VFC Index - Watershed (Plan)

Program: Watershed

IDEM Document Type: Plan

Document Date: 7/7/2021

Security Group: Public

Project Name: WMP for Lower East Fork White River

Plan Type: Watershed Management Plan

HUC Code: 05120208 Lower East Fork White

Sponsor: Pike County SWCD

Contract #: 30630

County: Pike

Cross Reference ID:

Comments: Pike, Dubois, Daviess, Martin

Additional WMP Information

Checklist: 2009 Checklist

Grant type: 319

Fiscal Year: 2018

IDEM Approval Date: 7/7/2021

EPA Approval Date: 6/25/21

Project Manager: Josh Brosmer

WATERSHED MANAGEMENT PLAN
for
LOWER EAST FORK WHITE RIVER

Pike County SWCD
2101 E Main Street
Petersburg, IN 47567
812.354.6120 ext. 3

June 2021

"This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement A305-3-77 to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use."

TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS AND GRAPHS

EXECUTIVE SUMMARY

The overall goal and purpose of the Lower East Fork White River watershed management plan is to provide data and maps to assist local citizens with improving water quality. The major water quality concerns in the watershed and recommended management strategies are addressed in this plan. Water quality management decisions and activities are most effective and efficient when managed at a sub-watershed level; however, the impact on the whole watershed must also be considered. This watershed management plan is a tool to accomplish non-point source (NPS) pollution reductions in the Lower East Fork White River watershed until target concentrations of nutrients and sediment meet state standards and streams are removed from the 303(d) list of impaired waterbodies.

WATERSHED COMMUNITY INITIATIVE

1. PROJECT INITIATION

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) impaired waters list. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual 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:

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

The Lower East Fork White (LEF White) River Watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, Indiana Department of Environmental Management's (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 by *E. coli*, Impaired Biotic Communities (IBC), nutrients, and dissolved oxygen.

The Pike County Soil and Water Conservation District's (SWCD) board of supervisors were already involved in the implementation of a 319 grant for the Middle Patoka watershed in the county, and thus had a watershed coordinator working closely with the IDEM watershed specialist, Josh Brosmer. The Pike SWCD supervisors were advised by their watershed coordinator of the TMDL in the LEF White watershed. The board was immediately interested in being able to implement water quality best management practices (BMPs) in that area of the county alongside the work already being done in the Patoka watershed. The watershed coordinator explained to the Pike board that first a watershed management plan would need to be written and approved by IDEM and EPA prior to any implementation of BMPs so that the BMPs could be targeted to critical areas. The Pike County SWCD board of supervisors then pursued a 319 grant to write a watershed management plan for the LEF White River watershed.

2. LOWER EAST FORK WHITE RIVER STEERING COMMITTEE

Upon the award of a 319 grant from IDEM, the Pike County SWCD hired a watershed coordinator to gather together stakeholders and concerned citizens to form a LEF White steering committee. A stakeholder meeting was held to gather interest in the project. The watershed coordinator used Geographic Information System (GIS) property layers to generate a mailing list of landowners in the watershed. Over 400 landowners were identified and contacted by letter to inform of the project. Newspaper articles were published as well to generate interest in the project.

A stakeholder kickoff meeting was held May 2019 with 33 stakeholders in attendance. Most of those in attendance were interested in the project, but not interested in the quarterly commitment of steering meetings. However, water quality improvements and conservation issues were at the heart of the stakeholders' interest in the project. At this meeting, natural resource concerns were gathered from stakeholders. Table 1 lists the LEF White steering team members committed to the project.

TABLE 1 – LEF WHITE STEERING COMMITTEE	
Julie Loehr, Watershed Coordinator	Lower East Fork White Watershed
Josh Brosmer, Watershed Specialist	IDEM
Brad Smith, Lower Wabash / Wetland program director	The Nature Conservancy
Kyla Estey, district administrator	Pike County SWCD
Megan Frederick, district administrator	Daviess County SWCD
Judi Brown, district administrator	Dubois County SWCD
Teresa Harder, district administrator	Martin County SWCD
Robert Sullender, property manager	Glendale FWA
Shawn Werner, Environmental Health Specialist	Dubois Dept. of Health
Amanda Howald, Environmental Health Specialist	Pike Dept. of Health

3. NATURAL RESOURCE CONCERNS IN THE WATERSHED

On May 6, 2019, a stakeholder kickoff meeting was held at the St. Paul's Lutheran church in Haysville, Indiana. One of the goals of the meeting was to gather natural resource concerns of stakeholders and concerned citizens living or owning land in the watershed. As stated earlier, letters were sent out to those owning property in the watershed as well as media articles published inviting concerned business owners and citizens.

At the meeting, the watershed coordinator led discussion regarding the watershed and the work being done with IDEM and the TMDL. IDEM staff were present to answer questions regarding the TMDL. The watershed coordinator discussed the work of a 319 grant and how the TMDL data would be used to help address critical areas in the watershed.

The watershed coordinator led discussion regarding issues the stakeholders knew about in the watershed. Natural resource concerns were gathered and recorded from the 33 in attendance. After thoughts and comments were heard, a ranking response was handed out with all the concerns in the watershed. Those in attendance were given a chance to rate or rank the natural resource concerns as they felt pertinent to their relationship with the watershed.

A total of 25 ranking survey responses were submitted. Table # 2 shows the natural resource concerns of the stakeholders and their ranking.

TABLE 2 – STAKEHOLDER NATURAL RESOURCE CONCERNS IN WATERSHED	
RANKING	CONCERN
1	Soil Erosion
2	Soil Quality, Soil Productivity, Soil Fertility, Soil Health, Organic Matter
3	Eroding Stream Banks and Lake Shores, Bank Stabilization
4	Flooding and Drainage
5	Water Quality
6	Livestock Management
7	Log Jams
8	Invasive Species
9	Precision Agriculture, Reduction of Traffic, Tillage and Chemicals on Ag Fields
10	Litter, Trash, Debris in Ditches / Streams / Lakes, Illegal Dumping
11	Wildlife Habitat
12	Wetlands (Construction, Restoration, Enhancement)
13	Other – Water Control Structures / Water Retention
14	Pesticide Transportation into Surface and Groundwater
15	Excess Nutrients in Surface and Groundwater
16	Waste Management
17	Forestry and Timber Stand Improvement (TSI)
Tie for 18	Air Pollution
Tie for 18	Petroleum, Heavy Metals and other Pollutants in Surface and Groundwater
Tie for 18	Outdoor Recreation
21	Insufficient Water

WATERSHED INVENTORY (part one)

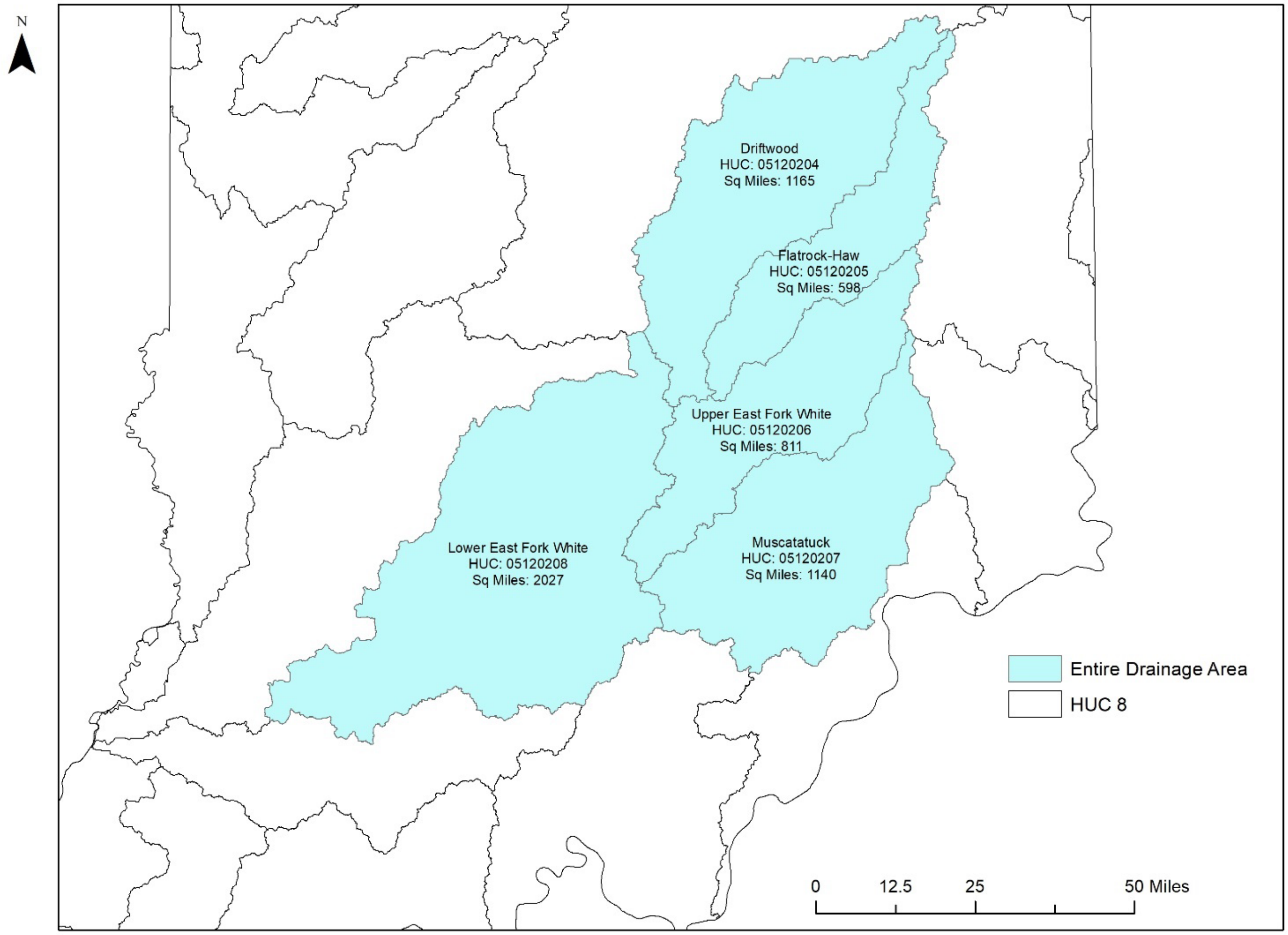
Project Location and Subwatersheds

The Lower East Fork White River Watershed (Hydrologic Unit Code or HUC 0512020815) is located in southwest Indiana and drains a total of 207.42 square miles or 132,748.8 acres. The watershed originates near the southwest corner of Martin County, and then flows west, where it ultimately joins the (west fork) White River, which is considered the main stem, in the northwest corner of Pike County near Petersburg.

Figure 1 on page 16 shows the location of the watershed (shaded black on map) this WMP covers in relation to the rest of the state. However, when looking at the overall drainage area, approximately 5,741 square miles (3,674,880 acres) flow to the LEF White including Driftwood (HUC 0512020204); Flatrock-Haw (HUC 05120205); Upper East Fork White (HUC 05120206) and Muscatatuck (HUC 05120207). Figure 2 on page 17 shows the overall drainage and locations of those upstream watersheds and gives a clearer picture of how this watershed is heavily influenced by being the lowest drainage point of the entire East Fork White.

FIGURE 1 – LOCATION MAP OF LEF WHITE WATERSHED

FIGURE 2 – OVERALL DRAINAGE AREA OF LEF WHITE



The LEF White watershed is comprised of nine subwatersheds at the 12-digit HUC level. Figure 3 shows the LEF White's position in Martin, Dubois, Daviess and Pike Counties, as well as the nine subwatersheds' location within the LEF White and their relationship to one another and with the main channel.

The nine subwatersheds and their HUC codes and size in acres are listed on Table 3 on page 19.

Examining subwatersheds enables an identification of key factors that affect water quality and provides a better understanding of the historic and current conditions 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.

FIGURE 3 – LEF WHITE SUBWATERSHEDS MAP

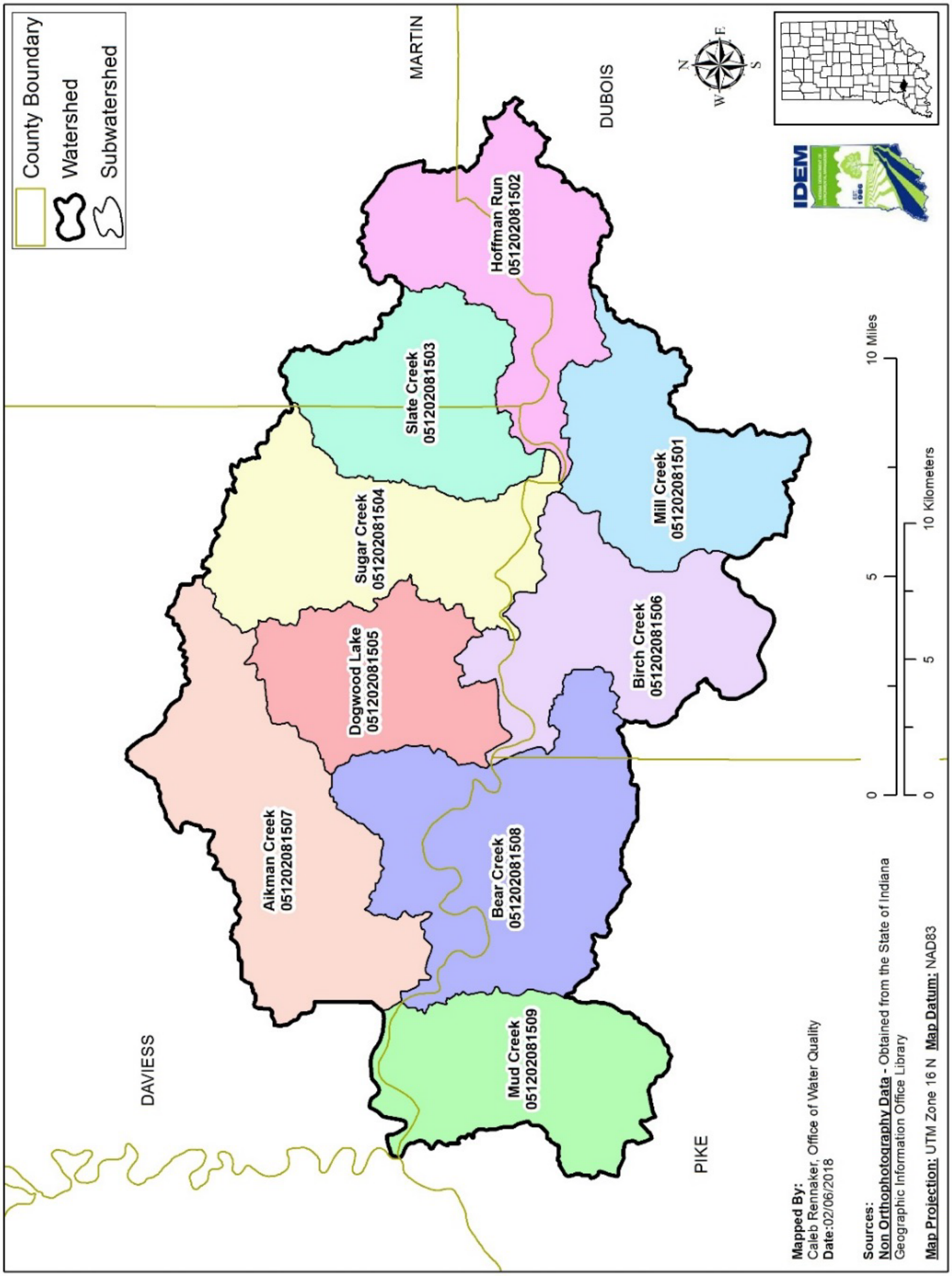


TABLE 3 – SUBWATERSHEDS OF LEF WHITE WATERSHED				
12-Digit HUC	Name	Acres in HUC	Sq. Miles in HUC	Percent of LEF White
051202081501	Mill Creek	12,524.8	19.57	9.43%
051202081502	Hoffman Run	14,348.8	22.42	10.81%
051202081503	Slate Creek	11,987.2	18.73	9.03%
051202081504	Sugar Creek	15,443.2	24.13	11.63%
051202081505	Dogwood Lake	10,720.0	16.75	8.08%
051202081506	Birch Creek	13,977.6	21.84	10.53%
051202081507	Aikman Creek	19,462.4	30.41	14.66%
051202081508	Bear Creek	20,844.8	32.57	15.70%
051202081509	Mud Creek	13,440.0	21.0	10.12%
		132,748.8	207.42	

4. WATERSHED GEOLOGY / TOPOGRAPHY

Geologic History of Watershed

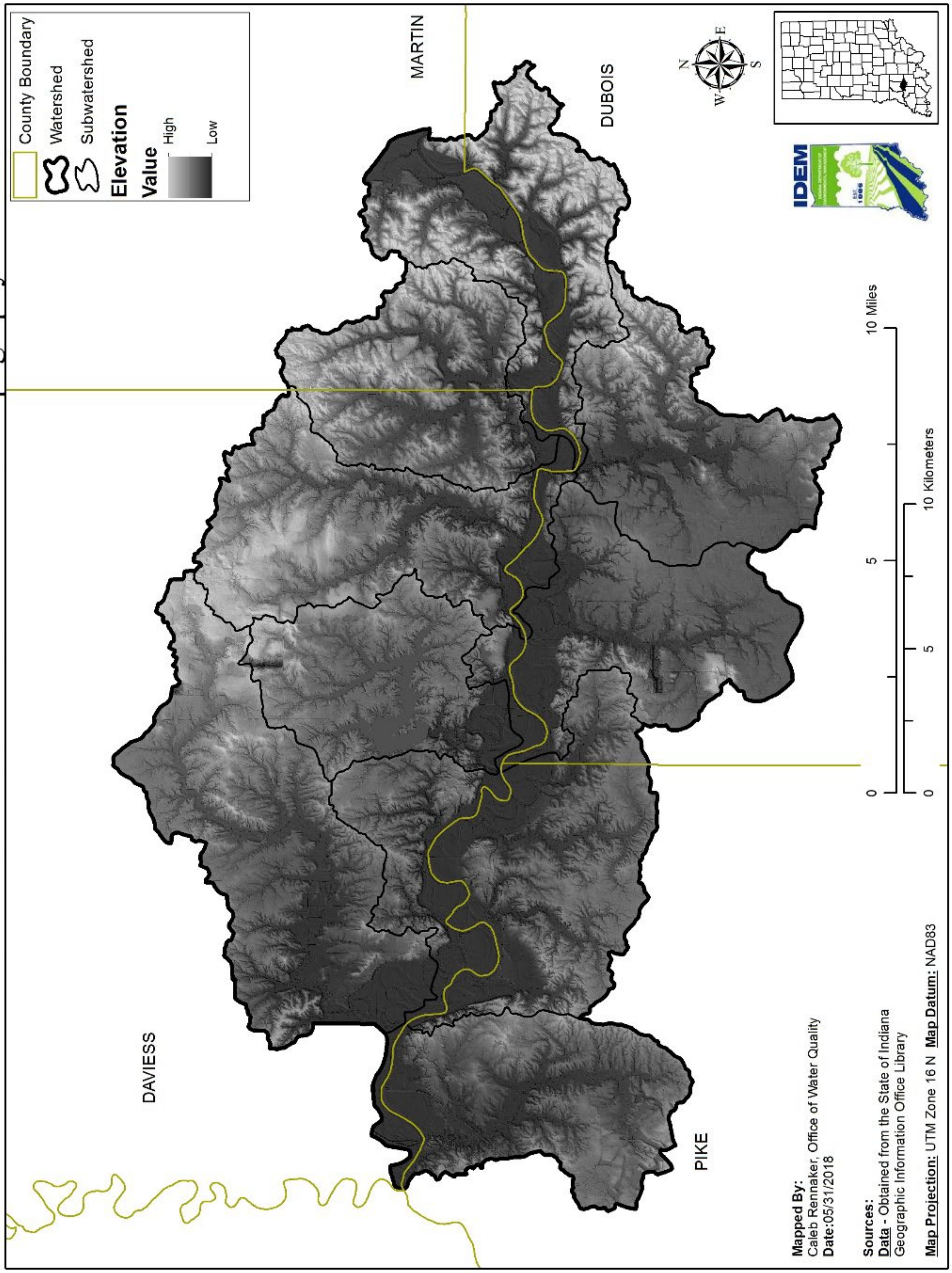
Throughout most of Indiana, the bedrock system dips gently to the southwest at an average of one-half degree into a large structural depression called the *Illinois Basin*. This means that rocks exposed at a given locality would be found buried beneath 30 feet of younger rock just one mile southwest of the outcrop. The rocks overlie one another in an imbricated sequence with the youngest found in the western part of the state and the oldest occurring at the bedrock surface in eastern Indiana. 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.

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. The varied topography of Indiana is a legacy of active glaciation and the inexorable forces of running water acting through geological time to erode and shape both soil and rock. This physiography has left its mark on nearly every facet of our cultural development, including the course of trails, location of modern highways and power lines, and our reservoirs.

The northern two-thirds of Indiana are composed of glacial deposits containing ground water. 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. However, ground water 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 ground water.

Detailed information concerning the topography and geology within the LEF White is available from the Indiana Geological and Water Survey (IGWS). The IGWS website is https://igws.indiana.edu/GroundWater. Figure 4 on page 20 displays the topography of the LEF White watershed.

FIGURE 4 – LEF WHITE TOPOGRAPHY



The LEF White watershed originates in Martin County, with the river traveling west through Dubois, Daviess, and Pike Counties, eventually discharging into the main stem (west fork) White River.

Located in the Southern Hills and Lowlands physiographic region, the LEF White 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 as much of the northern region was.

The LEF White subwatersheds saddle the main channel which has its own extensive floodplain. Each subwatershed thus decreases elevation nearing the main channel. However, Hoffman Run which is in both Martin and Dubois counties has significant elevation changes as the subwatershed is mainly hills and slopes juxtaposed against floodplain. The subwatersheds of Slate and Mill have significant elevation changes, but they are not as drastic as Hoffman Run.

Dogwood Lake subwatershed is made up mostly of Dogwood Lake which is part of the Glendale Fish and Wildlife Area (FWA) See page 31 for more information of the Glendale FWA and managed lands in the LEF White.

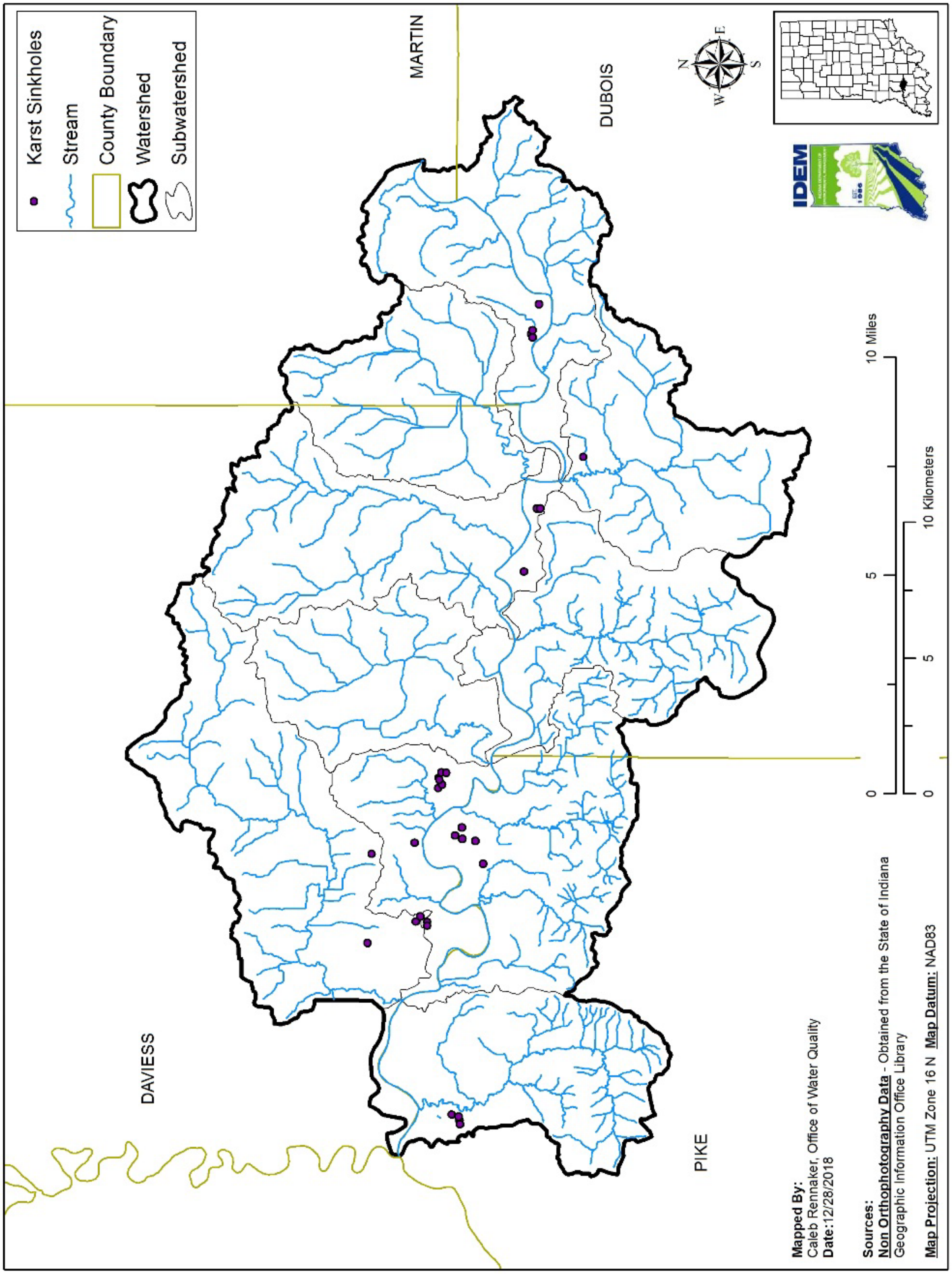
Karst Features

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 ground water 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 LEF White Watershed (Atlas of hydrogeologic terrains and settings of Indiana, 1995). Figure 5, page 22 displays the location of the karst features of the watershed. The Sinkhole Inventory (2011) GIS layer was created by the Indiana Geological Survey to support a statistical regression analysis of potential sinkhole development areas in and around the Hoosier National Forest. There are 30 karst sinkholes in the LEF White with 14 in Bear Creek; 4 in Hoffman Run, 4 in Aikman Creek and 4 in Mud Creek; 3 in Sugar and 1 in Mill Creek subwatersheds.

The Indiana Karst Conservancy (IKC) 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 http://www.ikc.caves.org/.

