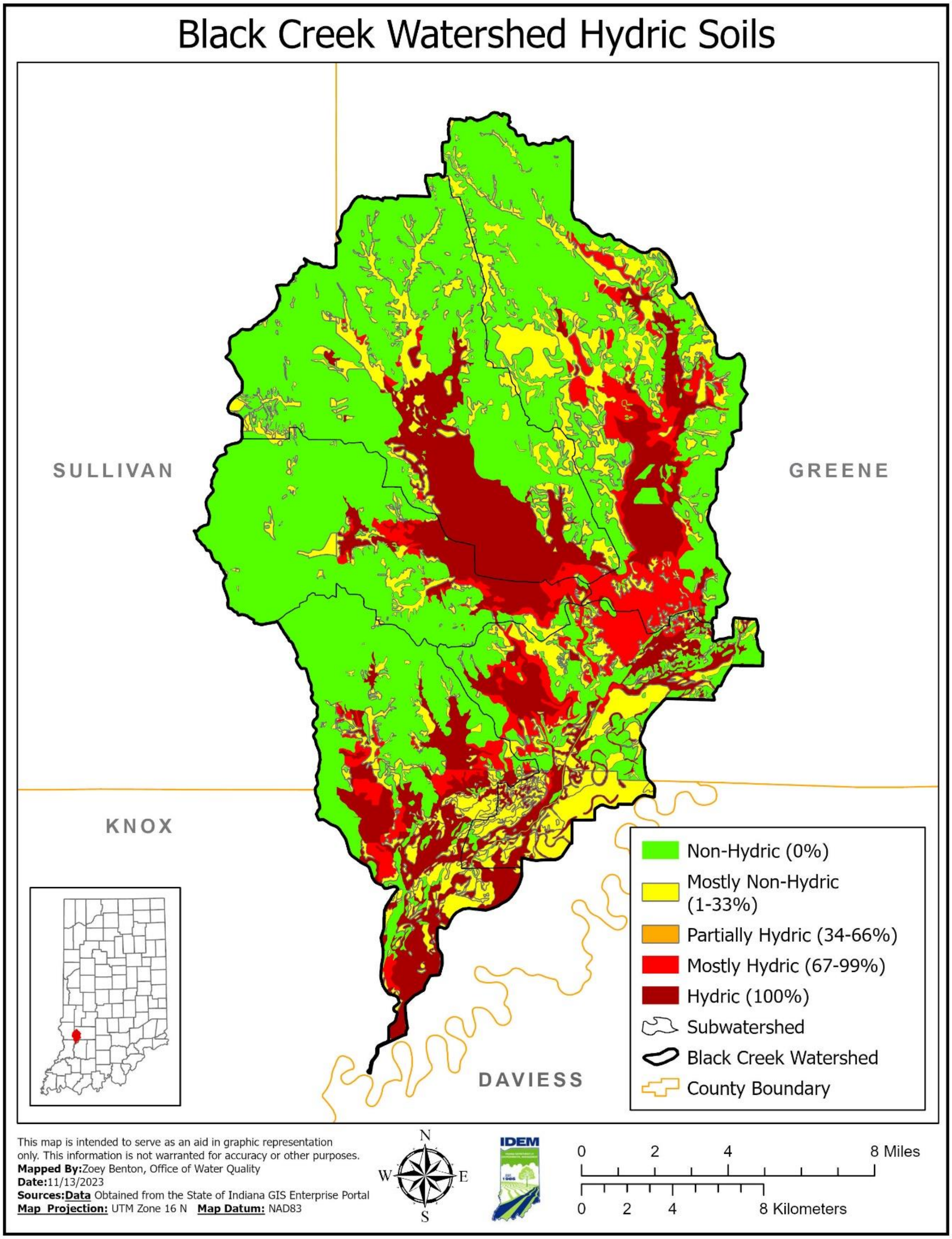

Figure 17: Hydric Soils in the Black Creek Watershed
(https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/)

Nationally, since the late 1600s roughly 50 percent of the wetlands in the lower 48 states have been lost. Indiana has lost a large number of its wetlands, approximating over 80 percent (USGS, 1999). In the 1800s and 1900s millions of acres of wetlands were drained or converted into farms, cities, and roads. In the early 1700s, wetlands covered 25 percent of the total area of Indiana. That number has been greatly reduced. By the late 1980s, over 4.7 million acres of wetlands had been lost. Before the conversion of wetlands, there were over 5.6 million acres of wetlands in the state, wetlands such as bogs, fens, wet prairies, dune and swales, cypress swamps, marshes, and swamps. Wetlands now cover less than 4 percent of Indiana. (http://www.in.gov/idem/wetlands/importance-of-wetlands/)

Wetlands are home to wildlife. More than one-third (1/3) of America's threatened and endangered species live only in wetlands, which means they need them to survive. Over 200 species of birds rely on wetlands for feeding, nesting, foraging, and roosting. Wetlands provide areas for recreation, education, and aesthetics. More than 98 million people hunt, fish, birdwatch, or photograph wildlife. Americans spend $59.5 billion annually on these activities.

Wetland plants and soils naturally store and filter nutrients and sediments. Calm wetland waters, with their flat surface and flow characteristics, allow these materials to settle out of the water column, where plants in the wetland take up certain nutrients from the water. As a result, our lakes, rivers and streams are cleaner, and our drinking water is safer. Constructed wetlands can even be used to clean wastewater, when properly designed. Wetlands also recharge our underground aquifers. Over 70 percent of Indiana residents rely on groundwater for part or all of their drinking water needs.

Wetlands protect our homes from floods. Like sponges, wetlands soak up and slowly release floodwaters. This lowers flood heights and slows the flow of water down rivers and streams. Wetlands also control erosion. Shorelines along rivers, lakes, and streams are protected by wetlands, which hold soil in place, absorb the energy of waves, and buffer strong currents.

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 run-off 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. Currently, the Black Creek watershed contains approximately 3,866 acres of wetlands or 4.5 percent of the total surface area. Additional information on wetlands can be found on the IDEM website http://www.in.gov/idem/wetlands/.

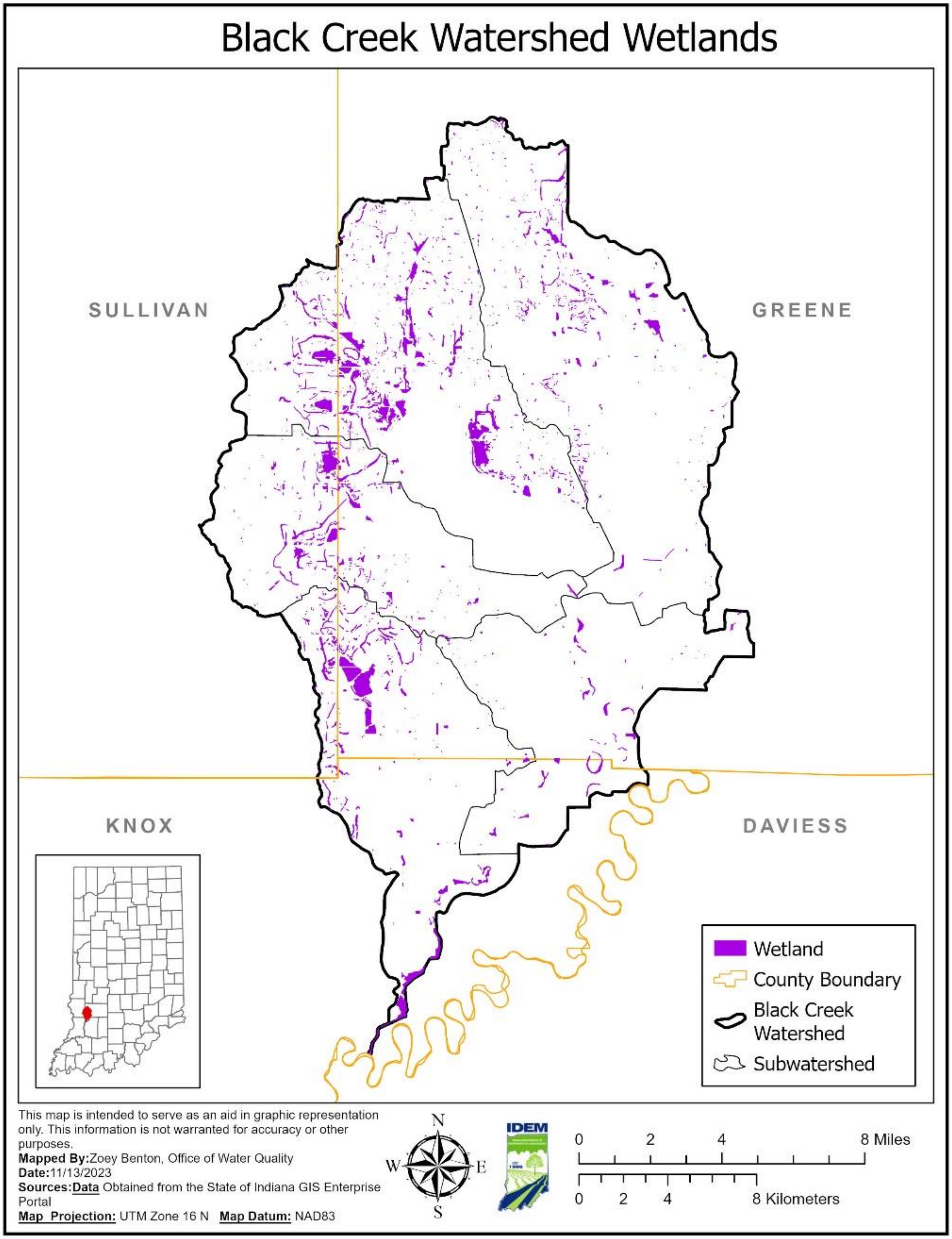

Figure 18: Location of Wetlands in the Black Creek Watershed

The USFWS has the responsibility for mapping wetlands in the United States. Those map products are currently held in the Fish and Wildlife Service Wetland Database (sometimes referred to as the National Wetlands Inventory or NWI). Figure 18 shows estimated locations of wetlands as defined by the USFWS's NWI. Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at https://www.fws.gov/wetlands/data/Mapper.html. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground soil surveys, and boundaries are generalized in most cases. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. Therefore, the estimate of the current extent of wetlands in the Black Creek watershed from the NWI may not agree with those listed in Section 2.1, which are based upon the National Agricultural Statistics Service. For more information on the wetland classification codes visit http://www.fws.gov/wetlands/Data/Wetland-Codes.html. The USFWS uses data standards to increase the quality and compatibility of its data.

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 (https://www.ispls.org/).

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.

2.3.4 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 run-off, 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 (https://efotg.sc.egov.usda.gov/references/public/NE/HEL_Intro.pdf). 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 topsoil 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 Black Creek watershed are listed in Table 17. HELs and potential HELs in the Black Creek watershed are mapped in Figure 19.

A total of 44,615 acres or 53 percent of the Black Creek watershed is considered highly erodible or potentially highly erodible. Rainfall surrounding the Black Creek watershed is moderately heavy with an annual average of 49.6 inches. This rainfall and climate data specific to the watershed is available from the Midwestern Regional Climate Center https://mrcc.purdue.edu/. 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.

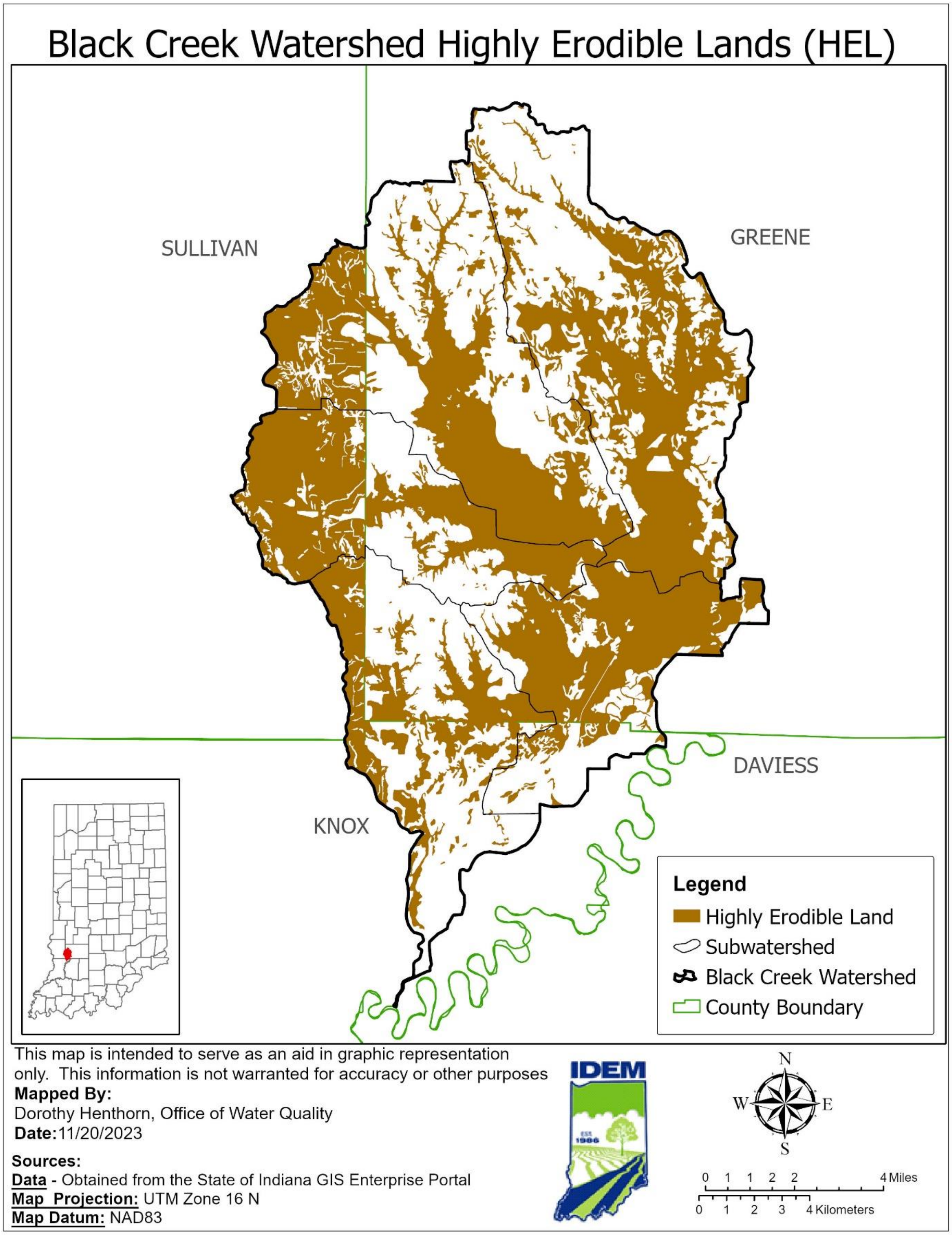

Figure 19: Location of Highly Erodible Lands (HEL) in the Black Creek Watershed

Table 17: HEL/Potential HEL Total Acres in the Black Creek Watershed

Map Symbol	HEL/Potential HEL Soil Types	Acres
AfB2	Alford silt loam, 2 to 5 percent slopes, eroded	6
AfB3	Alford silt loam, 2 to 5 percent slopes, severely eroded	11
AfC2	Alford silt loam, 5 to 10 percent slopes, eroded	13
AfC3	Alford silt loam, 5 to 10 percent slopes, severely eroded	17
AfD3	Alford silt loam, 10 o 18 percent slopes, severely eroded	11
AlB2	Ava silt loam, 2 to 6 percent slopes, eroded	1,348
AlB3	Ava silt loam, 2 to 6 percent slopes, severely eroded	11
AlC2	Alford silt loam, 5 to 10 percent slopes, eroded	95
AnB	Alvin-Bloomfield complex, 2 to 6 percent slopes	490
AnC	Alvin-Bloomfield complex, 6 to 12 percent slopes	376
Ao	Ambraw sandy loam	436
Ay	Aurshire sandy loam	727
BlB	Bloomfield loamy fine sand, 2 to 10 percent slopes	396
BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	22
Bo	Bonnie silt loam, frequently flooded	3,828
Br	Booker Clay	2,525
Bs	Booker mucky Clay	1,558
CnB2	Cincinnati silt loam, Wabash Lowland, 2 to 6 percent slopes	148
CnC2	Cincinnati silt loam, Wabash Lowland, 6 to 12 percent slopes	62
CnD2	Cincinnati silt loam, 12 to 18 percent slopes, eroded	8
CnD3	Cincinnati silt loam, 12 to 18 percent slopes, severely eroded	181
EnA	Elston loam, 0 to 2 percent slopes	578
Ev	Evansville silt loam, rarely flooded	481
FaB	Fairpoint silt loam, reclaimed, 2 to 8 percent slopes	852
Gu	Gullied land	3
HdA	Henshaw silt loam, 1 to 3 percent slopes	360
HkE	Hickory silt loam, 18 to 25 percent slopes	178
HkF	Hickory silt loam, 25 to 35 percent slopes	3
HkF3	Hickory silt loam, 18 to 35 percent slopes, severely eroded	113
HoB2	Hosmer silt loam, 2 to 5 percent slopes, eroded	18
HoC3	Hosmer silt loam, 5 to 10 percent slopes, severely eroded	10
IvB2	Iva silt loam, 2 to 4 percent slopes, eroded	2
MbB2	Markland silty clay loam, 2 to 6 percent slopes, eroded	212
MgA	McGary silt loam, 0 to 2 percent slopes	371
Mo	Montgomery silty clay loam	1,713
MuB2	Muren silt loam, 2 to 6 percent slopes, eroded	27
Ne	Newark loam, frequently flooded	75
No	Nolin silty clay loam, rarely flooded	320
Nr	Nolin silt loam, rarely flooded	162
PaC3	Parke silt loam, 6 to 12 percent slopes, severely eroded	2

Map Symbol	HEL/Potential HEL Soil Types	Acres
Pc	Patton silty clay loam, 0 to 1 percent slopes	1,754
Pf	Peoga silt loam, 0 to 1 percent slopes	2,726
RaA	Reeseville silt loam, 0 to 2 percent slopes	145
Rb	Rensselaer sandy loam	388
Rd	Rensselaer loam	177
RmA	Roby sandy loam, 0 to 2 percent slopes	134
St (Strip mines)	Strip mines	1,697
St	Stendal silt loam, frequently flooded	10,408
SyB2	Sylvan silt loam, 2 to 6 percent slopes, eroded	132
SyC3	Sylvan silt loam, 6 to 12 percent slopes, severely eroded	100
SyD3	Sylan silt loam, 12 to 18 percent slopes, severely eroded	9
VgA	Vigo silt loam, 0 to 2 percent slopes	5,642
VgB2	Vigo silt loam, 2 to 4 percent slopes, eroded	184
Wm	Wilhite silty clay, frequently flooded	223
Zp	Zipp silty clay, 0 to 2 percent slopes	3,000
	Total	44,466

Understanding Table 17 and Figure 19: Areas with the most acreage of HEL might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.

The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect county (https://secure.in.gov/isda/divisions/soil-conservation/conservation-transect/) can 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 Black Creek watershed are shown in Table 18. Tillage practices captured in ISDA's tillage transect include living cover and no-till practices. According to ISDA, living cover includes living cover crops and cereal grains planted into cash crops using direct seeding or broadcast methods, and no-till is any direct seeding system including site preparation, with minimal soil disturbance (ISDA, 2023).

Table 18: Tillage Transect Data for 2019 by County in the Black Creek Watershed

County	Tillage Practice 2019			
	Living Cover		No Till	
	Corn	Soybean	Corn	Soybean
Greene	3,577 Acres 9%	4,019 Acres 9%	34,181 Acres 86%	41,976 Acres 94%
Sullivan	3,827 acres 7%	3,380 acres 5%	30,290 acres 55%	60,439 acres 89%
Knox	21,896 acres 22%	38,599 acres 35%	88,578 acres 89%	97,050 acres 88%

Understanding Table 18: According to the table, in Knox County no till is predominant for corn, and living cover is predominant for soybeans. In Sullivan County, no till is predominant for soybeans, and living *cover is predominant for corn. Overall, living cover is utilized at a greater percentage in Knox County, but the percentage of no till is similar for both Knox and Sullivan counties. Sullivan County's data is based on a five-year average due to an incomplete survey.*

2.3.5 Streambank Erosion

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

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 run-off of rainfall and higher stream velocities that might cause streambank erosion.

2.4 Wildlife and Classified Lands

2.4.1 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, waterfowl, raccoon, beaver, etc. can be sources of *E. coli* and nutrients. The animal habitat and proximity to surface waters are important factors that determine if animal waste can be transported to surface waters. Waterfowl and riparian mammals deposit waste directly into streams while other riparian species deposit waste in the flood-plain, which can be transported to surface waters by runoff from precipitation events. Animal waste deposited in upland areas can also be transported to streams and rivers; however, due to the distance from uplands to surface streams, only larger precipitation events can sustain sufficient amounts of runoff to transport upland animal waste to surface waters.

Little information exists 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 19 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.

Table 19: Bacteria Source Load by Species

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

2.4.2 Classified Lands

Managed lands shown in Table 20 include natural and recreation areas which are owned or managed by the IDNR, 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. 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 impervious surfaces reduction, native vegetation plantings, wetland creation, and riparian buffer maintenance will help in reducing stormwater run-off transporting pollutants to the streams. Table 20 and Figure 20 show the managed lands within the Black Creek watershed. Table 21 and Figure 20 show the classified lands within Black Creek watershed.

Table 20: Managed Lands within the Black Creek Watershed

Unit Name	Manager	Area (acres)
Greene-Sullivan State Forest	DNR Forestry	9,071
Hillenbrand Fish and Wildlife Area	DNR Fish and Wildlife	3,615
Redbird State Recreation Area	DNR Outdoor Recreation	1,582
Goose Pond Fish and Wildlife Area	DNR Fish and Wildlife	9,003
Total		23,271

Table 21: Classified Lands within the Black Creek Watershed

Classified Lands	
Subwatershed	**Area (acres)**
Headwaters Black Creek	130
Buck Creek	134
Brewer Ditch	63
Calico Slash Ditch	0
Singer Ditch	160
Total	487

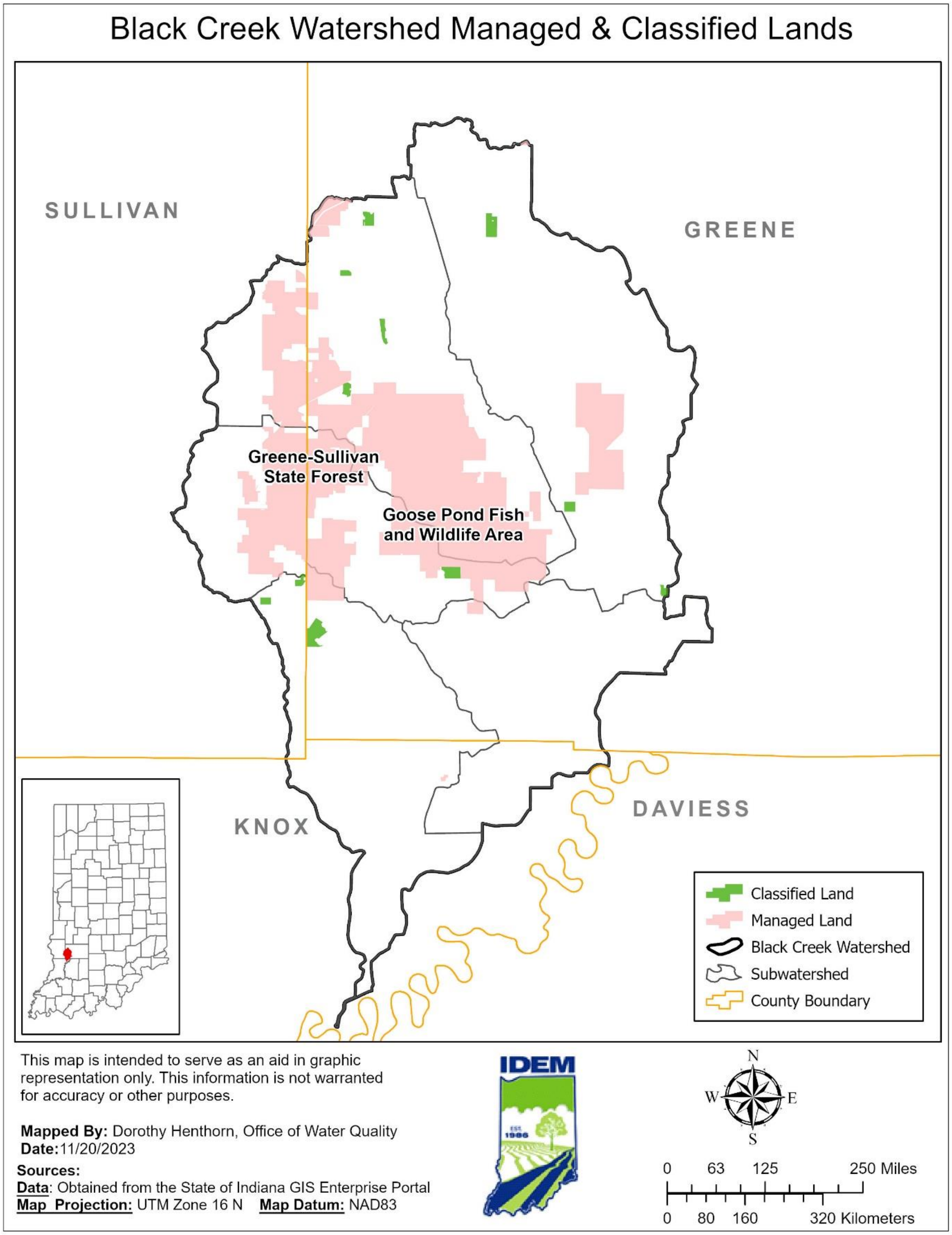

Figure 20: Managed and Classified Lands within the Black Creek Watershed

2.5 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 Midwestern Regional Climate Center (https://mrcc.purdue.edu/).

Climate data from Station USC00127959 located in Shakamak State Park, IN were used for climate analysis of the Black Creek watershed. Monthly data from 1989 - 2023 were available at the time of analysis. In general, the climate of the region is continental with hot, humid summers and cold winters. From 2013-2023, the average winter temperature in Shakamak State Park was 32.7°F and the average summer temperature was 73.9°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 192 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of run-off on water quality. From 2013 to 2023, the annual average precipitation in Shakamak State Park at Station USC00127959 was approximately 49.6 inches, including 12.9 inches on average of total annual Black Creek snowfall.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of stormwater on the Black Creek watershed. Using data from USC00127959 during 2013 to 2023, 73 percent of the measurable precipitation events were low intensity (i.e., less than 0.2 inches), while 4 percent of the measurable precipitation events were greater than one inch.

According to the "Impacts of Climate Change for the State of Indiana" report developed by the Purdue Climate Change Research Center; Indiana will face a number of potential impacts if greenhouse gas concentrations continue to increase. The occurrence and duration of extreme hot events is likely to increase in Indiana while the occurrence of extreme cold events is likely to decrease (Diffenbaugh et al., 2005). Indiana could experience a significant reduction in extreme cold temperatures leading to warmer winters (Diffenbaugh et al., 2005). Total annual average precipitation is likely to increase, but there may be a shift in when the precipitation occurs. Winter and spring precipitation are projected to increase by 21 and 30 percent, respectively, by the end of the century, but summer precipitation may decline by 9 percent. Warmer and wetter winters may result in higher streamflow and increased flooding frequency. Total runoff is also projected to increase annually by between 25 and 38 percent by the end of the century with the largest percent increase in total runoff occurring in the winter and spring (Purdue Climate Change Research Center, 2008).

Understanding when precipitation events occur helps in the linkage analysis in Section 4.0, which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Black Creek watershed currently occurs between the months of March and May.

2.6 Human Population

Counties with land located in the Black Creek watershed include Knox, Greene, and Sullivan. Major government units with jurisdiction at least partially within the Black Creek watershed include Linton and Sandborn. U.S. Census data for each county during the past three decades are provided in Table 22 (U.S. Census Bureau, 2012).

Table 22: Population Data for Counties in Black Creek Watershed

County	2000	2010	2020
Knox	39,256	38,440	36,282
Greene	33,157	33,165	30.803
Sullivan	21,751	21,475	20,817
Total	94,164	93,080	87,902

Understanding Table 22: 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. The table provides information that shows how population has changed in each of the counties located in the Black 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 in the Black Creek could help prevent further water quality degradation.

Estimates of population within Black Creek watershed are based on US Census data 2020 and the percentage of census blocks in urban and rural areas (Table 23). Based on this analysis, the estimated population of the watershed is 11,322 with approximately 44 percent of the population classified as rural residents and 56 percent classified as urban residents. **Error! Reference source not found.** below indicates population density within the Black Creek watershed.

Table 23: Estimated Population in the Black Creek Watershed

County	2020 Population	Total Estimated Watershed Urban Population	Total Estimated Watershed Rural Population	Total Estimated Watershed Population	Percent of Total Watershed Population
Knox	36,282	0	614	614	5.4%
Greene	30.803	6,325	3,666	9,991	88.2%
Sullivan	20,817	0	717	717	6.3%
Total	87,902	6,325	4,997	11,322	100.0%

Understanding Table 23: Understanding where the greatest population is concentrated within the Black Creek 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 stormwater flows, and large wastewater inputs. Alternatively, watersheds with mostly a non-urban population are more likely to suffer problems from failing septic systems, agricultural run-off, and other types of poor riparian habitat (e.g., channelized streams). Comparing the information in Table 22 with the information in Table 23 can provide an understanding of how population might change in the Black Creek watershed and which counties are experiencing the most growth and shifts in urban and non-urban population. Population change can serve as an indicator for changes in land uses. For example, growing populations might *mean more development, resulting in increased impervious surfaces and more infrastructure (e.g., sanitary sewer and storm sewer). Declining population in areas of the Black Creek watershed might signify communities with under-utilized infrastructure and indicate opportunities to "rightsize" existing infrastructure and promote changes to land use that would benefit water quality (e.g., green infrastructure).*

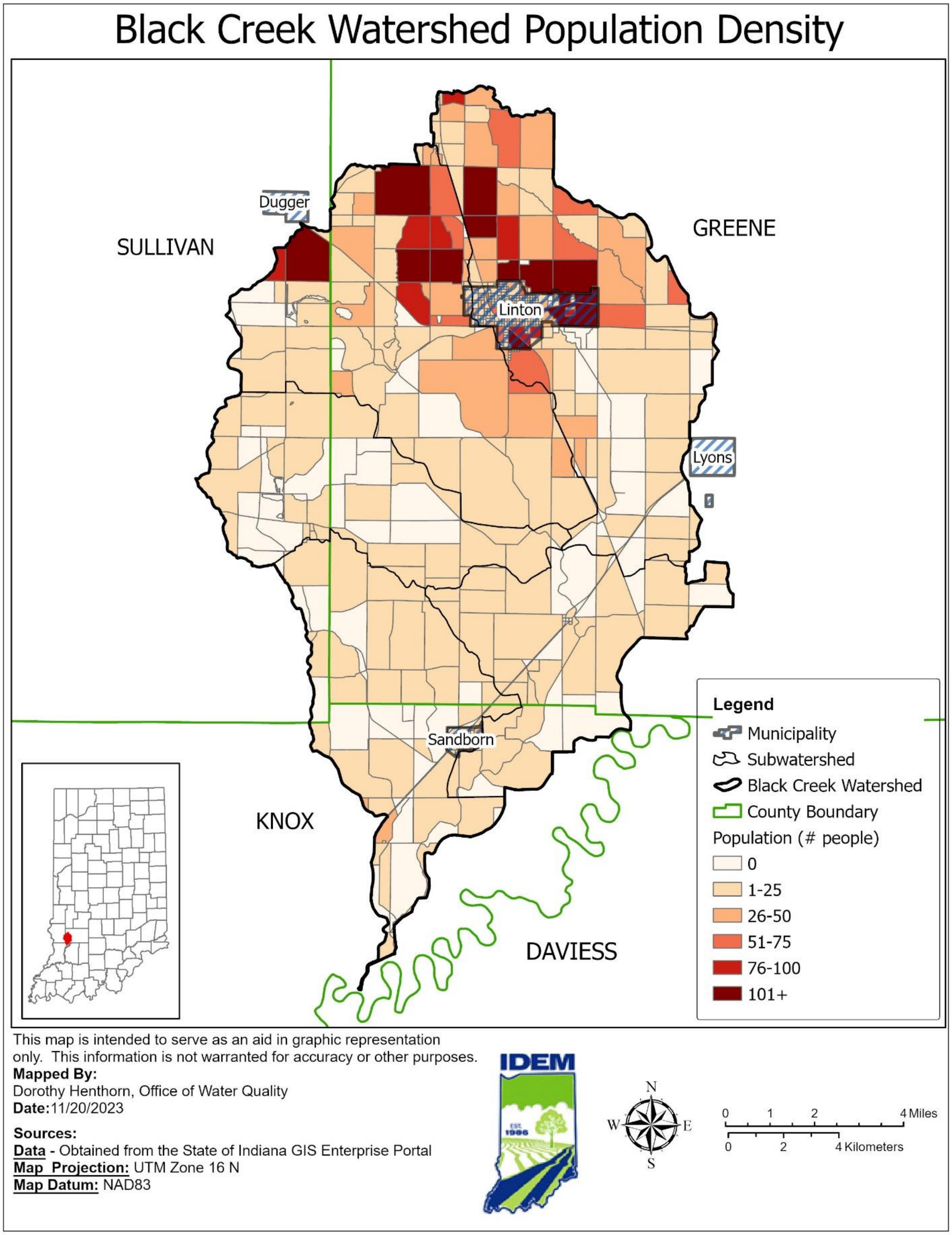

Figure 21: Population Density in the Black Creek Watershed

2.6.1 Onsite Sewage Disposal Systems

Onsite sewage disposal systems (i.e., septic systems) are underground wastewater treatment structures most commonly used in rural areas without centralized sewer systems. According to the U.S. EPA's SepticSmart Homeowners program, one in five U.S. homes has a septic system (U.S EPA, 2018). Local health departments regulate onsite residential sewage disposal systems via designated authority from the Indiana Department of Health (IDOH) (410 IAC 6-8.3). 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 (IDOH, 2020).