FIGURE 5 – LEF WHITE KARST FEATURES



5. WATERSHED HYDROLOGY

Waters in this watershed drain to the Lower East Fork White River which flows west until it merges with the White River at 38.545437, -87.241938. The west fork of the White River is just called the White River and is considered the main stem, even though both rivers are nearly equal in size at the confluence. After the confluence, the water flows through Pike and Gibson Counties to the Wabash River.

The rolling hills of southern Indiana make for sinuous creeks, streams and rivers, and the potential for the construction of dams to create ponds and lakes. The LEF White has sufficient water resources to be used by the public. With 2.61 % of the land use in the LEF White open water or wetlands, there is over 3,462 acres in the watershed that are open water or wetlands. Water resources in the LEF White are used as they are across all of Indiana: for drinking, agricultural production, aquaculture, swimming, boating, fishing, wildlife habitat, and industrial purposes.

Creeks, Streams and Tributaries

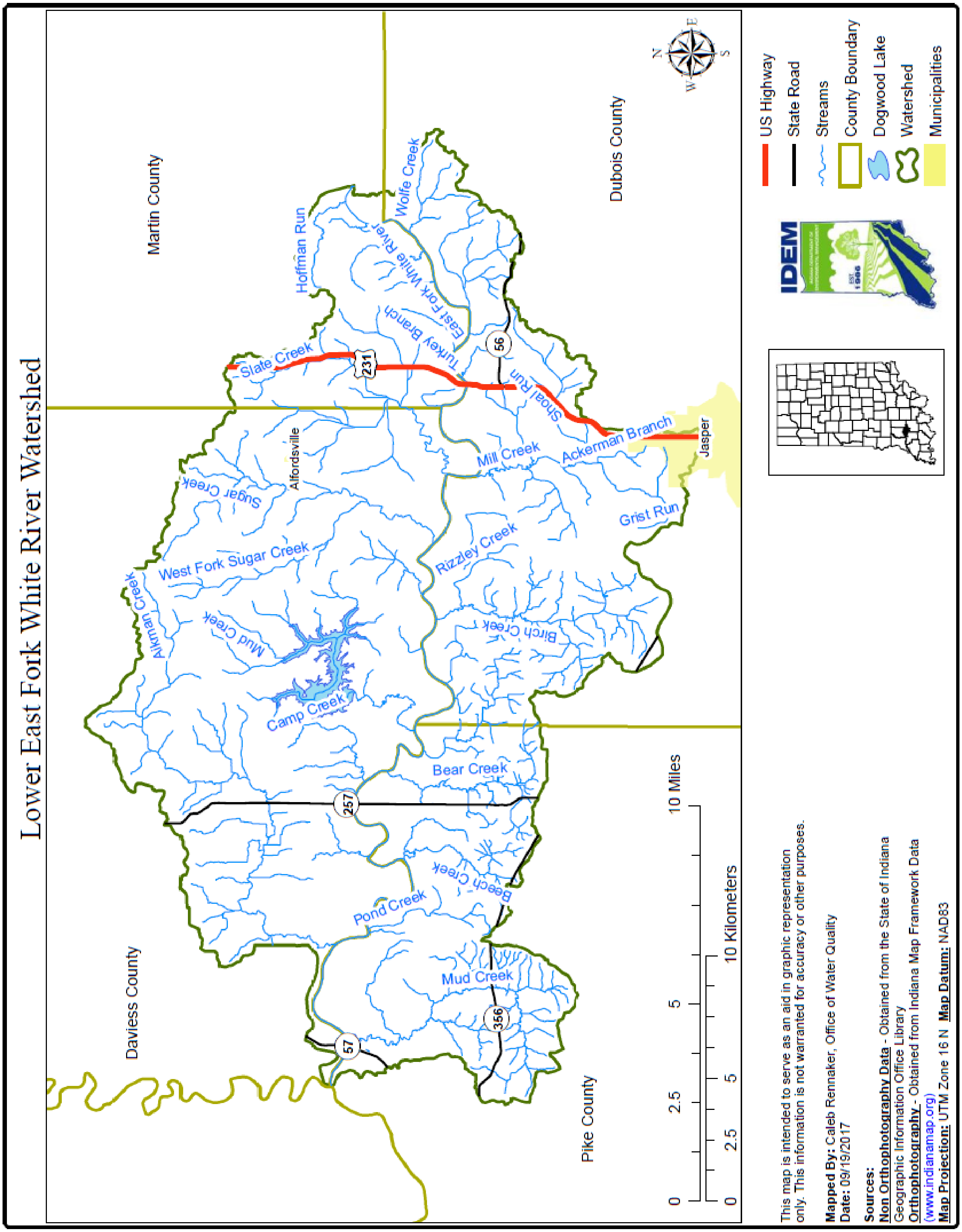
Within the LEF White River watershed, there are approximately 355 miles of streams, creeks and main stem. Like every watershed in the United States, there are often tributaries in the project area carrying names that, though known by the locals, may not be names on a USGS or EPA GIS layer. Known names of creeks / tributaries are listed in Table 4 on page 23. The table also shows estimated stream miles per subwatershed. Figure 6 on page 24 shows the location of those streams/tributaries.

TABLE 4 – NAMES OF TRIBUTARIES / CREEKS IN EACH SUBWATERSHED

12-Digit HUC	Name	Creek and Tributary Names	Miles
051202081501	Mill Creek	Mill Creek, Little Creek, E. Fork Mill, Sherritt Drain, Mudhole Branch, Grist Run, Shoal Run and Ackerman Branch	≈ 35
051202081502	Hoffman Run	Hoffman Run, Crooked Creek, Wolfe Creek, and Turkey Branch	≈ 47
051202081503	Slate Creek	Slate Creek	≈ 36
051202081504	Sugar Creek	Sugar Creek, W. Fork Sugar Creek, and an unnamed tributary to the main stem	≈ 36
051202081505	Dogwood Lake	Mud Creek	≈ 27
051202081506	Birch Creek	Birch Creek, Rizzley Creek, Riz Run and Portersville Drain	≈ 54
051202081507	Aikman Creek	Aikman Creek	≈ 51
051202081508	Bear Creek	Bear Creek, Beech Creek, Pond Creek and Camp Creek	≈ 80
051202081509	Mud Creek	Mud Creek	≈ 50
Total Estimated Creek / Stream Miles in the LEF White			≈ 416

At this point, there should be clarification regarding Mud Creek subwatershed and Dogwood Lake subwatershed, both of which have a Mud Creek draining it. Dogwood Lake subwatershed is in Daviess County with Mud Creek supplying and draining Dogwood Lake. Mud Creek subwatershed is in Pike County with Mud Creek draining that subwatershed to the main stem.

FIGURE 6 – LEF WHITE STREAMS IN WATERSHED



Lakes, Ponds and Open Water

The LEF White watershed has only a few named lakes and ponds. Most named ponds and lakes in the watershed are larger than 5 acres, but two named ponds are less than 5 acres: Big Piney Pond which is part of Glendale FWA and Ireland Lake which is part of the Sportsman Club in Ireland. There are also four unnamed lakes and ponds larger than 5 acres. Each subwatershed and the ponds or lakes located within them are detailed in Table #5.

TABLE 5 – LAKES AND PONDS IN EACH SUBWATERSHED

12-Digit HUC	Subwatershed	Lake/Pond Name and Size in Acres
051202081501	Mill Creek	Deerwood Lake: 8.15 acres. Izaak Walton Lake: 23.7 acres. Unnamed lake near Jasper: 4.69 acres.
051202081502	Hoffman Run	No lakes over 5 acres present in subwatershed.
051202081503	Slate Creek	Baver Lake: 5.43 acres. An unnamed pond: 4.695 acres.
051202081504	Sugar Creek	No lakes over 5 acres present in subwatershed.
051202081505	Dogwood Lake	Dogwood Lake: 1,238.25 acres. East Fork State Hatchery: 29.7 acres. Three unnamed ponds: 10.13 acres, 8.65 acres and 5.9 acres. Big Piney Pond: 3.45 acres.
051202081506	Birch Creek	Ireland Lake: 4.45 acres
051202081507	Aikman Creek	One unnamed pond: 5.18 acres
051202081508	Bear Creek	Chew Pond: 38.3 acres. Horseshoe Pond: 5.68 acres.
051202081509	Mud Creek	No lakes over 5 acres present in subwatershed.

The East Fork State Hatchery has approximately 29.7 acres of open water in their hatching ponds. But the largest open water in the watershed is Dogwood Lake which is 1,238.25 acres. This lake is part of the Glendale Fish and Wildlife Area near Montgomery. For more information on Glendale FWA, see page 31.

In addition to these larger lakes and ponds, there are also a sufficiently large number of small, private ponds and lakes in each of the nine subwatersheds, too numerous to count, all of which are under 4.6 acres in size.

In all, open water in the LEF White equates to 3,236.07 acres or 5.06 square miles.

Roadside Ditches

The LEF White watershed is located in four counties. Each county's highway department is responsible for constructing, reconstructing and maintaining the county's roads. Martin County has 370 miles of roads, Daviess county has 800 miles of roads, Dubois County has 660 miles of roads and Pike County has 544 miles of roads. However, to determine the miles of road within the watershed, each county's size in acres was determined, then the acres of LEF White in each county. Thus, one could know what percentage of the county was LEF White watershed. As county roads crisscross the counties in a regular pattern, it can be assumed that this percentage can be used to estimate the approximate miles of roads in the LEF White watershed. Table 6 on page 26 details the approximate miles of roads in the watershed.

TABLE 6 – LEF WHITE PRESENCE IN EACH CO / EST. ROAD MILES					
County	**County Size**	**LEF White Acres in County**	**% in County**	**County Road Miles**	**Watershed Road Miles**
Martin County	217,900 acres	13,051.8 acres	9.832%	370	≈ 36.37
Daviess County	280,000 acres	58,559.5 acres	44.113%	800	≈ 352.91
Dubois County	279,000 acres	35,745.3 acres	26.927%	660	≈ 177.72
Pike County	215,040 acres	25,392.2 acres	19.128%	544	≈ 104.06
Total LEF White Acres		132,748.8	Total Road Miles		≈ 671.06

From this data, the miles of roadside ditches can be further estimated with the knowledge that a constructed or natural drainage ditch exists on a least one side of the length of nearly every road. This then gives an estimate of at least 335 miles of roadside ditches in the watershed.

We know that these roadside ditches are frequently used by landowners for the discharge of excess surface water. Subsurface tile drainage of cropland is a common practice throughout Indiana with tile pipes emptying directly into the drains. Pollutants in the form of applied fertilizers and pesticides can be introduced into stream waters through these tile drainage systems.

Regulated (Legal) Drains

A regulated or legal drain is a drain which was established through either Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated or legal 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 / legal drain. Current Indiana drainage law is Indiana Code Title 36, Article 9, Chapter 27 (IC 36-9-27) and can be found at www.iga.in.gov.

To discover the regulated or legal drains present in the LEF White watershed, the surveyor in each of the four counties was contacted. In Pike County, the 2020 County Surveyor is Rich Williams. He stated the only legal drain in Pike County is Prides Creek which is regulated by Prides Creek Conservancy District and which is outside the LEF White watershed.

In Dubois County, the 2020 County Surveyor is Ken Brosmer. He stated there were 11 historic legal drains in Dubois County (1891 to 1916), but none are currently being assessed or regulated. In the July 2019 Dubois County Drainage Board meeting, it was reported that the drains were still being carried on county records, but that it was Mr. Brosmer's intent to vacate them.

In Daviess County, the 2020 County Surveyor is Phil Gabhart. He stated that Daviess county did have several legal drains but that nothing has been done with many of those since the 1940's and that there hasn't even been a county surveyor's office except in the last ten years. However, there are several being assessed and maintained in the county including Prairie Creek, Smothers, Tucker, Vertrees and Weaver. The legal drains were geolocated via Indiana Map and Google maps and none of these are located in the LEF White watershed.

In Martin County, the 2020 County Surveyor is Nathan Hoffman. He was contacted via email to determine if there were any legal drains in Martin County. Martin County does not have a drainage board and the Surveyor is in office only to maintain property records.

Wetlands

Wetlands, as defined by the US Army Corps of Engineers (USACE) and the EPA, are "those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Wetlands are very important features in the landscape that provide numerous benefits to people and wildlife such as protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters and maintaining surface water flows during dry periods. In fact, the EPA states that:

> *"**Wetlands are among the most productive ecosystems in the world, comparable to rain forests and coral reefs.** An immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish and mammals can be part of a wetland ecosystem. The combination of shallow water, high levels of nutrients and primary productivity is ideal for the development of organisms that form the base of the food web and feed many species of fish, amphibians, shellfish and insects. Many species of birds and mammals rely on wetlands for food, water and shelter, especially during migration and breeding. Wetlands' microbes, plants and wildlife are part of global cycles for water, nitrogen and sulfur.*
>
> ***Scientists now know that atmospheric maintenance may be an additional wetlands function.** Wetlands store carbon within their plant communities and soil instead of releasing it to the atmosphere as carbon dioxide. Thus, wetlands help to moderate global climate conditions. Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. Trees, root mats and other wetland vegetation also slow the speed of flood waters and distribute them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion. Thus, wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface- water runoff from pavement and buildings. The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands together with other water retention can often provide the level of flood control otherwise provided by expensive dredge operations and levees. Far from being useless, disease-ridden places, wetlands provide values that no other ecosystem can. These include natural water quality improvement, flood protection, shoreline erosion control, opportunities for recreation and aesthetic appreciation and natural products for our use at no cost.*

Because of their functions and values, there are several federal and state laws that regulate activities that affect wetlands. The major laws protecting wetlands include the Federal Clean Water Act, the River and Harbors Act, and Indiana's Flood Control Act. Figure 7 on page 29 shows the location of wetlands in LEF White.

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 and Americans spend $59.5 billion annually on these activities. (http://www.in.gov/idem/wetlands/2335.htm).

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. Man-made wetlands can even be used to clean wastewater, when properly designed. Wetlands also recharge our underground aquifers which is important since over 70% of Indiana residents rely on ground water for part or all of their drinking water needs. (http://www.in.gov/idem/wetlands/2335.htm)

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. (http://www.in.gov/idem/wetlands/2335.htm)

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 United States Geological Survey (USGS) and U.S. Fish and Wildlife Service (FWS) estimate that Indiana has lost approximately 85 % of the state's original wetlands. Currently, the LEF White River watershed contains approximately 8,162 acres of wetlands or 6.15 percent of the total surface area.

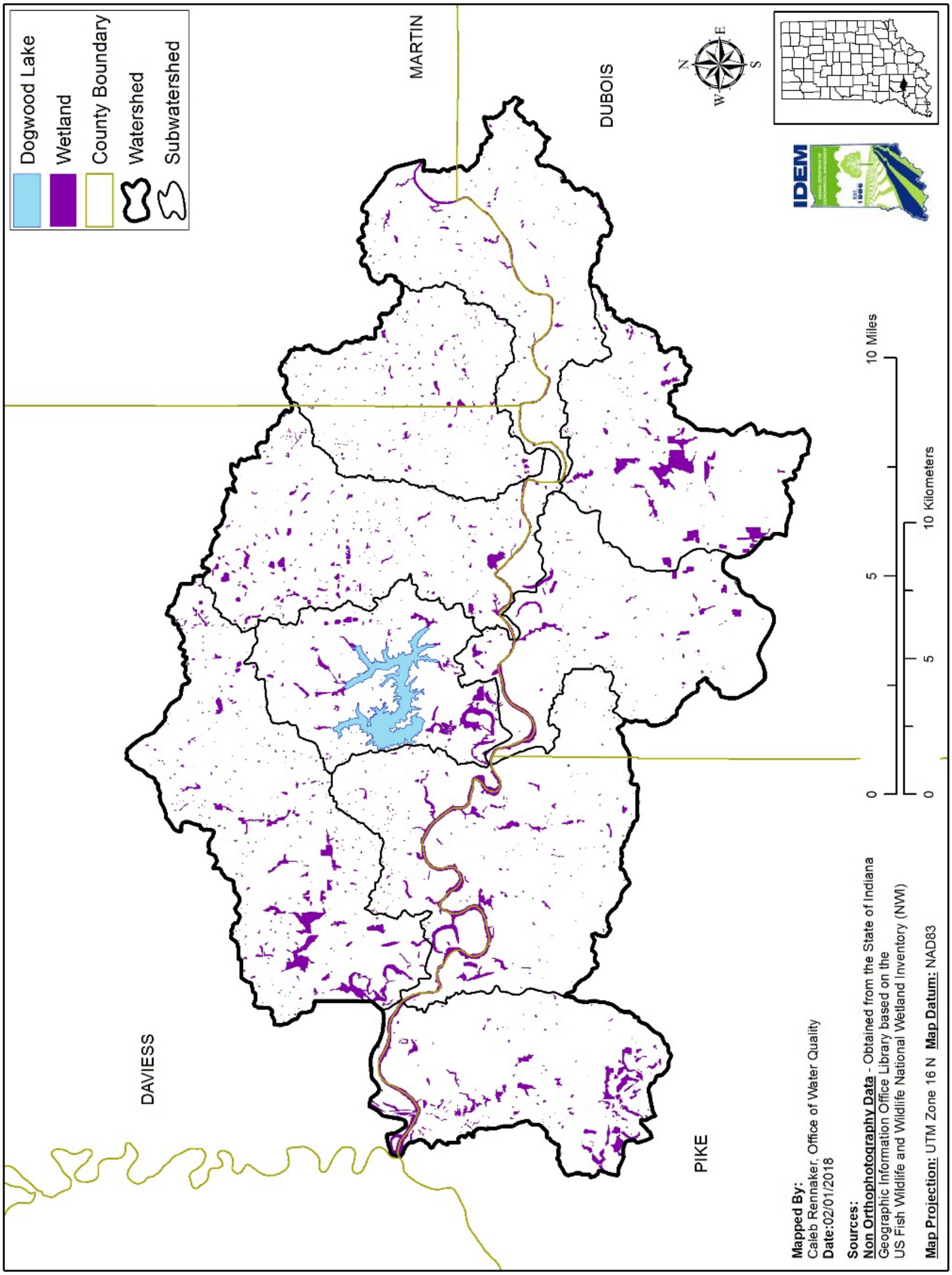
The FWS has the responsibility for mapping wetlands in the United States. Those map products are currently held in the Fish and Wildlife Service Wetland Database (sometimes referred to as the National Wetlands Inventory or NWI. Figure 7 on page 29 shows estimated locations of wetlands as defined by the FWS's NWI. Wetland data for Indiana is available from the FWS'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 LEF White River Watershed from the NWI may not agree with those listed in Land Use Descriptions on page 49-61, which are based upon the MRLC dataset. Visit http://www.fws.gov/wetlands/Data/Wetland-Codes.html for more information on the wetland classification codes. The FWS uses data standards to increase the quality and compatibility of its data.

Nationally, since the late 1600's, roughly 50% of the wetlands in the lower 48 states have been lost. Indiana has also lost a large number of its wetlands. In the 1800's and 1900's millions of acres of wetlands were converted into farms, cities, and roads, and, in addition, many Hoosiers converted wetlands to protect health. Before the conversion of wetlands, there were over 5.6 million acres of

FIGURE 7 – LEF WHITE WETLANDS



wetlands in the state, wetlands such as bogs, fens, wet prairies, dune and swales, cypress swamps, marshes, and swamps. In the early 1700's, wetlands covered 25% of the total area of Indiana. That number has been greatly reduced. By the late 1980's over 4.7 million acres of wetlands had been lost - wetlands now cover less than 4% of Indiana.

Wetlands and Hydric Soils
Soils that remain saturated or inundated with water for a 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. For more information on Hydric Soils in the LEF White watershed, see page 40.

Throughout Indiana, a large majority of these hydric soils have been drained for either agricultural production or urban development and would no longer support a wetland. The LEF White watershed is no exception to this fact. The location of the watershed's hydric soils can be seen on the map located in the Hydric Soils section (Figure 10 and Figure 11). Identifying the locations of hydric soils can help watershed groups determine possible locations of wetland creation or enhancement. However, there are many components in addition to soil type that must be considered before moving forward with wetland design and creation. Additional information on wetlands can be found on the IDEM website http://www.in.gov/idem/wetlands/.

Managed and Classified Lands
Managed and Classified Lands include natural and recreation areas which are owned or managed by the Indiana Department of Natural Resources (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. Table 7 and Figure 8 show managed and classified lands in LEF White watershed.

Public Access Sites
The Indiana Division of Fish and Wildlife runs a Public Access Program which was started in 1953. The program strives to provide free access to Indiana waters. There are 169 Public Access Sites (PAS) in southern Indiana. Within the LEF White watershed there is one: the Portersville Bridge PAS. There is also the Flat Rock boat ramp which is part of the Glendale FWA. The boat ramp (put-in) at Portersville Ramp is on the northwest side of the river, just northwest of the community of Portersville. One can put in here and take out at the Flat Rock boat ramp after a 4-mile float. The Flat Rock boat ramp is on the north side of the river at the southern end of Glendale FWA. A map of Glendale FWA can be found on Appendix B. Read more about Glendale FWA on page 31.

TABLE 7 – MANAGED AND CLASSIFIED LANDS IN WATERSHED			
Managed Lands	**Unit Name**	**Manager**	**Area in Acres**
	Portersville Bridge Public Access Site	DNR Fish and Wildlife	1
	Glendale Fish and Wildlife Area	DNR Fish and Wildlife	8,060
	Wening-Sherritt Seep Springs Nature Preserve	The Nature Conservancy	75
	Total Managed Lands		8,136
Classified Lands	**Subwatershed**	**HUC**	**Area in Acres**
	Mill Creek	051202081501	810
	Hoffman Run	051202081502	1,906
	Slate Creek	051202081503	592
	Sugar Creek	051202081504	131
	Dogwood Lake	051202081505	10
	Birch Creek	051202081506	274
	Aikman Creek	051202081507	242
	Bear Creek	051202081508	66
	Mud Creek	051202081509	365
	Total Classified Lands		4,396

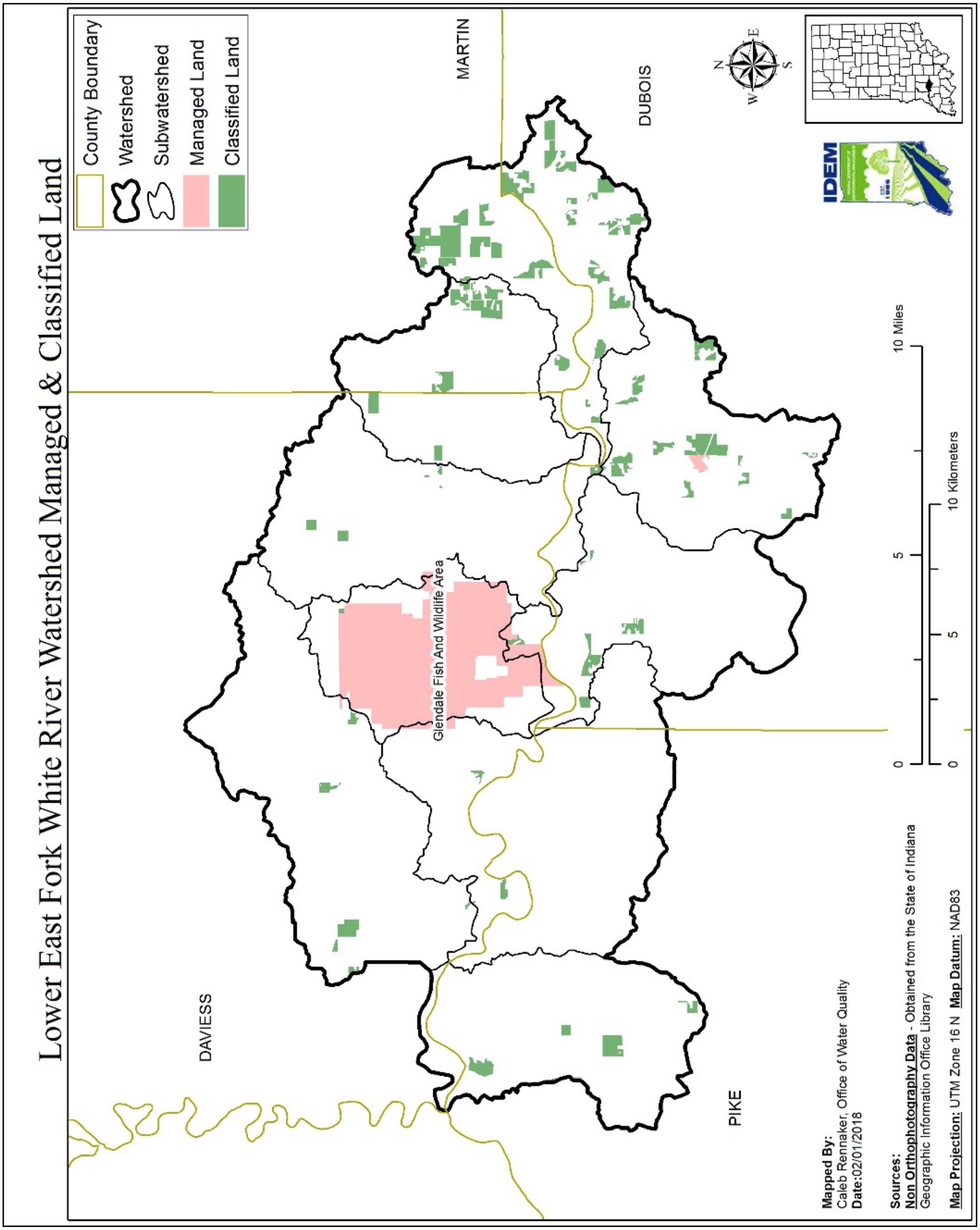
Glendale Fish and Wildlife Area
The Glendale FWA is dedicated to providing quality hunting and fishing opportunities while maintaining 8,060 acres of land and over 1,400 acres of lakes and impoundments. Acquisition of the land began in 1956. The construction of the dam that formed Dogwood Lake began in 1963 and was completed in 1965. The average depth of Dogwood Lake is 8 feet.

Glendale FWA offers a wide variety of outdoor activities including camping, picnicking, hiking, fishing, wildlife viewing and photography, boating and dog training areas. Wetland trapping and hunting opportunities (contact Glendale FWA for rules and regs) are available. There is a campground, handicap accessible fishing piers, and boat ramps. Berry, nut and mushroom collection on the property is allowed. The East Fork State Fish Hatchery is located on the Glendale FWA property. The Flat Rock Boat ramp to the LEF White is accessible from Glendale FWA property.

The Glendale FWA brochure with details of rules and regulations and what is offered, as well as how to contact the property manager, can be found in Appendix B.

Wening-Sherritt Seep Springs Nature Preserve
This nature preserve is located in northwest Dubois County, Boone Township, about three miles north of Jasper. It is owned by The Nature Conservancy (TNC) and managed by TNC and the IDNR Division of Nature Preserves. The 2020 manager is Mike Everidge. The property is 74.8 acres with no trails. However, it is open to the public for things like birding, enjoying nature and photography. The property has an acid seep wetland with upland mesic southwestern lowland forest and wet-mesic floodplain forests.