Septic systems typically consist 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, also known as the drainfield. The septic tank holds the wastewater to allow for separation of solids, fats, oil, and grease. The septic tank also contains microorganisms that aid in breaking down sludge and removing some contaminants from the wastewater. The drainfield allows for further removal of remaining contaminants through soil filtration.

Regular maintenance of septic systems, such as frequent inspections and pumping of the septic tank, is important to ensure the system is functioning safely and effectively. Septic systems that are properly designed and maintained should not serve as a source of contamination to surface waters. However, a septic system may fail if it is not properly installed or maintained or if it is installed in an unsuitable soil type as discussed in Section 2.3.2. A septic system that is not functioning properly may inadvertently contaminate groundwater and surface water due to elevated levels of nutrients and bacteria that can be found in untreated or inadequately treated household wastewater. A 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, groundwater, or surface water.

The general sewage disposal requirements (410 IAC 6-8.3-52) in the residential onsite sewage systems rule state that:

> No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or groundwaters 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.

> 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.

The violations and permit denial and revocation section (410 IAC 6-8.3-55) of the residential onsite sewage system rule states that:

> Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer.
>
> 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.
>
> 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 Black Creek watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The U.S. 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 using the census block population found within each area. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural household 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 Black Creek subwatersheds are shown in Table 24, 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 Black Creek watershed (U.S. Census Bureau, 2012).

Table 24: Rural and Urban Household Density in the Black Creek Subwatersheds

Subwatershed	**County**	**Area of County in Subwatershed (mi2)**	**County Households in Subwatershed**	**Urban Households**	**Rural Households**	**Rural Household Density (Houses/mi2)**	**Urban Household Density (Houses/mi2)**
Buck Creek	Greene	35.02	3,494	2,695	799	23	77
	Total	35.02	3,494	2,695	799		
Calico Slash Ditch	Greene	14.74	96	2	94	6	0
	Knox	4.76	25	0	25		
	Total	19.5	121	2	119		
Singer Ditch	Greene	9.28	47	3	44	14	0
	Knox	11.5	271	0	271		
	Sullivan	2.6	11	0	11		
	Total	23.38	329	3	326		

Brewer Ditch	Greene	10.62	43	3	40	8	0
	Sullivan	9.37	120	0	120		
	Total	19.99	163	3	160		
Headwaters Black Creek	Greene	27.92	940	178	762	26	5
	Sullivan	6.58	127	0	127		
	Total	34.5	1,067	178	889		

A report by the Indiana Advisory Commission on Intergovernmental Relations (ACIR) surveyed county health department officials statewide from 2016 to 2017. Of the 444 unsewered communities reported statewide, the study was able to identify 192 of those communities where at least 25 percent of the individual wastewater treatment systems were failing. Unsewered communities were defined as "contiguous geographical areas containing at least 25 homes and/or businesses that are not served by sewers" (Palmer et. al, 2019).

Table 25: Unsewered residences/businesses reported by county in 2016-2017.

Table 25 reports unsewered communities by county relevant to the Black Creek watershed.

Table 25: Unsewered residences/businesses reported by county in 2016-2017.

County	Unsewered Communities	Residences	Businesses
Knox	7	497	13
Greene	7	608	25
Sullivan	8	530	14

2.6.2 Urban Stormwater

In areas not covered under the NPDES construction stormwater general permit (CSGP), industrial stormwater permit (327 IAC 15-6), or MS4 programs, as discussed in Section 2.8.3, stormwater run-off from developed areas is not regulated under a permit and is therefore a nonpoint source. Run-off 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. Potential sources of *E. coli* in urban stormwater include pet waste, urban wildlife waste, homeless encampments, leaking sanitary sewers exfiltrating to storm drains, combined and sanitary sewer overflows, failing septic systems and more (Clary et al., 2014). 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 Black Creek watershed is discussed in Section 2.1. However, inputs from urban sources are difficult to quantify. Estimates can be made of residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of nutrients, TSS, and *E. coli* in the Black Creek watershed.

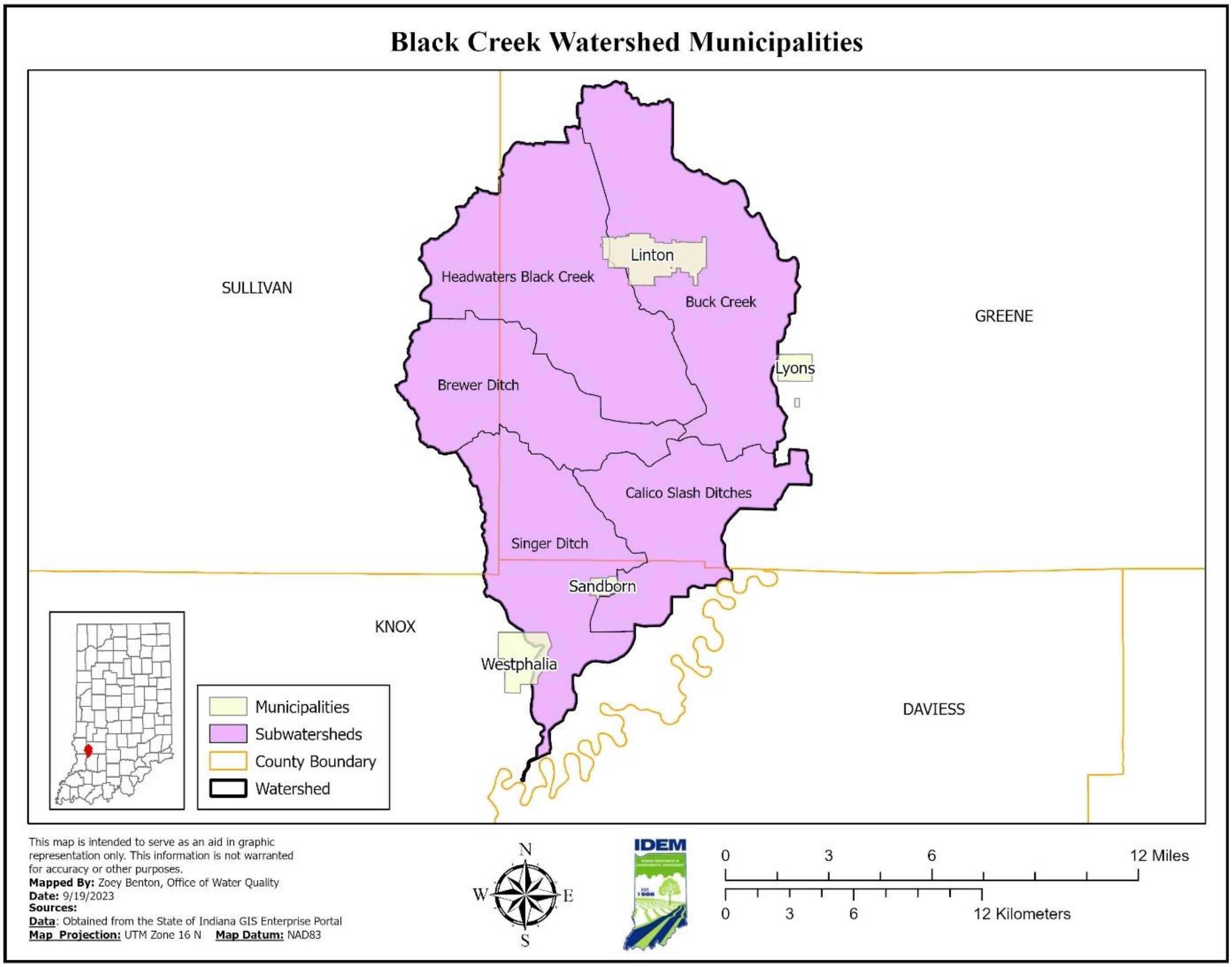

Figure 22: Municipalities in the Black Creek Watershed

2.7 Abandoned Mine Lands

Indiana has been coal mined (surface and underground) since the late 1800’s. Historic practices can have a significant impact on the streams and surrounding landscapes. Several of these impacts include:

Residual strip mine ponds and mine waste piles (gob piles)

Surface hydrology alteration

Elimination of some headwater streams

Altered topography and vegetation

Increased stream bank erosion and sedimentation

Alteration of fish habitat

Increased in-stream metals concentrations

The residual effects of historic mining can have a significant influence on water quality as acid mine drainage (AMD) from seeps, mine tailings/gob piles, and exposed coal seams enter streams and their tributaries. AMD generally displays elevated levels of one or more parameters including acidity, metals, sulfates, and suspended solids (Bauers et al., 2006).

It should also be noted that there is an important distinction between abandoned mine lands and current mining practices. Current mines are required to comply with the Surface Mining Control and Reclamation Act of 1977, which addresses the water-quality problems associated with AMD and requires that extensive information about the probable hydrologic consequences of mining and reclamation be included in mining-permit application so that the regulatory authority can determine the probable cumulative impact of mining on the hydrology. Since the onset of the Act, best management practices have been employed at all current mine sites and are aimed at minimizing adverse effects to the hydrologic balance. As a result, the current mines in the Black Creek watershed are not considered significant sources of the impairments noted in this TMDL.

For purposes of this TMDL, point sources are identified as permitted discharge points or discharges having responsible parties, and nonpoint sources are identified as any pollution sources that are not point sources. For example, there is not a single point of discharge associated with abandoned mine lands. Therefore, run-off from these areas consists of overland flow, and were treated in the allocations as nonpoint sources. As such, the discharges associated with these land uses were assigned LAs. The decision to assign LAs to nonpoint sources is not a determination by IDEM as to whether there are unpermitted point source discharges within these land uses. In addition, the assignment of LAs to nonpoint sources is not a determination that these discharges are exempt from NPDES permitting requirements.

2.8 Point Sources

This section summarizes the potential point sources of *E. coli*, TSS, and TP in the Black Creek watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program. As authorized by the CWA, the NPDES permit program controls water pollution by regulating facilities that discharge pollutants into waters of the United States. Point sources with NPDES permits within the Black Creek watershed include municipal wastewater treatment plants, a public water supply, a petroleum products terminal facility, surface coal mining operations, and construction sites. A summary of the potential point sources of *E. coli,* TSS, and TP in the Black Creek watershed, including an overview of the facilities and wasteload allocations (WLAs), is provided in Appendix G.

2.8.1 Municipal Wastewater Treatment Plants (WWTPs)

Municipal Wastewater Treatment Plants (WWTPs) that discharge wastewater through a point source to a surface water of the state are required to obtain a municipal NPDES wastewater permit. Some of the functions of a WWTP include sewage treatment and industrial waste treatment. Municipal wastewater facilities are required to disinfect their effluent for *E. coli* during the recreational season (April 1 to October 31) in accordance with 327 IAC 5-10-6. WWTPs are critical for maintaining public sanitation and a healthy environment. However, WWTPs may discharge wastewater with elevated concentrations of pollutants into streams. Municipal wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving waterbody and/or any more stringent technology-based limitations. There are two active WWTPs that discharge wastewater within the Black Creek watershed (Table 26 and Figure 23).

The City of Linton operates a major municipal WWTP (IN0020575). The WWTP is a Class III, 2.15 MGD facility consisting of a mechanical fine screen, a coarse bypass bar screen, a magnetic flow meter, an oxidation ditch, three secondary clarifiers, ultraviolet light disinfection, post aeration, an effluent flow meter, three aerobic digesters, a reed sludge drying bed, and four covered sand drying beds. The system is comprised of 100 percent separate sanitary sewers by design with no overflow or bypass points. Final solids are land applied in accordance with land application permit INLA000242. The facility has one outfall (Outfall 001) that discharges to Beehunter Ditch. The receiving water has a seven-day, ten-year low flow ($Q_{7,10}$) of 0 cubic feet per second at the outfall location.

The Town of Sandborn operates a minor municipal WWTP (IN0062685). The WWTP is a Class I, 0.066 MGD re-circulating sand filter (RSF) treatment facility consisting of a septic tank effluent pump pressure sewer system, an influent flow splitter structure, two re-circulation tanks, two granular medium re-circulating sand filters, UV disinfection, and an effluent flow meter. Bio-solids are hauled off-site for disposal. The system is comprised of 100 percent separate sanitary sewers by design with no overflow or bypass points. The facility has one outfall (Outfall 001) that discharges into Black Creek. The receiving water has a seven-day, ten-year low flow ($Q_{7,10}$) of 1.7 cubic feet per second at the outfall location.

Effluent from these facilities are potential point sources of *E. coli*, TSS, and nutrients. As discussed in Section 1.2 Water Quality Targets, the TMDL target value for TSS is 30.0 mg/L or interpreted from current permit limits. The TMDL target value for *E. coli* is the 235 counts/100 mL single sample maximum component of the water quality standard. The TMDL target value for TP is 0.3 mg/L or interpreted from current permit limits. These target values can be used to establish potential permit limits. Flows used to calculate pollutant 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. Pollutant concentrations used to calculate wasteloads from each treatment plant are based on known technological limitations of the facilities.

The facilities' permit effluent limits for *E. coli*, TSS, and TP are used to determine wasteload allocations for each treatment plant. The effluent limit for TSS is set at the NPDES permit limit of 30 mg/L monthly average. The effluent limit for *E. coli* is set at the 235 counts/100 mL single sample maximum component of the water quality standard. The effluent limit for TP is set at the

NPDES permit limit of 1.0 mg/L. As discussed in Section 1.2.2, treatment plants in compliance with the 1.0 mg/L TP permit limit typically meet the in-stream target for phosphorus (0.30 mg/L). Average design flow was determined from information reported by the facility during the permitting process. Compliance with the NPDES permit is believed to be consistent with the TMDL in protecting water quality.

Table 26: Municipal Wastewater Treatment Plant Facilities Discharging within the Black Creek Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow (MGD)
Buck Creek	City of Linton WWTP	IN0020575	INW0262_04	Beehunter Ditch	2.15
Calico Slash Ditch	Town of Sandborn WWTP	IN0062685	INW0264_05	Black Creek	0.066

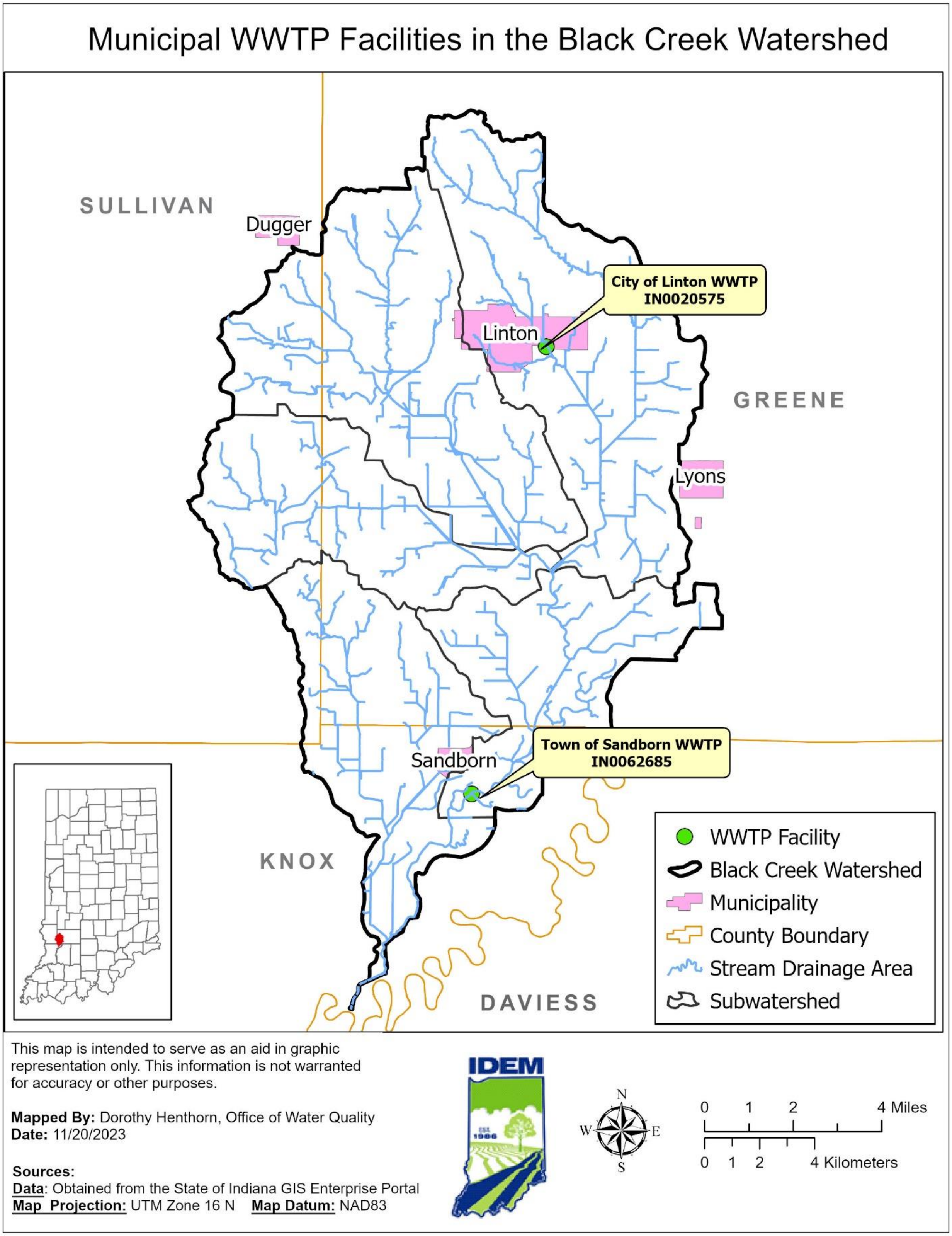

Figure 23: Municipal Wastewater Treatment Plant Facilities Discharging within the Black Creek Watershed

Permit Compliance

Table 27: Summary of Municipal Wastewater Treatment Plant Permit Compliance in the Black Creek Watershed for the Five-Year Period of 2018-2022.

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Water Quality Violations for the Last Five Years					
					Outfall	Month	Year	Parameter	Type	Exceedance
Buck Creek	City of Linton WWTP	IN0020575	Beehunter Ditch	Inspected by IDEM: 8/4/2022: Violations Observed	001	Aug.	2022	*E. coli*	Daily Max.	225%
Calico Slash Ditch	Town of Sandborn WWTP	IN0062685	Black Creek	NA	NA	NA	NA	NA	NA	NA

2.8.2 Industrial Wastewater

Industrial facilities that discharge wastewater through a point source to a surface water of the state are required to obtain an industrial NPDES wastewater permit. Industrial facilities typically generate wastewater through the production of a product. Wastewater discharges from these industrial sources may contain pollutants at levels that could affect the quality of receiving waters. Industrial wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving waterbody and/or any more stringent technology-based limitations.

An industrial facility may be required to obtain an individual or a general industrial wastewater permit, depending on the activities that occur at the facility. An individual permit includes effluent limitations and operating requirements that are tailored to the specific activities of the facility. A general permit is a "one size fits all" type of activity-specific permit. General permit requirements were originally contained in Indiana Administrative Code (IAC) and set by Indiana's Environmental Rules Board through its formal rulemaking process. Unlike individual permits, general permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. There are currently three industrial facilities with industrial wastewater permits within the Black Creek watershed.

Public Water Supply

Wastewater discharges from the Sandborn Water Department are regulated by an individual industrial wastewater permit (IN0064203) (Table 28 and Figure 24). Sandborn Water Department has one outfall (Outfall 002) which discharges into Langsford Ditch and flows to Hill Ditch. At the point of discharge, Langsford Ditch has a $Q_{7,10}$ low flow value of 0.0 cfs. Groundwater is the source of the permitted facility's drinking water supply. The wastewater discharged at Outfall 002 consists of filter backwash and water from floor drains. The backwash water is held in a sedimentation tank for a minimum of three days to allow for iron settling prior to discharge. The facility has an average discharge of approximately 0.005 MGD.

Effluent from this facility is a point source of TSS. As discussed in Section 2.1, the TMDL target value for TSS is 30.0 mg/l or interpreted from current permit limits. This target value can be used to establish potential permit limits. Flows used to calculate sediment loads from this facility are estimated based on current flow data from data monitoring reports (DMR) or design flow from the facility permit when actual flow data is not available. Sediment concentrations used to calculate sediment loads from the public water supply are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels).

The facility's permit effluent limit for TSS is set at the NPDES permit limit of 20 mg/L monthly average. Average design flow was determined from information reported by the facility during the permitting process. Discharges from this facility are not believed to be significant contributions of TSS in the watershed. Compliance with the NPDES permit is believed to be consistent with the TMDL in protecting water quality.

Table 28: Public Water Supply Facilities Discharging within the Black Creek Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow (MGD)
Singer Ditch	Sandborn Water Department	IN0064203	INW0265_T1002	Langford Ditch	0.005

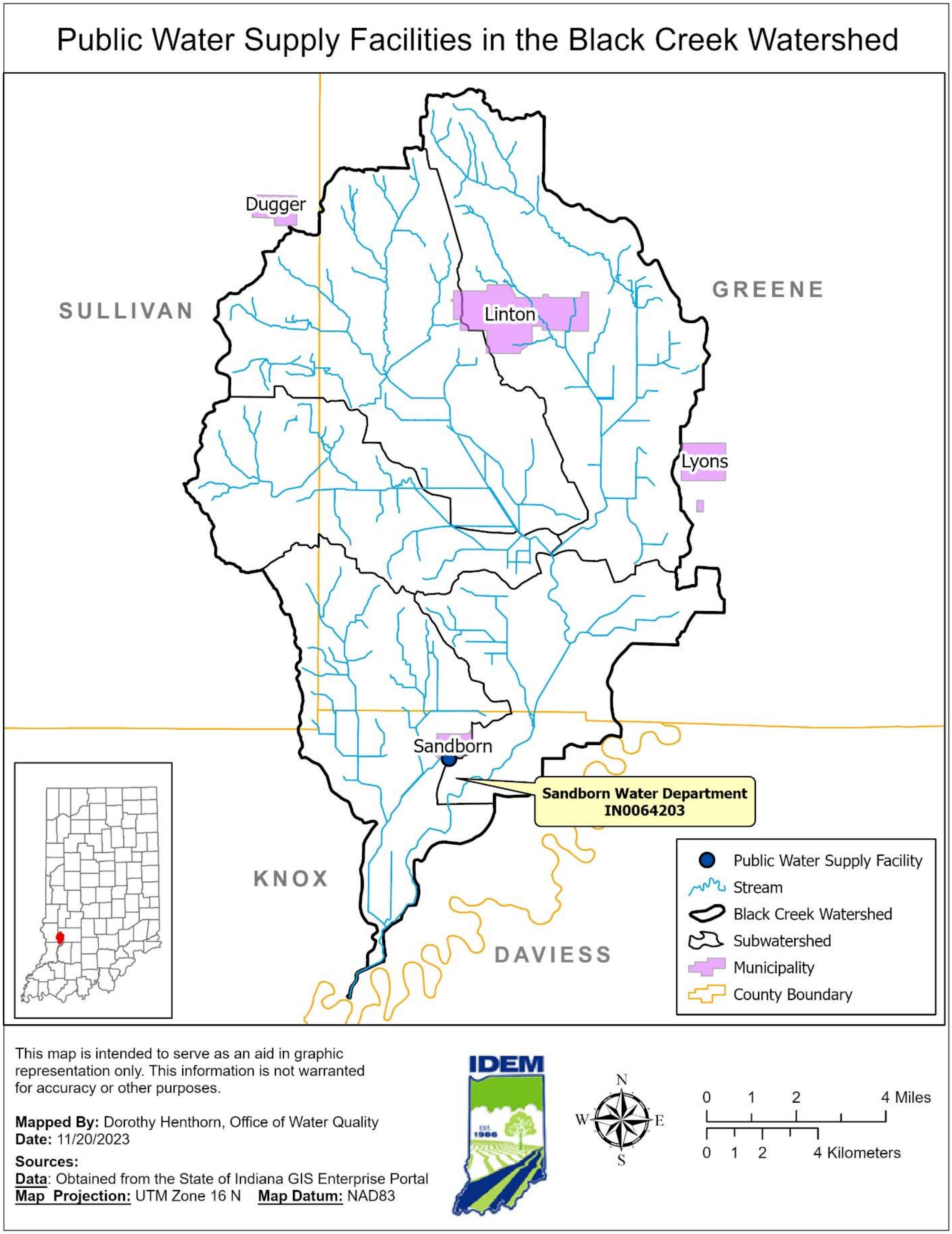

Figure 24: Public Water Supply Facilities Discharging within the Black Creek Watershed

Petroleum Products Terminals

Discharges from petroleum products terminal facilities may be regulated through the petroleum products terminals NPDES general permit. The purpose of the petroleum products terminals general permit is to regulate the discharge of petroleum products terminals wastewater so that the public health, existing uses, and aquatic biota are protected. For purposes of the general permit, a petroleum products terminal is defined as an area where petroleum products are supplied by pipeline or barge or where petroleum products are transferred to trucks for transport to other locations. Wastewater discharges regulated by this general permit include discharge from any conveyance used for collecting and conveying wastewater which is directly related to the storage area of the petroleum products terminal. This includes stormwater run-off, tank bottom water, and water used for hydrostatically testing the storage tanks or on-site pipelines. The petroleum products terminals general permit provides a standard set of conditions for discharges attributed to typical petroleum products terminal activities.

There is one petroleum products terminal permitted through the petroleum products terminals general permit located within the Black Creek watershed. Wastewater discharges from the Countrymark Refining & Logistics – Switz City Terminal are regulated through the general permit (ING340064) (Table 29 and Figure 24). Countrymark Refining & Logistics – Switz City Terminal has two outfalls (Outfall 001 and Outfall 002) which discharge into an unnamed tributary that flows to Buck Creek.

Effluent from this facility is a point source of TSS. As discussed in Section 2.1, the TMDL target value for TSS is 30.0 mg/l or interpreted from current permit limits. This target value can be used to establish potential permit limits. Flows used to calculate sediment loads from this facility are estimated based on current flow data from data monitoring reports (DMR) or design flow from the facility permit when actual flow data is not available. Sediment concentrations used to calculate sediment loads from the public water supply are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels).

The facility's permit effluent limit for TSS is set at the NPDES permit limit of 30 mg/L monthly average. Average design flow was determined from information reported by the facility during the permitting process. Discharges from this facility are not believed to be significant contributions of TSS in the watershed. Compliance with the NPDES permit is believed to be consistent with the TMDL in protecting water quality.

Table 29: Petroleum Products Terminal Facilities Discharging within the Black Creek Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow 2022 (MGD)
Buck Creek	Countrymark Refining & Logistics – Switz City Terminal	ING340064	INW0262_T1004	Buck Creek	0.0557

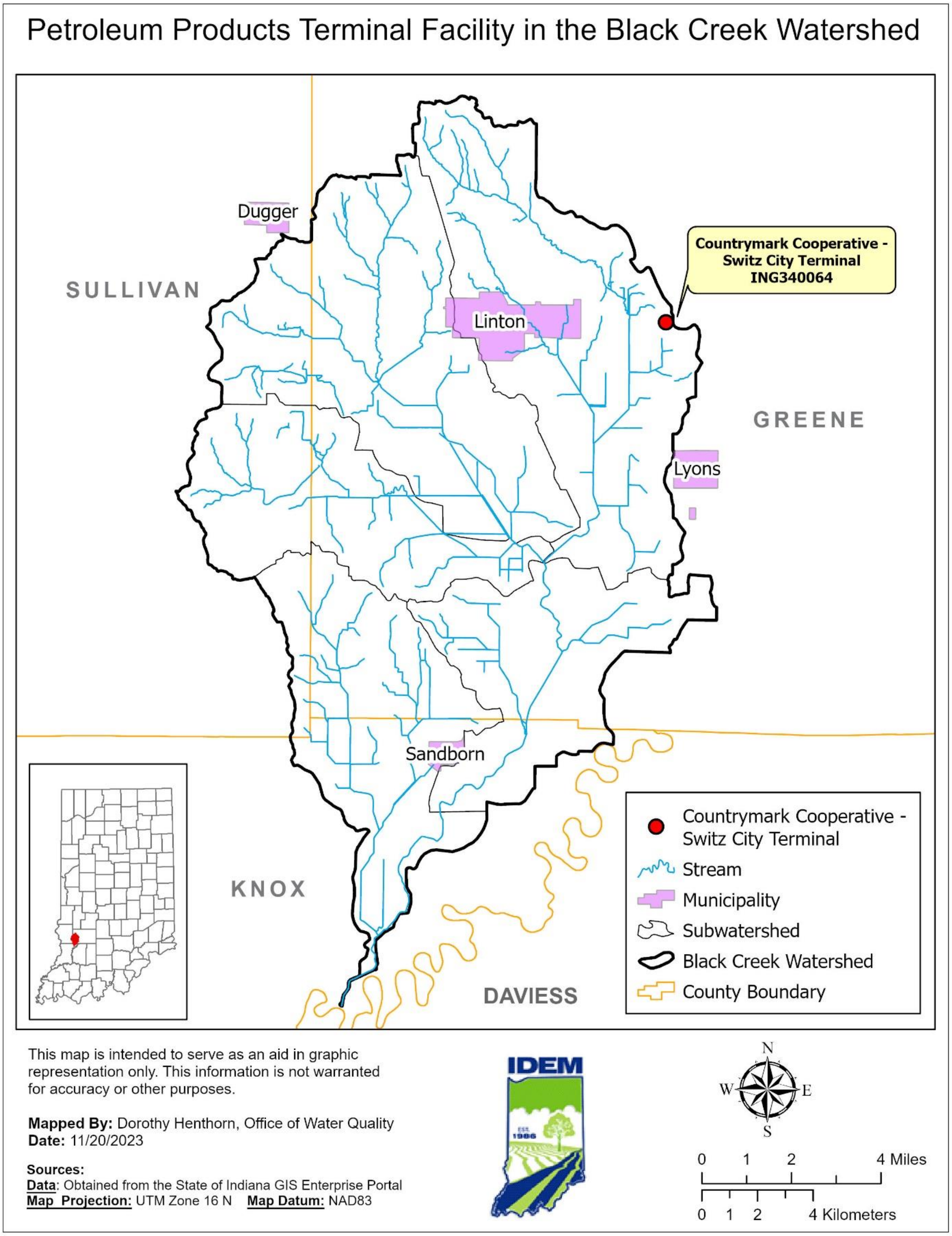

Figure 25: Petroleum Products Terminal Facilities Discharging within the Black Creek Watershed

Coal Mining

Discharges from facilities engaged in mining of coal, coal processing, and reclamation activities may be regulated through a NPDES General Permit under 327 IAC 15-7. The purpose of the coal mining general permit rule is to regulate wastewater discharges from surface mining, underground mining, and reclamation projects which utilize sedimentation basin treatment for pit dewatering and surface run-off and to require best management practices for stormwater run-off to protect the public health, existing water uses, and aquatic biota. The coal mining general permit rule provides a standard set of conditions for discharges attributed to typical coal mining operations.