FIGURE 8 – LEF WHITE MANAGED AND CLASSIFIED LANDS



Classified Lands
In addition to the managed lands listed above, the LEF White watershed has an additional 4,396 acres of classified lands which are public and private lands set aside for natural resource conservation. Table 7 on page 31 shows each subwatersheds' total classified area in acres. Hoffman Run subwatershed has the greatest number of acres with 1,906 acres listed as classified.

Hydrologic Modifications
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.

The most notable hydrologic medication in the LEF White watershed is the dam construction in Daviess County on the Mud Creek resulting in Dogwood Lake. See page 31 and Appendix B for more information on Glendale FWA.

Relevant Stakeholder Concerns
The primary concern is that water resources should meet water quality standards for public, agricultural and industrial uses while being capable of supporting a well-balanced, aquatic community.

The stakeholders in the watershed listed flooding (ranked #4) as a major resource concern alongside water quality. However, wetlands and ground/surface water pollution (ranked 12, 14 and 15 respectfully) were also listed. We know that streams and ditches are used by many landowners in the watershed to discharge excess surface water. Subsurface tile drainage of cropland is common practice throughout the watershed with tile pipes emptying directly into the streams. Pollutants in the form of applied fertilizers and pesticides can be introduced into stream waters through these tile drainage systems.

6. SOIL CHARACTERISTICS OF WATERSHED

Soil Characteristics Impact on Water Quality
There are different soil characteristics that can affect the health of the watershed. Some of these characteristics include soil erodibility, soil saturation, soil drainage, and septic tank suitability. Each of these are discussed in detail below: soil erodibility (highly erodible soils) on page 34, soil drainage on page 37, soil saturation (hydric soils) on page 40, and septic tank suitability on page 40.

The LEF White watershed is comprised of a variety of soil types, many of which are perfect for growing some of the best crops in the Midwest. Soil types influence drainage and erodibility and are grouped into general soil associations. There are 30 major soil units (associations) in the project area as delineated by the Natural Resources Conservation Service-U.S. Department of Agriculture (NRCS-USDA). Unfortunately, soil associations are not generally regarded when it comes to making land management decisions. However, the NRCS does consult specific soil types when it comes to determining whether land is highly erodible, hydric or if it is suitable for proper septic system leaching. Additionally, soil types can also be used to determine if land is to be considered "prime farmland". Prime farmland is defined by the USDA as follows:

> "*Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is*

available for these uses. It could be cultivated land, pastureland, forestland, or other land, but is not urban or built-up land or water areas. The soil quality, growing season and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied."

Due to the productive nature of the soils throughout the LEF White watershed, much of the land is actively farmed (50.16%). If Best Management Practices (BMPs) are not applied, the soil is at definite risk for erosion and nutrient degradation. Excess sediment can be transported to streams and lakes during heavy rain events, degrading habitat and transporting field applied nutrients such as phosphorus.

During the initial stakeholder natural resource concern meeting, soil related concerns included soil erosion, soil quality, soil productivity, soil fertility, soil heath, agriculture's use of chemicals and nutrients getting into water sources.

Highly Erodible Soils

Soil loss is a definite concern within the LEF White watershed. 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.

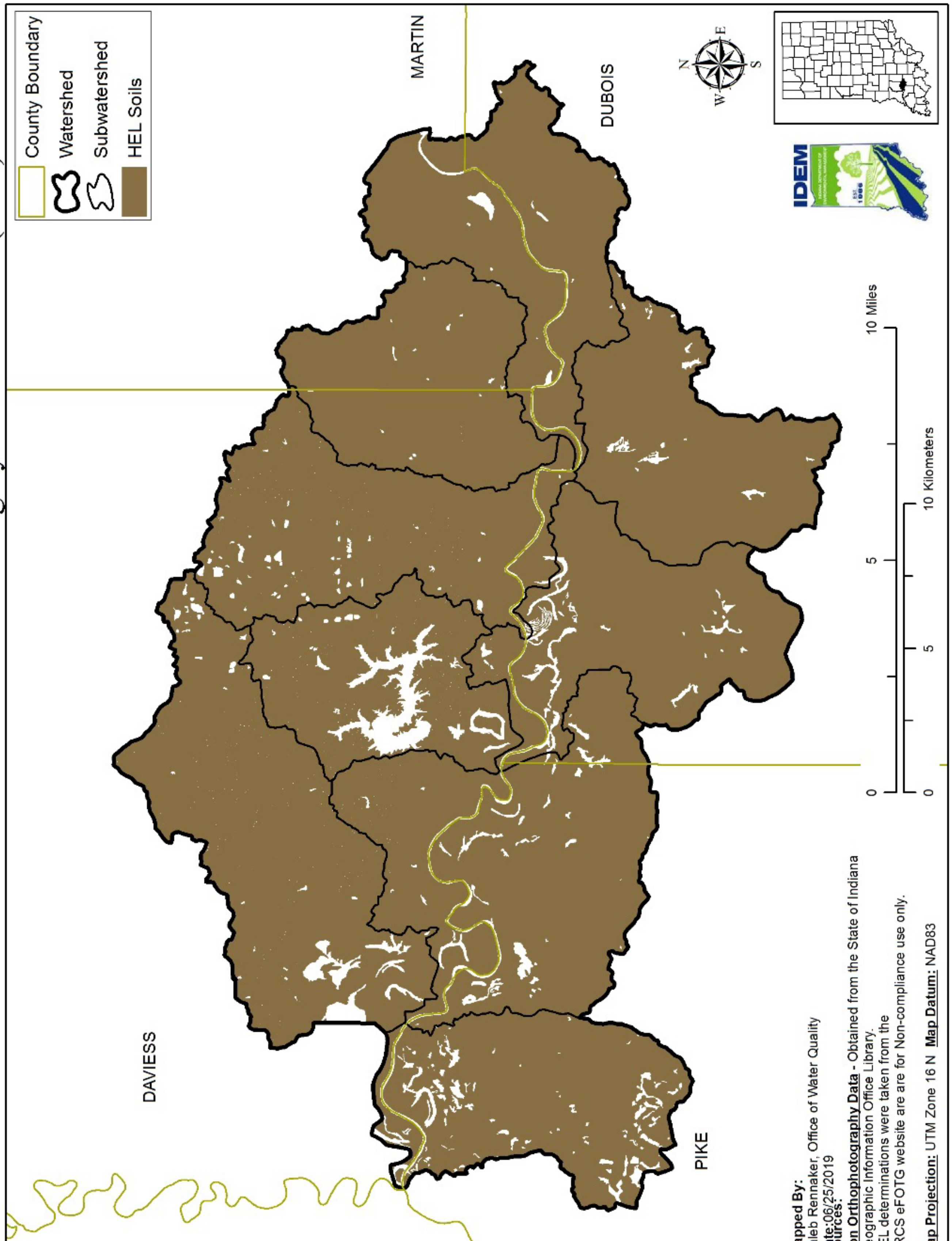
The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land. The NRCS Field Office Technical Guide (Section 11) describes highly erodible lands as follows:

" The Food Security Act of 1985 required that soil survey map units be separated into three categories based on potential erodibility due to wind erosion and sheet and rill erosion. A Highly Erodible Soil Map Unit list designates the category assigned to each map unit. It has been determined that no map units are highly erodible because of only wind erosion in Indiana. The equation for determining potential erodibility from sheet and rill erosion is:

$$\frac{A = RK\,(LS)}{T}$$

(A)is the amt. of soil loss in tons per acre, (R) is rainfall factor, (K) is soil erodibility factor, and (L) and (S) are slope length and steepness factors, respectively, and (T) is the tolerable soil loss in tons per acre. A map unit is designated highly erodible (class 1) if the value (A) obtained from the equation is equal to or greater than 8 when the minimum slope length and minimum slope percent are used. A map unit is designated potentially highly erodible (class 2) if the value obtained from the equation is less than 8 when the minimum slope length and minimum slope percent are used but equal to or greater than 8 when the maximum slope length and maximum slope percent are used. A map unit is designated not highly erodible (class 3) if the value obtained from the equation is less than 8 when the maximum slope length and maximum slope % are used. The minimum and maximum slope % are obtained from the map unit name, i.e., Miami silt loam, 2 to 6 % slopes. Two is the minimum value and 6 is the maximum value. The minimum and maximum slope lengths were determined by district conservationists, soil scientists and other local people."

FIGURE 9 – LEF WHITE HIGHLY ERODIBLE LANDS



Thus, the classification of HELs is based upon an erodibility index for the soil and the tolerable maximum annual rate of erosion that can occur without causing a decline in long-term productivity. These HELs (also called Highly Erodible Soils) 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.

In the LEF White watershed, there is 126,337 acres of HES. That means 94 percent of the LEF White watershed soils are considered highly erodible or potentially highly erodible. It is no surprise that stakeholders cited soil erosion as the number one natural resource concern. The potential HEL soil types and acreages in each subwatershed of the LEF White Watershed are listed in Appendix A. HELs / potential HELs in the LEF White watershed are mapped in Figure 9 on page 35.

Tillage Transects

Soil types and soil slopes are not the only indication of soil erosion. Land uses are also key to interpreting the potential for soil degradation. The producers (farmers and ranchers) in the watershed are asked to voluntarily incorporate soil conservation measures such as grassed waterways, no-till farming and planting of fall cover crops.

The Indiana State Department of Agriculture (ISDA) tracks these trends in conservation and cropland through annual county tillage transects. The local SWCDs along with NRCS and ISDA staff complete the soil tillage transects at least once a year and often in both the spring and the fall.

Data collected through the tillage transect can be found at https://secure.in.gov/isda/2383.htm. This county data 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 LEF White watershed are shown in Table 8 on page 37. This data is not reflective of a particular watershed, as at the writing of this WMP, the data is not divided into those parameters. However, county-wide data can give watershed groups a glimpse of trends perhaps occurring in the watershed.

Tillage practices captured in ISDA's tillage transect include living cover, no-till, conservation till, and conventional tillage practices. According to ISDA, living cover includes living cover crops and cereal grains planted into cash crops using direct seeding or broadcast methods. No-till is any direct seeding system including site preparation, with minimal soil disturbance. Conservation till is any tillage system leaving 16% to 75% residue cover after planting, excluding no-till (includes mulch and reduced tillage). Conventional tillage is any tillage system leaving less than 15% residue cover after planting. (ISDA)

According to the 2017 tillage transect, no-till is predominant in all counties in the LEF White watershed for soybeans and most counties for corn. Conventional till is the least used practice across all counties for both corn and soybeans.

Rainfall and Runoff

Rainfall surrounding the LEF White Watershed is moderately heavy with an annual average of 52.5 inches. This rainfall and climate data specific to the watershed is available from the Midwestern Regional Climate Center http://mrcc.isws.illinois.edu/CLIMATE/. Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases.

TABLE 8 – TILLAGE TRANSECT DATA FOR 2017 BY COUNTY								
	Tillage Practice 2017							
	Living Cover		No-till		Conservation Till		Conventional Till	
County	Corn	Soybean	Corn	Soybean	Corn	Soybean	Corn	Soybean
Daviess	11,435 ac 13%	16,594 ac 23%	35,184 ac 40%	62,048 ac 86%	51,896 ac 59%	8,658 ac 12%	- 0%	1,443 ac 2%
Dubois	8,616 ac 17%	6,435 ac 14%	33,957 ac 67%	42,284 ac 92%	13,684 ac 27%	2,758 ac 6%	3,041 ac 6%	460 ac 1%
Martin	503 ac 3%	1,631 ac 11%	9,222 ac 55%	14,825 a 100%	7,545 ac 45%	- 0%	- 0%	- 0%
Pike	2,529 ac 8%	9,160 ac 22%	28,456 ac 90%	39,973 ac 96%	2,529 8%	833 ac 2%	632 ac 2%	833 ac 2%

Velocity of water also increases as streambank steepness increases. Streambank erosion is potentially a significant source of Total Suspended Solids (TSS) in the LEF White Watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities. Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots. Streambank erosion can also occur as the result of increased flow volumes and velocity resulting from increased surface run-off throughout the upstream watershed.

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.

Soil Drainage

Soils have been categorized into hydrologic soil group classifications based on similar infiltration and run-off characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils as described in Table 9 on page 38 (NRCS, 2001). Data for the LEF White River 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. Figure 10 on page 39 maps the location of the four major hydrologic soil groups in the LEF White.

Table 10 on page 38 shows all four groups and the percentage of each that is present in the LEF White watershed. The majority of the watershed is covered by category D soils (59%) that have very slow infiltration rates. Category B soils are moderately deep and well drained, while Category C soils are finer and allow for slower infiltration.

TABLE 9 – NRCS HYDROLOGIC SOIL GROUPS		
Hydrologic Soils Group	**Description**	**% present in LEF White**
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little run-off.	3%
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.	28%
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.	10%
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of run-off.	59%

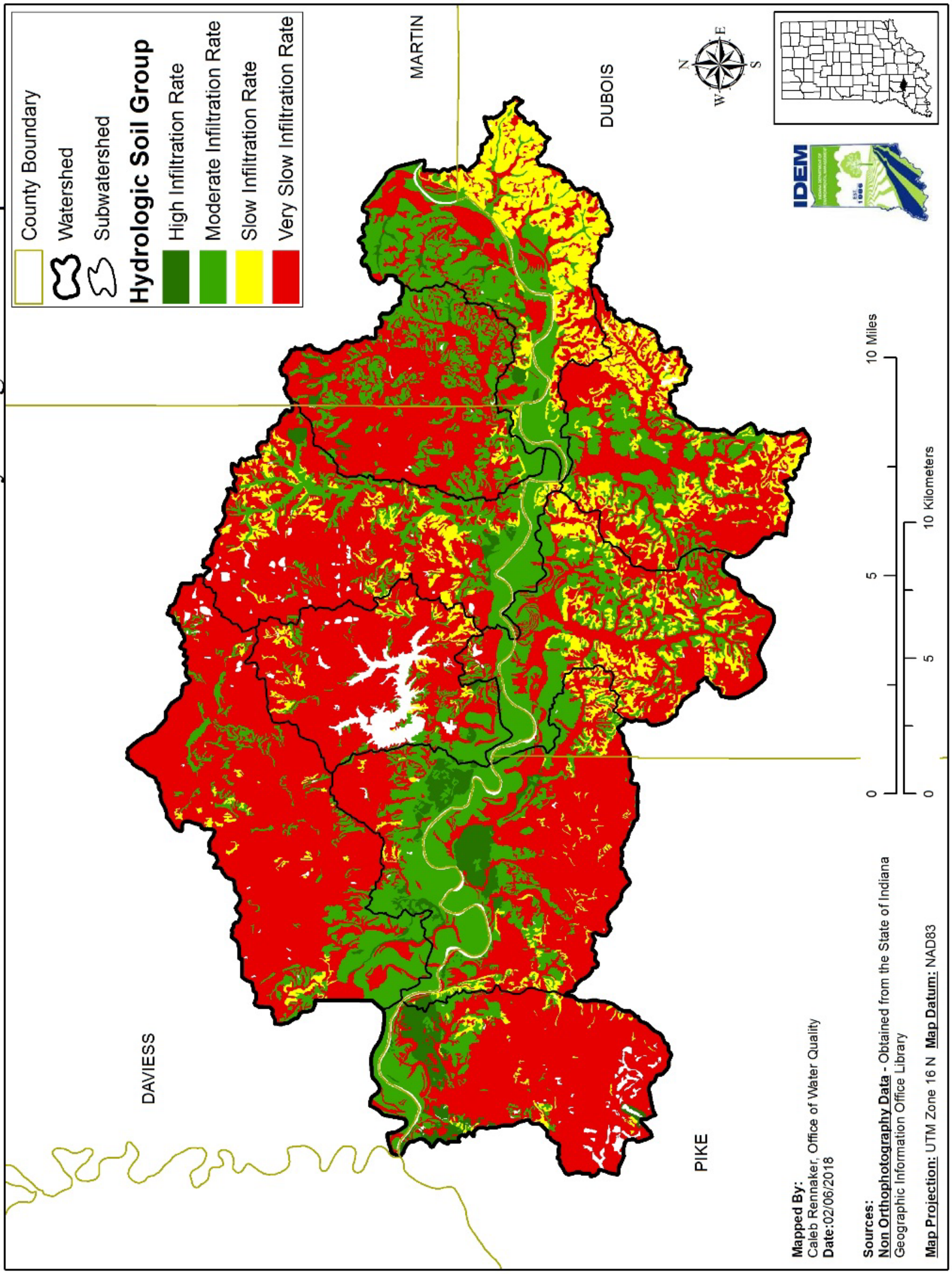
Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect pollutant loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore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

TABLE 10 – HYDROLOGIC SOIL GROUPS IN LEF WHITE SUBWATERSHEDS				
Subwatershed	Hydrologic Soil Group			
	A	**B**	**C**	**D**
Mill Creek	**0.00%**	**25.08%**	**21.72%**	**53.21%**
Hoffman Run	**2.14%**	**40.19%**	**29.01%**	**28.67%**
Slate Creek	**1.48%**	**33.45%**	**0.90%**	**64.18%**
Sugar Creek	**1.52%**	**27.76%**	**10.62%**	**60.10%**
Dogwood Lake	**0.68%**	**15.50%**	**6.55%**	**77.26%**
Birch Creek	**0.08%**	**36.16%**	**16.84%**	**46.92%**
Aikman Creek	**0.41%**	**17.23%**	**1.95%**	**80.41%**
Bear Creek	**7.74%**	**34.34%**	**4.92%**	**53.00%**
Mud Creek	**7.97%**	**16.13%**	**2.68%**	**73.22%**

Bear and Mud Creek subwatersheds have the highest percentage of well-drained soils. Aikman and Dogwood Lake have the highest percentage of poorly drained soils.

One can also compare the percent of hydrologic soil groups with Figure 10 on page 39 that maps the locations of the different hydrologic soil groups. Notice how the floodplains near the main stem are all high infiltration rates.

FIGURE 10 – LEF WHITE HYDOLOGIC SOIL GROUPS



Hydric Soils
Hydric Soils were discussed briefly under Wetlands on pages 27-30 regarding historic wetlands and locations of potential wetland restoration activities. Hydric soils are those that remain saturated or inundated with water for a length of time and thus 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.

Approximately 34,670 acres or 26.12 % of the LEF White River Watershed area contains soils that are considered hydric, as shown in Figure 11 on page 41 and Table 11 below.

TABLE 11 – ACRES OF HYDRIC SOILS PER SUBWATERSHED		
12-Digit HUC	**Name**	**Acres of Hydric Soils**
051202081501	Mill Creek	1,436
051202081502	Hoffman Run	3,237
051202081503	Slate Creek	1,733
051202081504	Sugar Creek	1,810
051202081505	Dogwood Lake	2,548
051202081506	Birch Creek	6,543
051202081507	Aikman Creek	6,666
051202081508	Bear Creek	6,594
051202081509	Mud Creek	4,103

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

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

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

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures
2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters.
3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water.

Figure 12 on page 42 shows ratings that indicate the extent to which the soils are suitable for septic systems within the LEF White River Watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 91 percent of the LEF White River watershed is considered “very

FIGURE 11 – LEF WHITE HYDRIC SOILS

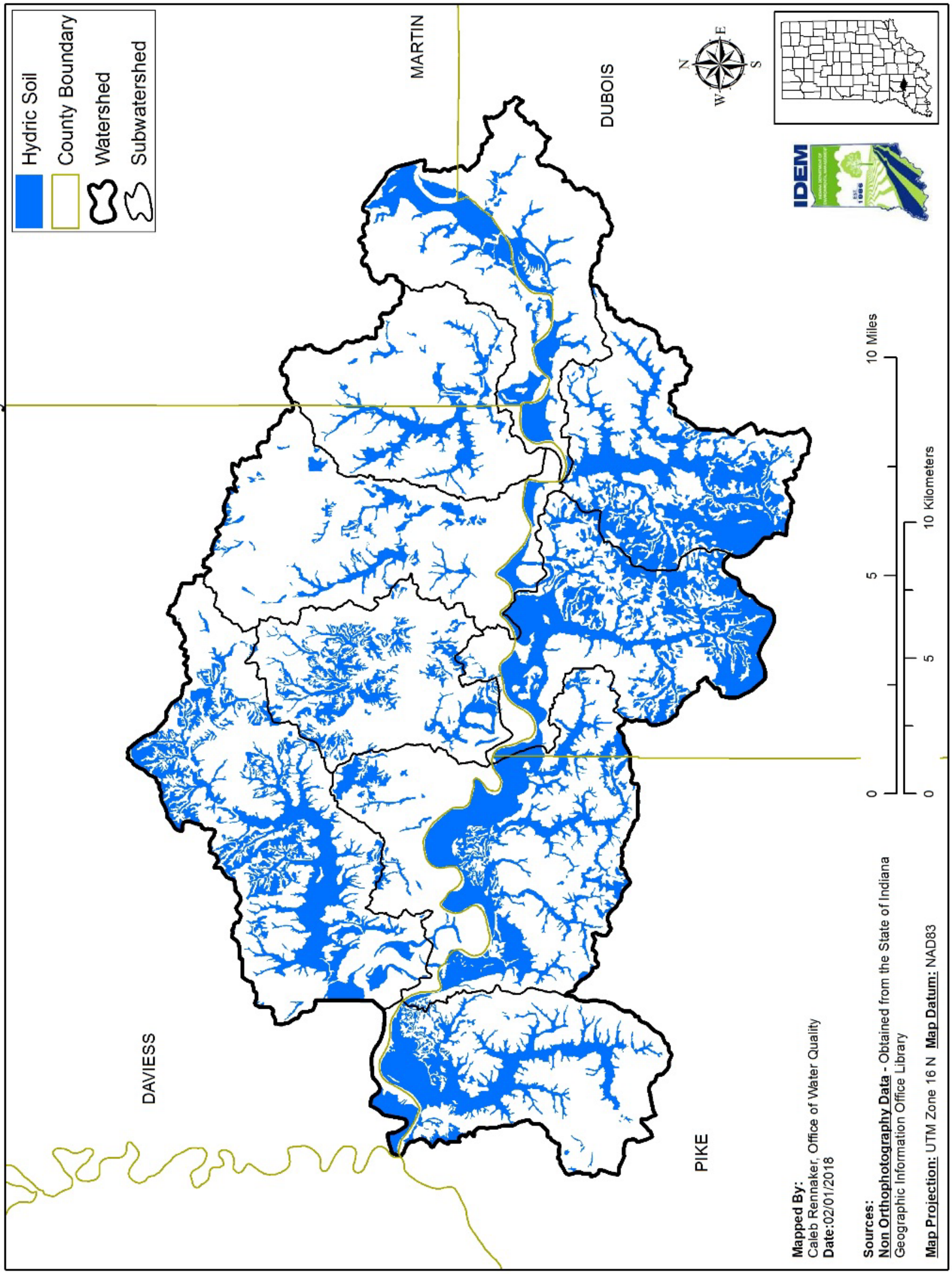
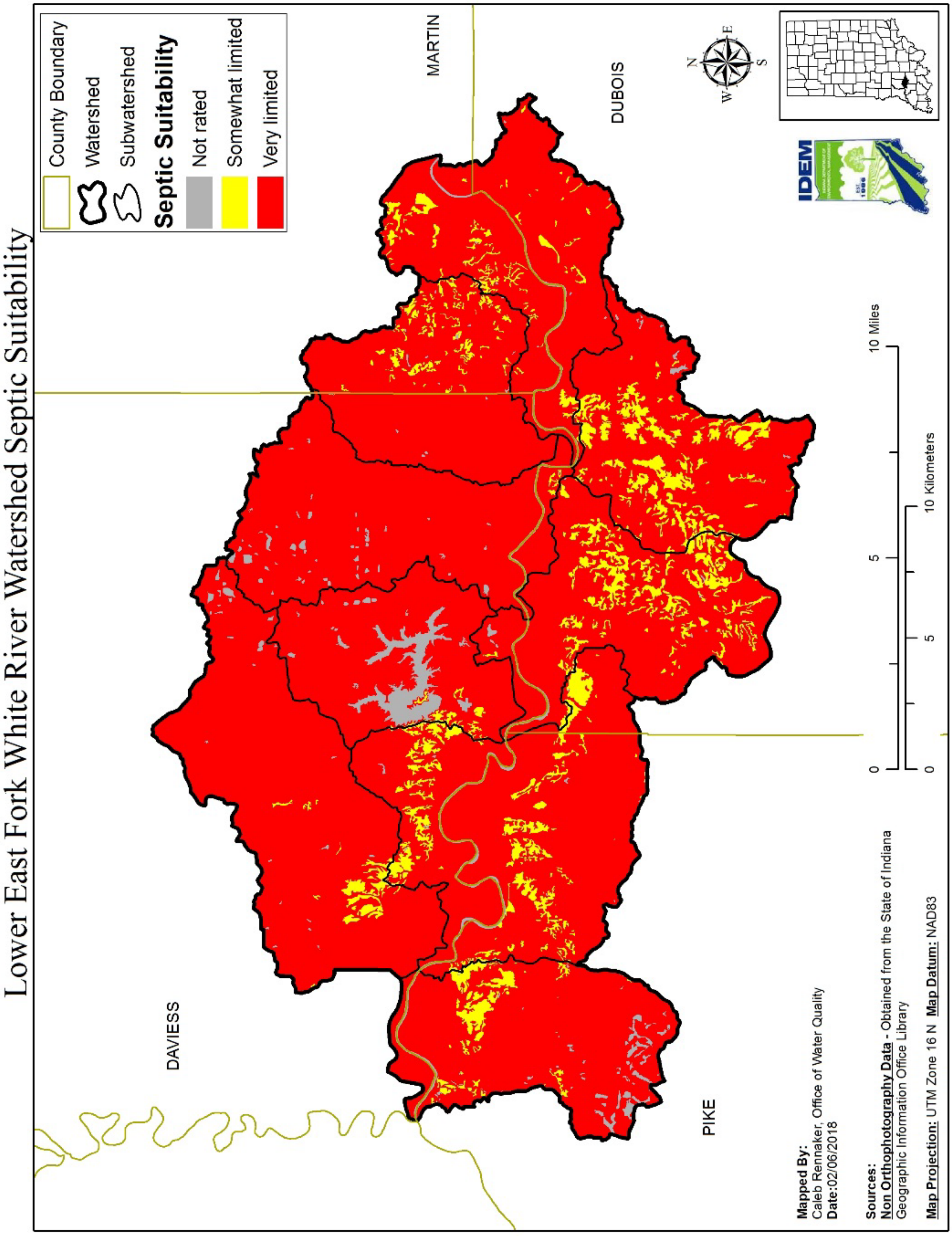


FIGURE 12 – LEF WHITE SEPTIC SUITABILITY



limited" in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation or expensive installation designs. Approximately less than 3 percent of the soils within the LEF White River 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 LEF White River watershed are designated "somewhat limited," meaning that the soil type is suitable for septic systems.

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

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

Unsewered Communities and Housing Clusters
A comprehensive database of septic systems within the LEF White River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems.

The 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.

TABLE 12 – ESTIMATED POPULATIONS IN LEF WHITE					
County	**2010 Population**	**Total Estimated Watershed Urban Population**	**Total Estimated Watershed Rural Population**	**Total Estimated Watershed Population**	**Percent of Total Watershed Population**
Daviess	31,648	≈ 94 (Alfordsville)	≈ 1,836	≈ 1,930	21.3%
Dubois	41,889	≈ 2,802 (Jasper)	≈ 2,935	≈ 5,737	63.4%
Martin	10,334	0	≈ 410	≈ 410	4.5%
Pike	12,845	0	≈ 973	≈ 973	10.8%
TOTAL	***96,716***	**≈ 2,896**	**≈ 6,154**	**≈ 9,050**	**100.0%**

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 LEF White River subwatersheds along with a calculated density (total rural households divided by total area) is shown in Appendix C. The rural household density can be used to compare the different subwatersheds within the LEF White River watershed.

It should also be noted that hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement. Table 9 and 10 on page 38 and Figure 10 on page 39 illustrates the hydrologic soil groups for the LEF White River subwatersheds.

Within the LEF White watershed, there are only two major government units with jurisdiction at least partially in the watershed: Jasper and Alfordsville. Alfordsville has a population of under 100 people (approximately 40 households) and there is no wastewater system in the community; so, everyone in this community must have an onsite septic system.

The city of Jasper is the urban population in Dubois County. Jasper is a MS4 Community (see more on page 61.) Jasper's footprint in Mill Creek subwatershed is an estimated 1,298 households with an estimated population of 2,802. Most of those households do have access to wastewater treatment. Figure 13 on page 45 shows that portion of Mill Creek subwatershed with urban population. The homes located within the blueline are on Jasper's wastewater system. Those homes outside the blue line are dependent on on-site septic systems. Notice the subdivision to the west which is outside the wastewater system's boundary (≈115 homes).

With this data, it can be estimated that over 6,300 (or 69.6%) people living in the watershed are dependent on having on-site septic systems.

A report by the Indiana Advisory Commission on Intergovernmental Relations 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 are defined as "contiguous geographical areas containing at least 25 homes and/or businesses that are not served by sewers" (Palmer et. al, 2019). Table 13 below reports unsewered communities, residences and businesses in LEF White River watershed by county.

TABLE 13 – LEF WHITE UNSEWERED BY COUNTY - REPORTED 2016-2017			
County	**Unsewered Communities**	**Residences**	**Businesses**
Daviess	No Report	No Report	No Report
Dubois	1	132	16
Martin	5	110	0
Pike	7	115	12

In addition, to this data, a desktop survey of the watershed using IndianaMap (IndianaMap.org) was used to locate the watershed's small, unincorporated communities. There were 16 named, unincorporated communities found, compared to the 13 reported in Table 13 above. This is probably due to lack of 25 homes / businesses in these named communities. Those named unincorporated communities are listed in Table 14 on page 45 per subwatershed.

FIGURE 13 – MILL CREEK – JASPER WASTEWATER SYSTEM BOUNDARY

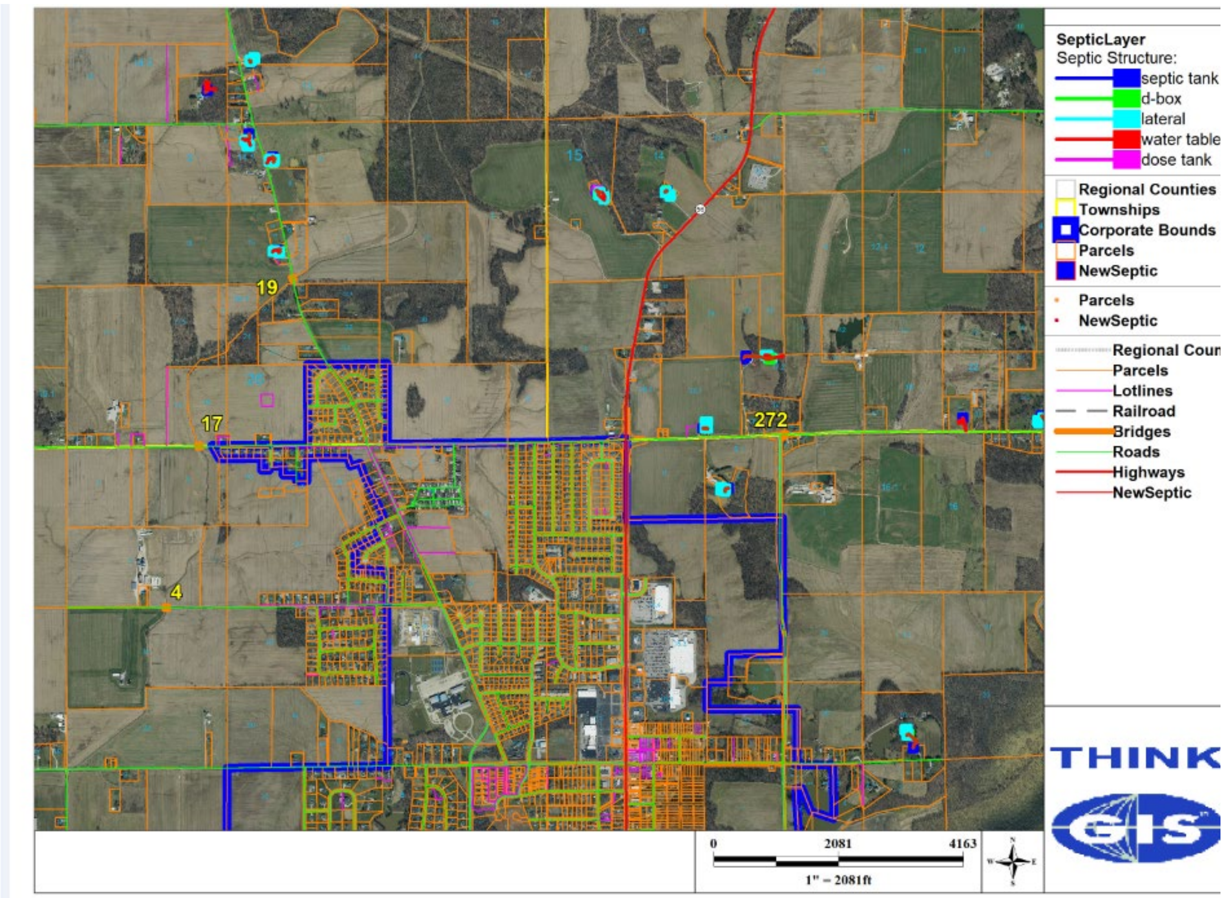
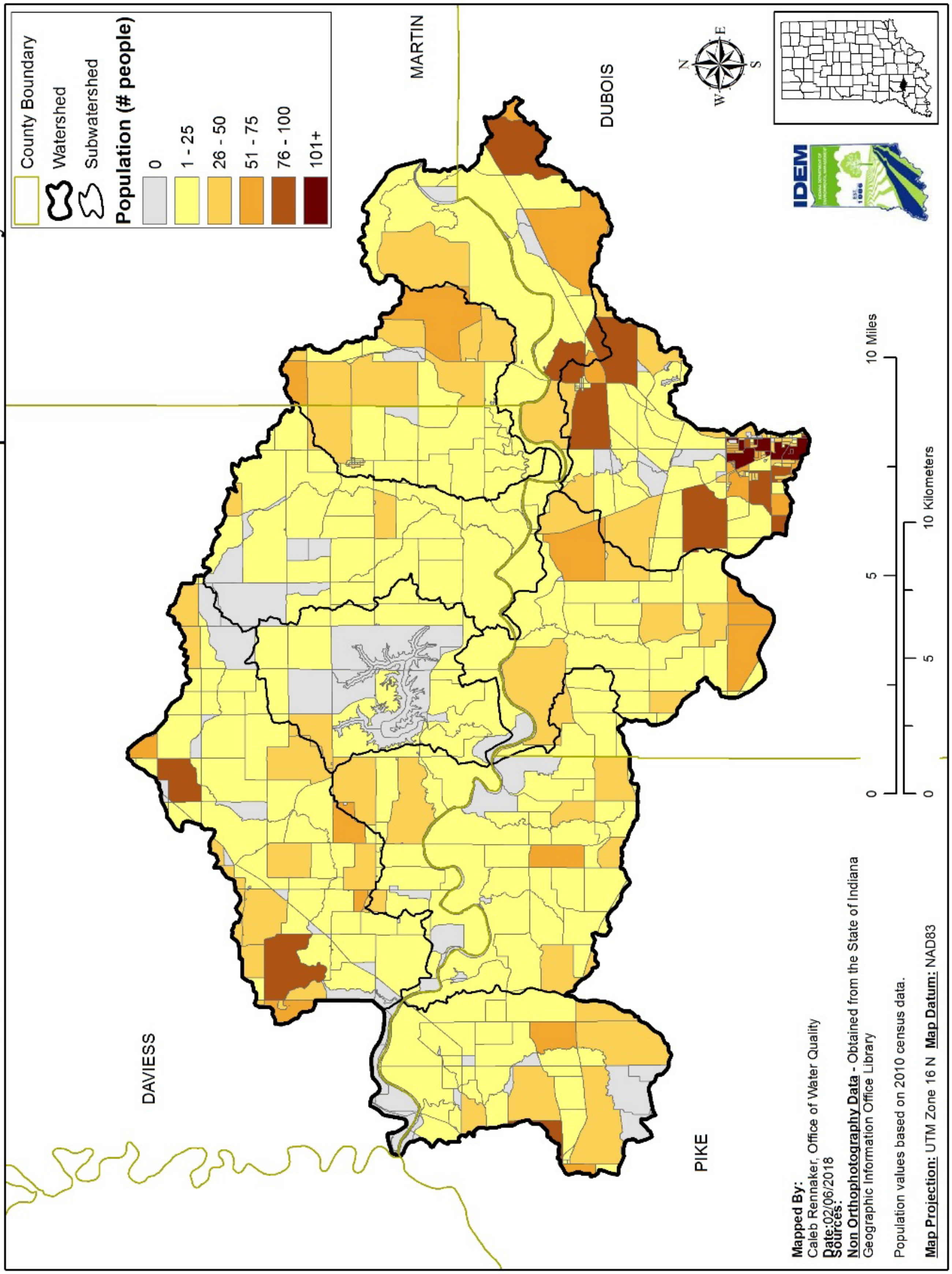


TABLE 14 – UNINCORPORATED COMMUNITIES IN LEF WHITE		
12-Digit HUC	**Name**	**Unincorporated Communities**
051202081501	Mill Creek	Haysville
051202081502	Hoffman Run	Thales
051202081503	Slate Creek	South Martin and Alfordsville
051202081504	Sugar Creek	Pennyville
051202081505	Dogwood Lake	Corning, Waco and Glendale
051202081506	Birch Creek	Portersville
051202081507	Aikman Creek	Cumback
051202081508	Bear Creek	Iva, Hudsonville, and Highbank
051202081509	Mud Creek	Alford, Algiers and Rogers

FIGURE 14 – LEF WHITE POPULATION DENSITY



LEF White Population
Estimates of population within LEF White River Watershed can be calculated by using the US Census data from 2010 (as shown in Table 12 page 43) and the percentage of census blocks in urban and rural areas (Table 13, page 44). Based on this analysis, the estimated population of the watershed is 9,050 with approximately 68 percent of the population classified as rural residents and 32 percent classified as urban residents. Figure 14 on page 46 indicates population density within the LEF White River Watershed.

Where the greatest population is concentrated within the LEF White River Watershed will help watershed stakeholders understand where different types of water quality pressures might currently exist. In general, watersheds with large urban populations are more likely to have problems associated with lots of impervious surfaces, poor riparian habitat, flashy 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).

Recent Population Changes
In addition to interpreting the population data in the watershed, one can look at population changes over time. There is no watershed-based recorded data for populations changes by watershed. However, the US Census data for each county that has land in the LEF White watershed can be examined for recent changes. Each county's population and changes in the past two decades can be found in Table 15 page 47. Looking at this data, one can see that Martin and Pike County populations have remained nearly the same, while Daviess and Dubois have had surges in populations. Thus Table 15 shows how population has changed in each of the counties over time, though not necessarily representation of population change within the watershed.

TABLE 15 – US CENSUS COUNTY POPULATIONS 1990-2010

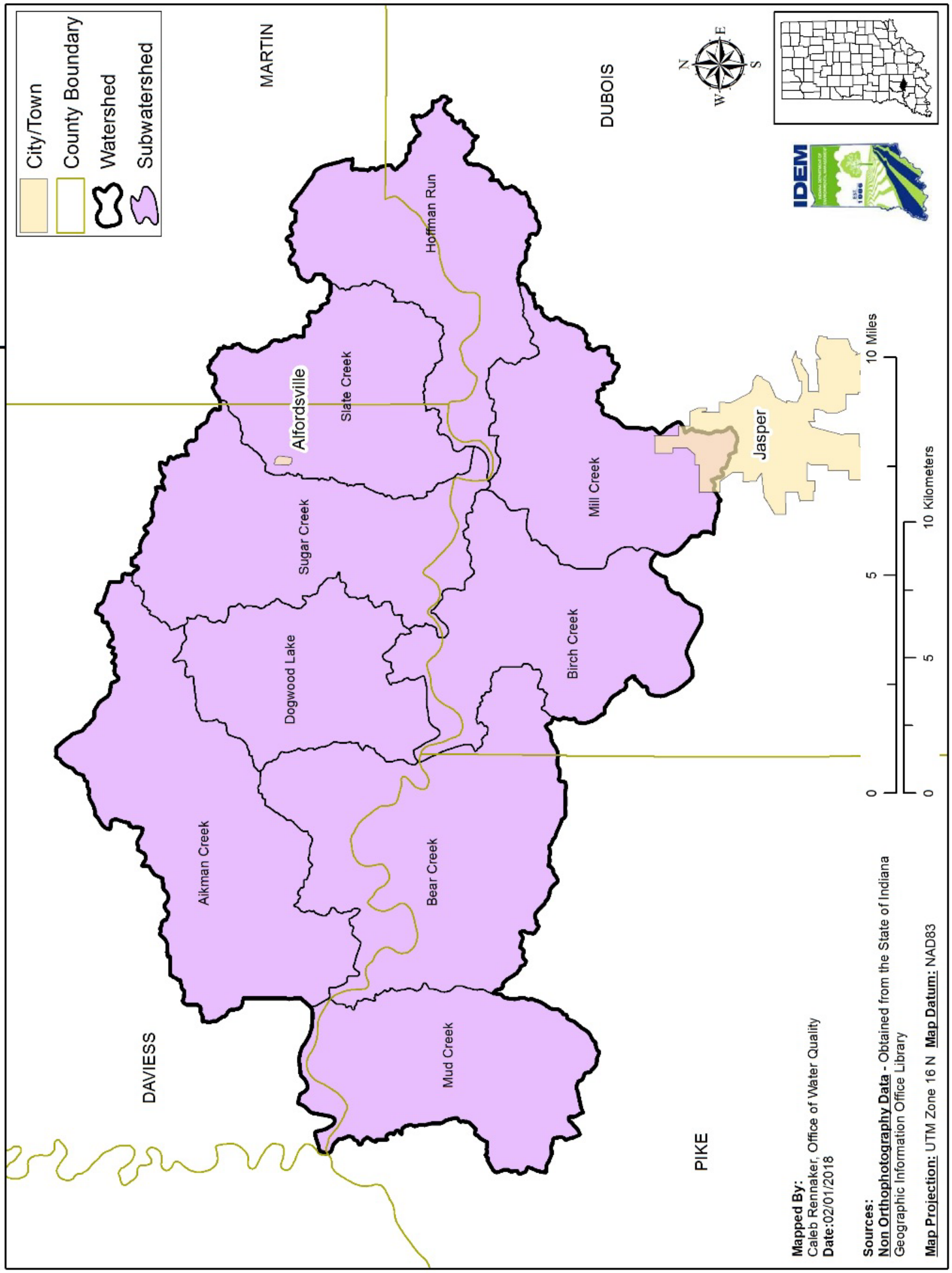
County	1990	2000	2010	Population Change	% change
Daviess	27,533	29,820	31,648	+ 4,115	14.945 % increase
Dubois	36,616	39,674	41,889	+ 5,273	14.401 % increase
Martin	10,369	10,369	10,334	- 35	0.3375 % decrease
Pike	12,509	12,837	12,845	+ 336	2.686% increase
TOTAL	***87,027***	***92,700***	***96,716***		

Population change can serve as an indicator for changes in land uses. Water quality is linked to population growth because a growing population often leads to more development, translating into more infrastructure to support more people. Infrastructure such as more houses, new roads, and increase in businesses means increased impervious surfaces, stormwater runoff and sanitary sewer systems.

Declining population 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).

Understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action in the LEF White River could help prevent further water quality degradation. Comparing the information in Table 12 with the information in Table 15

FIGURE 15 – LEF WHITE MUNICIPALITIES



can provide an understanding of how population might change in the LEF White River Watershed and which counties are experiencing the most growth and shifts in urban and non-urban population.

Urban Stormwater

The community of Jasper in Mill Creek watershed is an MS4 (Municipal Separate Storm Sewer System) community, regulated through National Pollution Discharge Elimination System) NPDES MS4 program (see more on page 61). However, in areas not covered under the NPDES MS4 program, stormwater run-off is not regulated under a permit and is therefore a nonpoint source. Run-off from developed areas can carry a variety of pollutants originating from a variety of sources.

Typically, urban sources of nutrients are fertilizer application to lawns and pet waste, which is also a source of *E. coli*. Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation.

The percent and distribution of developed land in the LEF White River watershed can be found in Table 16 on page 51. 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 LEF White River Watershed.

The locations of the two municipalities in the LEF White watershed (Jasper and Alfordsville) are shown on the map on page 49 (Figure 15).

7. LAND USE DESCRIPTIONS

Land Use in LEF White

Land use patterns provide important clues to the potential sources of impairments in a watershed. The predominant land use types in the LEF White River 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. Land use information for the LEF White River watershed is available from the National Agricultural Statistics Service (NASS) cropland data layer. This data categorizes the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2017.
Figure 16 on page 50 shows the distribution of the land uses and the data is summarized in Table 16 on page 51. Additionally, Table 17 on page 51 displays the breakdown of land uses within each of the nine subwatersheds.

Land use in the LEF White River watershed is primarily agriculture, comprising 50.16 percent of the total acres in the watershed. Approximately 31 percent of the land is forest (more pronounced in the eastern portions of the watershed surrounding Hoffman Run and around Dogwood Lake). Pasture / hay represents almost 10 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 10 percent of the total land area.

FIGURE 16 – LEF WHITE LAND USE

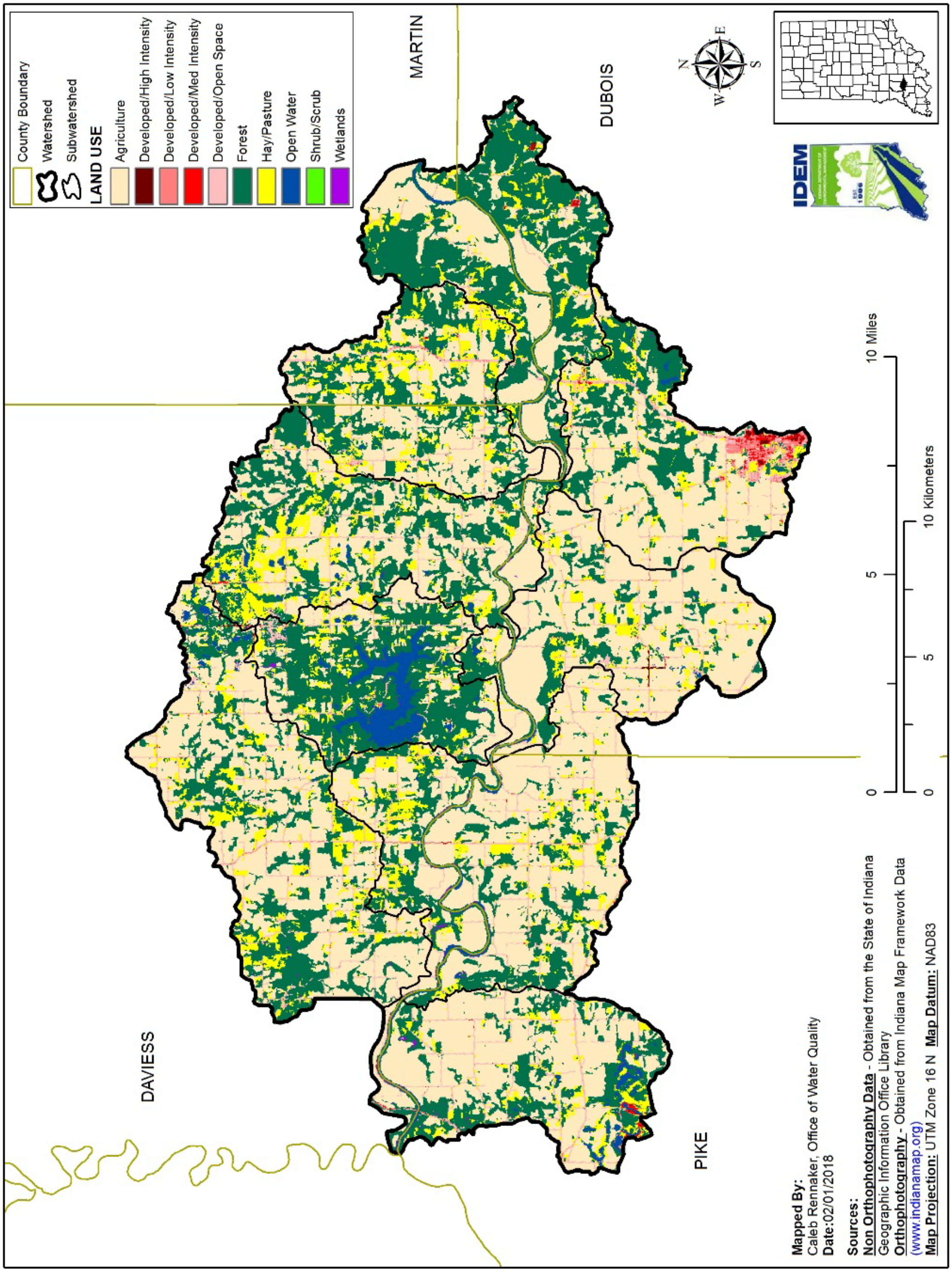


TABLE 16 – LAND USE CATEGORIES AND % OF TOTAL WATERSHED			
Land Use	**Area**		**Percent**
	Acres	**Square Miles**	
Agricultural Land	66,552.33	103.99	50.16
Developed Land	7,828.30	12.23	5.90
Forested Land	41,671.90	65.11	31.41
Hay/Pasture	13,148.87	20.55	9.91
Open Water	3,236.07	5.06	2.44
Shrub/Scrub	15.12	0.02	0.01
Wetlands	226.40	0.35	0.17
TOTAL	**132,679**	**207.31**	**100%**

TABLE 17 – LAND USE PER SUBWATERSHED									
Subwatershed	**Area**	**Land Use**							**Total**
		Agriculture	**Developed**	**Forest**	**Hay/ Pasture**	**Open Water**	**Shrub/ Scrub**	**Wetlands**	
Mill Creek (051202081501)	Acres	**6,669**	**1,458**	**3,401**	**946**	**47**	**1**	**2**	**12,523**
	Sq. Mi.	**10.42**	**2.28**	**5.31**	**1.48**	**0.07**	**0.00**	**0.00**	**19.57**
	Percent	**53%**	**12%**	**27%**	**8%**	**0%**	**0%**	**0%**	**100%**
Hoffman Run (051202081502)	Acres	**4,988**	**435**	**7,535**	**1,076**	**308**	**<1**	**12**	**14,354**
	Sq. Mi.	**7.79**	**0.68**	**11.77**	**1.68**	**0.48**	**0.00**	**0.02**	**22.43**
	Percent	**35%**	**3%**	**52%**	**7%**	**2%**	**0%**	**0%**	**100%**
Slate Creek (051202081503)	Acres	**5,227**	**746**	**4,047**	**1,935**	**30**	**0**	**2**	**11,987**
	Sq. Mi.	**8.17**	**1.17**	**6.32**	**3.02**	**0.05**	**0.00**	**0.00**	**18.73**
	Percent	**44%**	**6%**	**34%**	**16%**	**0%**	**0%**	**0%**	**100%**
Sugar Creek (051202081504)	Acres	**6,719**	**732**	**5,377**	**2,227**	**368**	**4**	**24**	**15,450**
	Sq. Mi.	**10.50**	**1.14**	**8.40**	**3.48**	**0.57**	**0.01**	**0.04**	**24.14**
	Percent	**43%**	**5%**	**35%**	**14%**	**2%**	**0%**	**0%**	**100%**
Dogwood Lake (051202081505)	Acres	**2,534**	**542**	**5,465**	**885**	**1,258**	**<1**	**34**	**10,719**
	Sq. Mi.	**3.96**	**0.85**	**8.54**	**1.38**	**1.97**	**0.00**	**0.05**	**16.75**
	Percent	**24%**	**5%**	**51%**	**8%**	**12%**	**0%**	**0%**	**100%**
Birch Creek (051202081506)	Acres	**9,632**	**752**	**2,334**	**1,039**	**211**	**2**	**9**	**13,980**
	Sq. Mi.	**15.05**	**1.18**	**3.65**	**1.62**	**0.33**	**0.00**	**0.01**	**21.84**
	Percent	**69%**	**5%**	**17%**	**7%**	**2%**	**0%**	**0%**	**100%**
Aikman Creek (051202081507)	Acres	**10,598**	**1,175**	**5,393**	**2,122**	**159**	**1**	**16**	**19,464**
	Sq. Mi.	**16.56**	**1.84**	**8.43**	**3.32**	**0.25**	**0.00**	**0.02**	**30.41**
	Percent	**54%**	**6%**	**28%**	**11%**	**1%**	**0%**	**0%**	**100%**
Bear Creek (051202081508)	Acres	**12,390**	**1,179**	**4,829**	**1,983**	**393**	**4**	**62**	**20,840**
	Sq. Mi.	**19.36**	**1.84**	**7.55**	**3.10**	**0.61**	**0.01**	**0.10**	**32.56**
	Percent	**59%**	**6%**	**23%**	**10%**	**2%**	**0%**	**0%**	**100%**
Mud Creek (051202081509)	Acres	**7,797**	**809**	**3,291**	**936**	**463**	**3**	**67**	**13,366**
	Sq. Mi.	**12.18**	**1.26**	**5.14**	**1.46**	**0.72**	**0.00**	**0.10**	**20.88**
	Percent	**58%**	**6%**	**25%**	**7%**	**3%**	**0%**	**1%**	**100%**