There are two surface mining operations located within the Black Creek watershed, Peabody Midwest Mining Bear Run Mine (ING040239) and Triad Mining Switz City Lyons Mine (ING040102) (Table 30 and Figure 23). Discharges from Bear Run Mine and Switz City Lyons Mine are regulated by the coal mining general permit rule. Bear Run Mine currently has nine active outfalls that discharge within the Black Creek watershed. Switz City Lyons Mine currently has no permitted outfalls that discharge within the Black Creek watershed. However, Switz City Lyons Mine will receive a TSS WLA for purposes of this TMDL report.

Bear Run Mine is operated by Peabody Midwest Mining LLC. The discharges at the outfalls in the Black Creek watershed consist of stormwater run-off that has potentially been contaminated by contact with overburden, coal product, coal byproduct, coal waste, or other mining operations and treated through detention within a sedimentation pond. Two stream segments located within the northeastern portion of the Headwaters of Black Creek subwatershed have been impacted by the Bear Run Mine surface mining activity. The stream segments include Black Creek (INB11I1_T1001) and a tributary of Black Creek (INB11I1_T1002). These stream impacts are permitted through the U.S. Army Corps of Engineers (LRL-2022-1117-GJD) and IDEM (2011-487-77-DDC-A). Mitigation of these streams is required after mining activities are completed in the area. Available plans indicate these stream segments will likely be mitigated onsite in a similar location as the original stream channels. Black Creek (INB11I1_T1001) was previously identified as impaired for *E. coli*, biological communities, and DO. These impairments will remain on the 2024 303(d) List of Impaired Waters. *E. coli* and TSS WLAs developed for this TMDL will be applicable to this stream segment, and any stream segments impaired for *E. coli* or biological communities impacted in the future, after stream mitigation is complete.

Discharges from the Bear Run Mine surface mine regulated through the general permit rule are believed to be primarily related to precipitation events. An estimated design flow is not available for this facility. WLAs were therefore calculated by using the drainage area of each permittee to estimate runoff flow volumes and using existing permit limits to calculate the allowable loadings. The total performance acres bonded were used to estimate the size of the mine for each subwatershed. As total permitted boundaries and not bonded acreage are typically available for spatial analysis, bonded acreage for each subwatershed was estimated by an area weighted approach using permitted area within each subwatershed. These permits have varying discharge limits based on dry and wet weather discharge flow rates. For wet weather discharges, dilution rates are assumed, and limits for TSS are suspended. WLAs for coal mining facilities regulated through the general permit rule are based on the NPDES permit limit of 70 mg/L daily maximum for TSS and are implemented through compliance with their NPDES permit.

The WLA for each coal mining operation outfall will be achieved through compliance with the facility's NPDES general permit coverage. The WLAs were estimated based upon consideration of TSS contributions from current operating conditions and current permit limits of the facility. This TMDL does not preclude new or modified mining activities that employ the 70 mg/L daily maximum and 35 mg/L monthly average for TSS under the general permit rule. New or modified discharges under individual permits will be addressed through the NPDES permit process and must follow the assumptions set forth in the TMDL.

Table 30: Coal Mining Facilities with General Permits Discharging within the Black Creek Watershed

Facility Name	Permit Number	Subwatershed	Outfall ID	AUID	Receiving Stream	Estimated Surface Impacts (Acres)
Peabody Midwest Bear Run Mine	ING040239	Headwaters Black Creek	047, 018R	INW0261_T1009A	Tributary of Black Creek	9,417
			009	INW0261_T1010A	Tributary of Black Creek	
		Brewer Ditch	052, 051, 40N, 061, 062	INW0263_T1005	Spencer Creek	
		Singer Ditch	207	INW0265_T1003	Singer Ditch	
Triad Mining Switz City Lyons Mine	ING040102	Buck Creek	NA	NA	NA	88.7

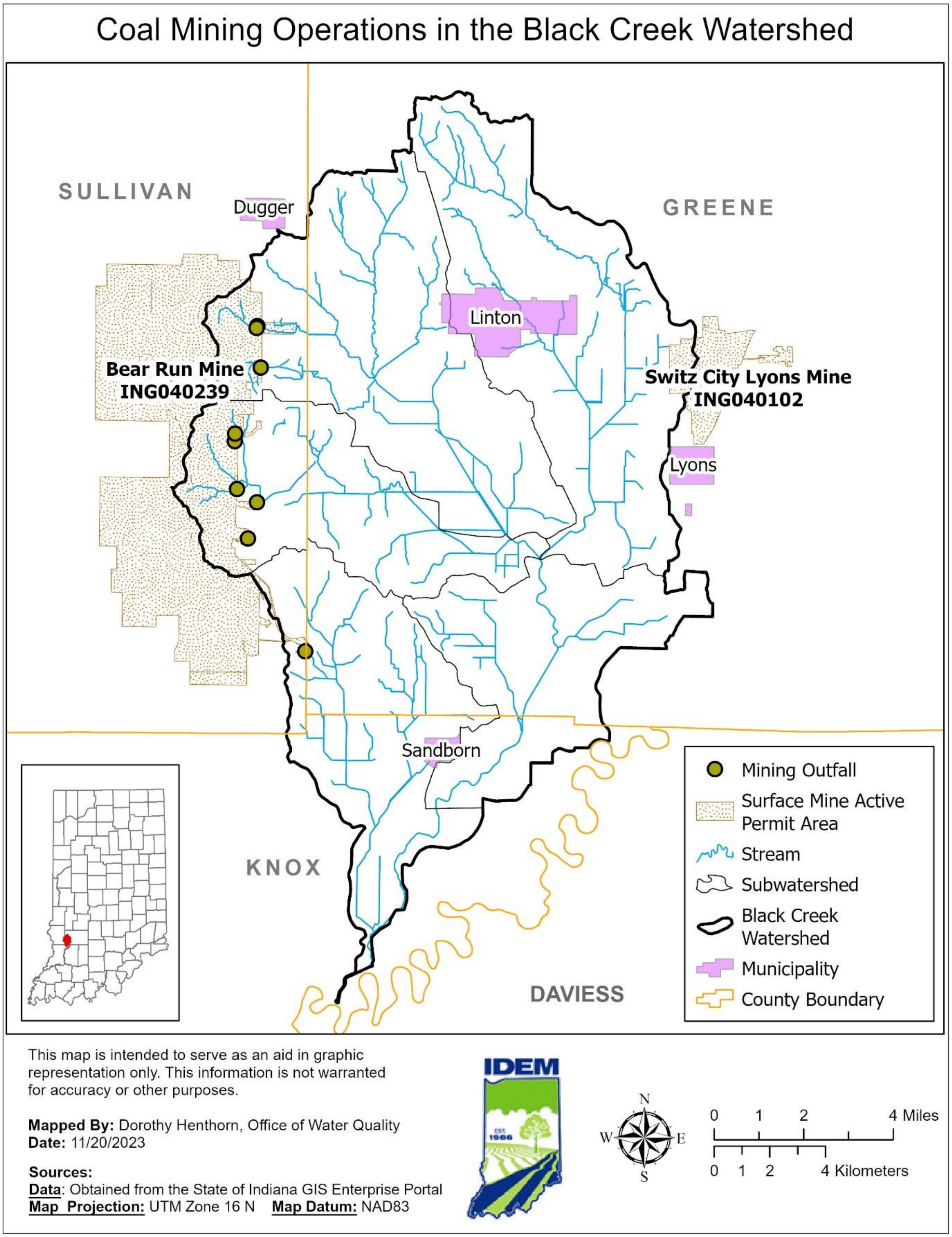

Figure 26: Coal Mining Facilities Discharging located within the Black Creek Watershed

Permit Compliance

Table 31: Summary of Industrial Wastewater Permit Compliance in the Black Creek Watershed for the Five-Year Period of 2018-2022.

Subwatershed	**Facility Name**	**NPDES Permit Number**	**Stream**	**Inspections for the Last Five Years**	**Water Quality Violations for the Last Five Years**					
					Outfall	**Month**	**Year**	**Parameter**	**Type**	**Exceedance**
Headwaters Black Creek	Peabody Midwest Bear Run Mine	ING040239	Tributary of Black Creek	Inspected by IDNR: NA	047 018R 009	NA	NA	NA	NA	NA
Buck Creek	Countrymark Cooperative – Swtiz City Terminal	ING340064	Buck Creek	Inspected by IDNR: 2/27/2023 Violation Observed 2/27/2023 Violation Observed 3/27/2023 Violation Observed 3/25/2022 Violation Observed 3/27/2023 Violation Observed	001 001 001 002S 002S	Jan. Jan. Feb. Feb. Feb.	2023 2023 2023 2022 2023	TSS TSS TSS TSS TSS	Monthly Avg. Daily Max. Daily Max. Daily Max. Daily Max.	53% 262% 47% 313% 1602%
	Triad Mining Switz City Lyons Mine	ING040102	Buck Creek	NA	NA	NA	NA	NA	NA	NA
Singer Ditch	Sandborn Water Department	IN0064203	Hill Ditch	Inspected by IDNR: 12/28/2020 Violation Observed	002A	Nov	2020	Total Iron	Monthly Avg.	11%

2.8.3 Regulated Stormwater

Activities that discharge stormwater are typically regulated through NPDES stormwater general permits. The stormwater general permit requirements were originally contained in IAC and set by Indiana's Environmental Rules Board through its formal rulemaking process. General permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. The industrial stormwater administrative general permit (327 IAC 1506) is also currently being updated and will be administered under a master general permit in 2024. being developed.

Construction Stormwater

Stormwater run-off associated with construction activity is currently regulated under the administrative construction general permit (CGP). The CGP is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. In Indiana, most construction projects are administered through the general permit. The requirements of the permit 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 stormwater permitting.

The CGP requires the development and implementation of a construction plan that includes a stormwater pollution prevention plan (SWP3). The SWP3 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. The SWP3 addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. The SWP3 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 SWP3. 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 SWP3 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, IDEM may require the site to obtain an individual stormwater permit. An individual stormwater permit is typically required only if IDEM determines the discharge will significantly lower water quality. If an individual stormwater permit is required, notice will be given to the project site owner. An individual stormwater permit is a written document developed specifically for the project site.

The average annual land disturbance associated with construction sites permitted under the CGP are reported in Table 32. The estimated land disturbance was calculated for each subwatershed using data from permitted construction sites for the past five years.

Table 32: Average Annual Land Disturbance from Permitted Construction Activity in the Black Creek Subwatersheds from 2018-2022.

Subwatershed	Estimated Annual Land Disturbance (Acres)
Headwaters Black Creek	12
Buck Creek	20
Brewer Ditch	0
Calico Slash Ditch	0
Singer Ditch	0

Industrial Stormwater

Stormwater run-off associated with industrial activity is currently regulated under 327 IAC 15-6, which is commonly referred to as "Rule 6" or the industrial stormwater general permit. Compliance with the industrial stormwater general permit is required for facilities where activities of the industrial operation are exposed to stormwater and run-off is discharged though a point source to a waters of the state. The general permit 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 327 IAC 15-6. There are currently no facilities with industrial stormwater general permits located in the Black Creek watershed.

Municipal Separate Storm Sewer Systems (MS4)

Stormwater run-off from certain types of urbanized areas are currently regulated under the administrative municipal storm sewer system (MS4) general permit. 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 state and is designed or used for collecting or conveying stormwater. 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. Municipalities with a population served by a MS4 of 100,000 or more are regulated as a Phase I MS4 entity. Municipalities with a population served by a MS4 of 7,000 or more are regulated as a Phase II MS4 entity. There are currently no MS4 entities in the Black Creek watershed.

2.9 Summary

The information presented in Section 1.0 helps to provide a better comprehensive understanding of the conditions and characteristics in the Black Creek watershed that, when coupled with the sources presented in Section 2.0, affect both water quality and water quantity.

In summary, the predominant land uses in the Black Creek watershed of agriculture and forestry serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the Black Creek watershed. Human population in the Black 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 Black Creek watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Black 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.

3.0 TECHNICAL APPROACH

Previous sections of the report have provided a description of the Black Creek watershed and summarized the applicable water quality standards, water quality data, and identified the potential sources of *E. coli*, TSS, and TP 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 as described in Section 4.0 to estimate the current allowable loads of *E. coli*, TSS, and TP in each subwatershed. This section focuses on describing the methodology and is helpful in understanding subsequent sections of the TMDL report.

3.1 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 provides 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 and 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., MPN/day for *E. coli*) with the following factors used for this TMDL:

E. coli: Flow (cfs) x TMDL Concentration Target (#/100mL) x Conversion Factor (24,465,758.4) = Load (MPN/day)

Total Phosphorus and TSS: 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 estimated 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 U.S. EPA'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" (U.S. EPA, 2007):

High Flows: Flows in this range represent flooding or near flooding stages of a stream. These flows are exceeded 0 – 10 percent of the time.

Moist Conditions: Flows in this range are related to wet weather conditions. These flows are exceeded 10 – 40 percent of the time.

Mid-Range Flows: Flows in this range represent median stream flow conditions. These flows are exceeded 40 – 60 percent of the time.

Dry Conditions: Flows in this range are related to dry weather flows. These flows are exceeded 60 – 90 percent of the time.

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 stormwater 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 33 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 33: Relationship between Load Duration Curve Zones and Contributing Sources

Contributing Source Area	Duration Curve Zone				
	High	**Moist**	**Mid-Range**	**Dry**	**Low**
Livestock direct access to streams				M	H
Wildlife direct access to streams				M	H
Pasture Management	H	H	M		
On-site wastewater systems/Unsewered Areas	M	M-H	H	H	H
Riparian Buffer areas		H	H	M	
Abandoned mines	H	H	H	H	H
Stormwater: Impervious		H	H	H	
Stormwater: 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)

3.2 Stream Flow Estimates

Daily stream flows are necessary to implement the load duration curve approach. Load duration assessment locations in the Black Creek 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 does not operate any stream flow gaging stations in the Black Creek watershed. Since there are no continuous flow data for the Black Creek watershed, flow data were estimated for the Black Creek watershed using flow data from a neighboring “surrogate” watershed. This is a standard practice when developing TMDLs for un-gaged watersheds and is appropriate when the two watersheds are located close to one another and have similar land use and soil characteristics.

The USGS gage for the Busseron Creek at Carlisle, IN (03342500) located just east of the Black Creek Watershed and was used for the development of the *E. coli*, TSS, and TP load duration curve analysis for the Black Creek watershed TMDL. USGS gage 03342500 is located in Sullivan County. Gage 03342500 drains approximately 228 sq. miles in the Middle Wabash-Busseron (HUC 8: 05120111) watershed as shown in Figure 27.

Table 34: USGS Site Assignment for Development of Load Duration Curve

Gage Location	Gage ID	Period of Record Used in Analysis
Busseron Creek in Carlisle, IN	03342500	2012-2022

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 3342500hy 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 Black Creek 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 municipal wastewater treatment plants that discharge upstream and are not directly reflected in the load duration curve method.

Table 35: Load Duration Curve Key Flow Percentile Estimates

Subwatershed	Drainage Area (sq. miles)	Flow Duration Exceedance Interval Flows (cfs)				
		High (5%)	Moist (25%)	Mid-Range (50%)	Dry (75%)	Low (95%)
Headwaters Black Creek	34.48	198	44	18	6	2
Buck Creek	35.02	205	48	22	9	5
Brewer Ditch	19.99	115	26	10	3	1
Calico Slash Ditch	108.97	630	144	60	22	9
Singer Ditch	132.33	764	174	72	26	10

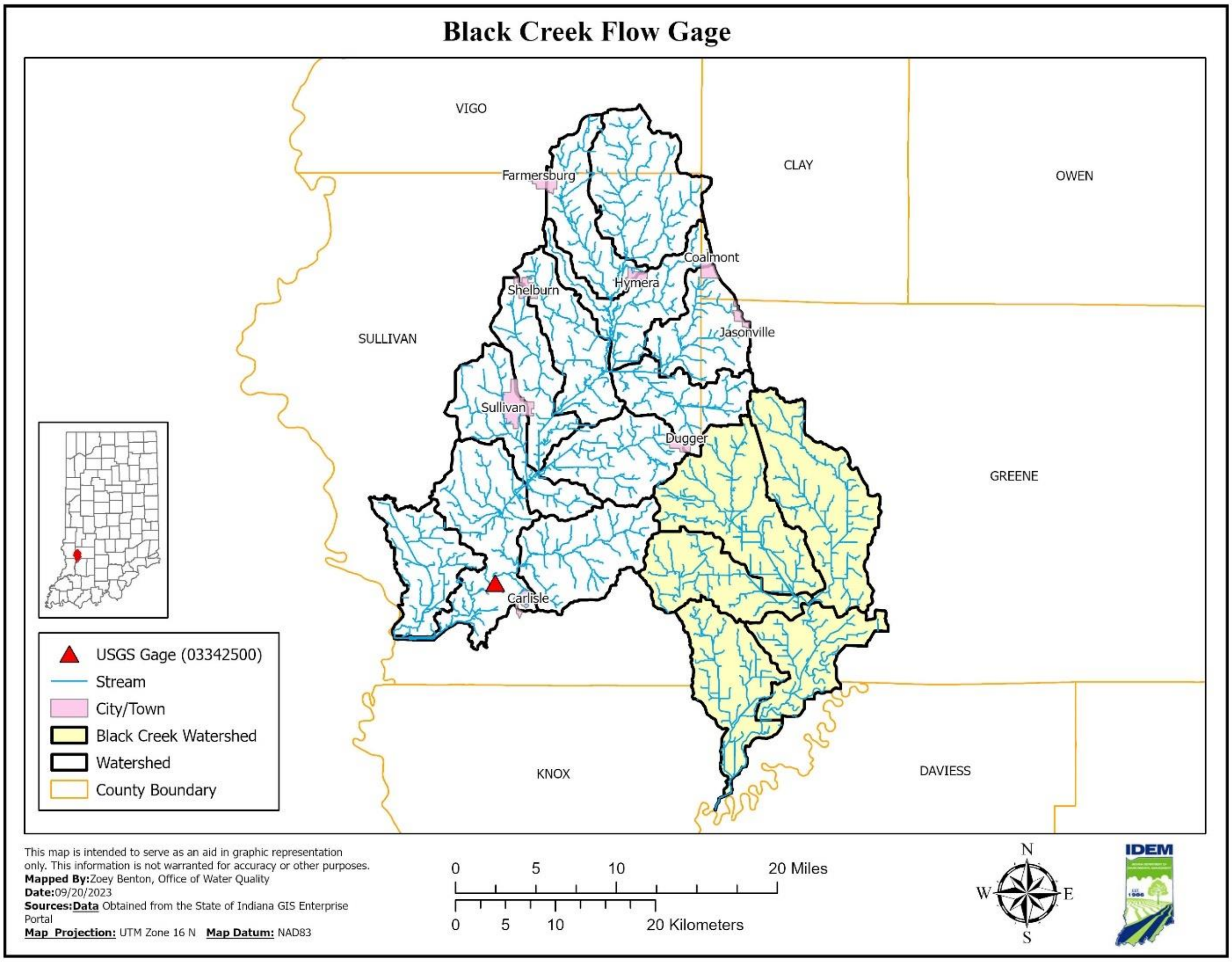

Figure 27: Location of Surrogate Flow Gage in Carlisle, IN

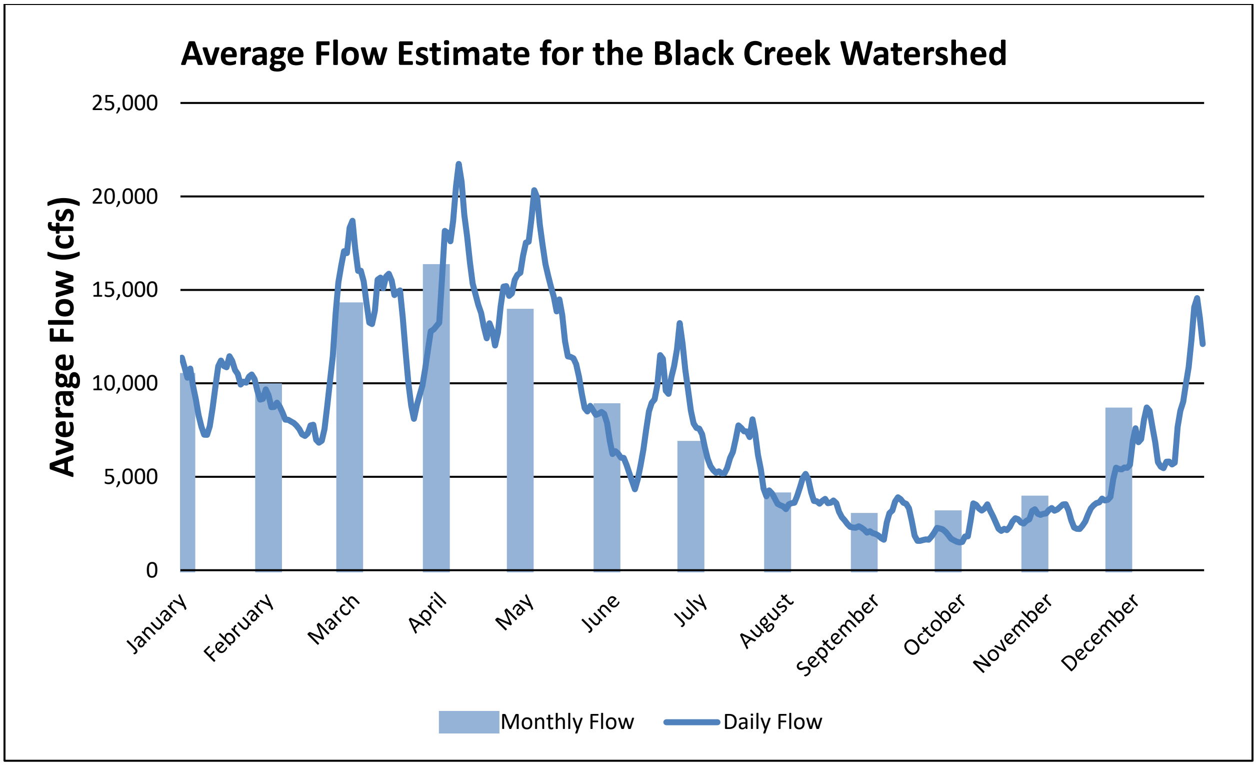

Figure 28: Average Daily Flow Estimate for the Black Creek Watershed for data from 2013-2022

3.3 Margin of Safety (MOS)

Section 303(d) of the Clean Water Act and U.S. EPA 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." U.S. EPA 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 10 percent of the allowable load. Ten 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 USGS gage.

An additional implicit MOS for *E. coli* is included because the load duration analysis does not address die-off of pathogens.

An additional implicit MOS for pollutants is realized in that when in compliance NPDES permitted sources are seldom discharging at their allowable limits.

3.4 Future Growth Calculations

Population trends are indicating that this watershed has been decreasing (Table 22) over the past two decades; uncertainty in future populations in the Black Creek watershed have led IDEM to choose to allocate 5 percent of the loading capacity toward future growth. IDEM anticipates that land uses will likely be changing in the watershed in the future and, in anticipation of those land use changes, has set aside 5 percent of the loading capacity to address increased bacteria and nutrient loads from those future contributors. Mining activity continues to play an important role in land use activities and disturbance in the Black Creek watershed. Mining operations are not static in the landscape and may move outfall locations as activities are conducted. Additionally, new sources of mining activities can change based on new technology for extracting coal and/or economic feasibility. As such, IDEM has chosen to allocate 10 percent of the loading capacity to address increased sediment loads from future contributors.

4.0 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 Section 2.0, and water quality data within the Black Creek watershed are discussed in Section 1.4. The purpose of this section 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 each subwatershed in the Black Creek watershed that were sampled by IDEM in 2021 and 2022. The load duration curve method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint). Load duration curves illustrate water quality standard and target value violations during all flow ranges that occurred during sampling events. Section 3.0 summarizes the load duration curve approach.

To further investigate sources, water quality precipitation graphs have been created. Elevated levels of pollutants during rain events indicate contributions of pollutants due to run-off. The precipitation data was taken from a weather station in Shakamak State Park, IN and managed by the Midwestern Regional Climate Center.

A linkage analysis for each subwatershed is included in this section. The analysis includes a summary of the subwatershed, including information regarding sampling sites, land use, NPDES facilities, CFOs, and soil characteristics. A summary table of each subwatershed is also provided that includes the load allocations (LAs), wasteload allocations (WLAs), and margin of safety (MOS) values for pollutants of concern. 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 concentrations of pollutants. Pollutants of concern for the Black Creek watershed identified by sampling data include *E. coli*, TP, and TSS.

4.1 Pollutants of Concern

4.1.1 *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. Additional information is outlined in Section 1.1.1.

E. coli sources typically associated with high flow and moist conditions include failing onsite wastewater systems, urban stormwater/CSOs, run-off 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.

4.1.2 Total Phosphorus (TP)

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 Black Creek watershed. Additional information is outlined in Sections 1.1.2.

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 curves indicate 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 run-off 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.

4.1.3 Total Suspended Solids (TSS)

Developing a linkage analysis to address the connection between siltation and its effect on aquatic life use 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. The sediment issues can occur when external inputs (e.g., sediment, run-off 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. Additional information is outlined in Section 1.1.3.

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 flood-plain 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 are 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 flood-plain and riparian areas that are often converted to developed or agricultural lands.

Since monitoring began, TSS in the Black Creek watershed has sporadically exceeded the target. TSS tends to exceed target values in the spring and summer months. High loads in the spring may be related to the plowing and planting of agricultural fields occurring during these months, increasing the opportunity for sheet and rill erosion. Further analysis pairing the TSS concentrations with flow conditions reveals elevated TSS concentrations during high flows and slightly 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 gully erosion.

In addition to TSS, siltation within a stream may be analyzed by taking a closer look into the Qualitative Habitat Evaluation Index (QHEI) scores assigned to each sampling location. Habitat assessments were completed at each sampling site after both fish community and macroinvertebrate community sample collections using the IDEM QHEI (IDEM, 2016). The QHEI allows for a quantitative assessment of physical characteristics of the sampled stream. Each sampling site was assigned a QHEI score in relation to the habitat quality for both fish and macroinvertebrate communities. Completed QHEI forms for the Black Creek watershed are available in Appendix C.

The overall QHEI score is composed of a total of six metric scores. The six individual metrics include substrate, instream cover, channel morphology, bank erosion/riparian zone, pool/glide and riffle/run quality, and gradient. Of these metrics, the substrate metric is the most indicative of excessive siltation within a stream, while the bank erosion/riparian zone metric provides an explanation for excessive amounts of observed siltation. The substrate and bank erosion/riparian zone metric scores were analyzed for each sampling location throughout the watershed to determine if excessive siltation is linked to poor fish community IBI scores and macroinvertebrate community mIBI scores. Additional information regarding IBI and mIBI scores is available in Section 1.1.3.

Substrate and bank erosion/riparian zone metric scores were totaled and plotted against both fish community IBI scores and macroinvertebrate community mIBI scores (Figure 29 and **Error! Reference source not found.**). Lower values for the substrate and bank erosion/riparian zone metrics indicate greater observed siltation within the stream and/or lower riparian and flood-plain quality. Lower IBI and mIBI scores indicate fewer individuals and/or low species diversity was observed within a stream. The R^2 value for the fish community analysis was approximately 0.85, and the R^2 value for the macroinvertebrate community was approximately 0.88. These values indicate a strong positive correlation between excessive siltation and low IBI and mIBI scores. This analysis provides additional evidence that excessive siltation within a stream is linked to IBCs throughout the Black Creek watershed in addition to elevated TSS monitoring data.

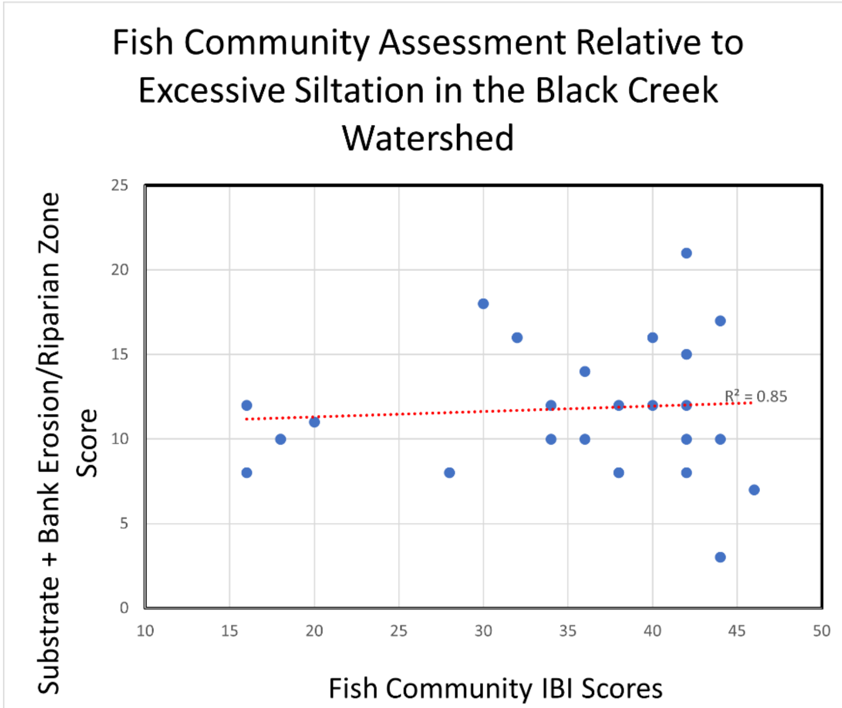

Figure 29: Substrate + Bank Erosion/Riparian Zone Score in Relation to Fish Community IBI Scores in the Black Creek Watershed

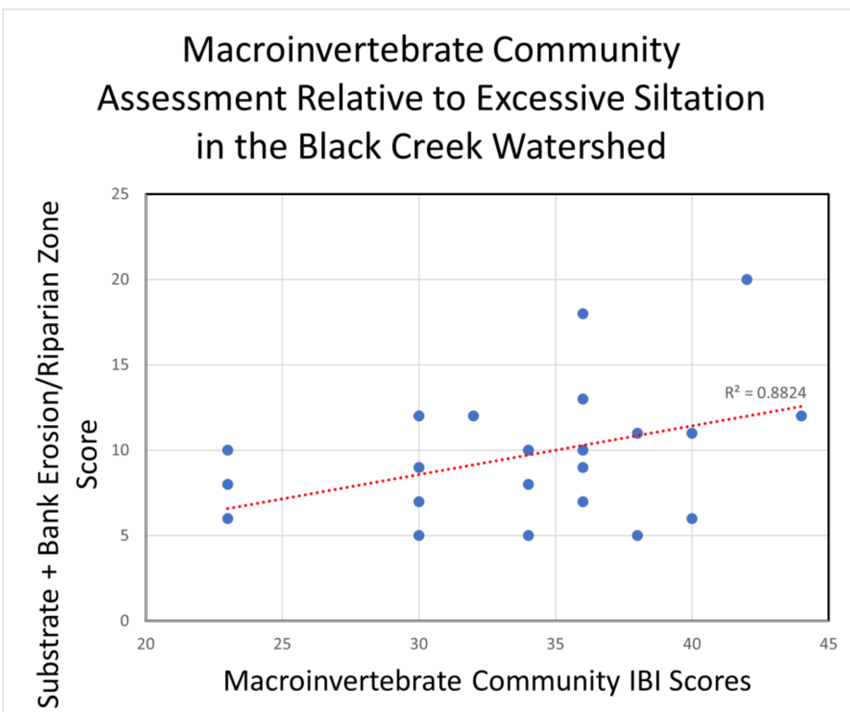

Figure 30: Substrate + Bank Erosion/Riparian Zone Score in Relation to Macroinvertebrate Community mIBI Scores in the Black Creek Watershed

4.2 Linkage Analysis by Subwatershed

The following sections discuss the load duration curves, precipitation graphs, water quality duration graphs, and linkage of sources to the water quality exceedances for each subwatershed. Load duration curves, precipitation graphs, and water quality duration graphs were created for each subwatershed.