Agricultural – Croplands in LEF White

Croplands can be a source of E. coli, sediments, and nutrients. Accumulation of nutrients and E. coli on cropland occurs from decomposition of residual crop material, chemical fertilizers (e.g., anhydrous ammonia) manure or inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal/industrial wastewater treatment facilities. Cropland Nitrogen (N) loading occurs from fertilization with commercial and manure fertilizers and use of

TABLE 18 – MAJOR CASH CROP ACREAGE IN LEF WHITE

Subwatershed	Crop	Total Acreage	% of Subwatershed Cash Crop Acreage
Mill Creek (051202081501)	Corn	3,098	50%
	Soybean	3,103	50%
	Winter Wheat	7	0%
	Total	6,208	100%
Hoffman Run (051202081502)	Corn	2,682	54%
	Soybean	2,259	46%
	Winter Wheat	3	0%
	Total	4,944	100%
Slate Creek (051202081503)	Corn	2,957	60%
	Soybean	1,950	40%
	Winter Wheat	<1	0%
	Total	4,907	100%
Sugar Creek (051202081504)	Corn	3,035	47%
	Soybean	3,420	53%
	Winter Wheat	7	0%
	Total	6,463	100%
Dogwood Lake (051202081505)	Corn	1,147	48%
	Soybean	1,235	52%
	Winter Wheat	1	0%
	Total	2,383	100%
Birch Creek (051202081506)	Corn	5,111	55%
	Soybean	4,196	45%
	Winter Wheat	9	0%
	Total	9,315	100%
Aikman Creek (051202081507)	Corn	4,648	47%
	Soybean	5,207	53%
	Winter Wheat	2	0%
	Total	9,857	100%
Bear Creek (051202081508)	Corn	5,190	43%
	Soybean	7,014	57%
	Winter Wheat	3	0%
	Total	12,206	100%
Mud Creek (051202081509)	Corn	4,331	56%
	Soybean	3,456	44%
	Winter Wheat	5	0%
	Total	7,793	100%

FIGURE 17 – LEF WHITE CASH CROP ACREAGE

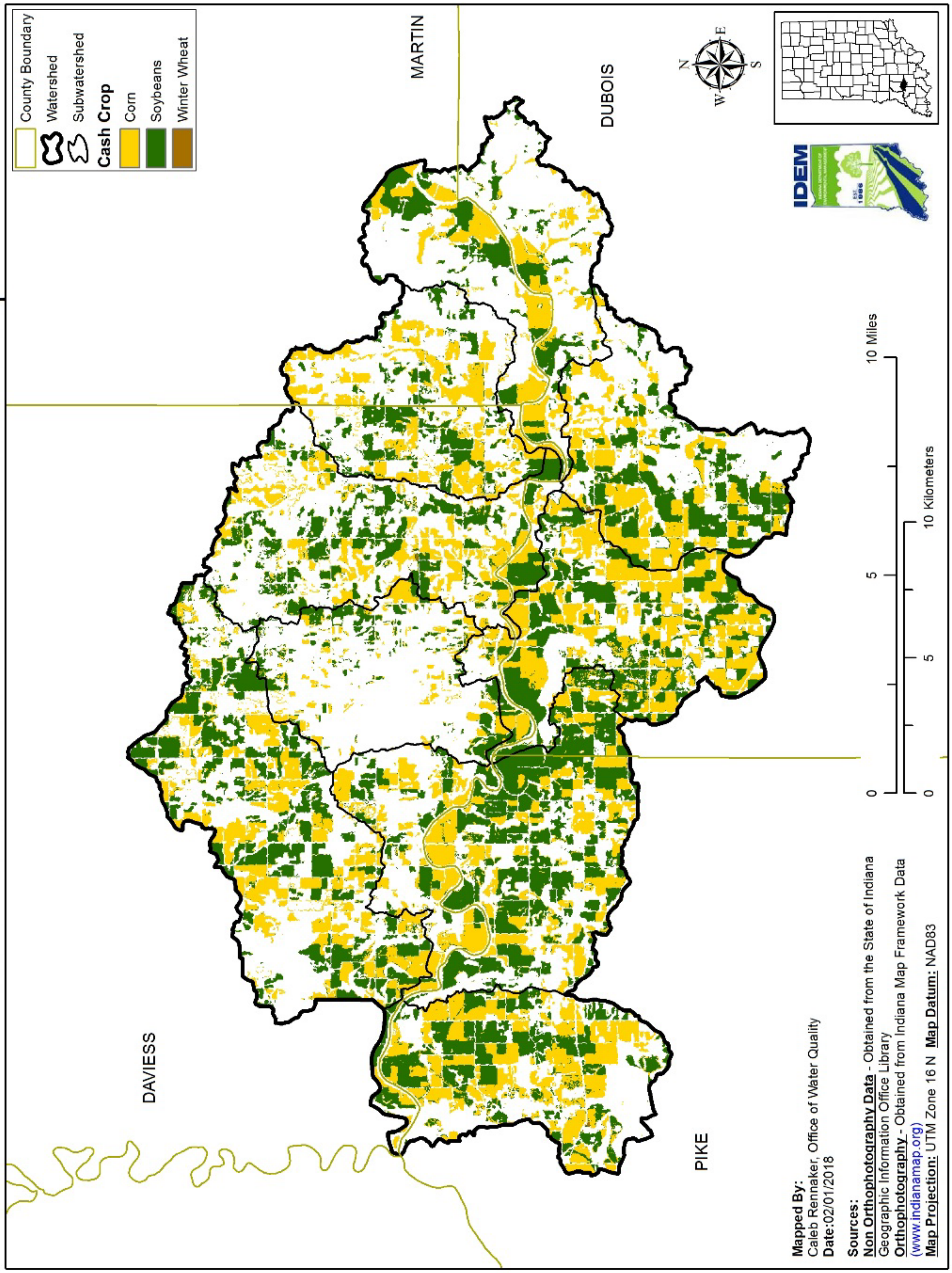
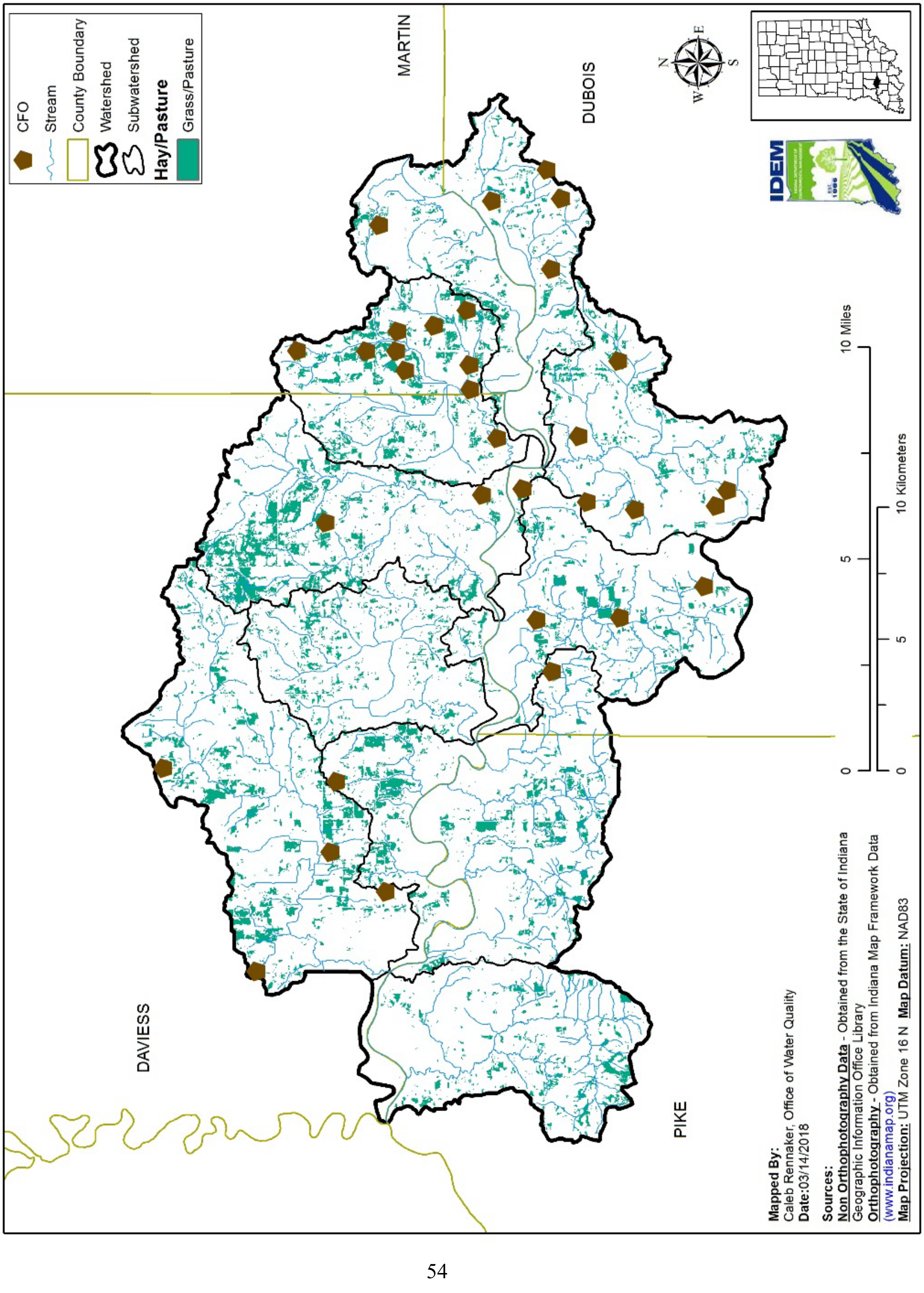


FIGURE 18 –GRASS / PASTURELAND and CFO LOCATIONS



manure often results in excessive Phosphorus (P) loads relative to crop requirements (U.S. EPA, 2003).

Data available from the National Agricultural Statistic Service was downloaded to estimate crop acreage in the subwatersheds.

Agricultural - Hay and Pasture in LEF White

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 locations and intensity of hay / pasture acres as well as locations of permitted livestock facilities within the LEF White River watershed are presented in Figure 18 on page 54.

Agricultural - 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.

Confined feeding operations that are not classified as Concentrated Animal Feeding Operations (CAFOs) are known as confined feeding operations (CFOs) in Indiana. Non-CAFO animal feeding operations identified as CFOs by IDEM are considered nonpoint sources by 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 CFOs, 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 zero facilities in Indiana that have an NPDES permit under 15-16.

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

- Improper application of manure can contaminate surface or ground water.
- Manure over application or improper application can adversely impact soil productivity.

There are 33 CFOs in the LEF White River watershed. They are listed individually and by subwatershed in Appendix E. Figure 18 on page 54 shows the location and intensity of pasture / hay lands as well as locates all 33 CFOs on the LEF White map with a dot.

Forests

Forests are vital ecosystems that provide for maintaining riparian zones, stabilizing hillsides, and carbon sequestration. Second only to agriculture in LEF White, there are significant acres of forest and natural areas in this watershed. Forest lands equate to 41,671.9 acres, or 65.11 square miles, which is 31.41% of the watershed. Figure 16 on page 50 shows forested lands in the watershed.

There are very few, if any, isolated areas of Indiana forestland where trees have never been cut. Most of these areas are thought of as small treasures and are preserved in state parks and nature preserves. A desktop survey using IndianaMap (https://maps.indiana.edu/) showed Mill Creek subwatershed had a couple of wooded areas covering 300 to 450 acres contiguously and that Hoffman Run subwatershed is mostly forested outside the main stem floodplain. Other than the significant wooded lands surrounding Dogwood Lake in Dogwood Lake subwatershed, the largest "patch" of unfragmented forested land is in Hoffman Run subwatershed near South Martin; in which nearly 1,000 acres of contiguous forest are present. The rest of the project area does not have any extensive, unfragmented forested areas. Rather there are "wood lots," riparian zones, and some public wildlife areas. However, conservation groups, private citizens, State, and Federal agencies all realize the importance of the remaining forests, rivers, and wetlands in the area and have undertaken projects to conserve, protect, and restore these valuable assets.

Mining

Indiana has been coal mined (surface and underground) from the late 1800's until the mid-1900's. Coal was discovered in Pike County in 1860. 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

Current mine activity in LEF White is focused in Daviess and Dubois Counties. See Figure 19 on page 58 for locations of active coal mining operations in LEF White.

Acid Mine Drainage (AMD)
Acid Mine Drainage (AMD) is caused by oxidation of pyrites during and after mining operations. AMD typically has a pH so low it is comparable to vinegar or battery acid. Obviously, nothing can live in this environment. During dry periods, the AMD collects in pools and then flushes out after a heavy precipitation event. Thankfully, the Surface Mining Control and Reclamation Act (SMCRA) imposes an extraction fee on each ton of coal mined, and with that money addresses AMD/Acid Mine Lands (AML) problems throughout the United States. The Division of Reclamation (DOR), Indiana Department of Natural Resources is the state agency which implements the SMCRA in Indiana. See below for more information on SMCRA.

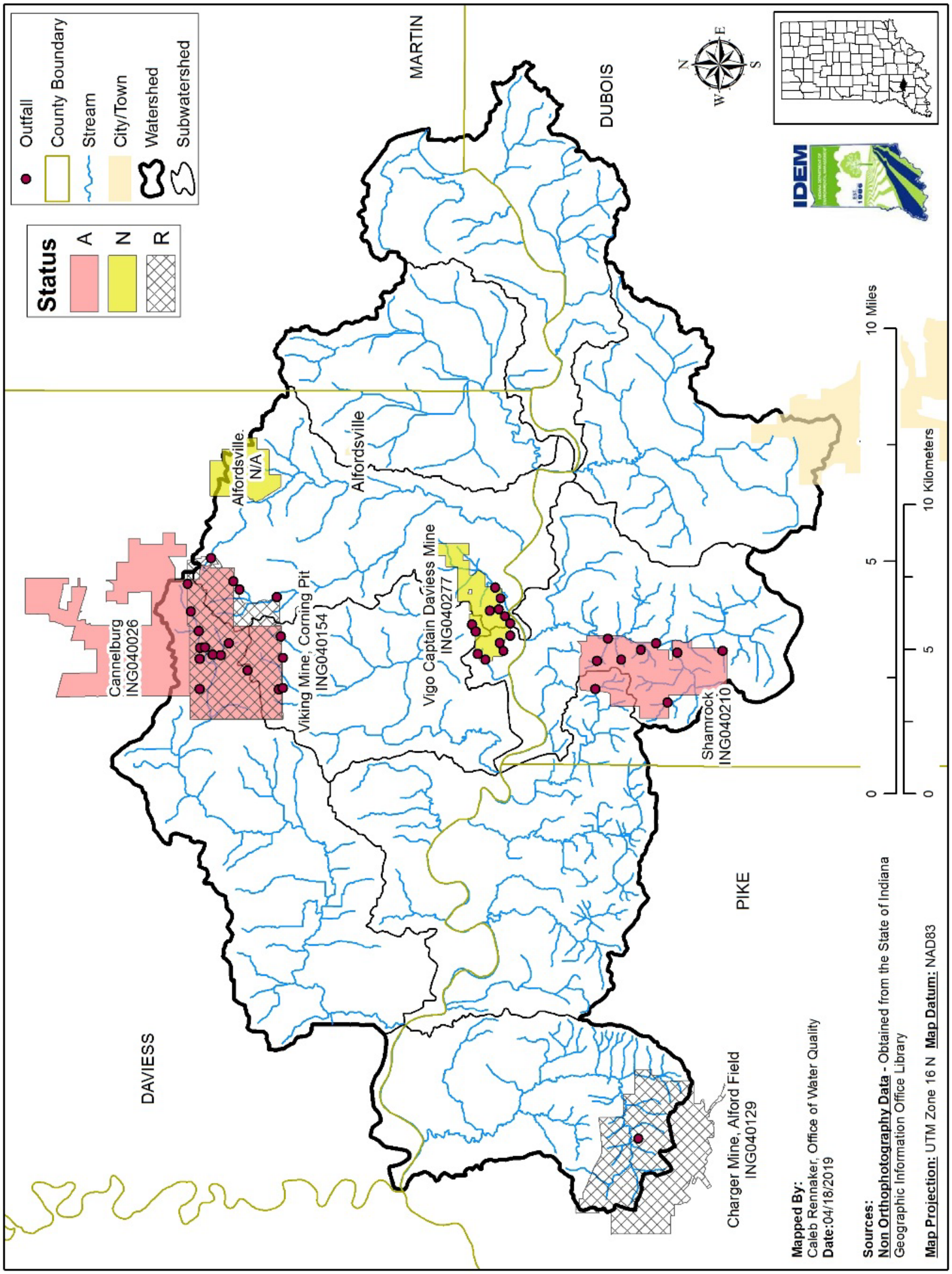
Even though reclamation guidelines dictate procedures to prevent the deterioration of the watershed, vigilance is required to ensure that the guidelines are in fact being followed. Reclaimed land is extremely vulnerable to erosion. The erosion not only contributes to sedimentation in the streams, but exposes pyretic materials, which can cause AMD. The residual effects of historic mining can have a significant influence on water quality as AMD from seeps, mine tailings/gob piles, and exposed coal seams enter into streams and their tributaries. The AMD generally displays elevated levels of one or more parameters including acidity, metals, sulfates, and suspended solids (Bauers et al, 2006).

Surface Mining Control and Reclamation Act (SMCRA)
It should also be noted that there is an important distinction between Abandoned Mine Lands (AML) and current mining practices. The United States government enacted the Surface Mining Control and Reclamation Act (SMCRA) in 1977 which imposed strict reclamation guidelines during and after mining operations. Prior to 1977 there were very little formal reclamation guidelines. Land was mined, which resulted in total devastation of the area, and frequently abandoned without any restoration resulting in AML. However, current mines are required to comply with SMCRA. The act 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.

Facilities engaging in mining of coal, coal processing, and reclamation activities are regulated through a NPDES General Permit under 327 IAC 15-7. The purpose of this 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 current mines in the LEF White are not considered significant sources of the impairments. However, this WMP will identify point sources as permitted discharge points or discharges having responsible parties, and nonpoint sources as any pollution sources that are not point sources. For example, there is not a single point of discharge associated with AMLs. Therefore, run-off from these areas consists of overland flow, and were treated 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.

FIGURE 19 –SURFACE MINES IN LEF WHITE



Permit status indicated by the following letters: A – active; N – new permit bonded (no overburden removal or coal extracted); R - overburden removal and coal extraction complete.

Open Water, Streams and Wetlands
The LEF White River watershed has a diverse network of streams as well as a good portion of open water and wetlands (2.6% of watershed). More regarding land use under these categories can be found under Hydrology section on pages 23-30.

Urban and Industrial Land Use
The Midwest seems to be ever changing. Actual farm numbers are decreasing, even as additional farm acres are being added. Unincorporated towns, housing clusters, and individual homes all pose threats such as septic systems, illegal trash dumping, fuel leaks, and non-permitted excavation in sensitive areas such as wetlands and floodplains. The construction of Interstate 69 through the watershed has greatly changed the landscape of Mud Creek subwatershed. And since the corridor has been completed from Evansville to Bloomington, traffic has increased on the Interstate, and no doubt, development will increase as well in the next few years.

Pet and Wildlife Waste
Pet waste, if not properly removed and discarded, can find its way into local streams after a heavy rain event and contribute to high E. coli levels. To estimate the amount of pet waste in the LEF White watershed, census records were examined. The LEF White watershed is predominantly rural with only 3,906 households estimated to be in the watershed (see Appendix C) which equates to roughly 15 acres per person. The American Veterinary Medical Association states that 36.5% of households have dogs and 30.4% have cats. This data brings the dog and cat population in the LEF White to one per 50 acres. Since the ratio of pets to acres is very low, pet waste in the LEF White watershed is insignificant to E. coli levels.

The LEF White watershed does have an abundance of wildlife, especially large populations of deer and migratory birds. Urban areas with a concentrated population may be a concern, but in a balanced ecosystem, wildlife waste is not considered to be a detriment to water quality. Large flocks do stopover during migration at Glendale FWA, but it is not a concern since the wetlands mitigate the waste pollution. In addition, many stakeholders enjoy Glendale FWA visiting the area to hunt, hike, fish, kayak, view wildlife, and take photos. Wildlife of any kind in a rural area is seen as a favorable indicator of good habitat and forage. Ongoing efforts will continue to monitor dense populations of wildlife that may negatively impact water quality with fecal waste.

Land Use Potential Impact on Water Quality / Stakeholder Concerns
Soil loss is a great concern for all stakeholders in the watershed. Turbid waters and embedded streambeds do not provide adequate habitat for fish and macroinvertebrates that contribute to a balanced ecosystem.

Additionally, producers are concerned with soil run-off as this lowers productivity and soil health significantly. Soil particles can also bind with certain additives, such as phosphorus, and transport these nutrients into the streams in excess. Soil is also lost in ditches, due to the practice of cleaning ditches periodically and not utilizing seed or erosion control measures of any type to prevent soil loss during rain events.

Streambank erosion is also a primary concern when it comes to the contribution of sediment in local streams. Logjams can create blockages in streams that cause water to reroute and cleave into banks, causing much soil loss. Windshield surveys (see page 68) in the watershed have proven that, especially under bridges, there are blockages in many creeks and streams created by trash, down logs, corn stalks and other debris.

In addition, much of the agricultural land in the LEF White watershed is also drained by tile systems. Current estimates of the amount of agricultural land drained in the Midwest are unclear at this time, but ongoing research suggests that much of Indiana's original wetland areas have been deforested and drained to increase farming productivity. (See hydric soils and wetland discussion on pages 27 and 40.) It is also a cause of great concern that the overloading of local streams from excess diversion of rainwater and run-off is a major contributing factor to streambank erosion and damaging flood events.

Fertilizer is primarily used in LEF White for increasing agricultural production. It should be noted that private landowners may apply fertilizer and pesticides to gardens, landscaping and decorative plants. But it is agricultural fertilizer, typically applied as a mix of nitrogen, phosphorus and potassium, which is a resource concern among many stakeholders. Applied at the time of spring planting, over application of fertilizer can lead to increase nutrient loads. Side-dressing (after planting if the producer has the equipment to do so) is a beneficial practice as it allows the producer to apply fertilizer in a timely manner, rather than on the field prior to the crop being able to utilize it. Fertilizer applications prior to planting are more likely to be washed away with a heavy spring rain. Also, cover crop acres, which can reduce soil erosion and thus nutrient loads throughout the winter months, fluctuate each year. This practice could increase soil organic matter and help to reduce the need for applied fertilizer in the spring.

Bottomland hardwood forests have a tremendous positive effect on down-stream flooding, nutrient uptake, and aquifer recharging. However, much of the LEF White floodplain is not forested, but rather hardwood forests are more prominent on the uplands of the watershed.

8. OTHER PLANNING EFFORTS IN WATERSHED

Other planning efforts in the watershed include the December 2019 TMDL completed by IDEM (see Recent Data Collection on page 68) and the Jasper MS4. Non-watershed-based planning commissions are active in Dubois, Daviess, Pike and Martin counties.

Regional Sewer Districts

The Otwell Water Department and Jefferson Township Regional Sewer District are located in the north east corner of Pike County. The community of Otwell is located in the Patoka River watershed and only a portion of Jefferson Township (3,177 acres) is located in the LEF White River watershed. Per the Otwell Water Department, the regional sewer district only covers the people in the town (165 customers) and is in the Patoka watershed. Martin and Daviess County do not have a regional sewer district. Dubois County has a regional sewer district located in Patoka watershed.
https://otwellindiana.wordpress.com/otwell-water-departmentjefferson-township-regional-sewer/

Rule 5 Enforcements

Indiana statue 327 IAC 15-5 regulates construction activities and associated stormwater run-off. This statue is commonly known as Rule 5. The occasional housing development or other construction project in the watershed that will exceed one acre of disturbed topsoil is required by IDEM Office of Water Quality (Indiana statue 327 IAC 15-5) to submit an Erosion Control Plan and Notice of Intent to the SWCD office in the county where the disturbance is occurring. The plan is reviewed by an IDEM storm water specialist. This "disturbance" refers to any manmade change of land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting and grading. Once plans are submitted, the SWCD District Coordinator forwards them to the IDEM storm water specialist who reviews the plans / projects for compliance.

At the writing of this plan, there are no enforcement/compliance issues in the LEF White watershed.

Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. In Indiana most construction projects subject to Rule 5 are administered through a general permit. The requirements of Rule 5 now apply to all persons who are involved in construction activity (which includes clearing, grading, excavation, and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land-disturbing activity results in the disturbance of less than one (1) acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to stormwater permitting.

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

TABLE 19 - AVG. PERMITTED CONSTRUCTION ACRES 2014-2018

Subwatershed	Estimated Annual Construction Acreage
Mill Creek	19
Hoffman Run	0
Slate Creek	0
Sugar Creek	8
Dogwood Lake	0
Birch Creek	0
Aikman Creek	4
Bear Creek	0
Mud Creek	11

If an adverse environmental impact from a project site is evident, a Rule 5 permit or, in more significant situations, an individual stormwater permit, may be required. An individual stormwater permit is typically required only if IDEM determines that the discharge will significantly lower water quality. If an individual stormwater permit is required, notice will be given to the project site owner. The average annual construction acreage (shown in Table 19) were calculated by using the past five years of permitted construction sites in each subwatershed.

Municipal Separate Storm Sewer Systems (MS4)

Municipal Separate Storm Sewer Systems (MS4s) are regulated by 327 IAC 15-13 commonly known as Rule 13 or the municipal stormwater general permit rule. MS4s are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying 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 (CSOs) and publicly owned treatment works.