4.2.1 Brewer Ditch

The Brewer Ditch subwatershed drains approximately 20 square miles. The subwatershed drains into the main stem of Black Creek. The land use is primarily forested land (40 percent) followed by agriculture (27 percent) and hay/pasture (18 percent). There is one NPDES permitted discharger in the Brewer Ditch subwatershed, Peabody Midwest Mining LLC Bear Run Mine (ING040239), which covers approximately 21% of the subwatershed by area. 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 are important to ensure proper function and capacity. The landscape in the area is relatively flat, leading to its intense conversion to agricultural production and use, especially on the eastern side. In many areas of the subwatershed there are little to no remaining riparian buffers left along its banks due to agricultural practices. Despite its flat nature, the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways on the western side of this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. Hay and pastureland dominate the landscape on the west side of this subwatershed and comprises 18 percent of the total land used, so pasture animals are to be expected.

There are four monitoring sites located in this subwatershed. Sites T15, T16, T17, T18 are located on Brewer Ditch (Figure 31). In 2021 and 2022 this watershed was sampled 50 times between the four sites. The *E. coli* geomean for site T15 was 507.2 cfu/100ml with 6/9 samples in exceedance of the single sample max. Site T16 had a geomean of 390.29 cfu/100ml with 5/10 samples in exceedance of the single sample max. Sites T17 and T18 each passed water quality standards for *E. coli*. Site T17's *E. coli* geomean was 52.41 cfu/100ml with 5/10 samples exceeding the single sample max and the *E. coli* geomean for site T18 was 43.21 cfu/100ml with 2/10 in exceedance of the single sample max. The *E. coli* water quality samples from sites T15, T16, T17, and T18 used to calculate the geomean were taken on the same day approximately one hour apart for five consecutive weeks.

Precipitation graphs (Figure 33 and Figure 35) and a water quality duration graph (Appendix D) were created to further analyze potential sources. Elevated levels of pollutants during precipitation events could indicate that streams are susceptible to high loads of *E. coli* and TSS from run-off. It should be noted that elevated levels of pollutants can only be attributed to individual precipitation events when sampling events concur with precipitation events. While there were instances of elevated levels of pollutants that could be attributed to a precipitation event, there were also several instances of elevated levels of pollutants during drier conditions. This indicates point sources may also be contributing in addition to nonpoint sources. Peabody Midwest Mining LLC Bear Run Mine (ING040239) is permitted to discharge a daily maximum of 70 mg/L TSS, according to NPDES permit standards. There were no permit violations for TSS within the Brewer Ditch subwatershed during the time of sampling. Peabody Midwest Mining LLC Bear Run Mine (ING040239) does not discharge *E. coli*. The water quality duration graph, as well as limited permitted sources, indicate the majority of sources of *E. coli* and TSS in this subwatershed are nonpoint sources. Nonpoint sources of *E. coli* may include wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and leaking and failing septic systems. Nonpoint sources of TSS may include agricultural practices, streambank erosion, and stormwater run-off. When calculating flow to develop these figures, the model used assumes all upstream flow enters the subwatershed at its most upstream point. To more accurately represent the amount of water flowing through the Brewer Ditch subwatershed in the model, it was adjusted to include the Brewer Ditch segments of Black Creek within the Headwaters Black Creek subwatershed instead. The confluence of Black Creek from the Headwaters Black Creek subwatershed with the Brewer Ditch stream occurs near the most downstream portion of the Brewer Ditch watershed.

The fish community IBI score for site T15 was 18 (poor) and the QHEI was 38 (not supporting). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 39 (not supporting). The fish community IBI score for site T16 was 32 (fair) and the QHEI was 49 (not supporting). The macroinvertebrate community mIBI was 34 and the QHEI was 35 (not supporting). The fish community IBI score for site T17 was 28 (poor) and the QHEI was 24 (not supporting). The macroinvertebrate community mIBI was 30 (poor) and the QHEI was 27 (not supporting). The fish community IBI score for site T18 was 42 (fair) and the QHEI was 54 (poor). The macroinvertebrate community mIBI was 36 (fair) and the QHEI was 50 (poor). Evaluation of TSS monitoring data and QHEI substrate and bank erosion/riparian zone metric scores indicate a linkage between siltation and biological communities impairments in the Brewer Ditch subwatershed. TSS concentrations ranged from 2.5 mg/L to 218 mg/L across 38 sampling events within the subwatershed and exceeded the target value 12 times. Dredging and the creation of new ditches was noted at one of the sampling sites. Heavy siltation and severe bank erosion was noted at one of the sites impaired for IBC. Riparian zones ranged from moderate in width (50m) to narrow (5m) to very narrow (less than 5m) at each of the sites.

Most of the sampling sites occurred at sites with little-to-no riparian zones surrounded by agriculture. Given that the target value for TSS was sporadically violated, high TSS is believed to be a linkage to the biotic community impairments. Therefore, a TMDL for TSS was developed for this subwatershed.

There are approximately 25 miles of streams in the subwatershed. Based on IDEM data collected in 2021 and 2022, there will be 8.61 stream miles impaired for *E. coli* (sites T15 and T16) and 11.22 stream miles with an IBC impairment (sites T15, T16, and T17). These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, TMDLs have been developed to address all *E. coli* and IBC (TSS) impairments in this subwatershed. The load duration curves for the Brewer Ditch subwatershed are shown in Figure 32 and Figure 34. **Error! Reference source not found.** provides a summary of the Brewer Ditch subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, CFOs, as well as LA, WLAs, and MOS values for TSS and *E. coli*.

To achieve necessary load reductions for *E. coli* and TSS, implementation in the Brewer Ditch subwatershed should primarily focus on best management practices (BMPs) that have an impact throughout moist, mid-range, and dry flow regimes. See Section 6.1 and **Error! Reference source not found.** for information pertaining to potentially suitable BMP selection for the Black Creek watershed.

Table 36: Summary of Brewer Ditch Subwatershed Characteristics

Brewer Ditch (051202020603)	
Drainage Area	54.47square miles
Surface Area	19.99 square miles
Site # [IDEM Station ID]	T15 [WWL060-0001], T16 [WWL-06-0144], T17 [WWL-06-0145], T18 [WWL-06-0121]
Listed Segments	INW0263_01, INW0263_T1006, INW0263_T1007
Listed Impairments [TMDL(s)]	Impaired Biotic Communities [TSS], *E. coli* [*E. coli*]
Land Use	Agricultural Land: 27% Forested Land: 40% Developed Land: 7% Open Water: 7% Pasture/Hay: 18% Grassland/Shrubs: <1% Wetland: 1%
NPDES Facilities	Peabody Midwest Mining LLC Bear Run Mine (ING040239)
CAFOs	NA
CFOs	NA

TMDL *E. coli* Allocations (MPN/day)

Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	5.613E+11	1.256E+11	5.056E+10	1.637E+10	4.908E+09
WLA (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MOS (10%)	6.604E+10	1.478E+10	5.948E+09	1.926E+09	5.774E+08
Future Growth (5%)	3.302E+10	7.391E+09	2.974E+09	9.628E+08	2.887E+08
TMDL = LA+WLA+MOS	6.604E+11	1.478E+11	5.948E+10	1.926E+10	5.774E+09

TMDL Total Suspended Solids Allocations (lbs/day)

Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	10,175.55	2,290.80	946.99	314.68	97.08
WLA (Total)	4,691.41	1,037.24	392.17	118.84	32.92
MOS (10%)	1,858.37	416.01	167.4	54.19	16.25
Future Growth (10%)	1,858.37	416.01	167.4	54.19	16.25

TMDL = LA+WLA+MOS	18,583.7	4,160.05	1,673.95	541.91	162.5
WLA (Individual)					
Peabody Midwest Bear Run Mine	4,691.41	1,037.24	392.17	118.84	32.92

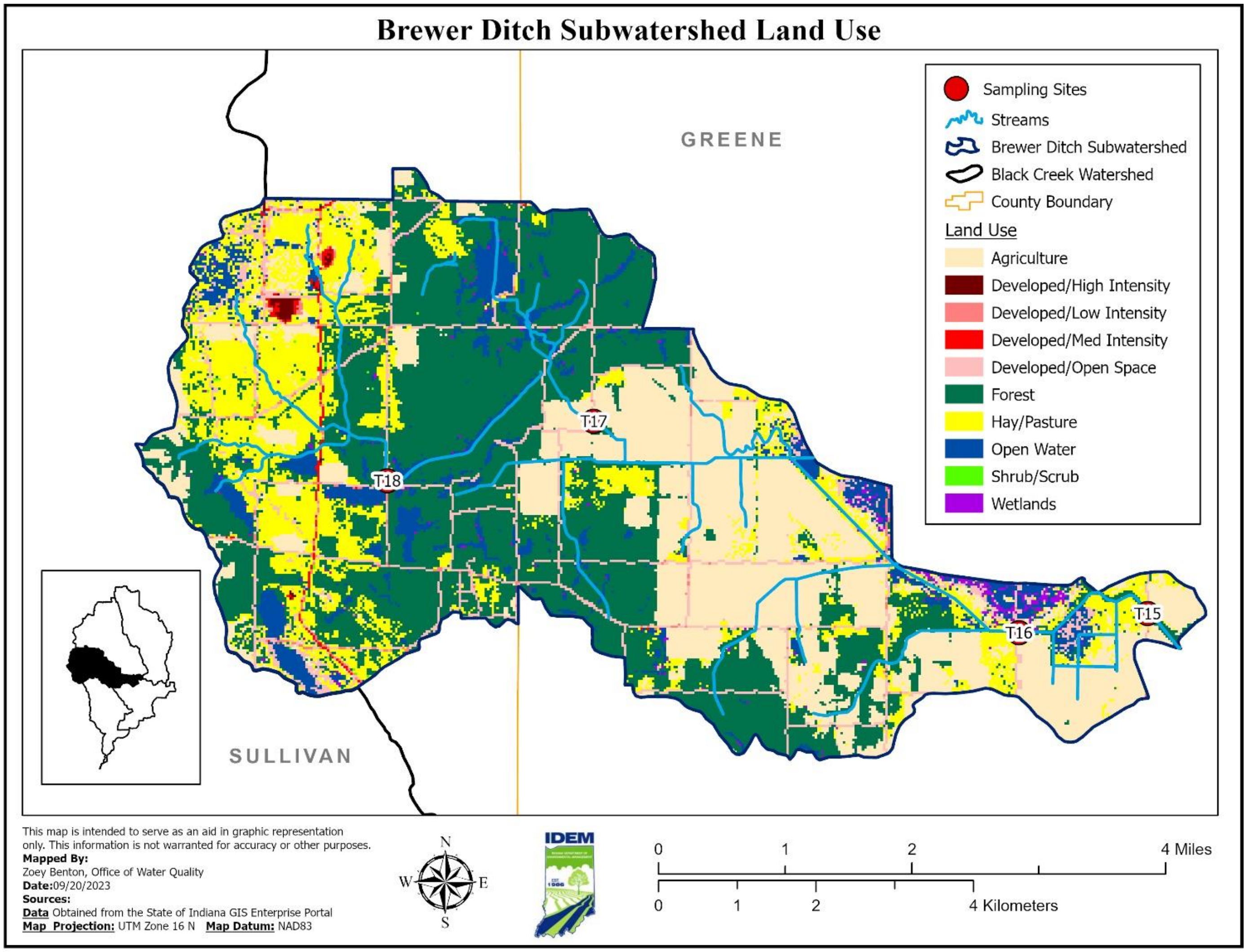

Figure 31: Sampling Stations in Brewer Ditch Subwatershed

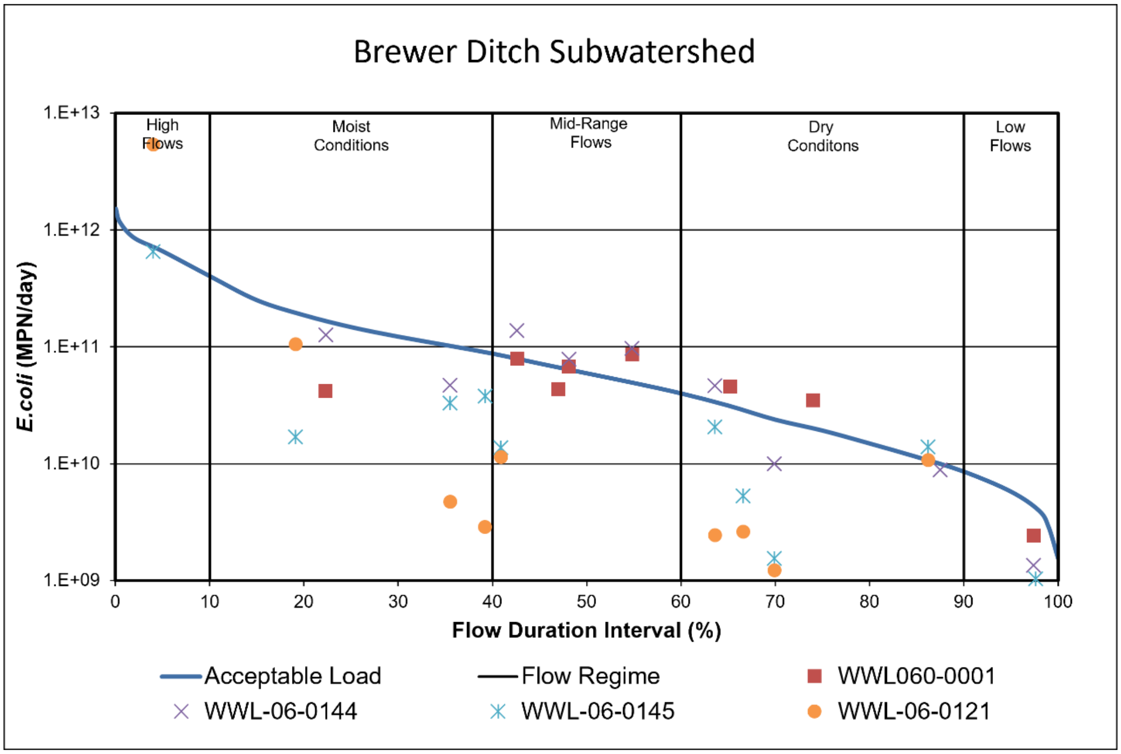

Figure 32: *E. coli* Load Duration Curve for Brewer Ditch Subwatershed.

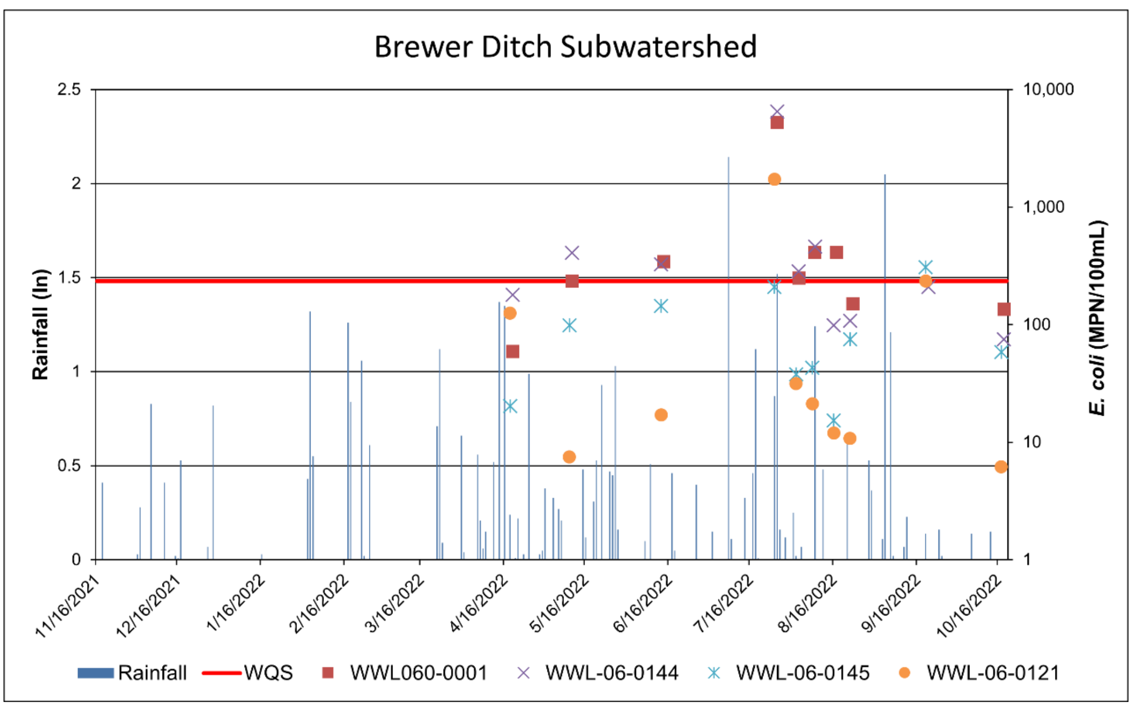

Figure 33: Graph of Precipitation and *E. coli* Data Brewer Ditch Subwatershed

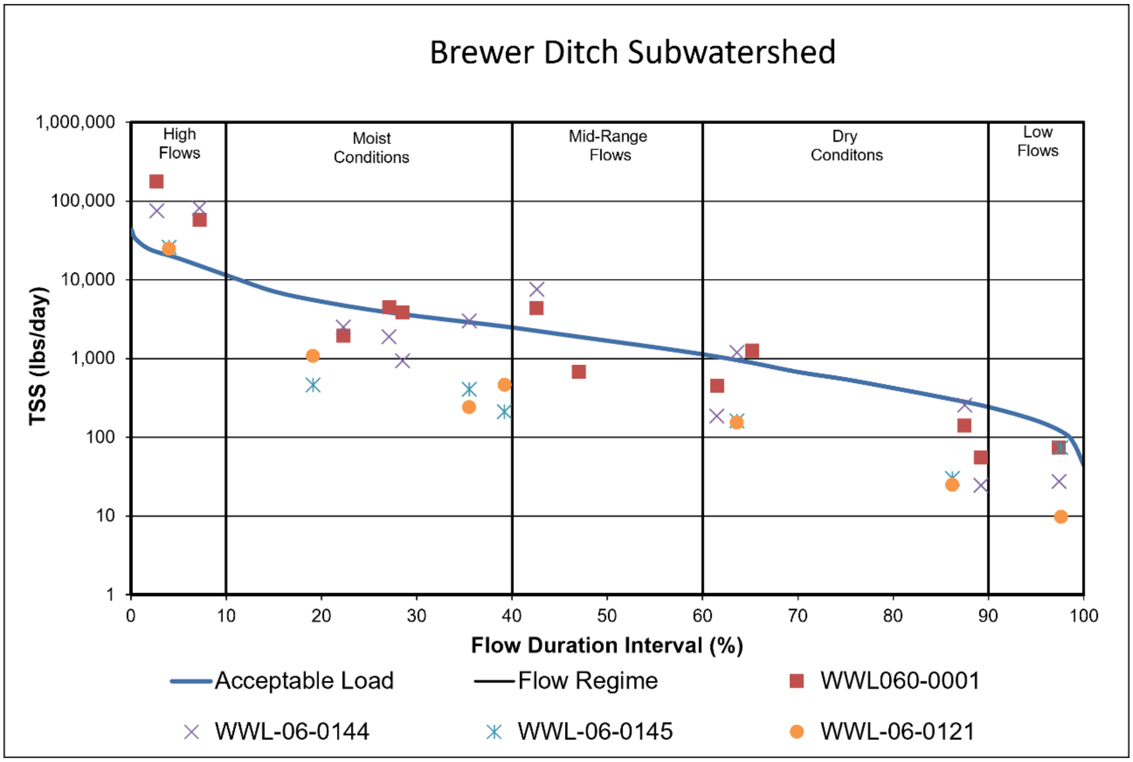

Figure 34: TSS Load Duration Curve for Brewer Ditch Subwatershed

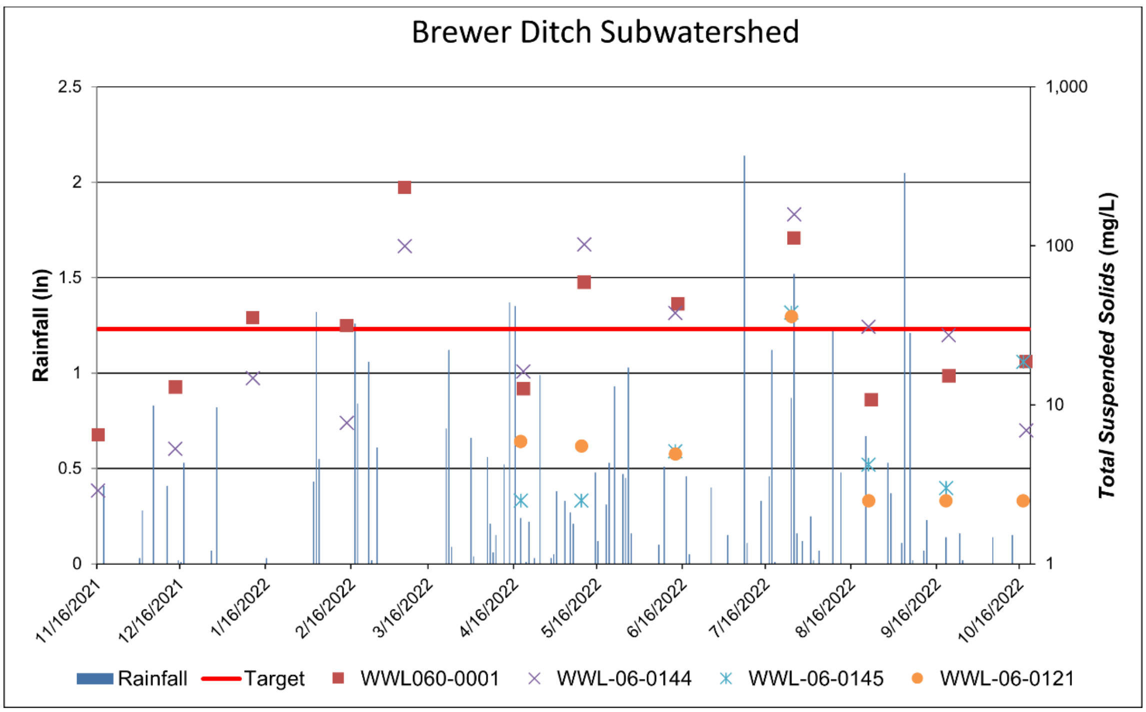

Figure 35: Graph of Precipitation and TSS Data Brewer Ditch Subwatershed

4.2.2 Buck Creek

The Buck Creek subwatershed drains approximately 35 square miles with an actual land area of approximately 35 square miles. Water drains into Beehunter Ditch and continues flowing north to south throughout the subwatershed. The land use is agriculture (45 percent), followed by forested land (27 percent) and hay and pastureland (14 percent). There are three NPDES permitted discharges in the Buck Creek subwatershed, including Linton WWTP (IN0020575), Countrymark Cooperative Switz City Terminal (ING340064), Triad Mining Switz City Lyons Mine (ING040102).

The Linton WWTP has a permit limit of 1.0 mg/L for TP. Site T11 is located approximately two miles downstream of the facility. TP exceeded water quality standards at this site during three of the six sampling events (sampling results ranged from 0.21 to 0.54 mg/L). Due to the Linton WWTP facility discharge, flow in this watershed is largely effluent driven at low flows. To support loading capacity, the MOS and Future Growth for Buck Creek subwatershed were calculated based on the TMDL less upstream contributions and the WLA from the Linton WWTP and using the facility's Average Facility Flow in 2023 of 0.92 MGD. At all other flow regimes, the MOS and Future Growth were calculated as normal, but used the facility's Actual Average Facility Flow of 1.5 MGD. Due to implicit assumptions of loadings coming from this facility, the resulting values are still believed to result in protection of water quality standards.

The majority of the population in the subwatershed is urban Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use, especially in the eastern and southern portions of the watershed. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 14 percent pastureland, a heavy presence of pasture animals is not expected. There are two permitted CFOs in the watershed.

There are five monitoring sites located in this subwatershed. Sites T10, T11, T12, T13, and T14 are located on Buck Creek (Figure 36). In 2021 and 2022, site T10 was sampled 15 total times for all parameters. Site T10 on Beehunter Ditch did not meet the water quality standard for *E. coli* as 9/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 2054.15 cfu/100ml. *E. coli* water quality samples from site T10 used to calculate the geomean were taken on the same day approximately one hour apart for five consecutive weeks.

Sites T11, T12, T13, and T14 were each sampled 10 times. Site T11 on Beehunter Ditch did not meet the water quality standard for *E. coli* as 8/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 1113.75 cfu/100ml. Site T12 on a tributary of Beehunter Ditch did not meet the water quality standard for *E. coli* as 9/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 969.14 cfu/100ml. Site T13 on Buck Creek also did not meet the water quality standard for *E. coli* as 5/10 samples taken exceeded the single sample max and its geomean was 448.49 cfu/100ml. Site T14 on Buck Creek did not meet the water quality standard for *E. coli* as 7/10 samples exceeded the single sample max and its geomean for *E. coli* was 801.09 cfu/100ml.

The fish community IBI score for site T10 was 42 (fair) and the QHEI was 35 (poor). The macroinvertebrate community mIBI score was 38 (fair) and the QHEI was 31 (poor). The fish community IBI score for site T11 was 42 (fair) and the QHEI was 36 (poor). The macroinvertebrate community mIBI score was 44 (fair) and the QHEI was 35 (poor). The fish community IBI score for site T12 was 36 (fair) and the QHEI was 54 (partially supporting). The macroinvertebrate community mIBI score was 44 (fair) and the QHEI was 46 (poor). The fish community IBI score for site T13 was 42 (fair) and the QHEI was 54 (partially supporting). The macroinvertebrate community mIBI score was 30 (poor) and the QHEI was 33 (poor). The fish community IBI score for site T14 was 30 (poor) and the QHEI was 51 (partially supporting). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 53 (partially supporting).

Evaluation of TSS monitoring data and QHEI substrate and bank erosion/riparian zone metric scores indicate a linkage between siltation and biological community impairments in the Buck Creek subwatershed. TSS concentrations ranged from 4 mg/L to 146 mg/L across seven sampling events at the upstream site of the main stem of Buck Creek and exceeded the target value 1/7 times. At the downstream site of Buck Creek concentrations ranged from 6.5 to 234 mg/L across 12 sampling events and exceeded the target value 6/12 times. Siltation was observed at most of the sampling sites with silt as a predominant substrate. Most of the sampling sides additionally had narrow to very narrow riparian zone widths and moderate erosion of the stream banks. The flood plain quality of most of the samples taken were documented as open pasture/row crop Therefore, a TMDL for TSS was developed for this subwatershed to address the impaired biotic communities.

A precipitation graph (Figure 38, Figure 40, and Figure 42) and a water quality duration graph (Appendix D) were created to further analyze potential sources. Elevated levels of pollutants during precipitation events could indicate that streams are susceptible to high loads of *E. coli* and TSS from run-off. It should be noted that elevated levels of pollutants can only be attributed to individual precipitation events when sampling events concur with precipitation events. While there were instances of elevated levels of pollutants that could be attributed to a precipitation event, there were also several instances of elevated levels of pollutants during drier conditions. This indicates point sources may also be contributing in addition to nonpoint sources. Linton WWTP (IN0020575) is permitted to discharge a monthly summer average of 18 mg/L and winter average of 30 mg/L TSS, as well as a daily maximum of 235 MPN/100 mL *E. coli*. Linton WWTP exceeded their permitted *E. coli* limits by 225% on 8/4/22. According to figure 38 and *E. coli* sampling data, the highest levels of *E. coli* were recorded in late July into early August with the most notable increase recorded during sampling on 8/9/22, therefore discharge from Linton WWTP way have influenced on some elevated levels of *E. coli* during that sampling event. Nonpoint sources of *E. coli* contributing to elevated levels during drier conditions may include wildlife, pasture animals with direct access to streams, straight pipes, and leaking and failing septic systems. Triad Mining Switz City Lyons Mine (ING040102) is permitted to discharge a daily maximum of 70 mg/L TSS, according to NPDES permit standards, however they do not discharge in the Black Creek watershed. Countrymark Cooperative Switz City Terminal (ING340064) is permitted to discharge a monthly average of 30 mg/L TSS. Countrymark Cooperative Switz City Terminal (ING340064) exceeded their permitted TSS limits by 313% on 3/25/22. According to figure 40 and TSS sampling data, the most notable increase in TSS levels recorded during sampling occurred on 3/7/22. Levels of TSS exceeded target values several times in the months before and after the 3/7/22 sampling event, therefore both nonpoint and point sources may be contributing to elevated levels of TSS. The water quality duration graph indicates most sources of TSS in this watershed are nonpoint sources. Nonpoint sources of TSS may include agricultural practices, streambank erosion, and stormwater run-off.

TP concentrations ranged from 0.05 mg/L to 0.54 mg/L across 36 sampling events within the subwatershed and exceeded the target value three times. One stream segment within the subwatershed was determined to be impaired for nutrients with TP being consistently over the target value in those determinations. Therefore, a TMDL for TP was developed to address the nutrient impairment for this subwatershed.

There are approximately 51 miles of streams in the subwatershed. Based on IDEM data collected in 2021 and 2022, there will be approximately 27.74 stream miles impaired for biotic communities (sites T13 and T14), 46 impaired for *E. coli* (sites T10, T11, T12, T13, and T14), and 9.12 impaired for nutrients (site 11). These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, TSS, TP, and *E. coli* TMDLs were developed to address IBCs, nutrients, and *E. coli* in this subwatershed. Load duration curves for the Buck Creek subwatershed are listed in Figure 37, Figure 39, and Figure 41. Table 37 provides a summary of the Buck Creek subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, CFOs, as well as LA, WLAs, and MOS values for TSS, *E. coli*, and TP.

To achieve necessary load reductions for TSS, TP, and *E. coli* implementation in the Buck Creek subwatershed should primarily focus on best management practices (BMPs) that have an impact throughout high, moist, mid-range, and dry flow regimes. See Section 6.1 and **Error! Reference source not found.** for information pertaining to potentially suitable BMP selection for the Black Creek watershed.