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

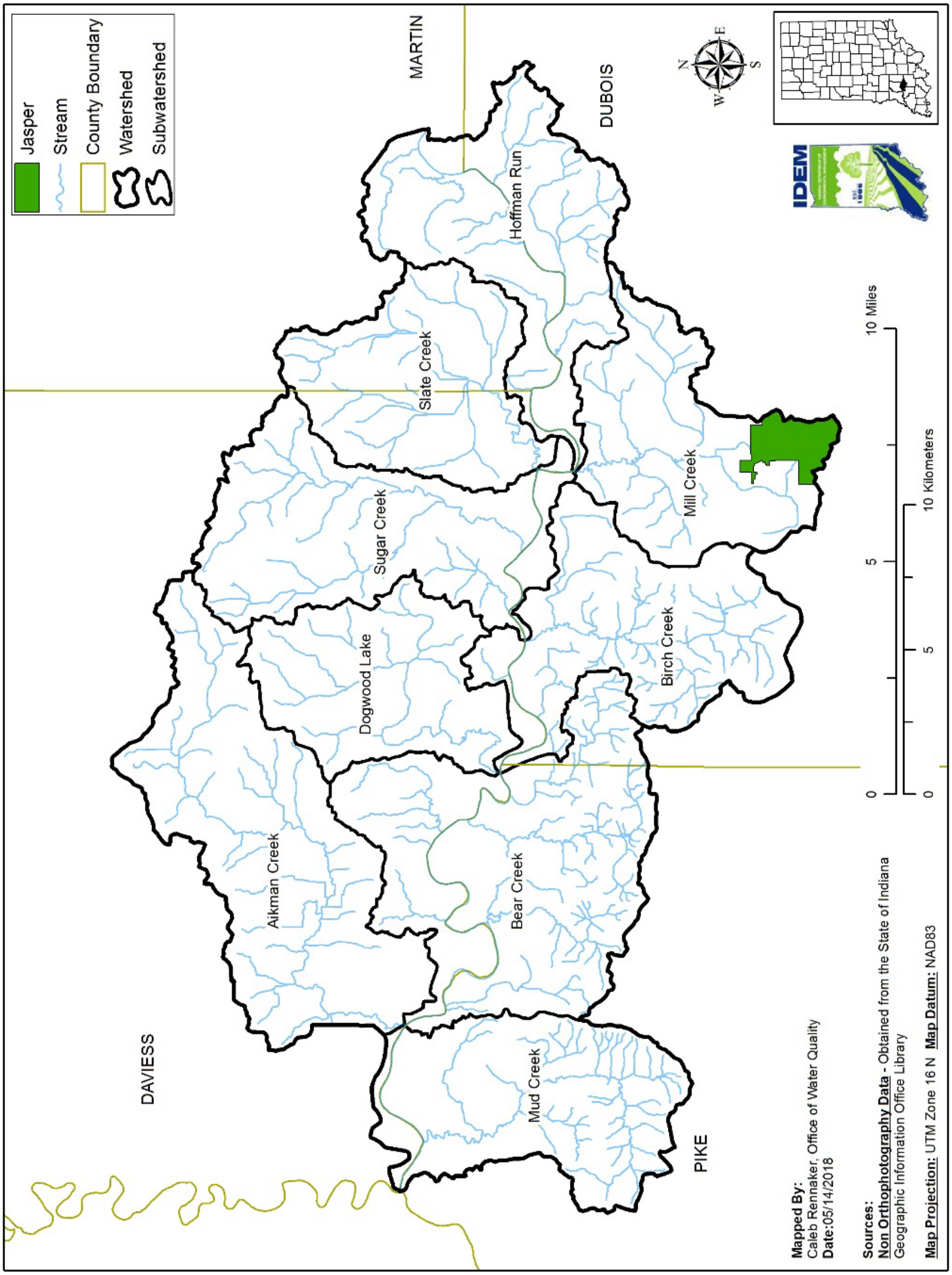
MS4 conveyances within urbanized areas have one of the greatest potentials for polluted stormwater run-off. The Federal Register Final Rule explains the reason as: "urbanization alters the natural infiltration capacity of the land and generates...pollutants...causing an increase in stormwater run-off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

There is one MS4 entity in the LEF White River watershed as shown in Table 20 below and Figure 20 on page 63. Municipal boundaries and MS4 boundaries are not always the same; but are often used to delineate the regulated MS4 area if a system map is not readily available. The MS4 WLAs are developed at High and Moist flow regimes; it is not expected that the MS4 will have non stormwater discharges. The MS4 operator shall develop a stormwater quality management plan (SWQMP) that includes a commitment to develop and implement a strategy to detect and eliminate illicit discharges to the MS4 conveyance.

TABLE 20 – MS4 COMMUNITIES IN LEF WHITE

Subwatershed	MS4 Community	Permit ID	Drainage Area (Acres)	% of Mill Creek Subwatershed
Mill Creek	Jasper	INR040067	1,245.57	9.95%

FIGURE 20 –MS4 BOUNDARIES IN LEF WHITE



Other planning efforts in the four counties have to do with economic development and zoning rather than watershed management or protection / conservation of water resources. These planning commissions are as follows:

- **Indiana 15 Regional Planning Commission**
  The Indiana 15 Regional Planning Commission is a multi-county governmental agency covering Crawford, Dubois, Orange, Perry, Pike and Spencer counties. The planning commission has been in operation since 1973 and was originally named Patoka Lake Regional Planning Commission. Indiana 15 is partially funded through annual county per-capita fees and an annual federal planning grant as an Economic Development District of the US Department of Commerce – Economic Development Administration. Indiana 15 is involved in a multitude of community and economic development projects, providing administrative, planning and technical services within the six-county region.
- **Daviess County Advisory Plan Commission**
  The Daviess County Advisory Plan Commission is a nine-member board responsible for making recommendations to the Daviess County Commissioners regarding application of re-zoniung or modifications to the Daviess County Zoning Ordinance.
- **Southern Indiana Development Commission**
  The Southern Indiana Development Commission serves the development needs of Daviess, Green, Knox, Lawrence and Martin Counties. Their mission is to establish a mutual forum to identify, discuss, study and bring into focus challenges / opportunities facing the five-county area and provide an organization for effective communication and coordination among governments and agencies.

9. ENDANGERED AND THREATENED PLANTS AND ANIMALS IN WATERSHED

The Indiana DNR defines potentially sensitive areas as areas where threatened or endangered species have been documented or areas that have been determined to be high quality natural areas. These areas should be considered prime candidates for preservation. Daviess, Dubois, Martin and Pike Counties are home to several endangered, threatened and rare species, as well as high-quality natural areas. There are numerous high-quality natural areas in the LEF White watershed as shown in Table 21 on page 65.

The managed and classified lands in the LEF White watershed are natural areas that 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.

Many threatened and endangered species call this watershed home. Various species of darters such as Western Sand Darter (Ammocrypta clara) and Tippecanoe Darter (Etheostoma tippecanoe) can be found in the watershed and surrounding counties and are dependent upon the health of the aquatic system. Additional information on state endangered, threatened and rare species can be found on the DNR website (http://www.in.gov/dnr/naturepreserve/4666.htm).

TABLE 21 – HIGH QUALITY NATURAL AREAS IN EACH COUNTY	
County Name	**High Quality Natural Areas**
Pike County	Wet-mesic Floodplain Forest, Southwestern Lowlands Dry-Mesic Upland Forest, Southwestern Lowlands Mesic Upland Forest
Daviess County	Wet Floodplain Forest, Sand Flat Wetlands, Circumneutral Seep Wetlands
Martin County	Sandstone Glades, Mesic Floodplain Forest, Shawnee Hills Dry Upland Forest, Shawnee Hills Dry-Mesic Upland Forest, Shawnee Hills Mesic Upland Forest, Sandstone Cliff and Acid Seep Wetland
Dubois County	Wet-mesic Floodplain Forest, Shawnee Hills Dry Upland Forest, Shawnee Hills Dry-Mesic Upland Forest, Shawnee Hills Mesic Upland Forest, Southern Bottomlands Mesic Upland Forest, Southwestern Lowlands Mesic Upland Forest, Sandstone Cliff, Acid Seep Wetland and Forested Swamp Wetland

The March 2020 IDNR list of Endangered, Threatened and Rare Species listed:

for Martin County: 1 insect, 1 flatworm, 1 diplopoda, 1 crustacean, 20 mussels, 4 springtails, 1 beetle, 4 mayflies, 1 arachnida, 3 fish, 2 amphibians, 4 reptiles, 14 birds, 7 mammals and 19 vascular plants;

for Daviess County: 1 insect, 15 mussels, 1 gastropoda, 2 mayflies, 2 fish, 1 amphibian, 3 reptiles, 6 birds, 8 mammals and 26 vascular plants;

for Pike County: 1 insect, 12 mussels, 1 beetle, 2 mayflies, 1 fish, 2 amphibians, 3 reptiles, 17 birds, 7 mammals, and 20 vascular plants;

for Dubois County: 1 crustacean, 10 mussels, 2 collembola, 1 odonata, 2 fish, 3 amphibians, 3 reptiles, 14 birds, 4 mammals and 18 vascular plants.

Appendix D lists each of these by Latin name and common name for each of the four counties.

10. RELEVANT RELATIONSHIPS BETWEEN CHARACTERISTICS

Topography and Soil Type

Most of the land (94%) in the LEF White watershed is highly erodible soil. These types of soils are at risk for weathering and eroding, especially during heavy rains. In addition, an abundance of farm acres is at risk for soil loss due to lack of minimal tillage practices, filter strips, buffers and other conservation measures. Often tilled hill fields within the watershed can be seen with deep gullies and washouts after a heavy rain. Many farms have crop rows right up to the edge of a creek or ditch, with little or no grass buffer between the tilled acres and the waterway.

In addition, the watershed has significant floodplain acres, and hydric soils make up (29%) of the watershed. Also, much of the farmland is drained by subsurface tile which can transmit some contaminants directly into streams and ditches with little filtration.

Soils Unsuitable for OnSite Septic Systems

Population centers within the LEF White are mainly individual homes and housing clusters except for the northern edge of Jasper. Thus, is can be stated that the majority of citizens living in the LEF White watershed mainly rely on onsite septic systems for waste disposal. Many of these homes were built prior to Indiana State Department of Health's current septic system regulations (Rule 410 IAC

6-8.3) meaning they may possess a system that does not have a proper drainage field, if a field is present at all. This can cause contaminated water to reach surface water and streams before harmful bacteria has been properly filtered. In addition, nearly 91% of soils in the LEF White are classified as very limited for septic system suitability. It is evident that all these factors can be contributing to high levels of E. coli.

Hydrology and Land Use
The LEF White watershed is the ending 132,748.8 acres of the 5,742 square miles (3,674,880 acres) included in the HUC 8-digit Lower White. This means the LEF White is 03.612% of the entire drainage basin. Due to extremely rural nature of the watershed, stakeholders' natural resource concerns stem from land use decisions – predominantly agricultural production, wetland / flood plains being drained for use and faulty, antiquated septic systems.

The goal is a nutrient and sediment load reduction across the watershed through decreased tillage, improved soil health with use of cover crops and BMPs and the increase of wetland acres through restoration and conversions.

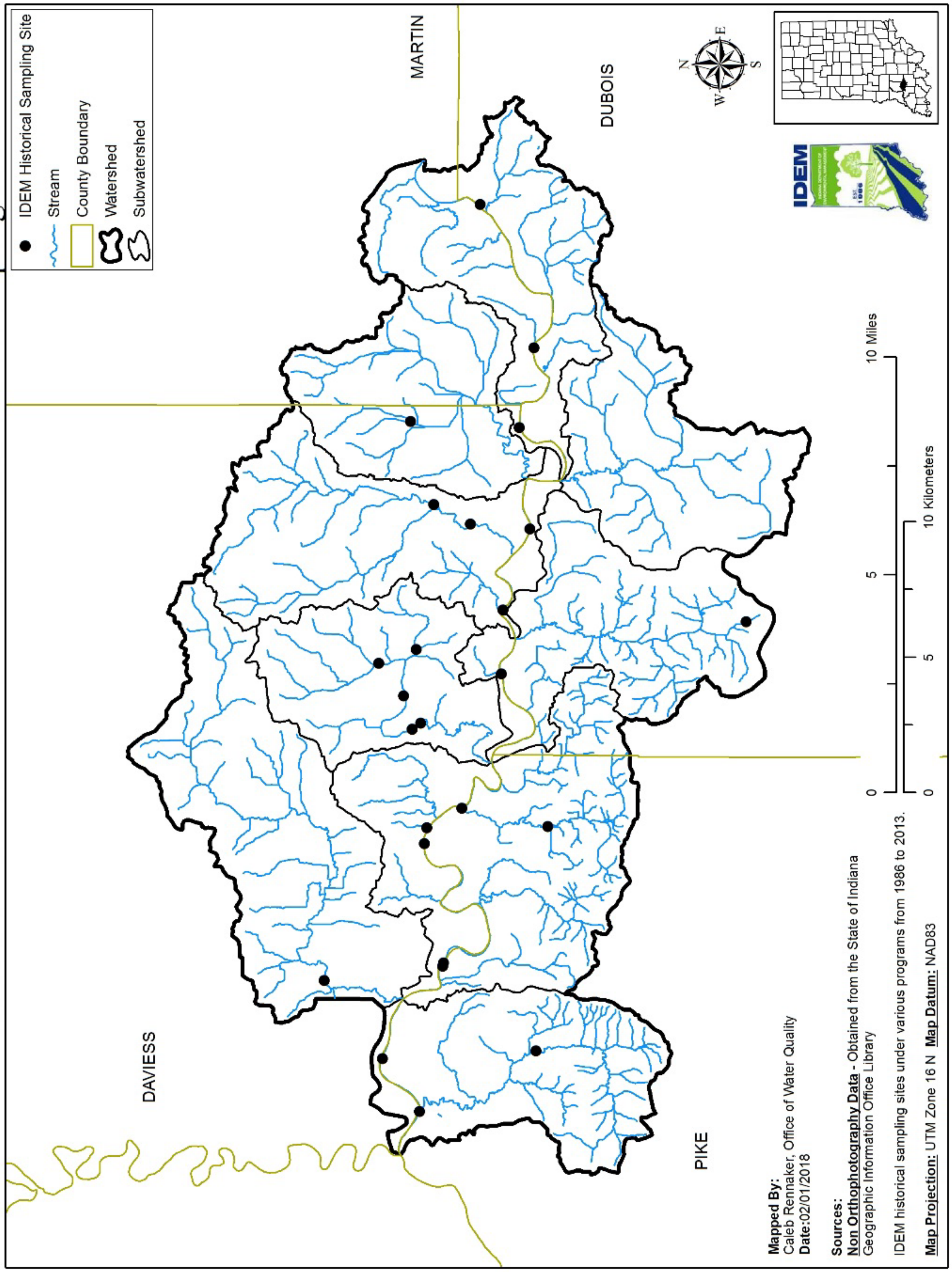
WATERSHED INVENTORY (part two)

11. WATER QUALITY DATA AND TARGETS

Historical Data Collection
There is a USDA NRCS Rapid Assessment document for the entire Lower East Fork White (HUC 05120208) available for review on the internet. This Rapid Watershed Assessment appears to be undated but was perhaps written around 2011 with data within the document from 2002-2007. However, due to the age of this data, it should be used only as a point of reference.
The document is found at https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_029902.pdf.

Figure 21 on page 67 shows historical IDEM sampling sites in the LEF White.

FIGURE 21 –HISTORICAL IDEM SAMPLING SITES



Recent Data Collection
Recently, IDEM completed a TMDL (Total Maximum Daily Load) to address *E. coli,* impaired biotic communities (IBC), nutrients, and dissolved oxygen in the LEF White River watershed in accordance with the TMDL Program Priority Framework. TMDL parameters included *E. coli*; total suspended solids (TSS); nitrogen, nitrates + nitrites; and total phosphorus.

After IDEM identifies a waterbody as 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 whole watershed. The reassessment data helps IDEM identify the area of concern for TMDL development. As a result of the reassessment for the LEF White River watershed, the pollutants and the impaired segments for which TMDLs were developed differ from the pollutants and impaired segments appearing on the 2018 Section 303(d) list since the sampling performed by IDEM in 2017-2018 generated new water quality data that was not available at the time of the 2018 Section 303(d) list was developed.

Windshield and Desktop Surveys
A windshield survey is an informal way to make observations in a watershed. Both major and minor roads are driven with observations made from the vehicle. IDEM staff were able to make observations during their water monitoring sampling. In addition, the watershed coordinator drove portions of the watershed to make observations. The windshield survey is good at showcasing a visual overview of the watershed.

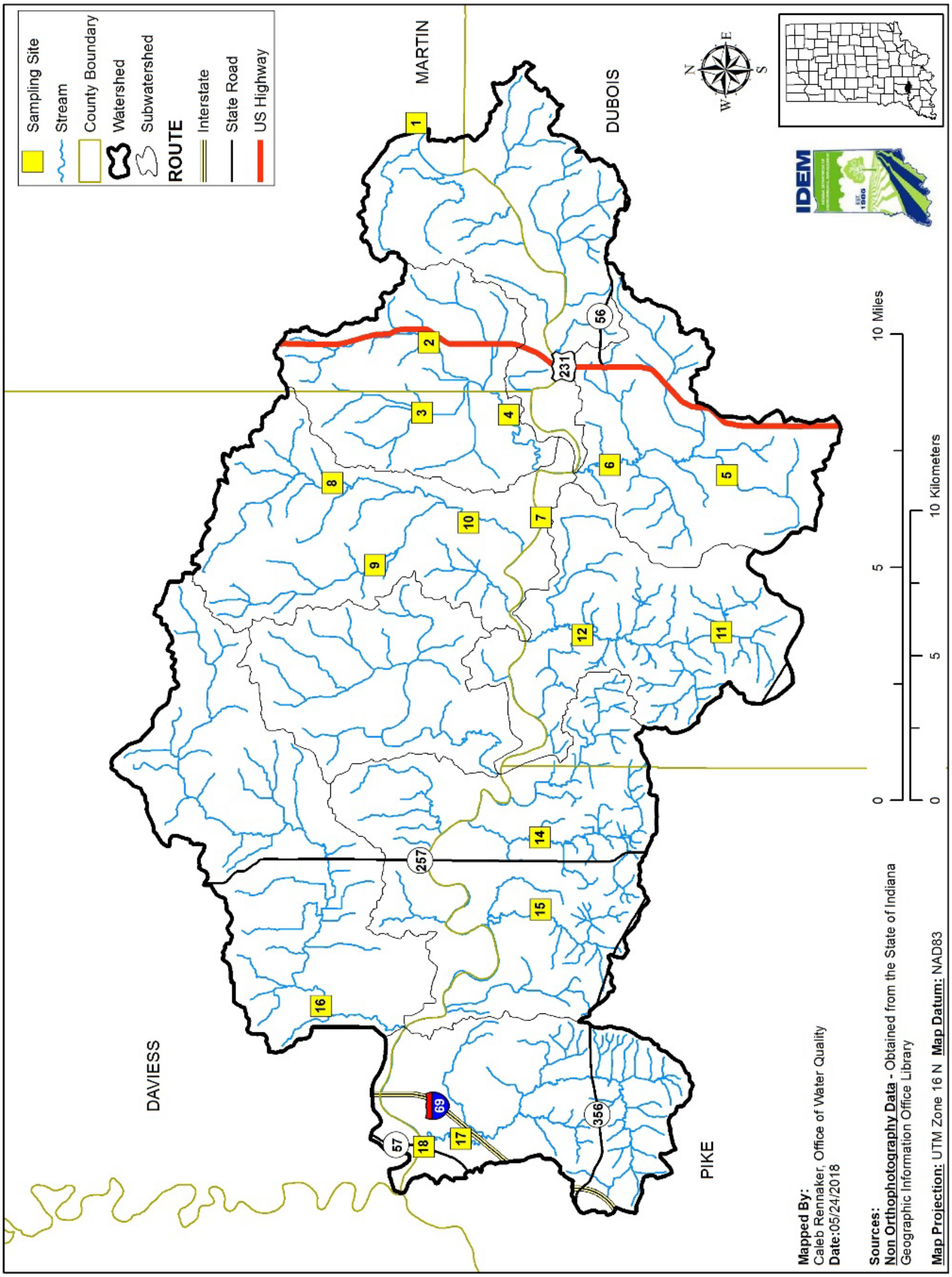
In addition, a desktop survey using Google Maps and IndianaMaps https://maps.indiana.edu/ was used to make some observations. Street View in Google Maps is a virtual representation of surroundings with panoramic images. This allowed the watershed coordinator to virtually "drive" the watershed without traveling in a vehicle.

Water Quality Monitoring
The water quality monitoring completed by IDEM for the TMDL involved 17 water monitoring sites (shown in Figure 22 and in Table 22).

Table 22 – WATER MONITORING SAMPLING SITES IN LEF WHITE

Site #	EPA assigned Site ID #	Stream Name	Road Name	AUID for 303(d) list	TMDL ID
1	18T-001	East Fork White River	CR 3 (Abel Hill Rd)	INW08E7_03	WEL-14-0003
2	18T-002	Slate Creek	CR 22	INW08F3_02	WEL-15-0008
3	18T-003	Trib of Slate Creek	CR 800 S	INW08F3_T1002	WEL-15-0021
4	18T-004	Slate Creek	CR 1250 E	INW08F3_03	WEL-15-0007
5	18T-005	Mill Creek	Portersville	INW08F1_01	WEL-15-0011
6	18T-006	Mill Creek	CR 700 N	INW08F1_03	WEL-15-0012
7	18T-007	East Fork White River	CR 1100 E	INW08F4_01	WEL-15-0010
8	18T-008	Sugar Creek	CR 600 S	INW08F4_T1004	WEL-15-0018
9	18T-009	Sugar Creek	CR 700 S	INW08F4_T1006	WEL-15-0022
10	18T-010	Sugar Creek	CR 900 S	INW08F4_T1003	WEL-15-0009
11	18T-011	Birch Creek	CR 500 N	INW08F6_T1006	WEL-15-0013
12	18T-012	Birch Creek	Portersville	INW08F6_T1003	WEL-15-0014
14	18T-014	Bear Creek	CR 550 N	INW08F8_T1008	WEL-15-0015
15	18T-015	Beech Creek	CR 550 N	INW08F8_T1010	WEL-15-0016
16	18T-016	Aikman Creek	CR 600 S	INW08F7_04	WEL-170-0008
17	18T-017	Mud Creek	CR 725 N	INW08F9_T1001	WEL-15-0017
18	18T-018	East Fork White River	SR 57	INW08F9_03	WEL-15-0020

FIGURE 22 –WATER MONITORING SAMPLING SITES



IDEM Assessment Unit Identifications (AUIDs)
IDEM identifies the LEF White River Watershed and its tributaries using a watershed numbering system developed by United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (shorter HUCs) to smallest (longer HUCs).

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 22 on page 68 shows the AUIDs for each of the water monitoring sites used for the TMDL.

IDEM's 303(d) List of Impaired Waters
There are a number of existing impairments in the LEF White River Watershed from the approved 2018 303(d) List of Impaired Waters (Table 23 page 71-72 and Map 23 on page 73). The listings and causes of impairment have been adjusted as a result of reassessment data collected at the sampling locations in the watershed. Within the LEF White River Watershed a total of 39 assessment unit IDs (AUIDs) will be cited as impaired for *E. coli*, 16 AUIDs cited as impaired for Fish Tissue, Mercury, and PCB impairments, 8 AUIDs cited as impaired for nutrients, 2 AUIDs cited as impaired for dissolved oxygen, and 10 AUIDs cited as impaired for IBC on Indiana's 2020 303(d) list (Table 23 page 71-72 and Map 24 on page 74). These impaired segments account for approximately 424 miles.