Table 37: Summary of Buck Creek Subwatershed Characteristics

Buck Creek (051202020602)					
Drainage Area	35.02 square miles				
Surface Area	35.02 square miles				
Site # [IDEM Station ID]	T10 [WWL-06-0152], T13 [WWL-06-0142], T14 [WWL-06-0143], T11 [WWL-06-0140], T12 [WWL-06-0141]				
Listed Segments	INW0262_03, INW0262_T1004, INW0262_T1003, INW0262_04, INW0262_05				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Nutrients [TP]				
Land Use	Agricultural Land: 45% Forested Land: 27% Developed Land: 11% Open Water: 3% Pasture/Hay: 14% Grassland/Shrubs: 0% Wetland: 0%				
NPDES Facilities	Linton WWTP (IN0020575), Countrymark Cooperative Switz City Terminal (ING340064), Triad Mining Switz City Lyons Mine (ING040102)				
CAFOs	NA				
CFOs	Nathan & Lauren Red White & Blue Farm (Farm ID: 4962), WIN Productions LLC Lyons Pride Sow Farm (Farm ID: 3701)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	9.76E+11	2.13E+11	8.12E+10	2.13E+10	1.24E+09
WLA (Total)	1.91E+10	1.91E+10	1.91E+10	1.91E+10	1.91E+10
MOS (10%)	1.17E+11	2.73E+10	1.18E+10	4.76E+09	2.40E+09
Future Growth (5%)	5.85E+10	1.36E+10	5.90E+09	2.38E+09	1.20E+09
TMDL = LA+WLA+MOS	1.17E+12	2.73E+11	1.18E+11	4.76E+10	2.40E+10
WLA (Individual)					
Linton WWTP	1.91E+10	1.91E+10	1.91E+10	1.91E+10	1.91E+10
TMDL Total Suspended Solids Allocations (lbs/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	25,679.80	5,945.20	2,264.96	582.99	19.28
WLA	676.79	580.51	558.71	554.95	553.69
MOS (10%)	3,294.57	767.73	332.20	133.88	67.41
Future Growth (10%)	3,294.57	383.87	166.10	66.94	33.70
TMDL = LA+WLA+MOS	32,945.74	7,677.30	3,321.96	1,338.76	674.08

WLA (Individual)					
Linton WWTP	538.16	538.16	538.16	538.16	538.16
Countrymark Cooperative Switz City Terminal	13.94	13.94	13.94	13.94	13.94
Triad Mining Switz City Lyons Mine	62.76	14.86	6.61	2.85	1.59
Construction Stormwater	61.93	13.54	0.00	0.00	0.00

TMDL Total Phosphorus Allocations (lbs/day)

Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	267.52	52.74	15.72	3.70	0.59
WLA	12.52	12.52	12.52	7.68	7.68
MOS (10%)	32.95	7.68	3.32	1.34	0.07
Future Growth (5%)	16.47	3.84	1.66	0.67	0.03
TMDL = LA+WLA+MOS	329.46	76.77	33.22	13.39	8.37
WLA (Individual)					
Linton WWTP	12.52	12.52	12.52	7.68	7.68

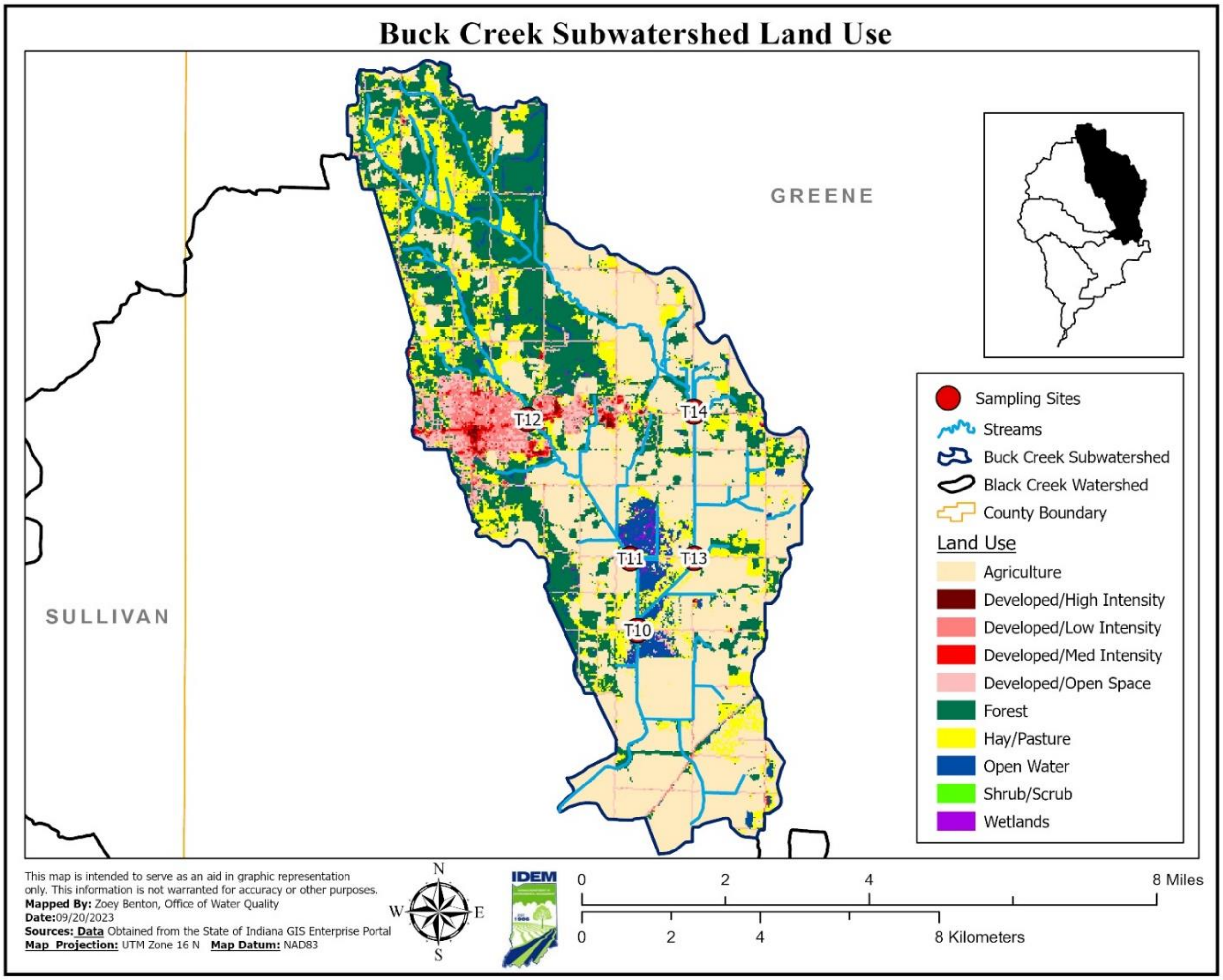

Figure 36: Sampling Stations in Buck Creek Subwatershed

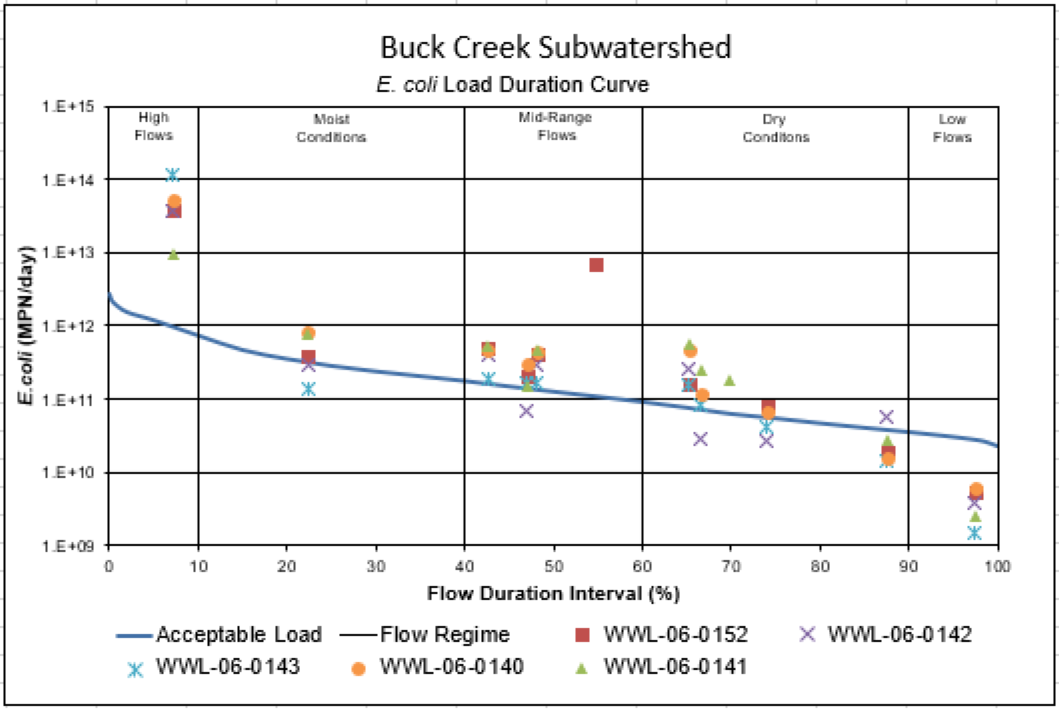

Figure 37: *E. coli* Load Duration Curve for Buck Creek Subwatershed

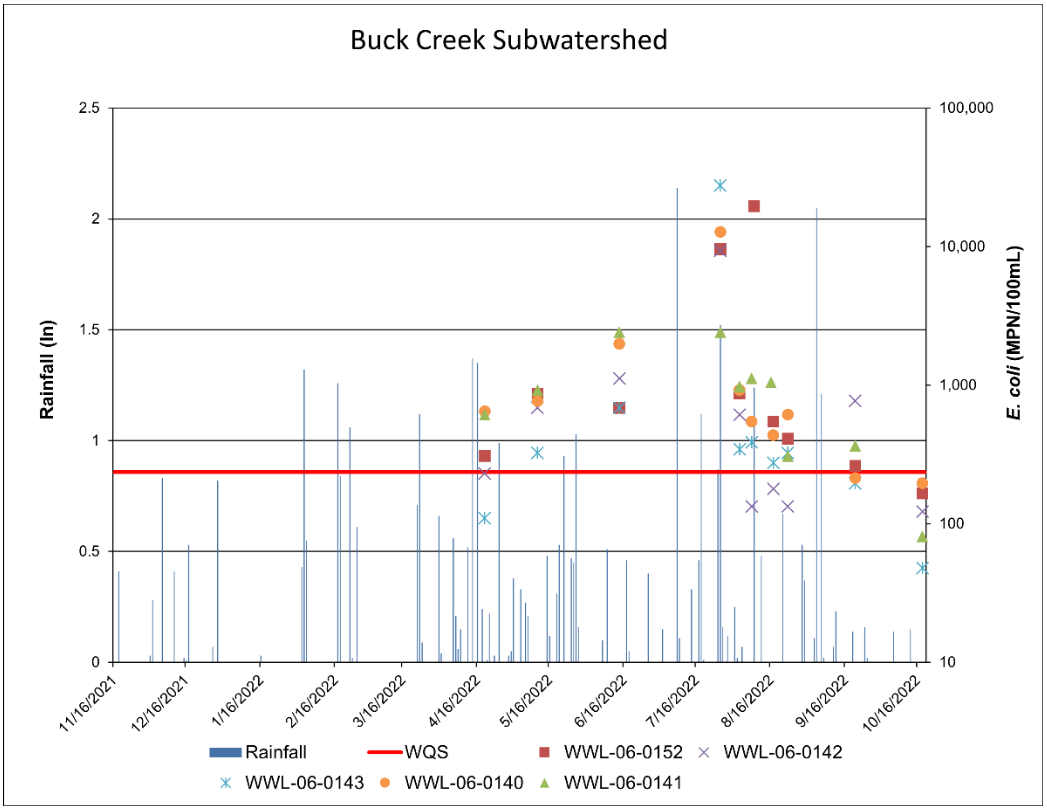

Figure 38: Graph of Precipitation and *E. coli* Data for Buck Creek Subwatershed

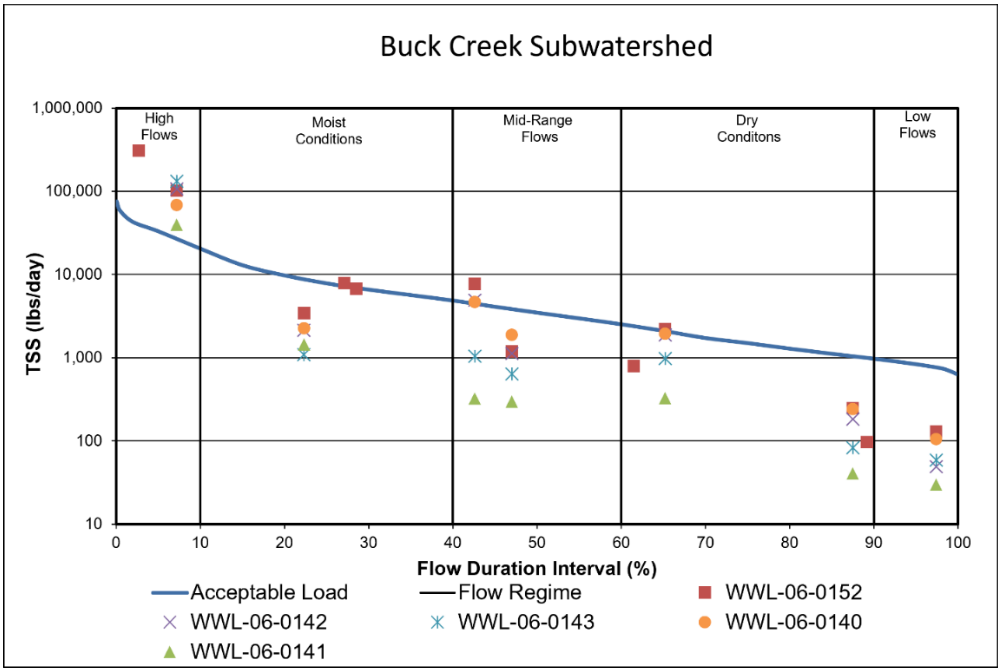

Figure 39: TSS Load Duration Curve for Buck Creek Subwatershed

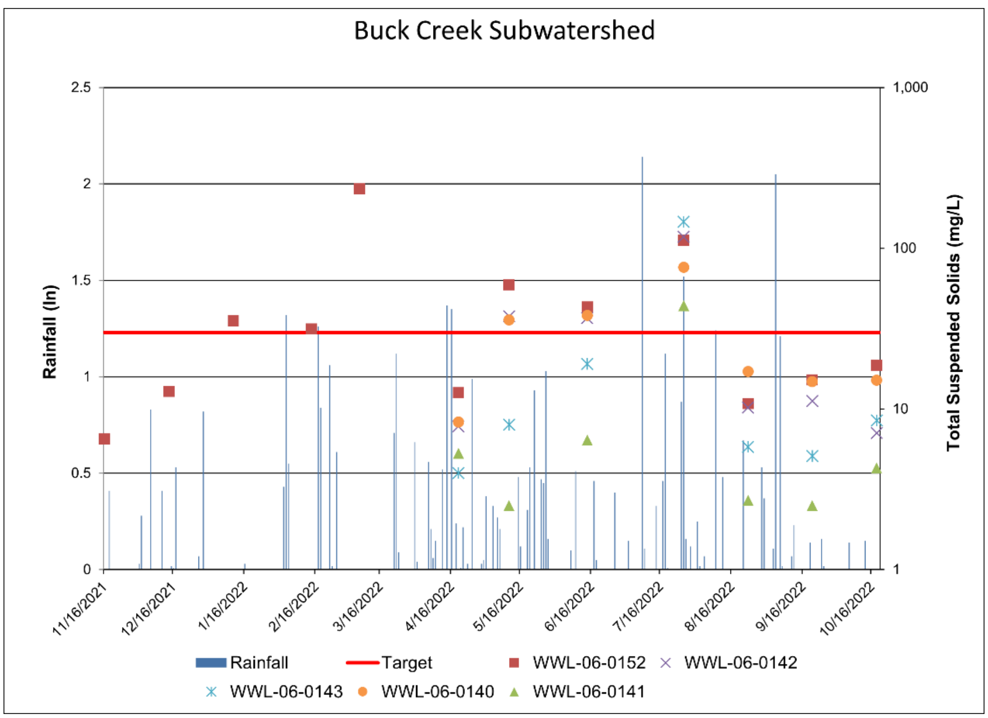

Figure 40: Graph of Precipitation and TSS Data in Buck Creek Subwatershed

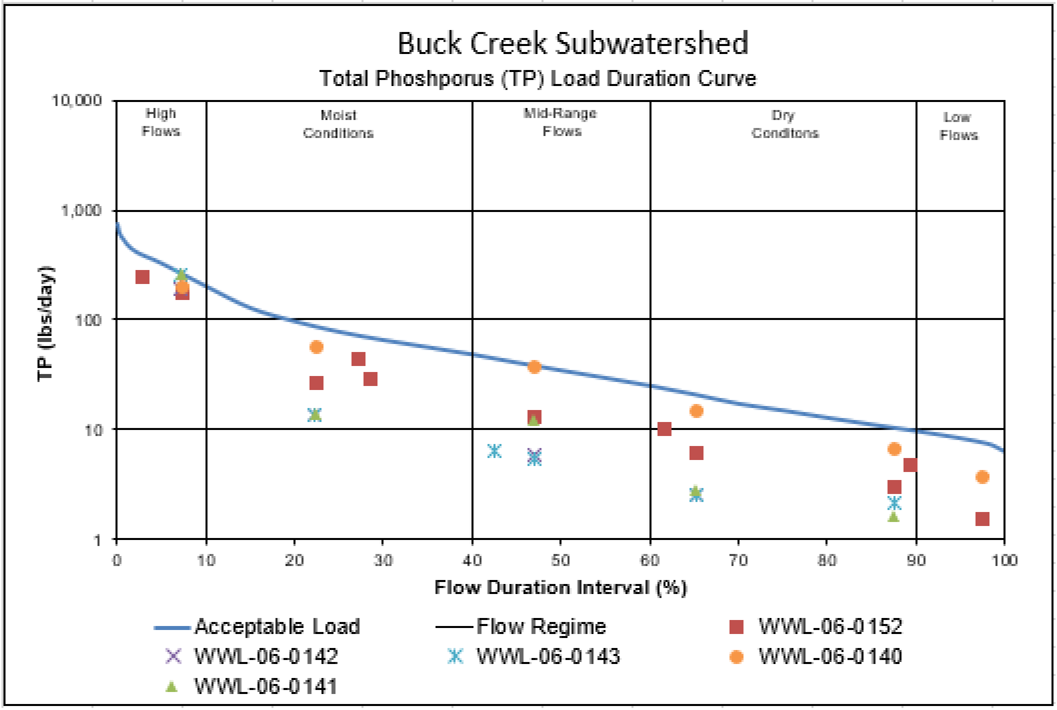

Figure 41: TP Load Duration Curve for Buck Creek Subwatershed

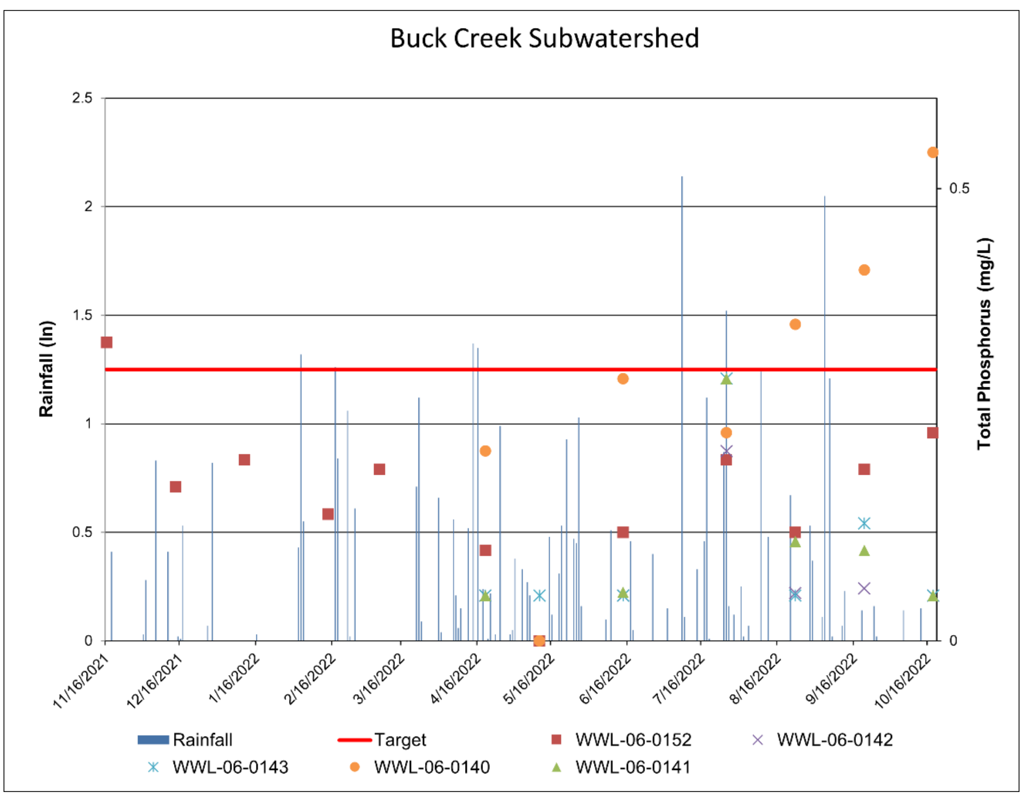

Figure 42: Graph of Precipitation and TP for Buck Creek Subwatershed

4.2.3 Calico Slash Ditch

The Calico Slash Ditch subwatershed drains approximately 109 square miles with an actual land area of approximately 20 square miles. The main stem of Buck Creek runs through this subwatershed and it drains from north to south. The land use is primarily forested land (88 percent). There is one NPDES permitted facility in the Calico Slash Ditch subwatershed: Sandborn WWTP (IN0062685). The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, nearly 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 relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed, there are little to no remaining riparian buffers along streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of two percent pastureland, a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

There are five monitoring sites located in this subwatershed. Sites T05, T06. T07, T08, and T09 are located on Calico Slash Ditch and Black Creek (Figure 43). In 2021 and 2022, this watershed was sampled 52 times between the five sites resulting in all five failing the water quality standard for *E. coli*. The *E. coli* geomean for site T05 was 615.67 cfu/100ml with 8/10 samples in exceedance of the single sample max. Site T06 had a geomean of 613.38 cfu/100ml with 5/10 samples in exceedance of the single sample max. Site T07 had a geomean of 19.67 cfu/100ml with 3/10 samples in exceedance of the single sample max. Site T08 had a geomean of 625.43 cfu/100ml with 7/10 samples in exceedance of the single sample max. Finally, site T09 had a geomean of 827.38 cfu/100ml with 5/10 samples in exceedance of the single sample max.

The fish community IBI score for site T05 was 40 (fair) and the QHEI was 55 (partially supporting). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 53 (partially supporting). The fish community IBI score for site T06 was 18 (very poor) and the QHEI was 41 (poor). The macroinvertebrate community mIBI score was 36 (fair) and the QHEI was 42 (poor). The fish community IBI score for site T07 was 44 (fair) and the QHEI was 17 (poor). The macroinvertebrate community mIBI score was 38 (fair) and the QHEI was 19 (poor). The fish community IBI score for site T08 was 38 (fair) and the QHEI was 19 (poor). The macroinvertebrate community mIBI score was 36 (fair) and the QHEI was 22 (poor). The fish community IBI score for site T09 was 16 (very poor) and the QHEI was 31 (poor). The macroinvertebrate community mIBI score was 34 (poor) and the QHEI was 31 (poor).

IDEM biologists used their best professional judgement to impair sampling site T07 for dissolved oxygen (DO). Excessive algae encountered at the site was observed at the time of one DO reading below 4.0 mg/L (3.73 mg/L) and two marginally low DO readings below 5.0 mg/L. This co-occurrence of low DO and excessive algae on 8/25/22 led site T07 to also be impaired for Nutrients. TP levels were not exceeding during sampling 5 out of 6 sampling events. However, excessive algae observations indicate phosphorus is likely available for plant uptake and may be driving excessive algae growth. Excessive algae growth can result in decreased dissolved oxygen levels as described in Section 1.1.2. Samples taken may have shown low TP levels due to algal uptake prior to when sampling was conducted. Therefore, a TMDL for TP was developed for this subwatershed to address nutrient and DO impairments.

Evaluation of TSS monitoring data and QHEI substrate and bank erosion/riparian zone metric scores indicate a linkage between siltation and biological communities impairments in the Calico Ditch subwatershed. TSS concentrations ranged from 4.2 mg/L to 856 mg/L across 39 sampling events within the subwatershed and exceeded the target value 22 times. Heavy siltation was observed at four-of-five sampling sites with silt as a predominant substrate. One site had no riparian zone, while the other four had narrow or very narrow riparian zones. Heavy/severe erosion was noted at three sampling sites. The flood-plain quality was documented as open pasture/row crop at each of the sampling sites. Given that the target value for TSS was sporadically violated and excessive siltation or indicators of siltation were documented throughout the subwatershed, high TSS is believed to be a linkage to the biotic communities and dissolved oxygen (3 of 10 sites failed the single sample minimum for DO) impairments. Therefore, a TMDL for TSS was developed for this subwatershed.

There are approximately 21.26 miles of streams in the subwatershed. Based on IDEM data collected in 2021 and 2022, there will be 7.58 stream miles impaired for *E. coli* (sites T05, T06, T08, and T09), 4.83miles impaired for biological communities (site T06 and T09), 9.1 miles impaired for dissolved oxygen (site T07), and 9.1 miles impaired for nutrients (site T07). These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, TSS TMDLs were developed to address all IBCs, and a TP TMDL was developed to address the DO and nutrient impairments. The load duration curves for the Calico Slash Ditch subwatershed are shown in Figure 44, Figure 46, and Figure 48. **Error! Reference source not found.** provides a summary of the Calico Slash Ditch subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, CFOs, as well as LA, WLAs, and MOS values for *E. coli*, TSS, and TP.

Precipitation graphs (Figure 45, Figure 47, and Figure 49) and water quality duration graphs (Appendix D) were created to further analyze potential sources. Elevated levels of pollutants during precipitation events could indicate that streams are susceptible to high loads of *E. coli* and TSS from run-off. It should be noted that elevated levels of pollutants can only be attributed to individual precipitation events when sampling events concur with precipitation events. While there were instances of elevated levels of pollutants that could be attributed to a precipitation event, there were also several instances of elevated levels of pollutants during drier conditions.

This indicates point sources may also be contributing in addition to nonpoint sources. Sandborn WWTP (IN0062685) is permitted to discharge a monthly average of 30 mg/L TSS, as well as a daily maximum of 235 MPN/100 mL *E. coli*. Sandborn WWTP had no permit violations during the time of sampling in Calico Slash Ditch subwatershed. The water quality duration graph, as well as limited permitted sources, indicate the majority of sources of *E. coli* and TSS in this subwatershed are nonpoint sources. Nonpoint sources of *E. coli* may include wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and leaking and failing septic systems. Nonpoint sources of TSS may include agricultural practices, streambank erosion, and stormwater run-off.

To achieve necessary load reductions for *E. coli* and TSS, implementation in the Slate Creek subwatershed should primarily focus on best management practices (BMPs) that have an impact throughout moist, mid-range, and dry flow regimes. See Section 6.1 and **Error! Reference source not found.** for information pertaining to potentially suitable BMP selection for the Black Creek watershed.

Table 38: Summary of Calico Slash Ditches Subwatershed Characteristics

Calico Slash Ditch (051202020604)					
Drainage Area	108.97 square miles				
Surface Area	19.48 square miles				
Site # [IDEM Station ID]	T05 [WWL-06-0134], T06 [WWL-06-0135], T07 [WWL-06-0136], T08 [WWL-06-0137], T09 [WWL-06-0138]				
Listed Segments	INW0264_05; INW0264_04; INW0264_03; INW0264_02, INW0264_T1002				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Dissolved Oxygen [TP], Nutrients [TP]				
Land Use	Agricultural Land: 88% Forested Land: 5% Developed Land: 5% Open Water: 0% Pasture/Hay: 2% Grassland/Shrubs: 0% Wetland: 0%				
NPDES Facilities	Sandborn WWTP (IN0062685)				
CAFOs	NA				
CFOs	NA				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	5.469E+11	1.224E+11	4.918E+10	1.586E+10	4.695E+09
WLA (Total)	5.870E+08	5.870E+08	5.870E+08	5.870E+08	5.870E+08
MOS (10%)	6.441E+10	1.446E+10	5.855E+09	1.935E+09	6.214E+08
Future Growth (5%)	3.220E+10	7.232E+09	2.928E+09	9.676E+08	3.107E+08
Upstream Drainage Input	2.970E+12	6.756E+11	2.801E+11	1.000E+11	3.969E+10
TMDL = LA+WLA+MOS	3.614E+12	8.202E+11	3.387E+11	1.194E+11	4.590E+10
WLA (Individual)					
Sandborn WWTP	5.87E+08	5.87E+08	5.87E+08	5.87E+08	5.87E+08
TMDL Total Suspended Solids Allocations (lbs/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	15,390.67	3,443.35	1,384.08	446.39	132.12

WLA	16.52	16.52	16.52	16.52	16.52
MOS (10%)	1,812.61	407.04	164.78	54.46	17.49
Future Growth (5%)	906.31	203.52	82.39	27.23	8.74
Upstream Drainage Input	83,583.77	19,012.88	7,883.25	2,815.38	1,116.88
TMDL = LA+WLA+MOS	101,709.87	23,083.32	9,531.01	3,359.98	1,291.75
WLA (Individual)					
Sandborn WWTP	16.52	16.52	16.52	16.52	16.52

TMDL Total Phosphorus Allocations (lbs/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	154.07	34.60	14.01	4.63	0.10
WLA	0.00	0.00	0.00	0.00	0.00
MOS (10%)	18.13	4.07	1.65	0.54	0.01
Future Growth (5%)	9.06	2.04	0.82	0.27	0.01
Upstream Drainage Input	835.84	190.13	78.83	28.15	12.80
TMDL = LA+WLA+MOS	1,017.10	230.83	95.31	33.60	12.92

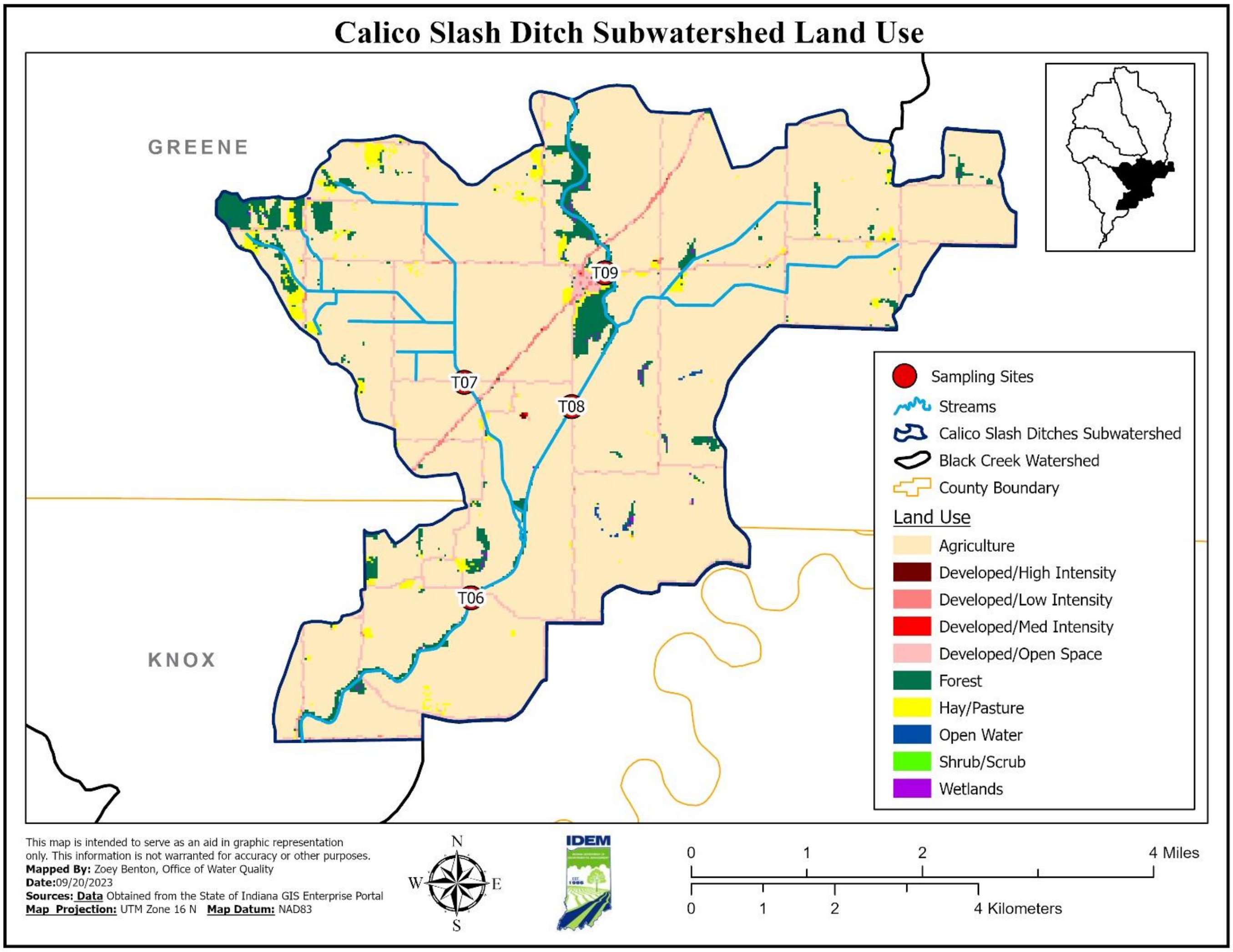

Figure 43: Sampling Stations in Calico Slash Ditch Subwatershed

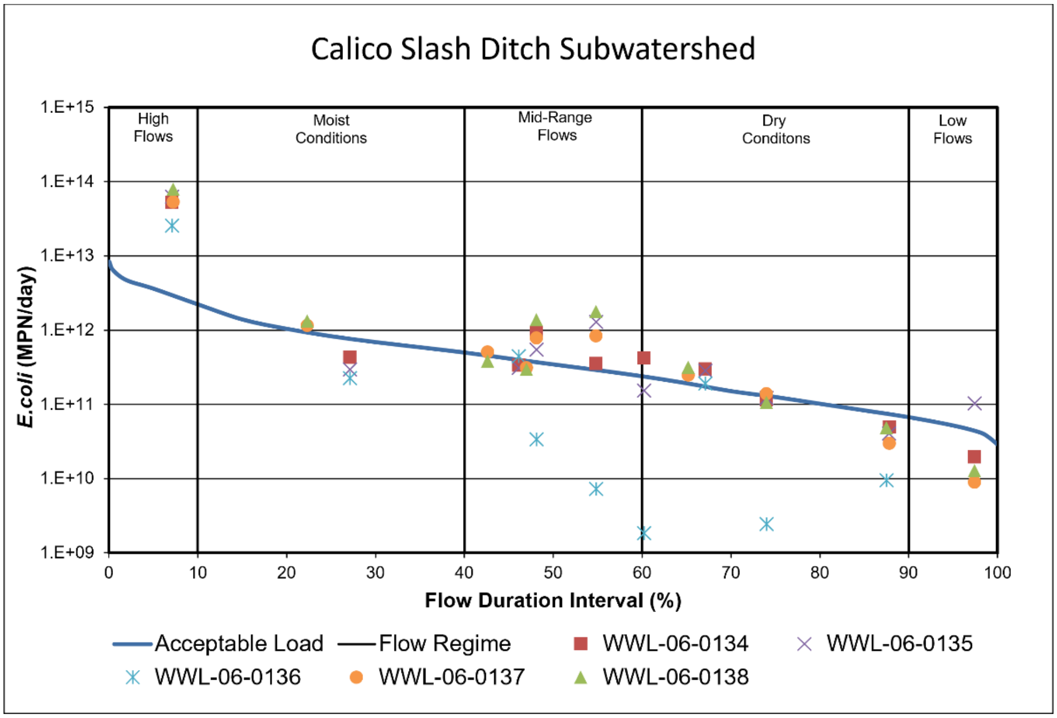

Figure 44: *E. coli* Load Duration Curve for Calico Slash Ditch Subwatershed

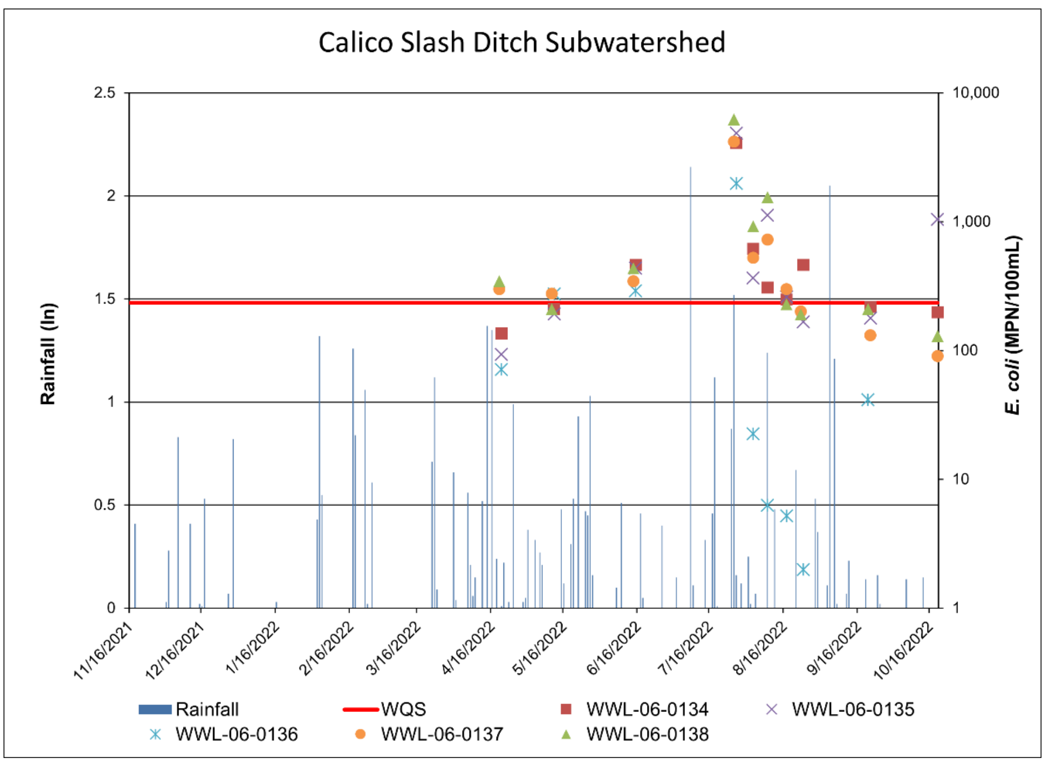

Figure 45: Graph of Precipitation and *E. coli* Data at Calico Slash Ditch Subwatershed

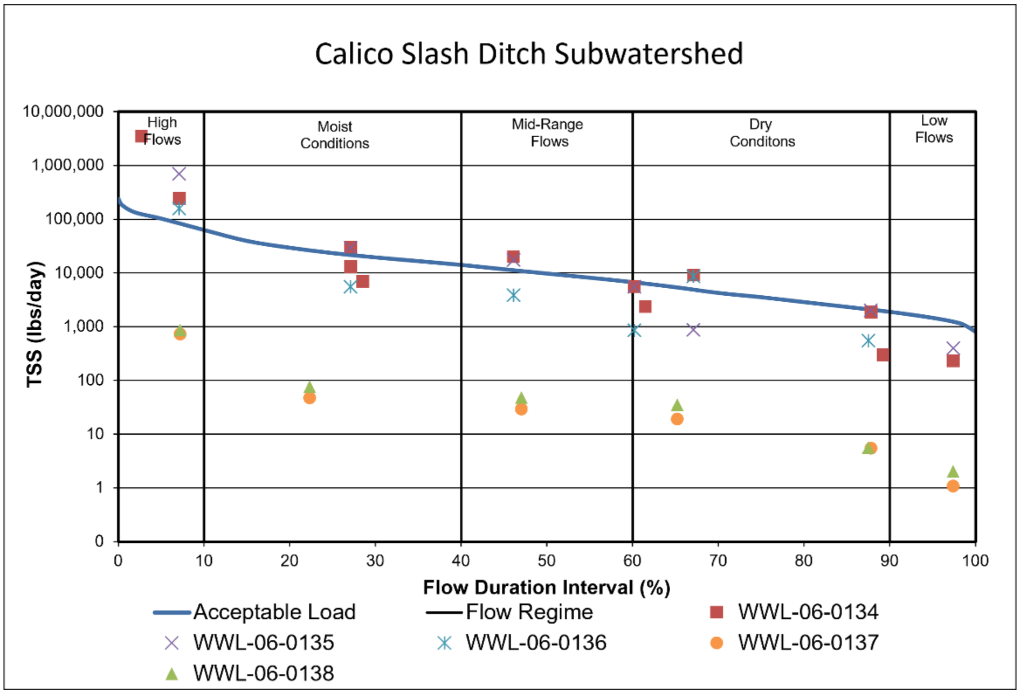

Figure 46: TSS Load Duration Curve for Calico Slash Ditches Subwatershed

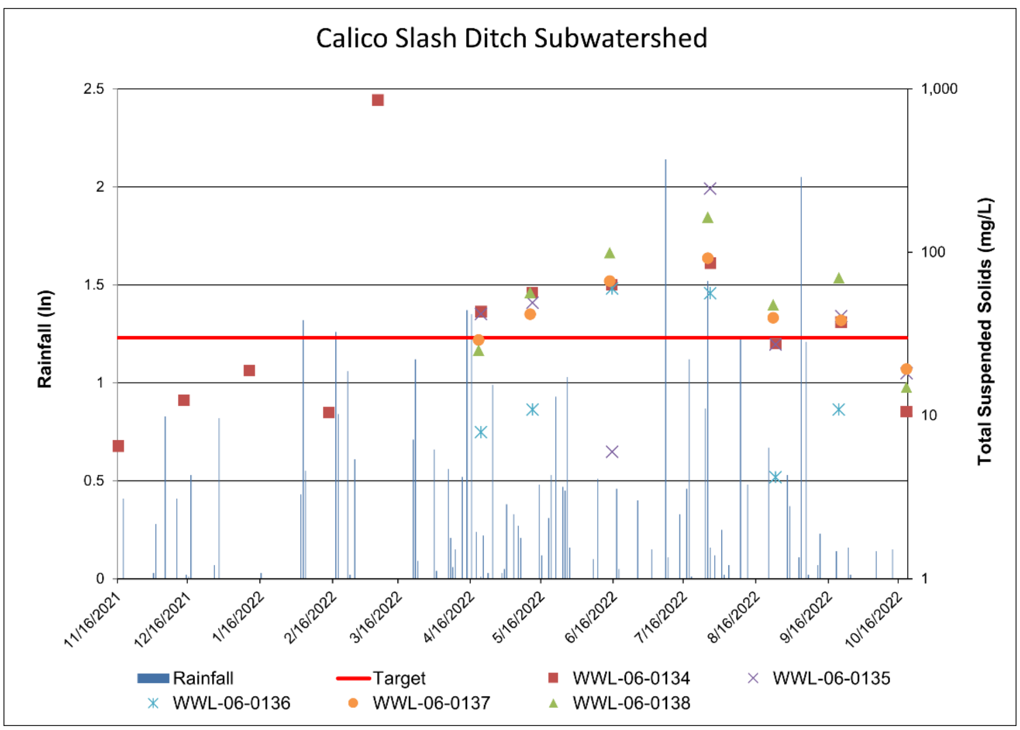

Figure 47: Graph of Precipitation and TSS Data at Calico Slash Ditches Subwatershed

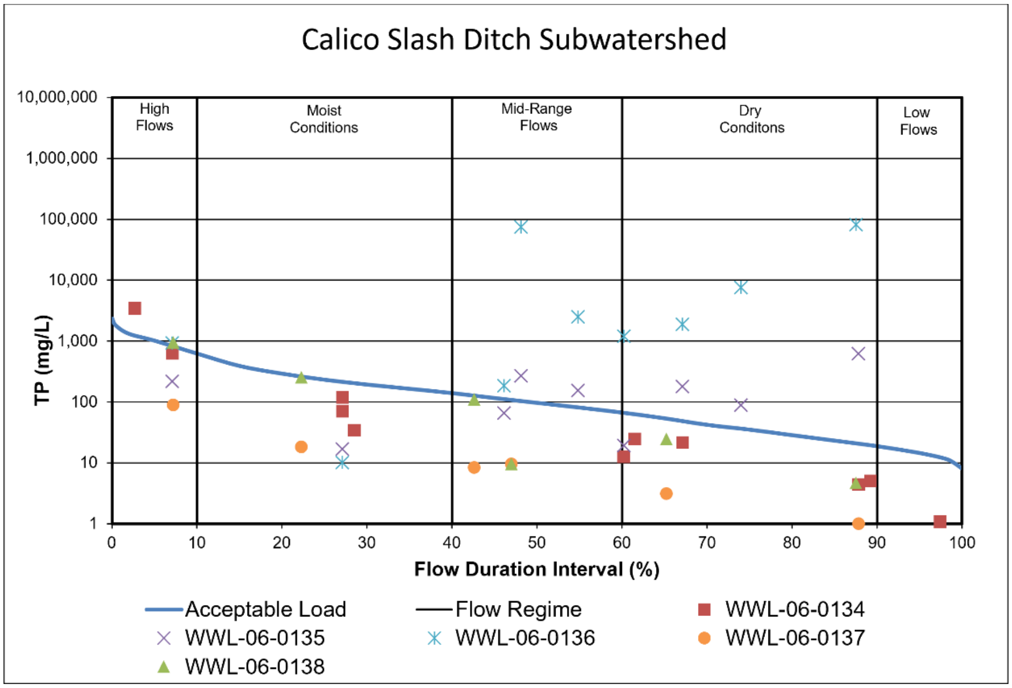

Figure 48: TP Load Duration Curve for Calico Slash Ditch Subwatershed

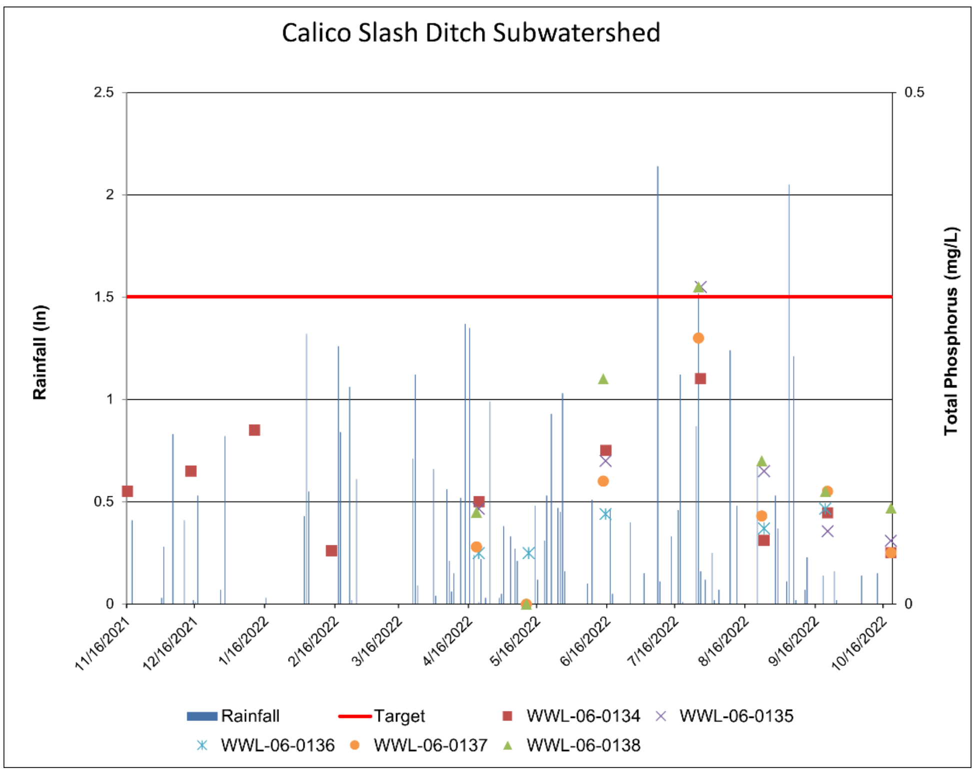

Figure 49: Graph of Precipitation and TP Data at Calico Slash Ditch Subwatershed

4.2.4 Headwaters Black Creek

The Headwaters Black Creek subwatershed drains approximately 35 square miles. The land use is primarily forested land (43 percent), followed by agriculture (18 percent) and hay/pastureland (both 17 percent). Peabody Midwest Mining LLC Bear Run Mine (ING040239) is the only NPDES permitted facility in this subwatershed. The majority of the subwatershed is rural, indicating many homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Black Creek watershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. While the landscape in the area is relatively hilly, 35% of the subwatershed has been converted to agricultural production and use or pastureland. In parts of the subwatershed there are little to no remaining riparian buffers left along the banks, due to agricultural practices. The subwatershed does contain significant amounts of highly erodible soil types, which can be susceptible to sheet, rill, and isolated gully erosion, and can contribute to sediment loss from agricultural lands, as well as lands from the high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With less than 20 percent of land used as pastureland, a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

There are five monitoring sites located in this subwatershed. Sites T19, T20, T21, T22, and T23 are located on Headwaters Black Creek (Figure 50). In 2021 and 2022 Site T19 on Black Creek was sampled a total of 15 times. Site T19 failed the water quality standard for *E. coli* 4/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 406.9 cfu/100ml. The *E. coli* water quality samples from site T19 used to calculate the geomean were taken on the same day approximately one hour apart for five consecutive weeks.

Sites T20, T21, T22, and T23 were each sampled a total of 10 times. Site T20 on a tributary of Black Creek met the WQS for *E. coli* as 1/10 samples exceeded the single sample max and its *E. coli* geomean was 56.17 cfu/100 ml. However, the *E. coli* sample taken at site T20 on 7/26/2022 was estimated as greater than the *E. coli* method limit of 2419.6 cfu/100 ml, which may have resulted in a true *E. coli* geomean much larger than what was calculated. Due to this uncertainty, BPJ was used to impair site T20 for *E. coli* exceedance. Site T21 on Black Creek did not meet the water quality standard for *E. coli* as 4/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 259.02 cfu/100ml. Site T22 on a tributary of Black Creek also did not meet the water quality standard for *E. coli* as 5/10 samples taken exceeded the single sample max and its geomean was 252.21 cfu/100ml. Site T23 on Black Creek did not meet the water quality standard for *E. coli* as 7/10 samples exceeded the single sample max and its geomean for *E. coli* was 875.83 cfu/100ml.

The fish community IBI score for site T19 was 16 (very poor) and the QHEI was 41 (fair). The macroinvertebrate community mIBI score was 32 (poor) and the QHEI was 38 (fair). The fish community IBI score for site T20 was 44 (fair) and the QHEI was 37 (fair). The macroinvertebrate community mIBI score was 30 (poor) and the QHEI was 24 (poor). The fish community IBI score for site T21 was 40 (fair) and the QHEI was 42 (fair). The macroinvertebrate community mIBI score was 30 (poor) and the QHEI was 37 (fair). The fish community IBI score for site T22 was 38 (fair) and the QHEI was 54 (excellent). The macroinvertebrate community mIBI score was 36 (fair) and the QHEI was 42 (fair). The fish community IBI score for site T23 was 20 (very poor) and the QHEI was 41 (fair). The macroinvertebrate community mIBI score was 32 (poor) and the QHEI was 42 (fair).

Evaluation of TSS monitoring data and QHEI substrate and bank erosion/riparian zone metric scores indicate a linkage between siltation and biological community impairments in the Headwaters subwatershed. TSS concentrations ranged from 2.5 mg/L to 175 mg/L across 12 sampling events at the upstream site of the main stem of Black Creek and exceeded the target value 4/12 times. Heavy siltation was also noted as silt, while hardpan and muck were observed to be the primary substrate at this sampling site. Additionally, heavy/severe bank erosion was observed along with a moderate riparian zone.

There are approximately 55.26 miles of streams in the subwatershed. Based on IDEM data collected in 2021 and 2022, there will be 27.7 stream miles impaired for *E. coli* (sites T19, T20, T21, T22, and T23) and 21.3 stream miles for biological communities (site T19, T20, T21, and T23). These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, TMDLs have been developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all IBCs in the subwatershed. Table 39 provides a summary of the Headwaters subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, CFOs, as well as LA, WLAs, and MOS values for *E. coli* and TSS.

Precipitation graphs (Figure 52 and Figure 54) and water quality duration graphs (Appendix D) were created to further analyze potential sources. Elevated levels of pollutants during precipitation events could indicate that streams are susceptible to high loads of *E. coli* from run-off. It should be noted that elevated levels of pollutants can only be attributed to individual precipitation events when sampling events concur with precipitation events. While there were instances of elevated levels of pollutants that could be attributed to a precipitation event, there were also several instances of elevated levels of pollutants during drier conditions. This indicates point sources may also be contributing in addition to nonpoint sources. Peabody Midwest Mining LLC Bear Run Mine (ING040239) does not discharge *E. coli*. The water quality duration graphs, as well as limited permitted sources, indicate most sources of pollutants in this subwatershed are nonpoint sources. Nonpoint sources of *E. coli* may include wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and leaking and failing septic systems.

To achieve necessary load reductions for *E. coli* and TSS, implementation in the Headwaters subwatershed should primarily focus on best management practices (BMPs) that have an impact throughout high, moist, mid-range, and dry flow regimes. See Section 6.1 and **Error!**

Reference source not found. for information pertaining to potentially suitable BMP selection for the Black Creek watershed.

Table 39: Summary of Headwaters Black Creek Subwatershed Characteristics

Headwaters Black Creek (051202020601)					
Drainage Area	34.48 square miles				
Surface Area	34.48 square miles				
Site # [IDEM Station ID]	T19 [WWL-06-0146], T21 [WWL-06-0148], T20 [WWL-06-0147], T23 [WWL-06-0150], T22 [WWL-06-0149]				
Listed Segments	INW0261_03, INW0261_T1006, INW0261_01, INW0261_T1009				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 18% Forested Land: 43% Developed Land: 8% Open Water: 11% Pasture/Hay: 17% Grassland/Shrubs: 0% Wetland: 3%				
NPDES Facilities	Peabody Midwest Mining LLC Bear Run Mine (ING040239)				
CAFOs	NA				
CFOs	NA				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	9.682E+11	2.167E+11	8.721E+10	2.823E+10	8.466E+09
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	1.139E+11	2.550E+10	1.026E+10	3.321E+09	9.960E+08
Future Growth (5%)	5.695E+10	1.275E+10	5.130E+09	1.661E+09	4.980E+08
TMDL = LA+WLA+MOS	1.139E+12	2.550E+11	1.026E+11	3.321E+10	9.960E+09
TMDL Total Suspended Solids Allocations (lbs/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	22,453.87	5,035.22	2,047.37	668.22	202.20
WLA	3,189.59	705.20	262.50	79.55	22.03
MOS (10%)	3,205.43	717.55	288.73	93.47	28.03
Future Growth (10%)	3,205.43	717.55	288.73	93.47	28.03
TMDL = LA+WLA+MOS	32,054.33	7,175.52	2,887.34	934.71	280.29
WLA (Individual)					
Construction Sites	49.44	10.93	0.00	0.00	0.00
Peabody Midwest Bear Run Mine	3,140.15	694.27	262.50	79.55	22.03

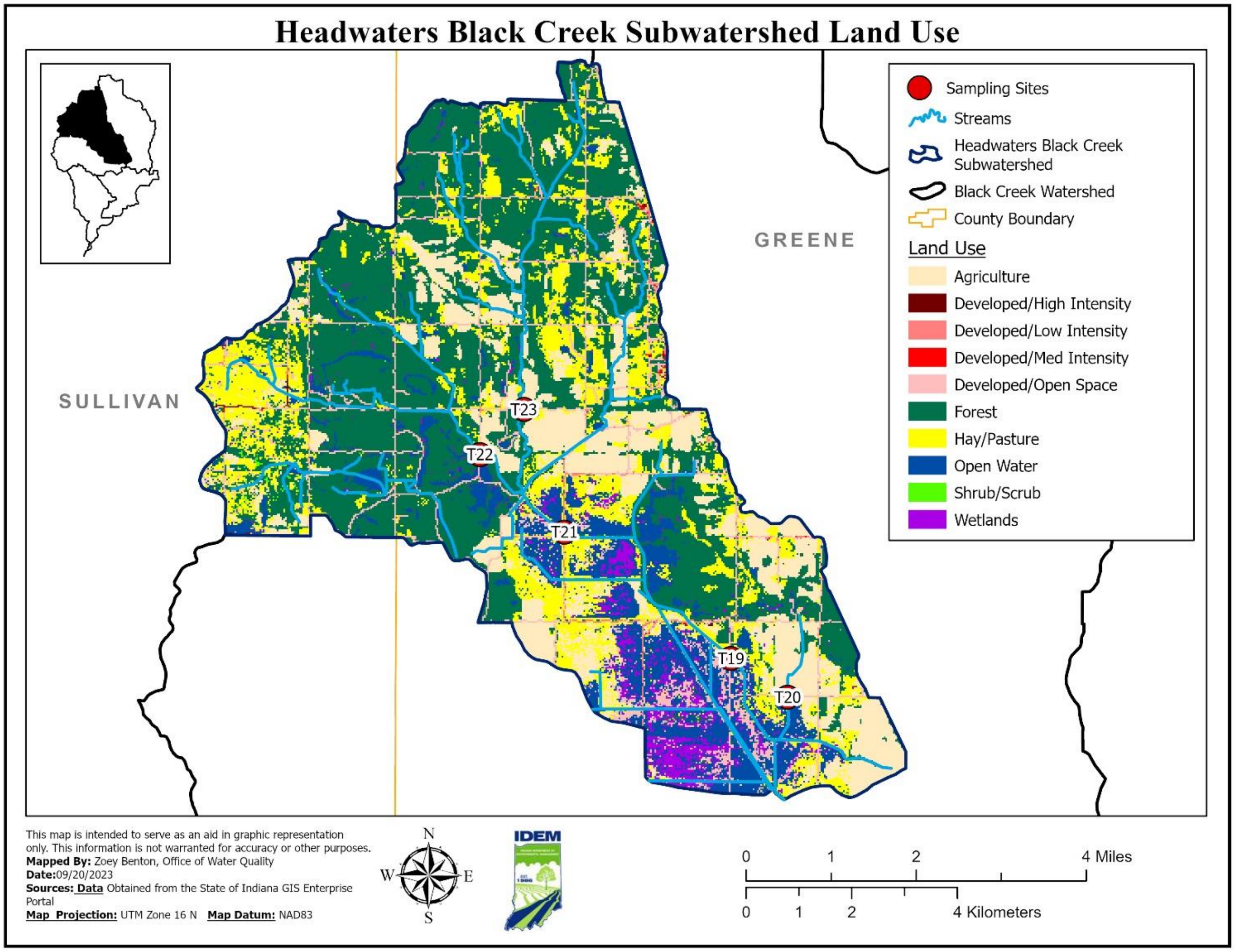

Figure 50: Sampling Stations in Headwaters Black Creek Subwatershed

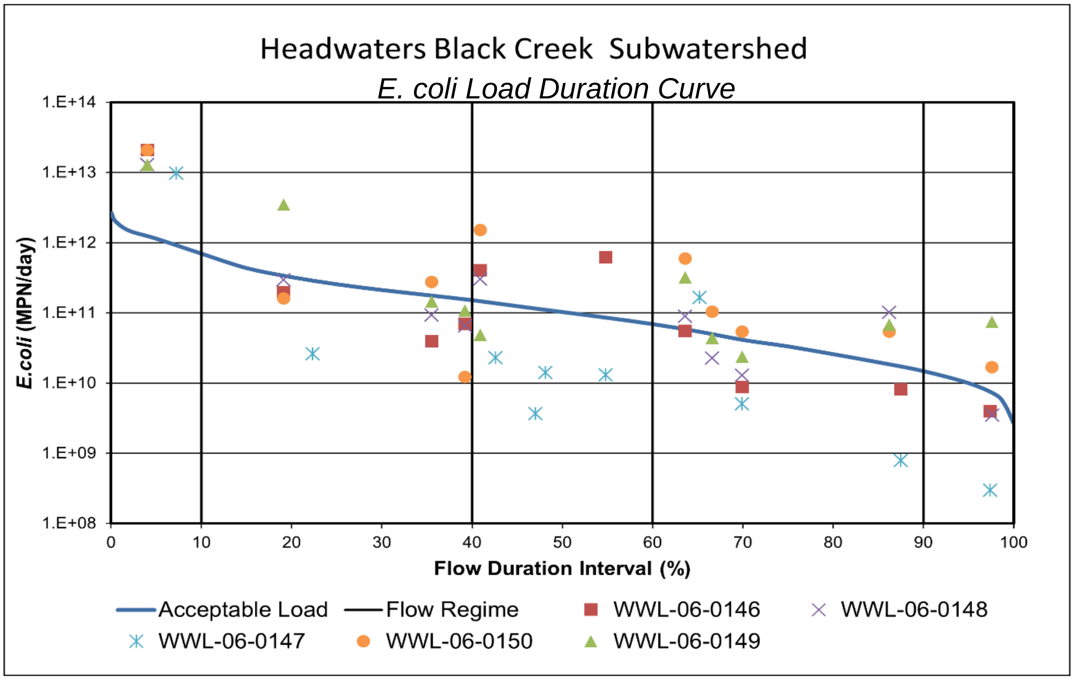

Figure 51: *E. coli* Load Duration Curve for Headwaters Black Creek Subwatershed

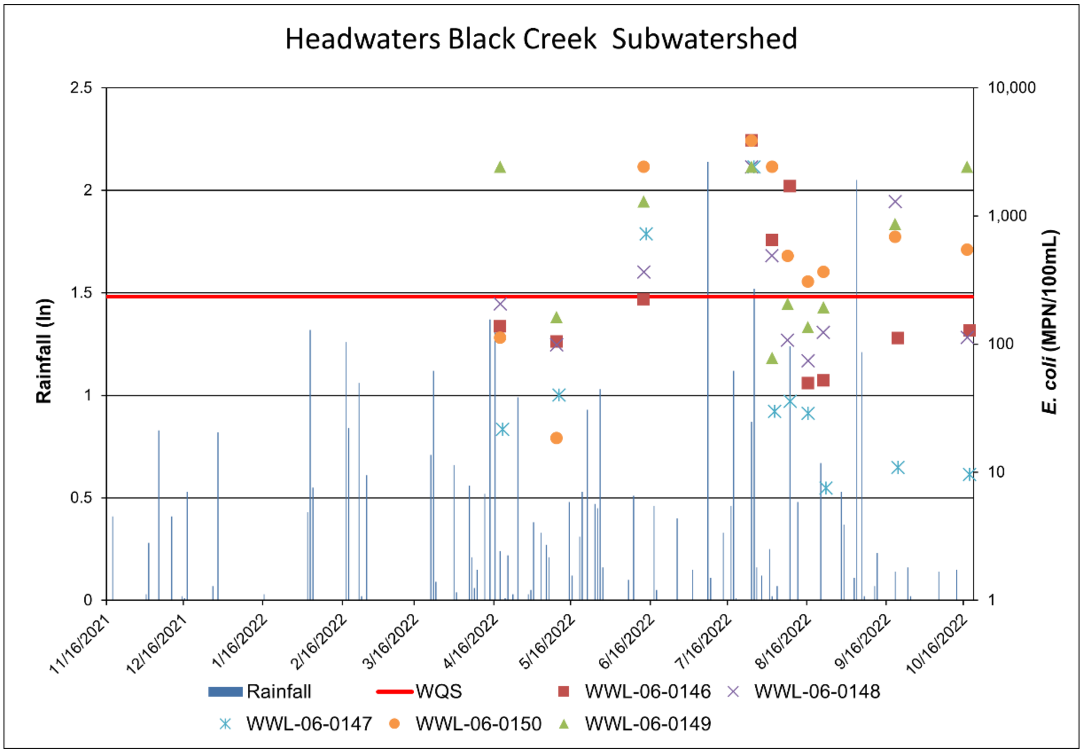

Figure 52: Graph of Precipitation and *E. coli* Data at Headwaters Black Creek Subwatershed