TABLE 23 – SECTION 303(D) LIST INFORMATION FOR LEF WHITE 2018-20				
Name of Subwatershed	**Current AUID**	**Length (mi)**	**2018 Section 303(d) Listed Impairment**	**Updated Impairments to be listed 2020 303(d)**
Mill Creek 051202081501	INW08F1_01	5.51		*E. coli*
	INW08F1_02	3.01		*E. coli*
	INW08F1_03	4.52		*E. coli*
	INW08F1_T1001	1.66		*E. coli*
	INW08F1_T1004	5.99		*E. coli*
	INW08F1_T1005	8.28		*E. coli*
	INW08F1_T1006	4.83		*E. coli*
	INW08F1_T1007	0.46		*E. coli*
	INW08P1085_00	0.38		
Hoffman Run 051202081502	INW08F2_02	9.10	*E. coli, IBC, PCBs (FT)*	*PCBs (FT), IBC*
	INW08F2_03	8.52	*E. coli, IBC, PCBs (FT)*	*PCBs (FT), IBC*
	INW08F2_T1002	4.38		
	INW08F2_T1004	11.37		
	INW08F2_T1005	2.04		
	INW08F2_T1006	2.18		
	INW08F2_T1007	6.03		
	INW08F2_T1008	3.27		
Slate Creek 051202081503	INW08F3_01	3.31		*E. coli, Nutrients*
	INW08F3_02	8.26		*E. coli, IBC, Nutrients*
	INW08F3_03	4.00		*E. coli, IBC, Nutrients, DO*
	INW08F3_T1002	8.83		*E. coli, IBC, Nutrients*
	INW08F3_T1003	1.39		*E. coli, Nutrients*
	INW08F3_T1004	3.74		*E. coli, Nutrients*
	INW08F3_T1005	6.11		*E. coli, Nutrients*
Sugar Creek 051202081504	INW08F4_01	2.70	*PCBs (FT)*	*IBC, PCBs (FT)*
	INW08F4_03	1.72	*PCBs (FT)*	*PCBs (FT)*
	INW08F4_04	0.75	*PCBs (FT)*	*PCBs (FT)*
	INW08F4_T1002	5.85	*E. coli, DO*	*E. coli*
	INW08F4_T1003	2.67	*E. coli, DO*	*E. coli*
	INW08F4_T1004	17.66	*E. coli, DO*	*E. coli, IBC*
	INW08F4_T1005	4.88	*E. coli, DO*	*E. coli*
	INW08F4_T1006	7.25	*E. coli, DO*	*E. coli*
Dogwood Lake 051202081505	INW08F5_01	2.35		
	INW08F5_02	4.72		
	INW08F5_T1001	3.12		
	INW08F5_T1002	2.22		
	INW08F5_T1003	0.46		
	INW08F5_T1004	3.51		
	INW08F5_T1005A	0.69		
	INW08F5_T1005B	0.49		
	INW08P1016_00	9.84		
Birch Creek 051202081506	INW08F6_02	0.86	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_03	2.32	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_04	3.15	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_T1002	7.99		

TABLE 23 – SECTION 303(D) LIST INFORMATION FOR LEF WHITE 2018-20				
Name of Subwatershed	**Current AUID**	**Length (mi)**	**2018 Section 303(d) Listed Impairment**	**Updated Impairments to be listed 2020 303(d)**
	INW08F6_T1003	15.96		*E. coli*
	INW08F6_T1004	3.55		
	INW08F6_T1005	3.10		
	INW08F6_T1006	13.20		*E. coli, IBC*
	INW08F6_T1007	3.73	*PCBs (FT)*	*PCBs (FT)*
	INW08P1084_00	0.17		
Aikman Creek 051202081507	INW08F7_02	6.10		*E. coli*
	INW08F7_03	10.97		*E. coli*
	INW08F7_04	11.03		*E. coli, IBC, Nutrients, DO*
	INW08F7_05	2.06		*E. coli*
	INW08F7_T1001	4.52		*E. coli*
	INW08F7_T1002	2.08		*E. coli*
	INW08F7_T1003	2.55		*E. coli*
	INW08F7_T1004	2.66		*E. coli*
	INW08F7_T1005	3.63		*E. coli*
	INW08F7_T1006	2.40		*E. coli*
	INW08F7_T1007	1.69		*E. coli*
	INW08F7_T1008	1.38		*E. coli*
	INW08F7_T1009	0.24		*E. coli*
Bear Creek 051202081508	INW08F8_02	0.57	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_03	1.63	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_04	5.54	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_05	2.86	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_06	2.05	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_T1001	14.52		
	INW08F8_T1003	7.44		
	INW08F8_T1004	2.94		
	INW08F8_T1006	0.25		
	INW08F8_T1008	16.29		*E. coli, IBC*
	INW08F8_T1009	5.18		*E. coli*
	INW08F8_T1010	8.56		*E. coli, IBC*
	INW08F8_T1011	4.00		
	INW08F8_T1012	2.73		
	INW08F8_T1013	5.32		
	INW08P1073_00	0.37		
Mud Creek 051202081509	INW08F9_02	3.06	*PCBs (FT)*	*PCBs (FT)*
	INW08F9_03	1.21	*PCBs (FT)*	*IBC, PCBs (FT)*
	INW08F9_T1001	21.04		*E. coli*
	INW08F9_T1002	5.94		
	INW08F9_T1003	1.36		
	INW08F9_T1004	2.38		
	INW08F9_T1005	5.15		
	INW08F9_T1006	5.37		
	INW08F9_T1007	4.39		

FIGURE 23 –2018 IMPAIRED STREAMS IN LEF WHITE

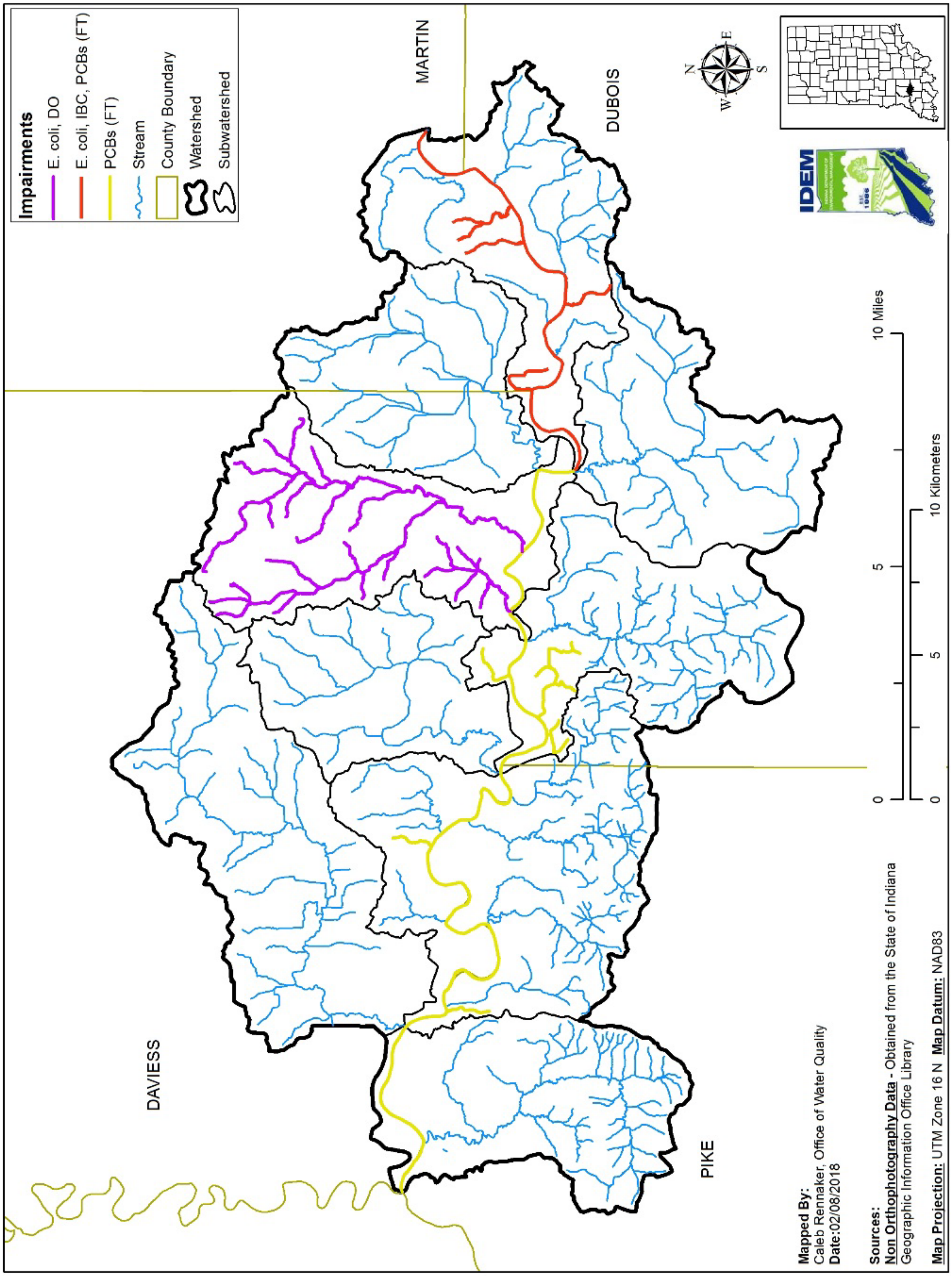
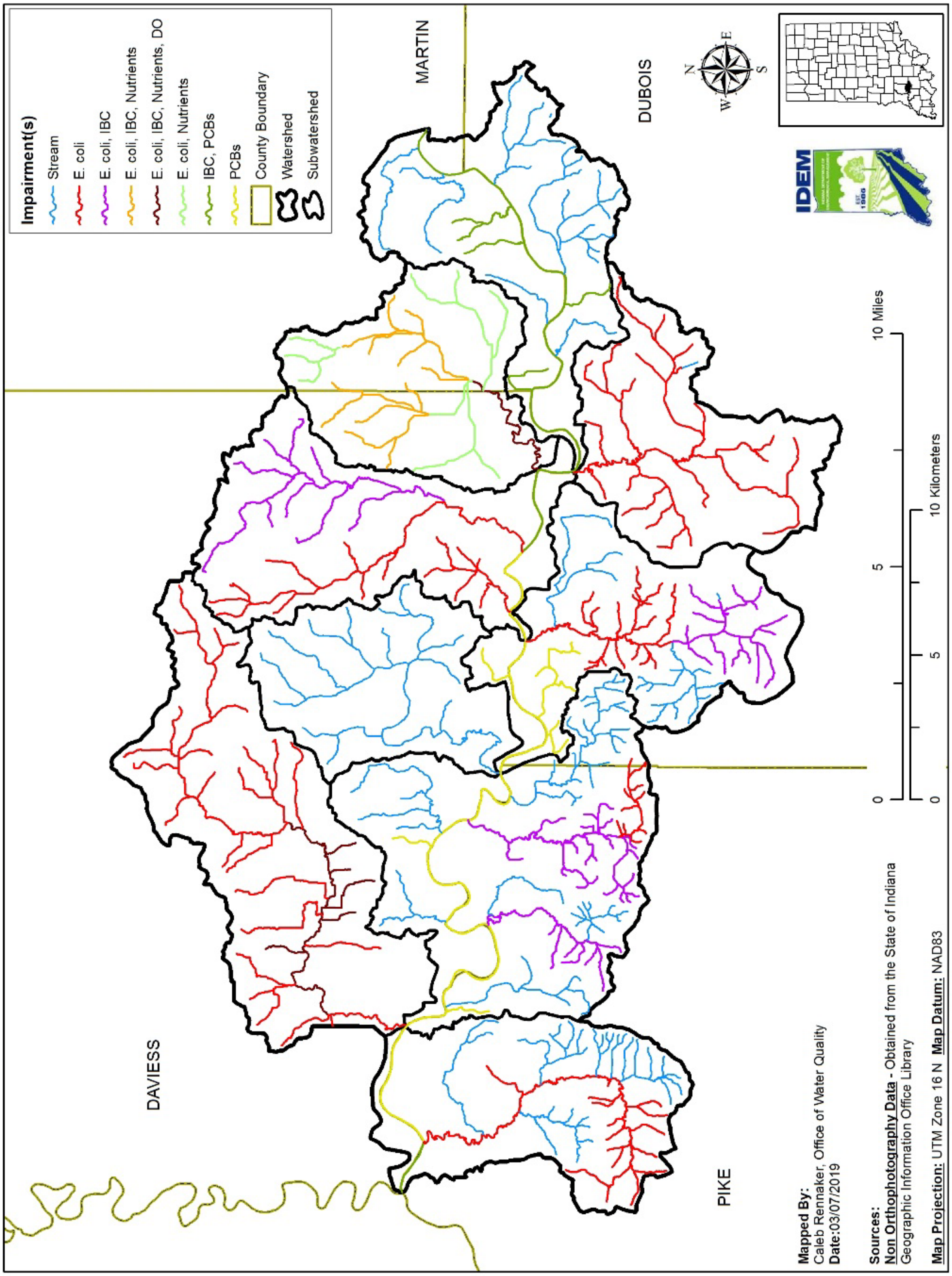


FIGURE 24 –2020 IMPAIRED STREAMS IN LEF WHITE



Indiana 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 goals of "swimmable/fishable" waters.

The Indiana Administrative Code Title 327 Water Pollution Control Division, Article 2 addresses water quality standards. The IDEM Office of Water Quality uses Water Quality (WQ) Standards as a foundation for WQ-based control programs mandated by the Clean Water Act. A standard can consist of either numeric or narrative criteria for a specific physical or chemical parameter and is used as the regulatory target for permitting, compliance, enforcement, and monitoring and assessing the quality of the state's waters. When assessments identify a waterbody as not meeting adopted WQ standards, the assessment may lead to a determination of impairment, initiating further action such as a Total Maximum Daily Load (TMDL) or other regulatory procedure aimed at addressing the impairment.

Table 24 on page 76 lists WQ Targets or Standards. These are state or national recommendations, or when possible, parameters used in other areas and nearby watersheds. The water quality targets for ten parameters and whether the values are required, or recommended, and the source of the standard are listed in the table.

WQ standards are the basis for determining whether a certain level of a contaminant such as E. coli is acceptable. Often, different levels of a contaminant are allowed for different water uses. For example, for drinking water, E. coli must be less than 1 CFU (colony forming unit) per 100 mL. Most surface water in Indiana would not meet this standard, but surface water compliance with the drinking water standard is not required because surface water drawn for drinking water use is treated before being consumed.

However, all Indiana streams and lakes are designated to meet the WQ standard for "full body contact recreation", or swimming, based on E. coli levels as recommended by the EPA. Monitoring results for E. coli are given in terms of number of E. coli CFU/100 mL of water. For water to meet the recreation standards, no sample should test higher than 235 CFU/100 mL.

WQ standards thus have the component of designated use. 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 recent LEF White River TMDL focused on protecting the designated aquatic life support and full body contact recreational uses of the waterbodies.

TABLE # 24 – WATER QUALITY TARGETS / STANDARDS			
PARAMETER	**WATER QUALITY TARGETS**	**REQUIRED VALUE OR RECOMMENDED VALUE**	**SOURCE OF REQUIREMENTS OR RECOMMENDATIONS**
Total Suspended Solids	30.0 mg/L	Recommended Value	NPDES permit limit
E. Coli	<235 cfu/100 ML	Required Value	Indiana Administrative Code
Nitrate/Nitrite	$\leq$ 1.0 mg/L	Recommended Value	Based on comparison of multiple regional WMPs
Total Phosphorus	$\leq$ 0.30 mg/L	Recommended Value	U.S. EPA recommendations
Temperature	Monthly Standard	Required Value	Indiana Administrative Code
Dissolved Oxygen	Min: 4.0 mg/L Max: 12.0 mg/L	Required Value	Indiana Administrative Code
% Saturation	80-120% saturation (DO mg/L x 100% Max DO mg/L)	85-120% saturation = excellent 70-80% or 121-130% saturation = good 131%+ saturation = poor quality /dangerous to fish <70% saturation = poor water/increased Toxicity	IDEM
BOD^5	1-4 mg/L	1-2 mg/L BOD^5 = clean water w/ little organic waste 3-5 mg/L = fairly clean water w/ some organic waste 6-9 mg/L = lots of organic material and bacteria 10+ mg/L = very poor water quality with very large amts. of organic material in water	IDEM
pH	6.0 to 9.0	Required Value	Indiana Administrative Code
Turbidity	< 10.4 NTU	Recommended Value	U.S. EPA recommendations
Water Quality Index	Excellent or Good Ratings	Excellent rating for 90-100 Good rating for 70-89 Medium rating for 50-69 Bad rating for 25-49 Very bad rating for 0-24	IDEM
Qualitative Habitat Evaluation Index	20-100	Recommended Value	IDEM
IBI and mIBI of Biotic Integrity (Pollution Tolerance Index)	See Table 25 on page 79	Recommended Value	IDEM

Indiana WQ Standard Details for *E. coli*, IBC, and Nutrients from TMDL

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 organisms in 100 milliliters of water (count/100 mL) and may vary at a particular site depending on the baseline *E. coli* level already in the river, inputs from other sources, dilution due to precipitation events, and die-off or multiplication of the organism within the river water and sediments.

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

"The criteria in this subsection are to be used to evaluate waters for full body contact recreational uses, to establish wastewater treatment requirements, and to establish effluent limits during the recreational season, which is defined as the months of April through October, inclusive. E. coli bacteria, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period. . . However, a single sample shall be used for making beach notification and closure decisions." [Source: Indiana Administrative Code Title 327 Water Pollution Control Board. Article 2. Section 1-6(a).]

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 nutrients. 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. Sec. 6. (a)(1)]…

(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]

(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]

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)].

IBC is not a source of impairment but a symptom of other sources. To address these impairments in the LEF White River Watershed, TSS has been identified as a pollutant for TMDL development. IDEM has not yet adopted numeric water quality criteria for total suspended solids (TSS). The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

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

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

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

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 IBI (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 for Indiana. 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 25 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 a biological community impairment (IBC) and no other pollutants that might be contributing to the impairment have been identified, the IBC is not 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 25 – 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	Few species and individuals present, tolerant species dominant
	No Organisms	12	No fish captured during sampling.
Benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) Scores Multihabitat (MHAB) Methods (Range of possible scores is 12-60)			
Fully Supporting mIBI ≥ 36 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	Few species and individuals present, tolerant species dominant
	No Organisms	12	No macroinvertebrates captured during sampling.

Water Quality Target Values

WQ target values are needed for the calculation of 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 assess water quality data collected in LEF White River watershed are described below and shown in Table 26 on page 80.

The *E. coli* target value used for the LEF White River watershed TMDL was based on the 235 counts/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 EPA report, "An Approach for using Load Duration Curves in the development of TMDLs" (EPA 2007) 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. 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.

TABLE 26– TARGET VALUES USED FOR DEVELOPMENT OF LEF WHITE TMDL	
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)

The nutrients and TSS target values for the LEF White River watershed TMDL were used to develop IBC and DO. Although Indiana has not yet adopted numeric water quality criteria for nutrients, IDEM has identified the following nutrient benchmarks that are used to assess potential nutrient impairments: total phosphorus should not exceed 0.30 mg/L (U.S. EPA's nationwide 1986 Quality Criteria for Waters also known as the *Gold Book*).

The total phosphorus value (0.30 mg/L) was used as the target during the development of the LEF White TMDL. IDEM has determined that meeting this target will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community. Phosphorus is interpreted as an average in the NPDES permits. Monitoring data, reviewed by IDEM during the TMDL development process, indicated that when WWTPs were in compliance with their individual permit limit for P (1.0 mg/L), the in-stream target for P (0.30 mg/L) was typically met.

Although Indiana has not yet adopted numeric WQ criteria for TSS, IDEM has identified a target value of 30.0 mg/L for TSS based on IDEM's NPDES permitting process. 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.

Various subwatersheds in the LEF White have IBC impairments. Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect conditions over time. An IBC listing on Indiana's 303(d) list means that IDEM's monitoring data shows the aquatic communities are not as healthy as they should be. A few subwatersheds in the LEF White have DO impairments. Dissolved oxygen is not a source of impairment, but a symptom of other sources. To address these impairments, phosphorus and TSS, where applicable, have been identified as a pollutant for TMDL development.

The LEF White River Watershed contains nine 12-digit HUC subwatersheds. Examining subwatersheds enables a closer look at key factors that affect water quality. The subwatersheds include:

- Mill Creek (051202081501)
- Hoffman Run (051202081502)
- Slate Creek (051202081503)
- Sugar Creek (051202081504)
- Dogwood Lake (051202081505)
- Birch Creek (051202081506)
- Aikman Creek (051202081507)
- Bear Creek (051202081508)
- Mud Creek (051202081509)

12-14. SUBWATERSHED DESCRIPTIONS

While compiling information for this watershed management plan, the following items were not found for any of the nine subwatersheds (either in relation to water quality or habit/biological information) and will therefore not be discussed in the following discussions for each subwatershed.

⇒ Office of Land Quality Data
⇒ Past / Ongoing LARE Studies
⇒ Brownfield and Remediation Sites
⇒ CAFOs (Combined Animal Feeding Operations)
⇒ Combined Sewer Overflow (CSOs) or Sanitary Sewer Overflow (SSOs)
⇒ Application of Wastewater Sludge
⇒ Non-ag Animal Operations (like zoos)

The following items will be addressed generally for the LEF White watershed as well as noted in each subwatershed's narrative if applicable:

⇒ LUSTs (Leaking Underground Storage Tanks)
⇒ Fertilizer Usage
⇒ Hobby Farms and Animal Operations
⇒ Confined Feeding Operations
⇒ Stream Buffer Miles and Bank Stabilization
⇒ Active Mines in the Watershed
⇒ USGS flow gage data from # 03375300 near Shoals, Indiana
⇒ Permitted Public Water Supply

Leaking Underground Storage Tanks (LUSTs)

The IDEM Office of Land Quality oversees the identification and remediation of LUSTs. Seven (7) Underground Storage Tanks were located in LEF White watershed in Mill Creek subwatershed. Three of those were listed on IndianaMap as leaking. However, the watershed coordinator researched the seven underground tanks via IDEM's virtual file cabinet for issues or problems and found all seven of them clear of any recent incidents. The Dubois Co Bank Plaza tank in Haysville was closed August 2006; the Haas Family Mart tank passed inspection February 2005; and the Kiel Bros Marathon tank was closed June 1998.

The IDEM LUST program website is https://www.in.gov/idem/tanks/2333.htm. The IDEM's virtual file cabinet can be found at https://vfc.idem.in.gov/DocumentSearch.aspx.

Fertilizer Usage
A large percentage of land in the LEF White watershed (50.16%) is devoted to cultivated crops. In order to increase productivity, fertilizer in the form of nitrogen, phosphorus and potassium is often applied to the 66,552 acres of cultivated crops each spring. A smaller number of producers still apply manure in the fall, though this is not typically an annual practice. In heavy rainfall events, fertilizer can be transmitted into streams via run-off and cause high nutrient loading.

Confined Feeding Operations
There are 33 NPDES permitted animal feeding operations or Confined Feeding Operations (CFOs) in the LEF White watershed. Appendix E lists each one; however they will also be discussed in the subwatershed description in which they are located. IDEM defines a CFO as *" an AFO engaged in the confined feeding of at least 300 cattle, or 600 swine or sheep, or 30,000 fowl, such as chickens, turkeys and other poultry. CFOs are issued a state no discharge permit. The IDEM regulates these confined feeding operations, as well as smaller operations which have violated water pollution rules or laws, under IC 13-18-10."* For more information regarding CFOs, see Map on page 54 and information on page 55 under Land Use Descriptions.

Hobby Farms and Non-CFO Livestock Operations
Generally, as a mainly rural watershed, the LEF White has a potential for small-scale livestock operation with over 13,000 acres of hay / pasture lands (9.91% of the watershed). Accounting for or determining the exact number of small-scale livestock operations or "hobby" farms in the watershed is a little more difficult than determining the number of cats / dogs (see page 59 on pets in watershed stats). Small, hobby-sized livestock operations can start up relatively easily, at any time. A landowner with 10 acres can fence in the backyard and purchase three goats and half a dozen chickens virtually overnight.

However, the population of LEF White is low in comparison to other watersheds in the area. One would assume a household would need to be present for a backyard chicken coop or a small rabbitry to be set up. However, southwest Indiana's rural areas are usually FFA and 4-H strong and LEF White watershed's counties are no exception. However, youth in these programs often have 10 or less head of beef, swine, goat, sheep or horses for the benefit of having a project in the county fair. Therefore, the best way to capture the potential for small-scale, hobby-farm livestock presence in the watershed is to look at and compare pasture/hay land acres and % of subwatersheds with the rural households. Table 27 on page 83 shows this data. The majority of the hay / pasture acres are located in Daviess and Martin Counties (see Figure 18 on page 54); particularly in Slate, Sugar, Aikman and the northern portion (the Daviess portion) of Bear Creek Subwatersheds. These same four subwatersheds have the larger percentage per HUC acres of hay / pasture as well.

TABLE 27 – POTENTIAL FOR SMALL LIVESTOCK OPERATIONS					
Subwatershed	**Acres in HUC**	**Hay / Pasture Acres**	**% of HUC in Hay / Pasture**	**Rural Households**	**Counties**
Mill Creek (051202081501)	12,524.8	946	7.55%	858	Dubois
Hoffman Run (051202081502)	14,348.8	1,076	7.49%	167	Dubois, Martin, Daviess
Slate Creek (051202081503)	11,987.2	1,935	16.14%	191	Martin, Daviess
Sugar Creek (051202081504)	15,443.2	2,227	14.42%	142	Daviess, Dubois
Dogwood Lake (051202081505)	10,720.0	885	8.26%	60	Daviess
Birch Creek (051202081506)	13,977.6	1,039	7.43%	202	Dubois, Daviess
Aikman Creek (051202081507)	19,462.4	2,122	10.9%	402	Daviess
Bear Creek (051202081508)	20,844.8	1,983	9.51%	333	Pike, Dubois, Daviess
Mud Creek (051202081509)	13,440.0	936	6.96%	213	Pike, Daviess
TOTALS	**132,748**	**13,149**		**2,568**	

Stream Miles in Need of Buffers / Streambank Stabilization
It is often difficult to quantify stream miles in need of buffers. However, for this WMP, observations during windshield surveys, tillage transects, and water monitoring indicated that a lack of adequate buffer width is a problem throughout the watershed In many cases, farming practices often occur much too close to streams and ditches. With over 50% of the LEF White being cultivated crops (66,552.33 acres), it is estimated that 50% of the stream miles (208 miles) lack a good buffer, which would be a large contributing factor when it comes to sediment being transported into the watershed's streams and lakes. With nearly half of the LEF White watershed's streams lacking sufficient buffer, it is easy to see why erosion and excessive sedimentation is a primary concern to the LEF White stakeholders.

Streambank stabilization is a complex engineering project with high construction costs and permitting often needed to successfully implement this practice. Therefore, it is difficult at best to offer solutions. Stakeholders ranked streambank erosion and stabilization 3rd in the list of concerns. The stakeholder's natural resource concerns ranking table can be seen on page 15.
Log jams, which stakeholders ranked 7th in their list of concerns, has also been identified as a concern. Log jams often cause significant stream bank erosion as well as flooding (ranked 4th). Often producers in the watershed opt to remove riparian buffers to create more tillage land. Loss of stabilizing roots along streams is another contributing factor to streambank erosion.

Active Mines
Discussion on mining activities in the watershed occurs on pages 56-57 with a map of active mines on page 58. There are three active surface mines in the LEF White: Shamrock ING040210, Viking Mine, Corning Pit ING040154, and Cannelburg ING040026. They are located in Daviess and Dubois Counties and the subwatersheds of Aikman, Dogwood Lake, Sugar, Birch and Bear all have at least a small portion of at least one of the three.

USGS Gage on LEF White at Shoals

The USGS does not operate any stream flow gaging stations in the LEF White River watershed. Since there are no continuous flow data for the LEF White River watershed, flow data was estimated for TMDL 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 East Fork White River at Shoals, Indiana is # 03373500. It is located just downstream of the confluence of the East Fork White and the Blue River. USGS gage 03373500 is located in Martin County. Approximately 4,927 square miles (05120208) drains to this USGS gage. The USGS website offers data in table or graph form for the river with current and historical flow and water heights at https://waterdata.usgs.gov/in/nwis/uv?site_no=03373500 .

Public Water Supply

There is one Public Water Supply (PWS) facility with a NPDES permits to discharge wastewater containing TSS into the LEF White River. The Otwell Water Corporation (IN0052086) contains two outfalls which directly discharge into an unnamed ditch that flows to the LEF White River. At the point of discharge, the unnamed tributary has a $Q_{7,10}$ low flow value of 0.0 cfs. Ground water is the source of the permitted facility's drinking water. The wastewater discharged at Outfall 001 consists of floor drain run-off. The wastewater discharged at Outfall 002 consists of filter backwash. The backwash undergoes sedimentation prior to discharge. The facility has an average discharge of approximately 0.002 MGD. Effluent from this facility is a point source of TSS. The TMDL target value for TSS is 30.0 mg/L (see page 75 and 76) or interpreted from current permit limits. This target value can be used to establish potential permit limits. TSS is interpreted as a daily maximum in the NPDES permit for this facility.