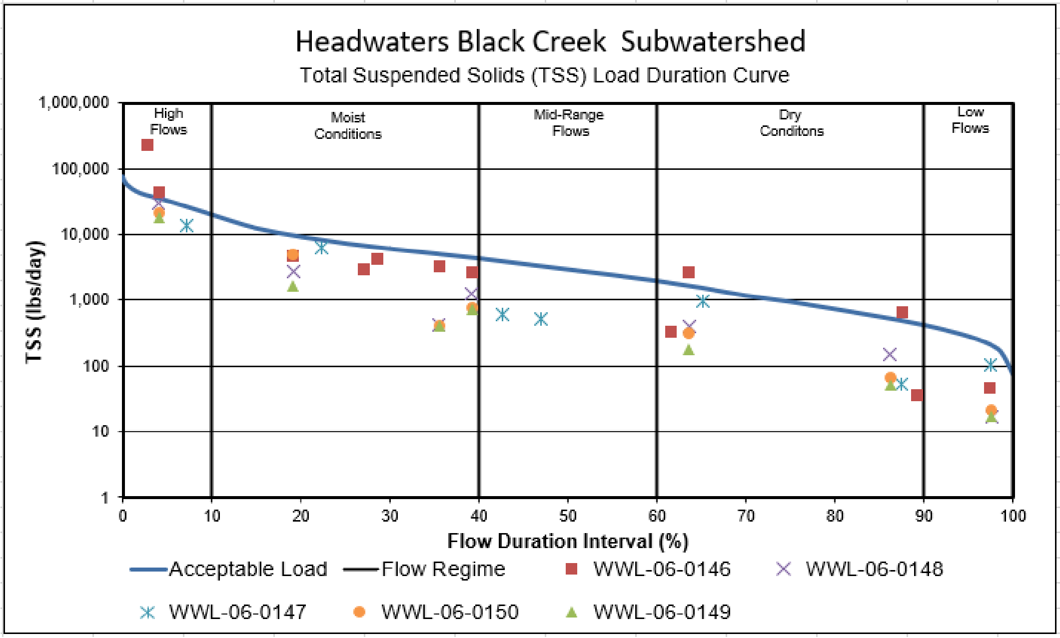

Figure 53: TSS Load Duration Curve for Headwaters Black Creek Subwatershed

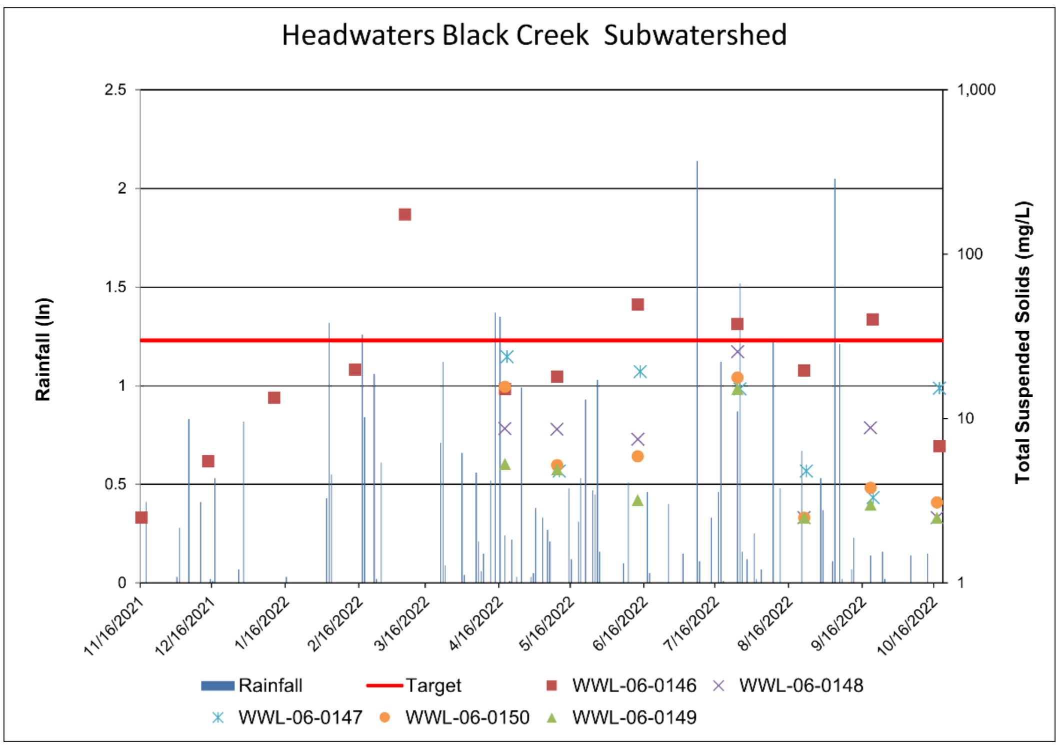

Figure 54: Graph of Precipitation and TSS Data at Headwaters Black Creek Subwatershed

4.2.5 Singer Ditch

The Singer Ditch subwatershed drains approximately 132 square miles with an actual land area of approximately 23 square miles. Singer Ditch subwatershed drains into Black Creek in the southernmost portion of the watershed. The land use is primarily agriculture (59 percent), followed by forested land (23 percent) and pasture/hay (8 percent). There are two NPDES permitted facilities in the subwatershed: Sandborn Water Department Treatment Plant (IN0064203) and Peabody Midwest Mining LLC Bear Run Mine (ING040239). 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 is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 8 percent pastureland, a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

There were four sampling sites within this subwatershed: T01, T02, T03, and T04. While sample site T05 is represented in Figure 55 within the Singer Ditch Subwatershed boundary, for the purposes of this TMDL, T05 was sampled for Calico Slash Ditch Subwatershed. In 2021 and 2022, site T01 was sampled 15 times. Site T01 on Black Creek did not meet the water quality standard for *E. coli* as 7/10 samples taken for *E. coli* exceeded the single sample max and its *E. coli* geomean was 601.83 cfu/100ml. *E. coli* water quality samples from site T01 used to calculate the geomean were taken on the same day approximately one hour apart for five consecutive weeks.

Sites T02, T03, and T04 were each sampled 10 times, and each passed single sample water quality standards for *E. coli*. Site T02 on Singer Ditch had a geomean of 151.22 cfu/100ml with 1/10 samples exceeding the single sample max for *E. coli*. Site T03 on Hill Ditch had a geomean of 74.03 cfu/100ml with 1/10 samples exceeding the single max for *E. coli.* Site T04 on Singer Ditch had a geomean of 136.92 cfu/100ml with 2/10 samples exceeding the single sample max for *E. coli.* The *E. coli* water quality samples from sites T02, T03, and T04 used to calculate the geomean were taken on the same day approximately one hour apart for five consecutive weeks.

The fish community IBI score for site T01 was 42 (fair) and the QHEI was 48 (poor). The macroinvertebrate community mIBI score was 36 (fair) and the QHEI was 44 (poor). The fish community IBI score for site T02 was 32 (poor) and the QHEI was 40 (poor). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 38 (poor). The fish community IBI score for site T03 was 46 (good) and the QHEI was 29 (poor). The macroinvertebrate community mIBI score was 34 (fair) and the QHEI was 20 (poor). The fish community IBI score for site T04 was 34 (poor) and the QHEI was 32 (poor). The macroinvertebrate community mIBI score was 34 (poor) and the QHEI was 21 (poor).

Evaluation of TSS monitoring data and QHEI substrate and bank erosion/riparian zone metric scores indicate a linkage between siltation and biological communities impairments in the Singer Ditch subwatershed. The siltation at each of these sites ranged from moderate to severe with silt as a primary substrate was observed at most of them. Most of these sites also had heavy bank erosion, narrow to very narrow riparian widths, and a flood plain that was open pasture or croplands. Therefore, a TMDL for TSS was developed for this subwatershed to address the IBCs.

There are approximately 42.11 miles of streams in the subwatershed. Based on IDEM data collected in 2021 and 2022, there will be 19.58 stream miles impaired for *E. coli* (T01, T02, and T04) and 30.94 stream miles impaired for IBC (T02, T03, and T04). These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. There are an additional 8.3 stream miles impaired for *E. coli* from the 2022 303(d) List of Impaired Waters, for a total of 27.88 stream miles impaired for *E. coli*. Therefore, TMDLs have been developed to address all *E. coli* and IBC impairments in this subwatershed. The load duration curves for the Singer Ditch subwatershed are shown in Figure 56 and Figure 58. Table 40 provides a summary of the Singer Ditch subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, CFOs, as well as LA, WLAs, and MOS values for *E. coli and TSS*.

A precipitation graph (Figure 57 and Figure 59) and a water quality duration graph (Appendix D) were created to further analyze potential sources. Elevated levels of pollutants during precipitation events could indicate that streams are susceptible to high loads of *E. coli* and TSS from run-off. It should be noted that elevated levels of pollutants can only be attributed to individual precipitation events when sampling events concur with precipitation events. While there were instances of elevated levels of pollutants that could be attributed to a precipitation event, there were also several instances of elevated levels of pollutants during drier conditions. This indicates point sources may also be contributing in addition to nonpoint sources. Sandborn Water Department Treatment Plant (IN0064203) is permitted to discharge a monthly average of 20 mg/L TSS and is not permitted to discharge *E. coli*. Sandborn Water Department Treatment Plant had no permit violations for TSS within the Singer Ditch subwatershed during the time of sampling. Peabody Midwest Mining LLC Bear Run Mine (ING040239) is permitted to discharge a monthly average of 70 mg/L TSS, according to NPDES permit standards, and does not discharge *E. coli*. Peabody Midwest Mining LLC Bear Run Mine had no permit violations for TSS within the Singer Ditch subwatershed during the time of sampling. The water quality duration graph, as well as limited permitted sources, indicate the majority of sources of *E. coli* and TSS in this subwatershed are nonpoint sources. Nonpoint sources of *E. coli* may include wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and leaking and failing septic systems. Nonpoint sources of TSS may include agricultural practices, streambank erosion, and stormwater run-off.

To achieve necessary load reductions for TSS and *E. coli*, implementation in the Buck Creek subwatershed should primarily focus on best management practices (BMPs) that have an impact throughout high, moist, mid-range, and dry flow regimes. See Section 6.1 and Table 44 for information pertaining to potentially suitable BMP selection for the Black Creek watershed.

Table 40: Summary of Singer Ditch Subwatershed Characteristics

Singer Ditch (051202020605)					
Drainage Area	132.33 square miles				
Surface Area	23.36 square miles				
Site # [IDEM Station ID]	T01 [WWL-06-0130], T02 [WWL-06-0131], T03 [WWL-06-0151], T04 [WWL-06-0133]				
Listed Segments	INW0265_03, INW0265_T1004, INW0265_T1002, INW0265_T1003				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 59% Forested Land: 23% Developed Land: 6% Open Water: 3% Pasture/Hay: 8% Grassland/Shrubs: 0% Wetland: 1%				
NPDES Facilities	Sandborn Water Department Treatment Plant (IN0064203), Peabody Midwest Mining LLC Bear Run Mine (ING040239)				
CAFOs	NA				
CFOs	NA				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	6.56E+11	1.47E+11	5.91E+10	1.92E+10	5.77E+09
WLA (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MOS (10%)	7.72E+10	1.73E+10	6.95E+09	2.25E+09	6.79E+08
Future Growth (5%)	3.86E+10	8.64E+09	3.48E+09	1.13E+09	3.40E+08
Upstream Drainage Input	3.61E+12	8.20E+11	3.39E+11	1.19E+11	4.59E+10
TMDL = LA+WLA+MOS	4.39E+12	9.93E+11	4.08E+11	1.42E+11	5.27E+10
TMDL Total Suspended Solids Allocations (lbs/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	18,303.01	4,097.89	1,650.33	534.74	160.66
WLA	154.03	34.63	13.18	4.51	1.78
MOS (10%)	2,171.42	486.18	195.71	63.44	19.11
Future Growth (5%)	1,085.71	243.09	97.85	31.72	9.56

Upstream Drainage Input	101,709.87	23,083.32	9,531.01	3,359.98	1,291.75
TMDL = LA+WLA+MOS	123,424.03	27,945.11	11,488.08	3,994.38	1,482.87
WLA (Individual)					
Sandborn Water Department PWS	0.83	0.83	0.83	0.83	0.83
Peabody Midwest Bear Run Mine	148.77	32.82	12.35	3.68	0.95
Construction Stormwater	4.43	0.98	0.00	0.00	0.00

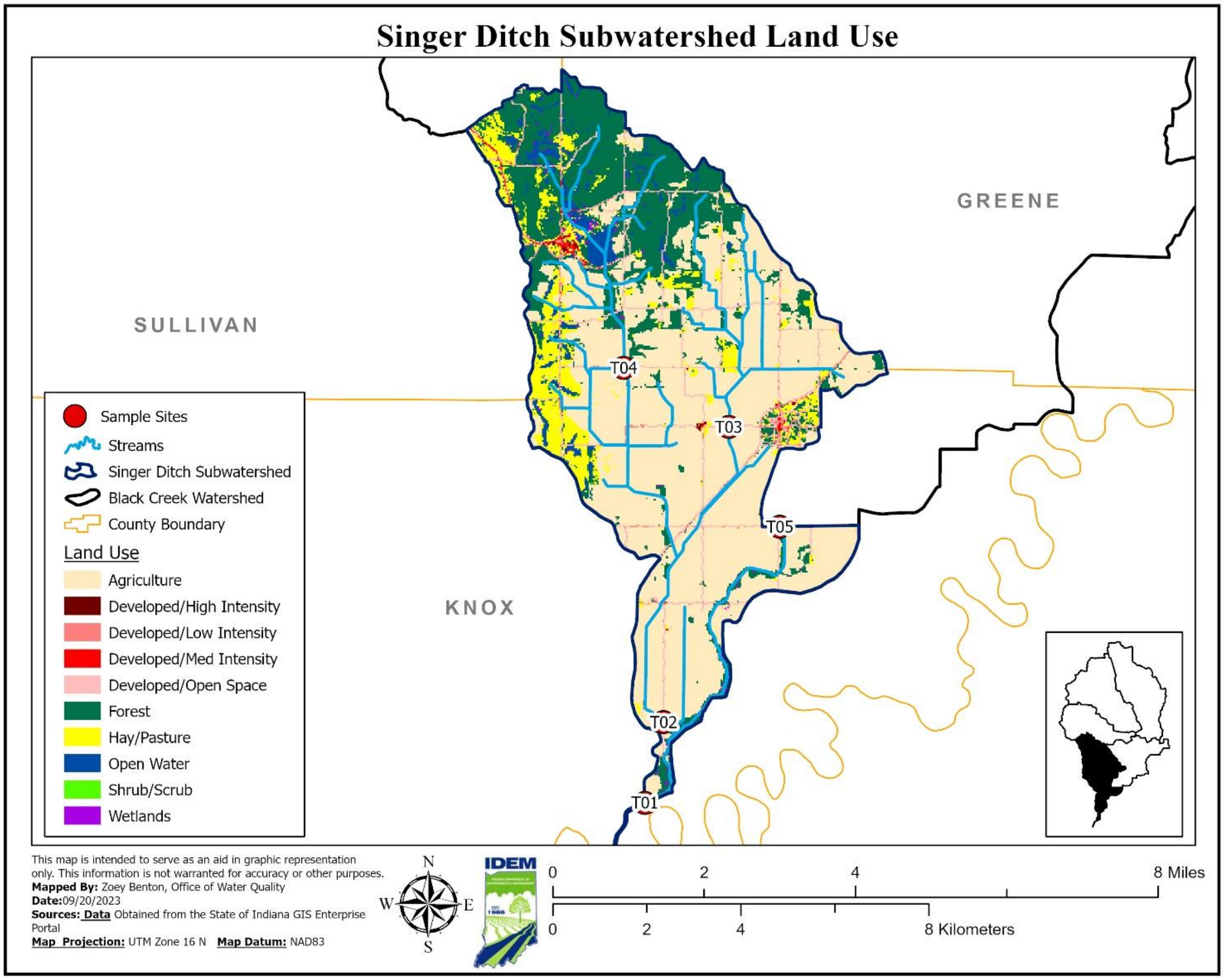

Figure 55: Sampling Stations in Singer Ditch Subwatershed

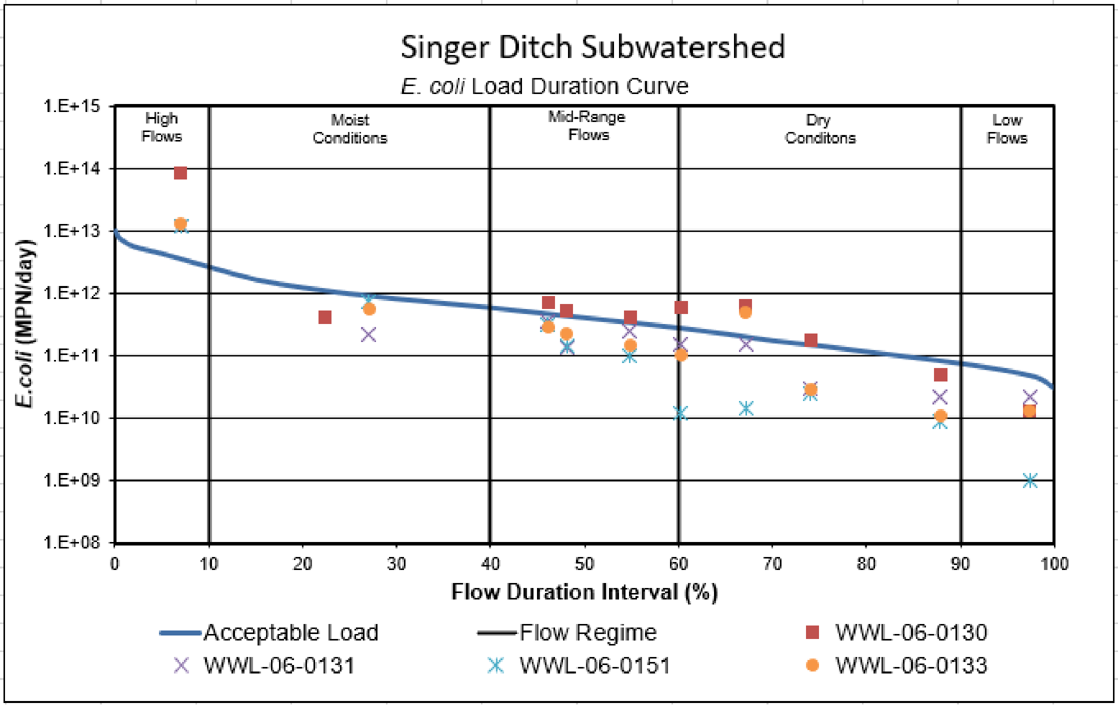

Figure 56: *E. coli* Load Duration Curve for Singer Ditch Subwatershed

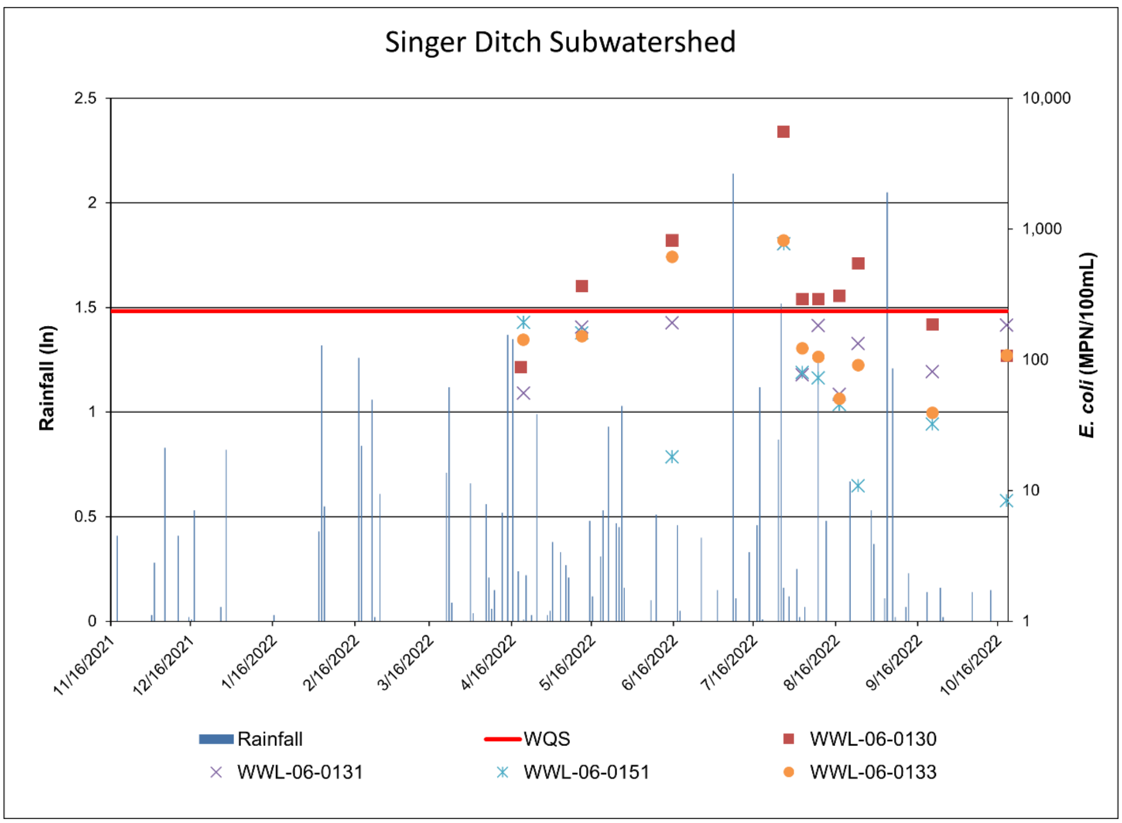

Figure 57: Graph of Precipitation and *E. coli* for Singer Ditch Subwatershed

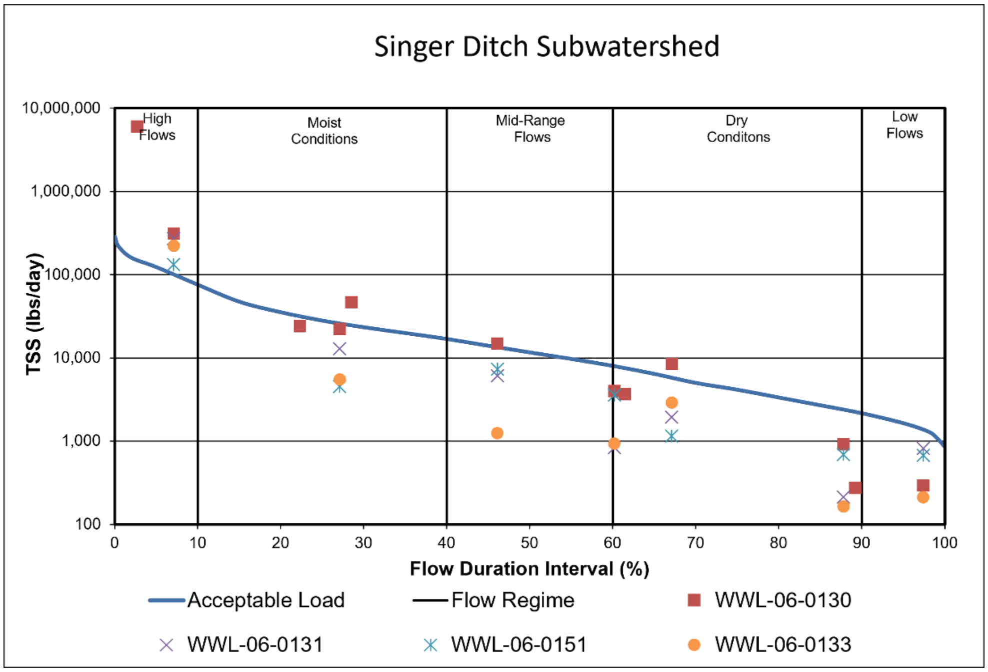

Figure 58: TSS Load Duration Curve for Singer Ditch Subwatershed

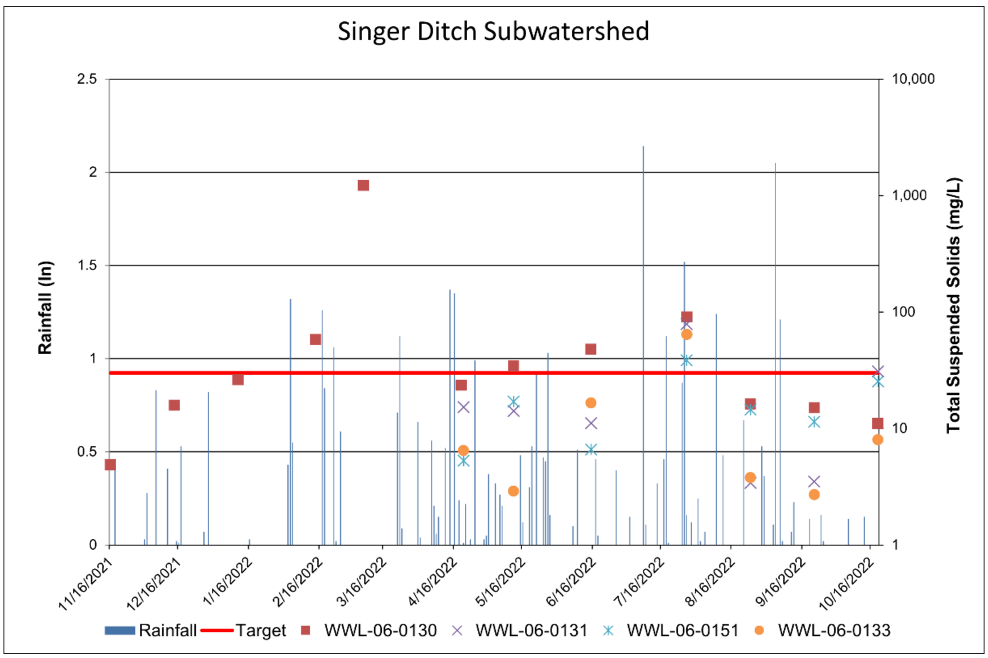

Figure 59: Graph of Precipitation and TSS for Singer Ditch Subwatershed

5.0 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:

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

5.1 Individual Allocations

This section presents the allowable pollutant loads and associated allocations for each of the subwatersheds and associated assessment units in the Black Creek watershed. Allocations were calculated for each 12-digit HUC (subwatershed). WLAs are typically calculated based on the design flow or estimated flow of the facility and the TMDL target or applicable permit limit. The following tables presents the individual WLAs for NPDES facilities in the Black Creek watershed by subwatershed.

Table 41: Individual WLAs for NPDES Individual Permit Municipal and Industrial Facilities in the Black Creek Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Flow Regime	Estimated Design Flow (MGD)	*E. coli* WLA (MPN/day)	NPDES Permit *E. coli* Limit	TSS WLA (lbs/day)	NPDES Permit TSS Limit	TP WLA (lbs/day)	NPDES Permit TP Limit
Buck Creek	Linton WWTP	IN0020575	INW0262_04	Beehunter Ditch	All	2.15	1.91E+10	235 MPN/100 mL Daily Max.	538.16	18 mg/L Monthly Summer Avg. 30 mg/L Monthly Winter Avg.	7.68 (Low and dry flows only) – 12.52	1.0 mg/L Monthly Avg.
	Countrymark Cooperative Switz City Terminal	ING340064	INW0262_T1004	Buck Creek	All	0.0557 (Average facility flow in 2022)	NA	NA	13.94	30 mg/L Monthly Avg.	NA	NA
	Triad Mining LLC	ING040102	NA	NA	High	NA	NA	NA	62.76	70 mg/L daily max.	NA	NA
					Moist				14.86			
					Mid				6.61			
					Dry				2.85			
					Low				1.59			
Headwaters Black Creek	Peabody Midwest Mining LLC	ING040239	INW0261_T1009A, INW0261_T1010A	Tributary of Black Creek	High	NA	NA	NA	3,140.15	70 mg/L daily max	NA	NA
					Moist				694.27			
					Mid				262.5			
					Dry				79.55			
					Low				22.03			
Brewer Ditch			INW0263_T1005	Spencer Creek	High				4,691.41	70 mg/L daily max		
					Moist				1,037.24			
					Mid				392.17			
					Dry				118.84			
					Low				32.92			

Singer Ditch			INW0265_T1 003	Singer Ditch	High				148.77	70 mg/L daily max		
					Moist				32.82			
					Mid				12.35			
					Dry				3.68			
					Low				0.95			
	Sandborn Water Department PWS	IN0064203	INW0265_T1 002	Langsford Ditch	All	0.005	NA	NA	0.83	20 mg/L Monthly Avg.	NA	NA
Calico Slash Ditch	Sandborn WWTP	IN0062685	INW0264_05	Black Creek	All	0.066	5.87E+08	235 MPN/100 mL Daily Max	16.52	30 mg/L Monthly Avg	NA	NA

Understanding Table 41: The WLA for each NPDES permitted facility will be achieved through compliance with the facility's NPDES individual permit.

5.1.1 Approach for Calculating General Permit Waste Load Allocations

A number of permittees in the Black Creek watershed have general rather than individual permits. An individual permit is site-specific and is developed to address discharges from a specific facility. A general permit is used to cover a category of similar discharges, rather than a specific site. IDEM may issue a general permit when there are several sources or activities involved in similar operations that may be adequately regulated with a standard set of conditions. Calculating WLAs for facilities with individual permits is straightforward; all the necessary information regarding allowable flows and effluent limits is contained within the permit. Calculating WLAs for facilities with general permits is more difficult because only limited information is available on historical flow and pollutant concentrations.

For example, several outfalls associated with surface mining operations in the watershed are regulated through general permits for treating run-off; discharge is believed to be primarily related to precipitation events rather than a “design” flow as is available for WWTPs. WLAs were therefore calculated by using an estimate of the surface impacts associated with each surface mine operation to determine run-off flow volumes, and existing permit limits were used to calculate allowable loadings. Bonded acres were used to represent estimated surface impacts. By assuming that the total area of permitted land is proportionate to the total area of bonded acres, we can calculate the area of bonded acres within the subwatershed based on the area of permitted land in the subwatershed. To determine the WLA, the estimated surface impact acreage was divided by the total subwatershed acreage and multiplied by the corresponding flow values for the subwatershed to determine flow from the facility. Flow based WLAs were then calculated by multiplying the flow values by the target concentration of 70 mg/L daily maximum.

Table 42: Individual WLA for NPDES General Permit Coal Mining Facilities in the Black Creek Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Estimated Surface Impacts (Acres)	High Flow Regime TSS WLA (lbs/day)	Low Flow Regime TSS WLA (lbs/day)	NPDES Permit TSS Limit
Buck Creek	Triad Mining LLC	ING040239	NA	NA	18	62.76	1.59	70 mg/L daily max
Headwaters Black Creek	Peabody Midwest Bear Run Mine	ING040239	INW0261_T1009A, INW0261_T1010A	Tributary of Black Creek	949	3,215.61	28.12	70 mg/L daily max
Brewer Ditch			INW0263_T1005	Spencer Creek	1415	4,796.57	41.94	70 mg/L daily max
Singer Ditch			INW0265_T1003	Singer Ditch	40	135.20	1.19	70 mg/L daily max

Understanding Table 42: The WLA for each NPDES permitted facility will be achieved through compliance with the facility’s NPDES general permit coverage.

Stormwater run-off associated with construction activity is currently regulated under 327 IAC 15-5, which is commonly referred to as “Rule 5” or the construction stormwater general permit. The WLA for sites regulated under the construction stormwater general permit was determined based on the average annual land disturbance associated with total overall acreage for all sites in the subwatershed. The average annual land disturbance was calculated for each subwatershed using data from permitted constructions sites for the past five years.

Stormwater run-off from certain types of urbanized areas is currently regulated under 327 IAC 15-13, which is commonly referred to as the municipal separate storm sewer system (MS4) general permit.

5.2 Critical Conditions

The CWA requires that TMDLs take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. 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 stormwater discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point sources (e.g., wastewater treatment facilities, livestock in the stream). Table 43 summarizes the general relationship between the five hydrologic zones and potentially contributing sources (the table is not specific to any individual pollutant). Existing loading is calculated as the 90th percentile of measured pollutant concentrations under each hydrologic condition class multiplied by the flow at the middle of the flow exceedance percentile.

For example, in calculating the existing loading under dry conditions (flow exceedance percentile = 60-90 percent), the 75th percentile exceedance flow is *multiplied* by the 90th percentile of pollutant concentrations measured under 60-90th percentile flows. Through the load duration curve approach, it has been determined that load reductions for *E. coli*, TSS, and TP are needed for specific flow conditions. The critical conditions (the periods when the greatest reductions are required) vary by location and are summarized in Table 44. After existing loading and percent reductions are calculated under each hydrologic condition class, the critical condition for each TMDL is identified as the flow condition requiring the largest percent reduction. For example, impacts from point sources 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. The table indicates that critical conditions for pollutants for most locations occur during the dry to moist regimes, and, therefore, implementation of controls should be targeted for these conditions.

Table 43: Relationship between Load Duration Curve Zones and Contributing Sources

Contributing Source Area	Duration Curve Zone				
	High (0%-10%)	**Moist (10%-40%)**	**Mid-Range (40%-60%)**	**Dry (60%-90%)**	**Low (90%-100%)**
Wastewater treatment plants (point source)			L	M	H
Livestock direct access to streams			L	M	H
Wildlife direct access to streams			L	M	H
Pasture management	H	H	M		
On-site wastewater systems/Unsewered areas	L	M	H	H	H
Riparian buffer areas	H	H	M	M	
Stormwater: Impervious	H	H	H		
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M	L	
Bank erosion	H	M	L		

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low) (Modified from An Approach for Using Load Duration Curves in the Development of TMDLs (U.S. EPA, 2007))

Table 44: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition				
		High	Moist	Mid-Range	Dry	Low
E. coli (counts/mL)	Headwaters Black Creek (51202020601)	97%	91%	88%	90%	93%
	Buck Creek (51202020602)	99%	80%	87%	90%	32%
	Brewer Ditch (51202020603)	98%	16%	71%	63%	--
	Calico Slash Ditch (51202020604)	98%	62%	88%	71%	86%
	Singer Ditch (51202020605)	98%	28%	73%	77%	35%
Total Phosphorus (mg/L)	Buck Creek (051202020602)	--	--	--	9%	28%
	Calico Slash Ditch (051202020604)	37%	--	--	--	--
Total Suspended Solids (mg/L)	Headwaters Black Creek (051202020601)	96%	98%	96%	98%	99%
	Buck Creek (051202020602)	81%	92 %	95%	95%	97%
	Brewer Ditch (051202020603)	98%	98 %	97%	98%	99%
	Calico Slash Ditch (051202020604)	88%	94%	96%	96%	97%
	Singer Ditch (051202020605)	93%	96%	97%	97%	98%

Note: -- = No Data Collected in Flow Regime; NA = No reduction needed

Table 43 and Table 44 provide the foundation necessary to identify subwatersheds that are in need of the most significant pollutant reductions to achieve water quality standards in the Black Creek watershed. Using these two tables, along with the Linkage Analysis in Section 4.0, 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 Black Creek watershed for implementation. The tables above focus on the information and data collected and analyzed through the TMDL development process for percent reduction purposes, whereas critical areas take into account other factors for 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. This information can be key to watershed organizations in the process of identifying and selecting critical areas and implementation activities for the purposes of watershed management plan development. IDEM recommends that watershed organizations take the percent reductions into consideration when selecting critical areas for purposes of watershed management planning. By also taking into account different flow regimes, watershed groups will be able to prioritize practices that give them the most efficient load reductions for each critical area that is chosen.

6.0 REASONABLE ASSURANCES/IMPLEMENTATION

This section of the Black Creek watershed TMDL focuses on implementation activities that have the potential to achieve the WLAs and LAs presented in previous sections. 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 *E. coli*, TSS, and TP loads from sources throughout the Black Creek watershed, particularly in the critical areas identified in Section 5.2. 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 Black Creek 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 relevant sources in the Black Creek watershed.

Point Sources

- Public Water Supply
- Surface coal mining facilities
- Illicitly connected straight pipe systems

Nonpoint Sources

- Cropland
- Pastures and livestock operations
- Streambank erosion
- Onsite wastewater treatment systems
- Wildlife
- Urban nonpoint source run-off

6.1 Implementation Activity Options for Sources in the Black Creek Watershed

Keeping the list of significant sources in the Black Creek watershed in mind, it is possible to review the types of BMPs that are most appropriate for the pollutants and the source type. Table 45 provides a list of implementation activities that are potentially suitable for the Black Creek watershed based on the pollutants 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 Table 45 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 45: List of Potentially Suitable BMPs for the Black Creek Watershed

Implementation Activities	Pollutant			Point Sources			Nonpoint Sources						
	Bacteria	Nutrients	Sediment	WWTPs and Industrial Facilities	CAFOs	Illicitly Connected " Straight Pipe" Systems	Cropland	Pastures and Livestock Operations	CFOs	Streambank Erosion	Onsite Wastewater Treatment Systems	Wildlife/Domestic Pets	Urban NPS Run-off
Inspection and maintenance	X	X	X	X	X						X		
Outreach and education and training	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	X			
Riparian forested/herbaceous buffers	X	X	X		X		X	X	X	X		X	
Manure handling, storage, treatment, and disposal	X	X			X				X				
Alternative watering systems	X		X		X			X	X	X			
Stream fencing (animal exclusion)	X	X	X		X			X		X			
Prescribed grazing	X	X	X					X		X			
Conservation easements	X	X	X										
Two-stage ditches		X	X										
Rain barrel		X	X										
Rain garden		X	X										
Porous pavement		X	X										
Stormwater planning and management	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						
Nutrient Management Plan		X					X			X			
Land Reconstruction of Mined Land			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				

Implementation Activities	Pollutant			Point Sources			Nonpoint Sources						
	Bacteria	Nutrients	Sediment	WWTPs and Industrial Facilities	CAFOs	Illicitly Connected " Straight Pipe" Systems	Cropland	Pastures and Livestock Operations	CFOs	Streambank Erosion	Onsite Wastewater Treatment Systems	Wildlife/Domestic Pets	Urban NPS Run-off
Field Border	X	X					X	X	X			X	
Conservation Crop Rotation	X	X	X				X			X			

The information provided in Section 5.2 assisted in the development of Table 45, which provides a more refined suite of recommended implementation activities targeted to the critical flow condition identified in Section 5.2. Watershed stakeholders can use the implementation activities identified in Table 45 for each critical flow condition and select activities that are most feasible in the Black Creek watershed. This table can also help watershed stakeholders to identify implementation activities for critical areas that they select through the watershed management planning process.

6.2 Implementation Goals and Indicators

For each pollutant in the Black Creek 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 provide the information necessary to complete a watershed management plan.

***E. coli* Goal Statement:** The waterbodies (or streams) in the Black Creek watershed should meet the 235 colonies/100 mL daily maximum 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 Black Creek 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 Suspended Solids Goal Statement: The waterbodies (or streams) in the Black Creek 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.

6.3 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 Black Creek watershed. 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 Black Creek watershed.

6.3.1 Federal Programs

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 IDEM Office of Water Quality administers the Section 319 program for the NPS-related projects.

U.S. EPA 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.

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 nonpoint 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 those plans;

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.

HUD Community Development Block Grant Program (CDBG)

The Community Development Block Grant Program (CDBG) is authorized under Title I of the Housing and Community Development (HCD) Act of 1974, as amended. The main objective of the CDBG program is to develop viable communities by helping to provide decent housing and suitable living environments and expanding economic opportunities principally for persons of low- and moderate-income. The U.S. Department of Housing and Urban Development (HUD) provides federal CDBG funds directly to Indiana annually, through the Office of Community and Rural Affairs (OCRA), which then provides funding to small, incorporated cities and towns with populations less than 50,000 and to non-urban counties.

CDBG regulations define eligible activities and the National Objectives that each activity must meet. OCRA is responsible for ensuring projects that receive funding in Indiana are in accordance with the National Objectives and eligible activities.

OCRA is required to develop a Consolidated Plan that describes needs, resources, priorities, and proposed activities to be undertaken. Indiana’s Consolidated Plan includes four goals for prioritizing fund allocations. These goals include: expand and preserve affordable housing opportunities throughout the housing continuum, reduce homelessness and increase housing stability for special needs populations, promote livable communities and community revitalization through addressing unmet community development needs, and promote activities that enhance local economic development efforts. OCRA has funded a variety of projects, including sanitary sewer and water systems.

USDA Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) helps landowners build on their existing conservation efforts while strengthening their operation. Whether they are looking to improve grazing conditions, increase crop yields, or develop wildlife habitat, NRCS can custom design a CSP plan to help them meet those goals. NRCS can help landowners schedule timely planting of cover crops, develop a grazing plan that will improve the forage base, implement no-till to reduce erosion or manage forested areas in a way that benefits wildlife habitat. If landowners are already taking steps to improve the condition of the land, chances are CSP can help them find new ways to meet their goals.

USDA Conservation Reserve Program (CRP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program (CRP) 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.

USDA Conservation Reserve Enhancement Program (CREP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Conservation Reserve Enhancement Program (CREP), an offshoot of CRP, targets high-priority conservation concerns identified by a state and federal funds are supplemented with non-federal funds to address those concerns. In exchange for removing environmentally sensitive land from production and establishing permanent resource conserving plant species, farmers and ranchers are paid an annual rental rate along with other federal and state incentives as applicable per each CREP agreement. Participation is voluntary, and the contract period is typically 10–15 years.

USDA 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.

USDA Farmable Wetlands Program (FWP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees. By restoring farmable wetlands, FWP improves groundwater quality, helps trap and break down pollutants, prevents soil erosion, reduces downstream flood damage, and provides habitat for water birds and other wildlife. Wetlands can also be used to treat sewage and are found to be as effective as “high tech” methods. The Farm Service Agency runs the program through the Conservation Reserve Program (CRP) with assistance from other government agencies and local conservation groups.

USDA 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.

USDA Section 504 Home Repair Program

USDA Rural Development administers the Section 504 Home Repair Program, or Single-Family Housing Repair Loans and Grants. The Section 504 Home Repair Program provides loans to very low-income homeowners to repair, improve, or modernize their home and provides grants to elderly very low-income homeowners to remove health and safety hazards. The purpose of this program is to help families stay in their own home and keep their home in good repair. Applicants must live in a rural area below 50 percent of the area median income. Grant applicants must be age 62 or older and unable to repay a repair loan. Loans may be used to repair, improve, or modernize homes or to remove health and safety hazards. Grants must be used to remove health and safety hazards. For example, repairing a failed septic system may be an applicable health and safety hazard. The maximum loan amount is $20,000, and the maximum grant amount is $7,500.

USDA 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 flood-plain management assistance. The focus of these plans is to identify solutions that use land treatment and non-structural measures to solve resource problems.

USDA Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

Agricultural Land Easements protect the long-term viability of the nation’s food supply by preventing conversion of productive working lands to non-agricultural uses. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat, and protection of open space.

Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity, and provide opportunities for educational, scientific, and limited recreational activities.

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 American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland, or grassland protection programs.

Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

USDA Regional Conservation Partnership Program (RCPP)

The Regional Conservation Partnership Program (RCPP) encourages partners to join in efforts with producers to increase the restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales. Through the program, NRCS and its partners help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.

USDA Healthy Forests Reserve Program (HFRP)

The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HRFP aids the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration.

HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Some landowners may avoid regulatory restrictions under the Endangered Species Act by restoring or improving habitat on their land for a specified period of time.

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

The Voluntary Public Access and Habitat Incentive Program (VPA-HIP) is a competitive grants program that helps state and tribal governments increase public access to private lands for wildlife-dependent recreation, such as hunting, fishing, nature watching, or hiking.

State and tribal governments may submit proposals for VPA-HIP block grants from NRCS. These governments provide the funds to participating private landowners to initiate new or expand existing public access programs that enhance public access to areas previously unavailable for wildlife-dependent recreation. Nothing in VPA-HIP preempts liability laws that may apply to activities on any property related to grants made in this program.

U.S. Army Corps of Engineers

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged or fill material into Waters of the United States, including wetlands. Dredge and fill activities are controlled by a permit process administered by the U.S. Army Corps of Engineers and overseen by the U.S. Environmental Protection Agency. In addition, when a project is planned in Indiana that will impact a wetland, stream, river, lake, or other Water of the U.S., the Indiana Department of Environmental Management (IDEM) must also issue a Section 401 Water Quality Certification. A Section 401 WQC is a required component of a federal permit and must be issued before a federal permit or license can be granted. Depending on the extent of impact, mitigation may be required to offset the impacts. Stream and wetland mitigation is usually conducted onsite or offsite within the same 8-digit HUC watershed.

Coal mining often results in wetland and stream impacts that require permits from the U.S. Army Corps of Engineers and IDEM due to the significant land disturbing activities associated with operations. There are two coal mining operations that discharge within the Black Creek watershed, as discussed in Section 2.8.2. Four stream segments located within Black Creek watershed have been impacted by the Bear Run Mine surface mining activity. The stream segments include Tributary of Black Creek (INW0261_T1010A, INW0261_T1009A), Spencer Creek (INW0263_T1005), and Singer Ditch (INW0265_T1003). These stream impacts are permitted through the U.S. Army Corps of Engineers (LRL-2022-1117-GJD) and IDEM (2011-487-77-DDC-A). Available plans indicate these stream segments will likely be mitigated onsite in a similar location as the original stream channels. Mining operations take several years to complete, so mitigation is often phased over the course of several years. Additional stream and wetland impacts within the watershed are likely as coal mining operations move and expand. As stream and wetland mitigation is planned and constructed, there is a potential for partnerships between the local community, coal mining facilities, and regulatory agencies for mitigation of streams and wetlands to improve water quality and address impairments in the Black Creek watershed.

6.3.2 State Programs

IDEM Point Source Control Program

Point source pollution is regulated by several IDEM Office of Water Quality branches, including the Wastewater Compliance Branch, the Wastewater Permitting Branch, and the Surface Water, Operations, and Enforcement Branch. The Wastewater Permitting Branch issues NPDES and construction permits to sources that discharge wastewater to streams, lakes, and other waterbodies, including municipal wastewater treatment plants and industrial wastewater dischargers. The Stormwater Program, which is managed under the Surface Water, Operations, and Enforcement Branch, issues NPDES permits for stormwater discharges associated with industrial activities, active construction that results in a land disturbance of an acre or more, and municipal separate storm sewer systems (MS4). NPDES permits are issued in accordance with the Clean Water Act, federal laws, and state laws and regulations. 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. The Wastewater Compliance Branch and Stormwater Program conduct inspections of facilities and projects with NPDES permits and review and evaluate compliance data to ensure permittees abide by the requirements of their permit. Control of discharges from point sources consistent with WLAs are implemented through the respective NPDES program.

IDEM 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 U.S. EPA, with U.S. EPA reserving the right to make final changes to the list. Actual funding depends on approval from U.S. EPA 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 managers 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.

IDEM Hoosier Riverwatch Program

Hoosier Riverwatch (HRW) is a statewide volunteer stream water quality monitoring program administered by the IDEM Office of Water Quality, Watershed Assessment and Planning

Branch. The mission of HRW is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources and to increase public awareness of water quality issues and concerns. HRW accomplishes this through watershed education, hands-on training of volunteers, water monitoring, and clean-up activities. HRW 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.

ISDA Division of Soil Conservation

The Indiana State Department of Agriculture (ISDA) 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.

ISDA Clean Water Indiana (CWI) Program

The ISDA Division of Soil Conservation administers the Clean Water Indiana (CWI) program under the direction of the State Soil Conservation Board. The CWI program provides financial assistance to landowners and conservation groups to support the implementation of conservation practices which will reduce nonpoint sources of water pollution through education, technical assistance, training, and cost sharing programs. The program is responsible for providing local matching funds, as well as competitive grants for sediment and nutrient reduction projects through Indiana's SWCDs.

ISDA INfield Advantage (INFA) Program

The ISDA Division of Soil Conservation administers Infield Advantage (INFA). INFA is a collaborative opportunity for farmers to collect and understand personalized, on-farm data to optimize their management practices. Participating farmers use precision agricultural tools and technologies, such as aerial imagery and the corn stalk nitrate test, to conduct research on their own farms to determine nitrogen use efficiency in each field that they enroll. Peer to peer group discussions, local aggregated results, and collected data allow participants to make more informed decisions and implement personalized best management practices. INFA is available to farmers as a resource and a conduit to diverse on-farm research, innovative ideas, and technologies. INFA collaborates with local, regional, and national partners to help Indiana farmers improve their bottom line, adopt new management practices, protect natural resources, and benefit their surrounding communities.

IDNR Lake and River Enhancement (LARE) Program

The Lake and River Enhancement program is part of the Aquatic Habitat Unit of the Fisheries Section in the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife.

The goal of the LARE program is to protect and enhance aquatic habitat for fish and wildlife and to ensure the continued viability of Indiana’s publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce nonpoint source sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards. The LARE program provides technical and financial assistance to local entities for qualifying projects that improve and maintain water quality in public access lakes, rivers, and streams.

IFA State Revolving Fund (SRF) Loan Program

The SRF is a fixed rate, 20-year loan administered by the Indiana Finance Authority (IFA). 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 nonpoint source projects that are tied to a wastewater loan. Any project where there is an existing pollution abatement need is eligible for SRF funding.

6.3.3 Local Programs

Programs taking place at the local level are key to successful TMDL implementation. While the Greene County SWCD is the organization sponsoring the Black Creek Watershed Project, partners such as Knox, Daviess and Sullivan SWCDs are instrumental to bringing grant funding into the Black Creek watershed to support local protection and restoration projects. Knox and Sullivan County SWCDs are within the Black Creek Watershed boundary, while the Daviess County SWCD is not. This section provides a brief summary of the local programs taking place in the Black Creek watershed that will help to reduce pollutant loads, as well as provide ancillary benefits to the Black Creek watershed.

Local groups frequently conduct monitoring in watersheds with watershed management plans to engage the public through Hoosier Riverwatch volunteer monitoring events and through more formal monitoring efforts to determine if implementation activities have been successful in reducing nonpoint source pollutant loads. After best management practices are implemented by local groups, IDEM may also conduct performance monitoring at specific sites in the watershed through the Targeted Monitoring Program. Data collected through performance monitoring is compared to water quality standards and targets, as discussed in Section 1.0, to determine if previously impaired waterbodies can be delisted from the Section 303(d) List of Impaired Waters.

Greene, Knox, and Sullivan counties are all active in obtaining funding and implementing projects in their respective watersheds to improve water quality. All counties conduct an annual tillage/cover crop transect. In 2020, Knox County led a multi-county Reclaimed Mined Lands Regional Conservation Partnership Program (RCPP) through NRCS that included Greene, Knox, and Sullivan counties. All three counties are partnered with NRCS to provide technical and administrative assistance for Farm Bill conservation programs. In addition, there are active and upcoming 319 grants in nearby watersheds located in all three counties that will be beneficial for the promotion of water quality initiatives and public awareness.

Greene County
Greene County has received the following funding to improve water quality and conservation in 2023:

Conservation Reserve Program & Conservation Reserve Enhancement Program: $350,000

Conservation Stewardship Program: $85,000

Environmental Quality Incentives Program: $700,000

Total: $1,135,000

Sullivan County
Sullivan County has received the following funding to improve water quality and conservation in 2023:

Conservation Reserve Program & Conservation Reserve Enhancement Program: $350,000

Conservation Stewardship Program: $85,000

Environmental Quality Incentives Program: $700,000

Total: $1,135,000

Knox County
Knox County has received the following funding to improve water quality and conservation in 2023:

Conservation Reserve Program & Conservation Reserve Enhancement Program: $46,670

Total: $46,670

6.4 Implementation Programs by Source

Section 6.3 identified a number of federal, state, and local programs that can support implementation of the recommended management or restoration activities for the Black Creek watershed. Table 46 and the following sections identify which programs are relevant to the various sources in the Black Creek watershed.

Table 46: Summary of Programs Relevant to Sources in the Black Creek Watershed

Source	IDEM NPDES program	Local agencies/programs	CWA 319(h) Grants	CWA 205(j) Grants	ISDA Division of Soil Conservation (INFA & CWI)	IDNR Division of Fish and Wildlife (LARE)	IFA State Revolving Fund (SRF) Loan Program)	HUD Community Development Block Grant Program (CDBG)	USDA Conservation Stewardship Program (CSP)	USDA Conservation Reserve Program (CRP)	USDA Conservation Reserve Enhancement Program (CREP)	USDA Conservation Technical Assistance (CTA)	USDA Environmental Quality Incentives Program (EQUIP)	USDA Farmable Wetlands Program	USDA Agricultural Conservation Easement Program (ACEP)	USDA Regional Conservation Partnership Program (RCPP)	USDA Healthy Forests Reserve Program (HFRP)	USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)	USDA Watershed Surveys and Planning	USDA Section 504 Program
Municipal & Industrial Wastewater	X			X			X													
Regulated Stormwater	X			X			X													
Illicitly Connected "Straight Pipe" Systems	X	X		X				X												
Cropland		X	X	X	X	X			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	X	X	X	X	X	
CFOs	X			X		X														
Streambank Erosion		X	X	X	X	X						X	X	X	X	X		X	X	
Onsite Wastewater Treatment Systems		X		X			X	X												X
In-stream Habitat	X	X	X																	

6.4.1 Point Source Programs

Municipal Wastewater Treatment Plants (WWTPs)

Municipal Wastewater Treatment Plants (WWTPs) that discharge wastewater through a point source to a surface water of the state are required to obtain a municipal NPDES wastewater permit. Municipal wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving waterbody and/or any more stringent technology-based limitations. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Industrial Wastewater

Industrial facilities that discharge wastewater through a point source to a surface water of the state are required to obtain an industrial NPDES wastewater permit. Industrial wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving waterbody and/or any more stringent technology-based limitations. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Construction Stormwater

Stormwater run-off associated with construction activity is currently regulated under 327 IAC 15-5, which is commonly referred to as “Rule 5” or the construction stormwater general permit. The construction stormwater general permit requires the development and implementation of a construction plan that includes a stormwater pollution prevention plan (SWPPP). The SWPPP 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. The primary pollutant of concern from active construction sites is sediment, or TSS. TSS TMDLs were developed to address IBCs in the Buck Creek, Calico Slash Ditch, Headwaters Black Creek, Singer Ditch, and Brewer Ditch subwatersheds. Identification of impaired waters with TMDLs, specifically those with TSS TMDLs, in the SWPPP is recommended to ensure adequate stormwater control measures are implemented to minimize discharges of sediment to impaired waters. It is assumed that permitted construction sites that are in compliance with the construction stormwater general permit meet the requirements of the TMDL. However, in order to ensure sediment-laden stormwater discharges from construction sites to impaired waters with TMDLs are minimized, implementation of additional measures may be considered, such as:

> Identify any waterbodies within the project site that have a U.S. EPA approved or established TMDL, including the name of the TMDL and pollutant(s) for which there is a TMDL.
>
> Increase self-monitoring in locations on the project site that discharge to impaired waters with TSS TMDLs.

Improve construction sequencing to limit the amount of exposed soil at any given time as much as possible throughout the project.

Increase frequency of stabilization of areas that are void of vegetative cover. When an area is left idle for seven days initiate stabilization. Stabilization includes permanent stabilization with structured armor, permanent seed mixes, or temporary seed mixes.

Place signage or easily identifiable barriers, such as orange safety fencing, near impaired waters to alert construction crews of the sensitive resource.

Increase the maintenance schedule of measures installed adjacent to impaired waters with TSS TMDLs to promote effective sediment removal.

Industrial Stormwater

Stormwater run-off associated with industrial activity is currently regulated under 327 IAC 15-6, which is commonly referred to as “Rule 6” or the industrial stormwater general permit. Facilities may also be required to obtain an individual stormwater permit as discussed in Section 2.8.3. There are currently no facilities in the Black Creek watershed that have coverage under the industrial stormwater general permit or an individual stormwater permit.

Municipal Separate Storm Sewer Systems (MS4)

Stormwater run-off from certain types of urbanized areas are required to obtain permit coverage under the MS4 general permit. There are currently no MS4s in the Black Creek watershed that have coverage under IDEM’s MS4 general permit.

CAFOs

CAFOs are point sources regulated through the NPDES Program. Indiana regulations for CAFOs can be found in 327 IAC 15-15 and federal regulations for all CAFOs can be found in 40 CFR Parts 9, 122, and 412. The Effluent Limitations Guidelines and New Source Performance Standards for CAFOs require, in general, zero discharge from these areas and require proper design, construction, operation, and maintenance of the structures to contain all manure, litter, and process wastewater including the run-off and direct precipitation from a 25-year, 24-hour rainfall event. The NPDES general permit also requires that water quality standards shall not be exceeded in the event of an overflow from production areas. There are no CAFOs in the Black Creek watershed.

Examples of requirements for CAFO operators include

weekly inspections of waste storage facilities

develop a Soil Conservation Practice Plan for all manure application sites controlled by the CAFO

develop a Stormwater Pollution Prevention Plan for the area immediately around the production barns submit an annual report to IDEM

adjust land application rates based on nitrogen and phosphorus

Illegal straight pipes

Local health departments are responsible for locating and eliminating illicit discharges and illegal connections to the sewer system.

6.4.2 Nonpoint Sources Programs

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(h) Grants

Clean Water Act Section 205(j) Grants

Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)

Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)

USDA Conservation Stewardship Program (CSP)

USDA Conservation Reserve Program (CRP)

USDA Conservation Reserve Enhancement Program (CREP)

USDA Conservation Technical Assistance (CTA)

USDA Environmental Quality Incentives Program (EQIP)

USDA Farmable Wetlands Program

USDA Agricultural Conservation Easement Program (ACEP)

USDA Regional Conservation Partnership Program (RCPP)

USDA Healthy Forests Reserve Program (HFRP)

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

USDA Watershed Surveys and Planning

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(h) Grants

Clean Water Act Section 205(j) Grants

Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)

Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)

USDA Conservation Stewardship Program (CSP)

USDA Conservation Reserve Program (CRP)

USDA Conservation Reserve Enhancement Program (CREP)

USDA Conservation Technical Assistance (CTA)

USDA Environmental Quality Incentives Program (EQIP)

USDA Farmable Wetlands Program

USDA Agricultural Conservation Easement Program (ACEP)

USDA Regional Conservation Partnership Program (RCPP)

USDA Healthy Forests Reserve Program (HFRP)

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

USDA Watershed Surveys and Planning

CFOs

While CAFOs are regulated by federal law, CFOs are not. However, Indiana has CFO regulations 327 IAC 16 and 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.

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 run-off 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 stormwater 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(h) Grants

Clean Water Act Section 205(j) Grants

Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)

Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)

USDA Conservation Technical Assistance (CTA)

USDA Environmental Quality Incentives Program (EQIP)

USDA Farmable Wetlands Program

USDA Agricultural Conservation Easement Program (ACEP)

USDA Regional Conservation Partnership Program (RCPP)

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

USDA Watershed Surveys and Planning

Mitigation Funds

Onsite Wastewater Treatment Systems

Local health departments and the Indiana Department of Health (IDOH) regulate septic systems through local ordinances and the Onsite Sewage Disposal Program (410 IAC 6-8.3). Regulations include constraints on the location and design of current septic systems in an effort to prevent system failures. The onsite sewage system rule also prohibits failing systems, requiring that no system will contaminate groundwater, and no system will discharge untreated effluent to the surface. Programs available to address issues related to failing onsite wastewater treatment systems within a community include:

Clean Water Act Section 205(j) Grants

IFA State Revolving Fund Loan Program

HUD Community Development Block Grant Program (CDBG)

USDA Section 504 Program

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.

6.5 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 47 identifies key potential implementation partners and the type of technical assistance they can provide to watershed stakeholders. IDEM has also 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.

Table 47: Potential Implementation Partners in the Black Creek Watershed

Potential Implementation Partner	Funding Source
Federal	
USDA	Conservation Stewardship Program
USDA	Conservation Reserve Program
USDA	Conservation Reserve Enhancement Program
USDA	Conservation Technical Assistance (technical assistance only)
USDA	Environmental Quality Incentives Program
USDA	Farmable Wetlands Program
USDA	Agricultural Conservation Easement Program
USDA	Regional Conservation Partnership Program
USDA	Healthy Forests Reserve Program
USDA	Voluntary Public Access and Habitat Incentive Program
USDA	Watershed Surveys and Planning
USDA	Section 504 Home Repair Program
HUD	Community Development Block Grant Program
State	
ISDA	Division of Soil Conservation – Clean Water Indiana Program
ISDA	Division of Soil Conservation – INfield Advantage Program
IDNR	Division of Fish and Wildlife - Lake and River Enhancement program
IDEM	Clean Water Act Section 319(h) Grants
IDEM	Clean Water Act Section 205(j) Grants
Local	
Soil and Water Conservation Districts	Local funds
Indiana Karst Conservancy	
County Health Departments	

In addition, several tools are available to assist local watershed stakeholders with the estimation of pollutant load reductions from the implementation of various BMPs within the Black Creek watershed in order to optimize BMP selection. These tools include L-THIA LID, STEPL, the Region 5 Model, and the Indiana *E. coli* Calculator.

The Long-Term Hydrologic Impact Assessment (L-THIA) model is an online tool developed by Purdue University that estimates runoff, recharge, and pollutant loads for land use configurations based on precipitation data, soils, and land use data for an area. The L-THIA LID model is an enhancement to the original model, which can be used to simulate runoff and pollutant loads associated with low impact development (LID) practices at lot to watershed scales. The model can be used as a screening tool to evaluate the benefits of implementation of LID practices. LID practices included in the model include, but are not limited to, grass swales, rain barrel/cisterns, rain gardens, and porous pavement. The L-THIA LID tool is available online at https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php.

The Pollution Load Estimation Tool (PLET) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. PLET provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft Excel. It computes watershed surface runoff, nutrient loads, and sediment delivery based on land use distribution and management practices. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using known BMP efficiencies. The PLET package can be downloaded at https://www.epa.gov/nps/plet. Purdue University has also developed a web-based version of STEPL available at https://engineering.purdue.edu/mapserve/ldc/STEPL/?.

The Indiana *E. coli* Calculator (IEC) is a spreadsheet tool that estimates the *E. coli* contribution from multiple sources and calculates load reductions of BMP installations. The portions of the spreadsheet that calculate *E. coli* contributions are heavily based upon the U.S. EPA's Bacteria Indicator Tool (BIT). The BIT estimates the monthly accumulation rate of fecal coliform bacteria on four land uses (cropland, forest, built-up, and pastureland). The tool also estimates the direct input of fecal coliform bacteria to streams from grazing agricultural animals and failing septic systems. The IEC converts the fecal coliform values of the BIT to *E. coli* through a conversion equation based on Ohio water quality sampling results. The IEC is available in a condensed version as well as an expanded version. The IEC spreadsheet and user guide can be found at https://www.in.gov/idem/nps/watershed-toolkit/planning/.

7.0 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:

A kickoff public meeting was held in Linton, IN on September 14, 2021, to introduce the project and solicit public input. IDEM explained the TMDL process during these meetings, presented initial information regarding the Black Creek watershed, and answered questions from the public. Information was also solicited from stakeholders in the area.

IDEM and Greene County SWCD hosted a water monitoring demonstration on September 8, 2022. The demonstration was held at the Goose Pond Fish and Wildlife Area Visitor Center in Linton, IN. IDEM Staff were onsite to demonstrate their processes for collecting water chemistry samples, fish (through electrofishing techniques), and macroinvertebrate collection. Staff biologists and the TMDL project manager discussed the results of the 2022-2023 sampling of the Black Creek Watershed. The details of the partnership between IDEM and Greene County SWCD were discussed, as well as ways for the public to become involved in future planning efforts.

On April 10, 2023, a notice was posted to the Indiana Register to inform stakeholders of new impairments discovered during the 2021-2022 watershed characterization study in the Black Creek watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2024 303(d) List of Impaired Waters. Public comments were solicited through May 20, 2023. IDEM received no comments regarding the notice.

A draft TMDL public meeting was held in the watershed at Linton Public Library 95 S.E. 1st Street, Linton, IN, 47441 on November 14, 2023, at 6:00 PM. The draft findings of the TMDL were presented at the meeting and the public had the opportunity ask questions and provide information to be included in the final TMDL report. A representative from the Greene County SWCD was in attendance and presented information on the progress of the watershed management plan. A public comment period was from January 2, 2024, to February 2, 2024.

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