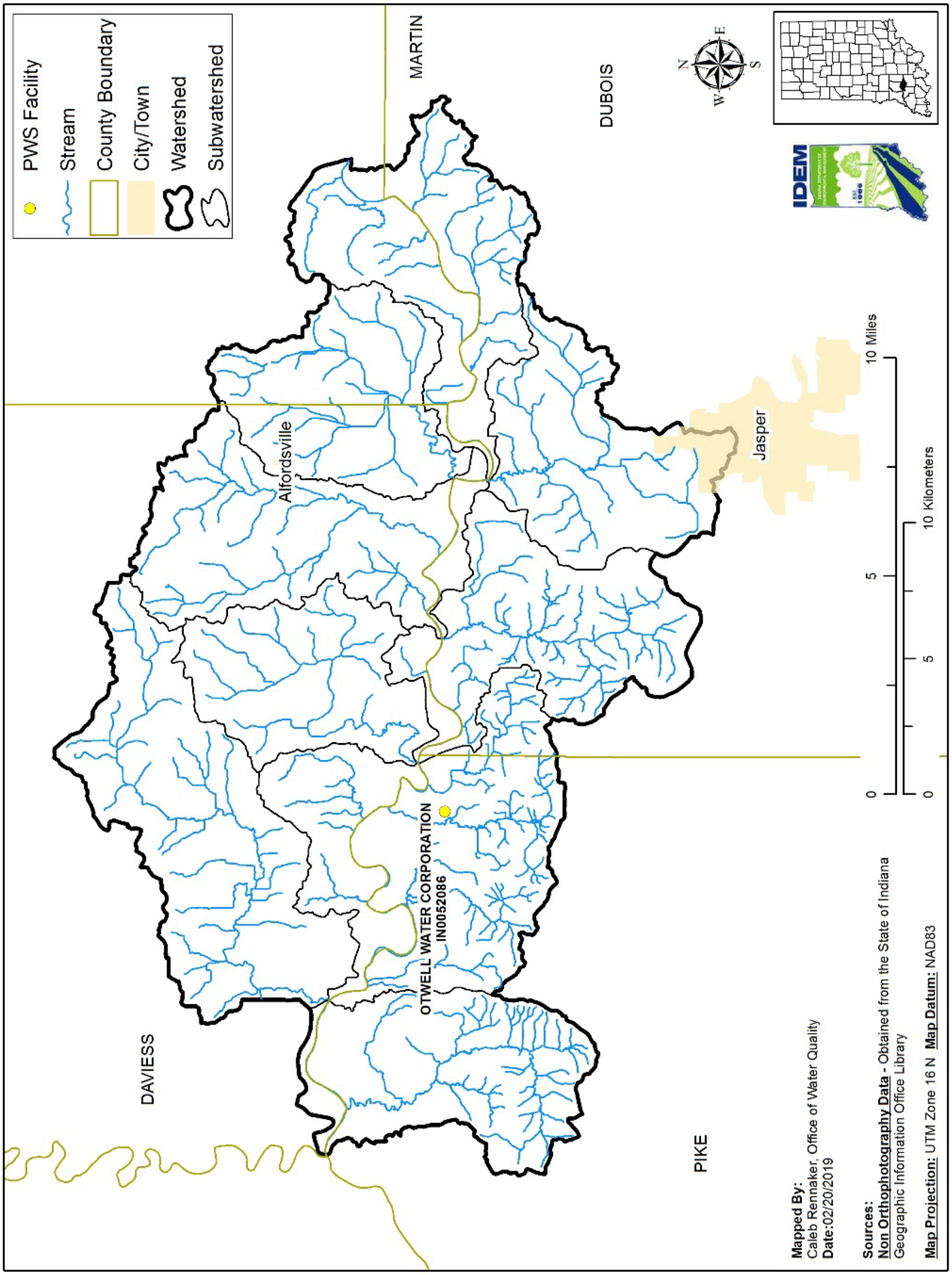
Flows used to calculate sediment loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Sediment concentrations used to calculate sediment loads from each treatment plant 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 40 mg/L daily maximum. 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 subwatershed. Meeting the assigned WLA will be achieved through compliance with the NPDES permit limits. Table 28 below and Figure 25 on page 85 display information on this facility.

TABLE 28 – NPDES PERMITTED WASTEWATER TREATMENT PLANTS DISCHARING WITHIN LEF WHITE

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow (MGD)
Bear Creek	Otwell Water Corporation	IN0052086	INW08F8_T1001	Unnamed Tributary of East Fork White River	0.002

FIGURE 25 –MAP OF PWS FACILITIES IN LEF WHITE



Introduction to Subwatersheds

IDEM completed a TMDL based on data collected from 17 sites in 2017 and 2018. In addition, a windshield survey and desktop survey were completed by the watershed coordinator hired by Pike County SWCD after being awarded the 319 grant to develop the WMP. Habitat and watershed characteristics were noted.

In the pages that follow, each subwatershed is described showcasing:

- Land use data including a table showcasing acres and % of subwatershed represented
- WQ monitoring data collected by the IDEM team including chemical data and stream flow.
- Indexes for each subwatershed including WQI (Water Quality Index) and PTI (Pollution Tolerance Index) from macroinvertebrate data.
- Streams listed on the 2020 proposed 303(d) list.
- Populations and unincorporated housing clusters.
- Photographs representing the typical landscape of the subwatershed as determined through a windshield survey.
- Any relevant information regarding the HUC that helps with understanding WQ in the subwatershed.

In addition, each subwatershed has load duration curves shown in figures. The Load Duration Curve approach was used by IDEM to determine allowable loads. More information on Load Duration Curve Approach can be found on page 151.

MILL CREEK 051202081501

Size and Land Use

The Mill Creek subwatershed surface area and drainage area are the same - 19.97 square miles. The subwatershed drains into the main stem of the LEF White River just north of Jasper, IN. The land use is primarily agriculture (53%) followed by forested land (27%) and developed land (12%).

TABLE # 29 - MILL CREEK - 051202081501		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	6,669	53%
Developed	1,458	12%
Forest	3,401	27%
Hay / Pasture	946	8%
Open Water	47	0.00%
Shrub / Scrub	1	0.00%
Wetlands	2	0.00%
Total Acres in Subwatershed	12,523	100%

Population and Housing Clusters

There is one MS4 permit held by the city of Jasper (INR040067) which covers approximately 10% of the subwatershed by area. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. In addition, the entire community of Haysville has 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.

FIGURE 26 – TYPICAL LANDSCAPE IN MILL CREEK

Landscape, Soils and Waterways

The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. Pictured above is a representative field from the windshield survey showing the gentle rolling hills along Portersville Road.

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.

FIGURE 27 – SMALL HOBBY FARM IN MILL CREEK

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.

Livestock and CFOs

With a land use of less than 10 percent hay / pasture, a heavy presence of pasture animals is not expected. However, during the windshield survey, the watershed coordinator noticed a few small hobby farms such as the one pictured here. There are 6 permitted CFOs in the watershed.

Water Quality Monitoring

There are two monitoring sites located in this subwatershed, WEL-15-0011 (T05) and WEL-15-0012 (T06), both on Mill Creek. In 2017-2018 this watershed was sampled 27 times between the two sites resulting in both failing WQ standards for *E.coli*. These stream reaches will be placed on the 2020 303(d) list of impaired waters. The *E. coli* geomean for T05 was 722.1 MPN with 4/10 samples in exceedance of the SSM (single sample max); while T06 had a geomean of 1,739.93 with 9/9 samples in exceedance of the SSM. The geomeans from site T05 and T06 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

TABLE # 30 MILL CREEK (051202081501) CHARACTERISTICS					
TMDL Sample Site	WEL-15-0011, WEL-15-0012				
Listed Segments	INW08F1_01; INW08F1_02; INW08F1_03; INW08F1_T1001; INW08F1_T1004; INW08F1_T1005; INW08F1_T1006; INW08F1_T1007				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*]				
NPDES Facilities	City of Jasper MS4 (INR040067)				
CFOs	T & J Hoffman Farm, LLC (Farm ID: 1245), Mill Creek Farms (Farm ID: 3884), Haysville Mill Farm Inc. (Farm ID: 4542), Mike Haase (Farm ID: 4923), Weisheit Brothers Farm (Farm ID: 6296), Fuhrman Farms (Farm ID: 6535)				
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	3.741E+11	1.605E+11	8.424E+10	3.159E+10	1.127E+10
WLA (Total)	4.132E+10	1.773E+10	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	4.887E+10	2.097E+10	9.911E+09	3.717E+09	1.326E+09
Future Growth (5%)	2.444E+10	1.048E+10	4.956E+09	1.858E+09	6.629E+08
TMDL = LA+WLA+MOS	**4.887E+11**	**2.097E+11**	**9.911E+10**	**3.717E+10**	**1.326E+10**
WLA (Individual)					
City of Jasper MS4	4.132E+10	1.773E+10	NA	NA	NA

The fish community IBI score for site T05 was 44 (fair) and the QHEI was 46 (poor). The macro community mIBI score was 38 (fair) and the QHEI was 43 (Poor). The fish community IBI score for site T06 was 46 (good) and the QHEI was 60 (good). The macro community mIBI score was 38 (fair) and the QHEI was 52 (good). Load Duration curves for the Mill Creek subwatershed are shown on page 91.

Based on the WQ duration graphs and limited permitted sources, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources. There are approximately 35 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 impairments include 34 stream miles for *E. coli* listed on the 2020 303(d) List of Impaired Waters. Therefore, TMDLs have been developed to address all *E. coli* impairments in Mill Creek.

The precipitation graph for these sites shows the streams are susceptible to high loads of *E. coli* from run-off. The streams are consistently in violation of WQ standards even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources. If animals have direct access to streams this could contribute to *E. coli* violations at dry and wet conditions

TABLE # 31 MILL CREEK (051202081501) TMDL Collected Data

Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0011	Portersville Road	4/9/2018	920.8	31.3	5.1	5.1	8.62	0.069	3.5	6.41
		5/21/2018	>2419.6	69.7	0.65	0.65	8.3	0.073	<5	4.29
		6/11/2018	>2419.6	>2419.6	3.9	3.9	7.23	0.19	67	82.2
		7/16/2018	>2419.6	172.5	1.1	1.1	7.89	0.072	3	4.34
		7/18/2018					8.07			4.37
		7/24/2018					7.81			4.8
		8/13/2018	>2419.6	68.3	0.55	0.55	8.42	0.055	4.5	5.81
		9/17/2018	>2419.6	2419.6	1	1	8.19	0.086	<5	3.74
		9/24/2018	>241960	51720			7.54			132
		10/1/2018	>2419.6	70.3			7.8			5.63
		10/8/2018	>2419.6	48.4			7.77			7.22
		10/15/2018	>2419.6	461.1	1	1	8.3	0.056	<5	3.09
WEL-15-0012	CR 700 N	11/13/2017			<0.2	5	7.85	0.12	8	116
		12/11/2017			<0.2	5.3	8.4	0.039	2.5	4.31
		1/22/2018			0.33	4.1	7.73	0.66	1100	601
		2/19/2018			0.16	5.5	7.68	0.11	35	36.8
		3/12/2018			0.1	3.7	7.75	0.097	22	20.5
		5/21/2018	>2419.6	435.2	0.36	5.7	7.73	0.093	13	16.9
		6/11/2018	>2419.6	>2419.6	0.65	2.7	7.25	0.089	870	639
		7/16/2018	>2419.6	866.4	<0.2	5.2	7.97	0.085	13	11.5
		7/23/2018					7.5			42.3
		8/13/2018	>2419.6	435.2	<0.2	6.4	8.58	0.08	13	13.3
		9/17/2018	46110	613.1	0.11	5.9	7.58	0.13	11	13.2
		9/24/2018	>241960	41060			7.68			407
		10/1/2018	>2419.6	435.2			8.05			10.6
		10/8/2018	>2419.6	1299.7			8.45			9.9
		10/15/2018	>2419.6	1119.9	0.11	4.7	8.43	0.063	4	4.52

FIGURE 28 –MILL CREEK SUBWATERSHED 051202081501

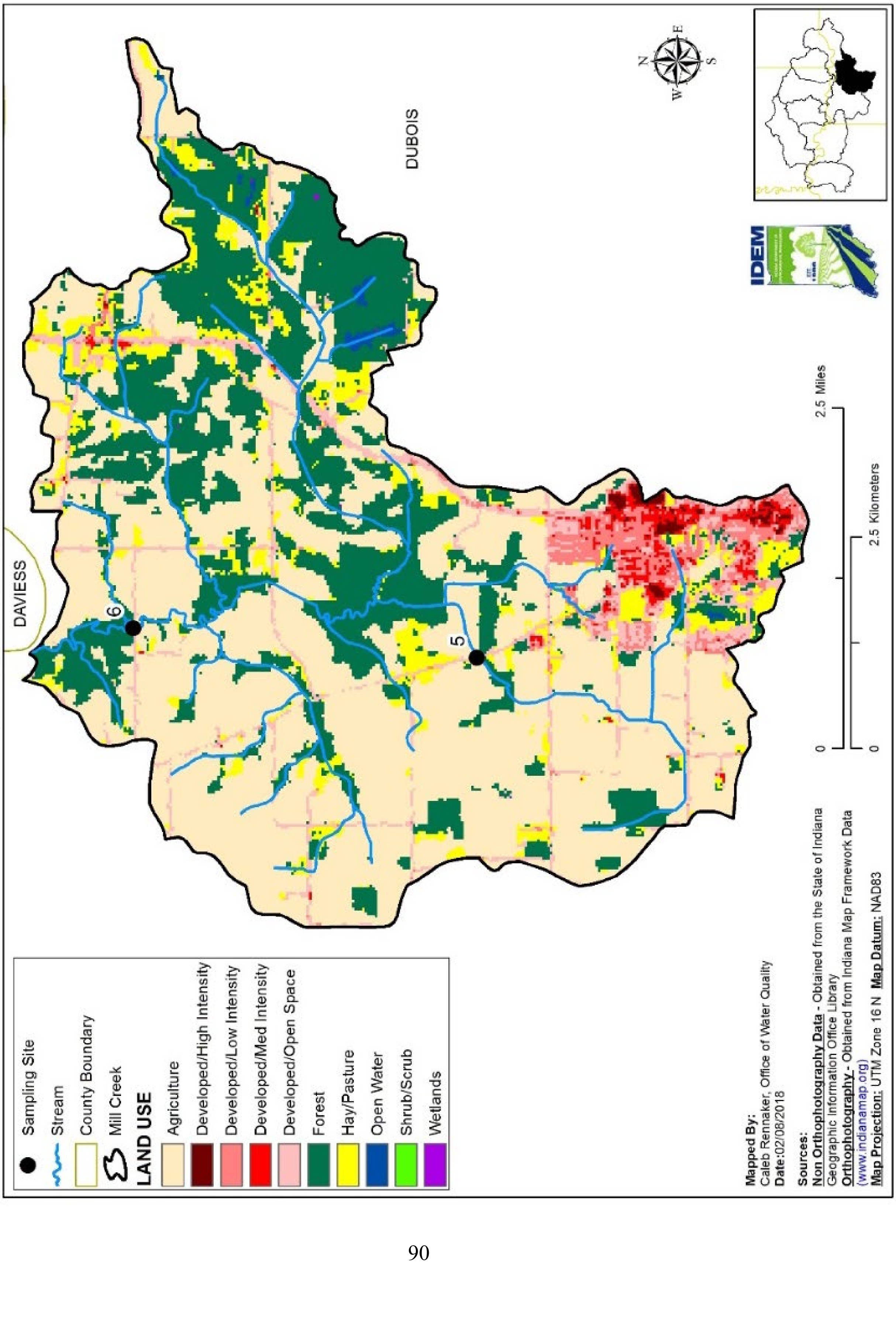


FIGURE 29 –MILL CREEK *E. coli* LOAD DURATION CURVE

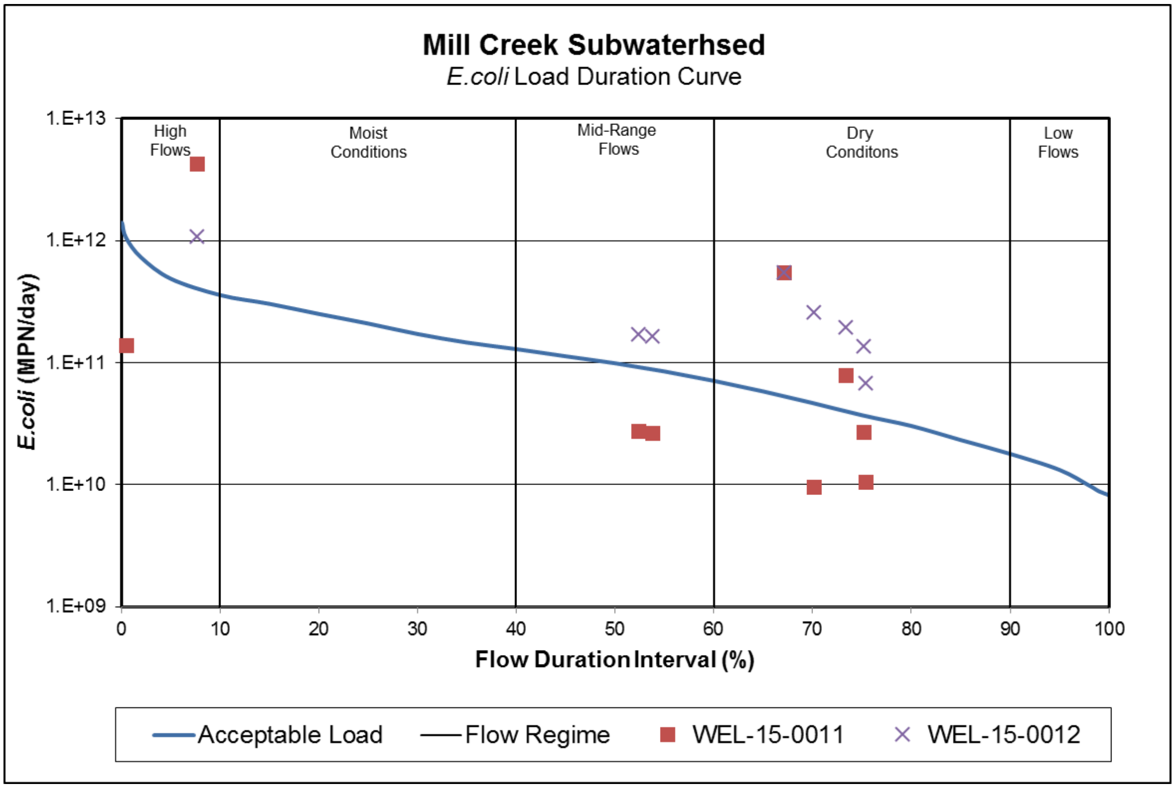
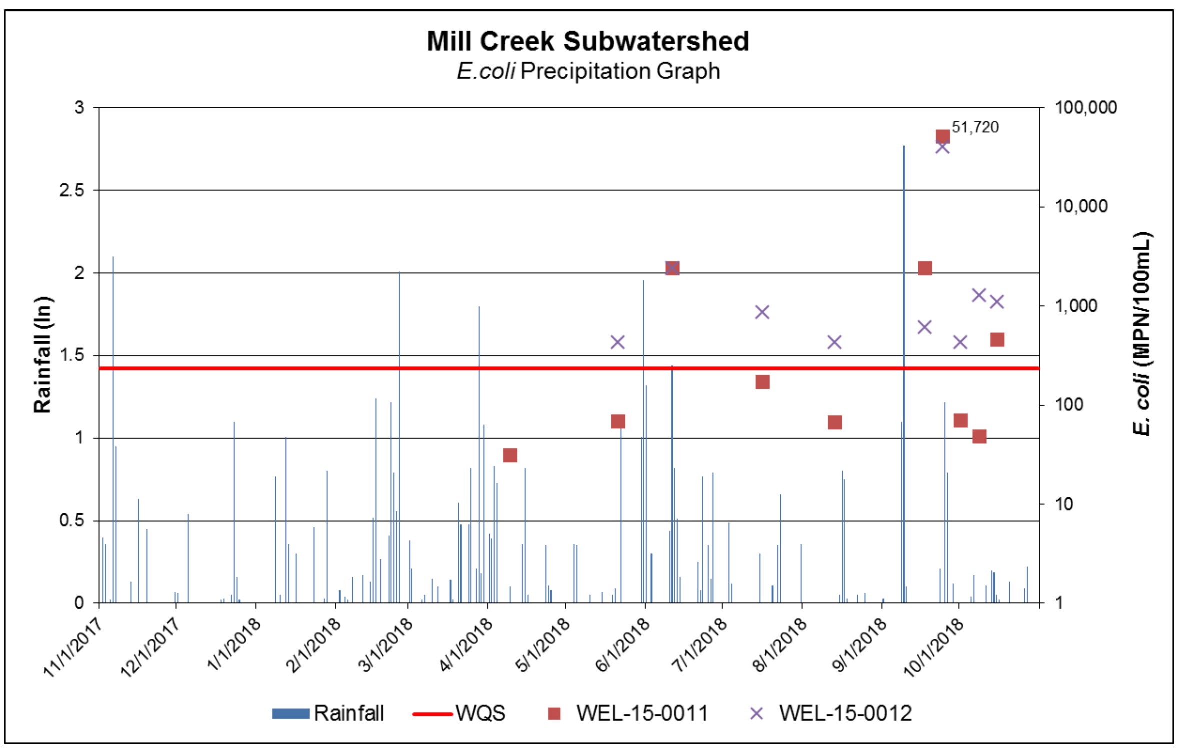


FIGURE 30 – MILL CREEK *E. coli* PRECIPITATION GRAPH



HOFFMAN RUN - 051202081502

Size and Land Use

The Hoffman Run subwatershed drains approximately 5,557 square miles with an actual land area of 22.42 square miles. Water drains into the LEF White River and continues flowing east to west throughout the subwatershed. The land use is primarily forest land (52%), followed by agriculture (35%) and hay and pastureland (7%). The picture shown is a good representation of what was found in the subwatershed during the windshield survey.

FIGURE 31 – TYPICAL LANDSCAPE IN SUBWATERSHED

Population and Housing Clusters

Hoffman Run only has 3% of the subwatershed developed. There are no NPDES permitted dischargers in the subwatershed. Also, there are no towns or communities; however, the unincorporated housing cluster known as Thales is located at east of Hickory Grove Road and south of east County Road 900 North. There are approximately a dozen households in the Thales area. Since the majority of the subwatershed is rural, 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.

TABLE # 32 – HOFFMAN RUN - 051202081502		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	4,988	35%
Developed	435	3%
Forest	7,535	52%
Hay / Pasture	1,076	7%
Open Water	308	2%
Shrub / Scrub	<1	0%
Wetlands	12	0%
Total Acres in Subwatershed	14,354	100%

Landscape, Soils and Waterways
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. **Livestock and CFOs**
With a land use of 7 percent pastureland, a heavy presence of pasture animals is not expected. There are 5 permitted CFOs in the watershed.

Stream Cleanup
A stream cleanup event was held in October 2020 which focused on the US Highway 231 bridge over the Lower East Fork White in Hoffman subwatershed. Significant trash was found on the north east side of the river where a paved area was accessible from the highway. Roadside trash such as Styrofoam cups, used diapers, and empty beer cans were found as well as tires, lumber, and old carpet and appliances. A picture of this section of the river as it flows under the Hwy 231 bridge can be seen on page 95.

TABLE 33 - HOFFMAN RUN (051202081502) CHARACTERISTICS					
TMDL Sample Site	WEL-14-0003 (US), WEL-15-0010 (DS)				
Listed Segments	INW08F2_02, INW08F2_03				
Listed Impairments [TMDL(s)]	Impaired Biotic Communities [TSS]				
CFOs	Ronald D Divine (Farm ID: 880), Deer Run (Farm ID: 2794), Wabash Valley Produce Inc. Sky View Farm (Farm ID:3745), D C Poultry Inc. (Farm ID: 3749), Farbest Farms Brooder 1 (Farm ID: 6446)				
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	12,666.76	5,435.16	2,568.87	963.32	343.63
WLA (Total)	0.00	0.00	0.00	0.00	0.00
MOS (10%)	1,583.34	679.40	321.11	120.42	42.95
Future Growth (10%)	1,583.34	679.40	321.11	120.42	42.95
Upstream Drainage Input (East Fork White River)	3,889,369.88	1,668,885.00	788,778.75	295,792.03	105,512.79
TMDL = LA+WLA+MOS	**3,905,203.32**	**1,675,678.95**	**791,989.83**	**296,996.19**	**105,942.33**

Water Quality Monitoring

Due to local constraints including accessibility, there were no sample sites located directly in this subwatershed. However, site WEL-14-0003 (T01) was sampled directly upstream of the subwatershed on the East Fork White River in order to better characterize incoming contributions from upstream sources. Additionally, site WEL-15-0010 (T07) on the East Fork White River is located within the Sugar Creek subwatershed directly downstream of the Hoffman Run subwatershed. These two sampling locations were used to characterize both inflowing and outflowing pollutants in the subwatershed.

TABLE # 34 HOFFMAN CREEK (051202081502) TMDL Collected Data

Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-14-0003	Abel Hill Road County Road 3	11/13/2017			<0.2	1.2	7.86	0.27	110	88.3
		12/11/2017			<0.2	1.8	8.44	0.084	3	4.72
		1/22/2018			<0.2	2.9	8.23	0.17	53	35.9
		2/19/2018			<0.2	1.7	7.98	0.27	160	204
		3/12/2018			<0.2	1.8	8.31	0.1	31	25.7
		5/21/2018	>2419.6	21.3	0.11	0.45	8.03	0.08	47	28.7
		6/11/2018	>2419.6	1732.9	0.18	1.9	8.08	0.077	150	128
		7/16/2018	>2419.6	13.4	<0.2	0.62	8.03	0.054	45	31.2
		8/13/2018	>2419.6	8.6	<0.2	0.45	8.12	0.14	58	44
		8/14/2018					8.12			30.2
		9/17/2018	20140	98.8	0.15	0.8	7.62	0.21	99	66.2
		9/24/2018	>2419.6	80.9			8.12			34.1
		10/1/2018	>2419.6	30.1			7.92			32.3
		10/8/2018	>2419.6	19.9			8.18			30.9
		10/15/2018	>2419.6	25.6	0.12	1.4	8.13	0.12	29	20.1
WEL-15-0010	County Road 1100 E	11/13/2017			<0.2	1.2	7.88	0.32	130	95
		12/11/2017			<0.2	2	8.38	0.085	4.5	5.39
		1/22/2018			0.12	2.9	8.03	0.23	110	60
		2/19/2018			<0.2	1.6	7.84	0.26	210	200
		3/12/2018			<0.2	1.8	8.08	0.096	38	28.9
		4/9/2018	850	71.7	<0.2	0.84	8.03	0.33	110	205
		5/21/2018	>2419.6	20.1	0.12	0.5	8.19	0.074	47	31.8
		6/11/2018	>2419.6	>2419.6	0.37	2.9	7.82	0.1	550	317
		7/16/2018	>2419.6	17.1	<0.2	0.79	8.16	0.046	48	31.6
		8/13/2018	>2419.6	20.1	<0.2	0.47	8.33	0.13	65	46.6
		8/15/2018					8.22			33.7
		9/17/2018	22820	140.1	<0.2	0.81	7.73	0.18	130	72.6
		9/24/2018	>2419.6	344.8			8.1			43
		10/1/2018	>2419.6	48.7			7.95			41.4
		10/8/2018	>2419.6	30.5			8.08			30.7
		10/15/2018	>2419.6	34.1	<0.2	1.5	8.28	0.096	26	18.4

In 2017-2018 T01, the upstream site, was sampled 15 times, and T07, the downstream site, was sampled 16 times which resulted in both sites meeting the WQS for *E. coli*. The *E. coli* geomean for T01 on the East Fork White River was 41.46 MPN with 1/9 samples in exceedance of the SSM. Site T07 had a geomean of 75.46 with 2/10 samples in exceedance of the SSM. The geomeans from sites T01 and T07 were taken on the same day approximately one hour apart for five consecutive weeks.

High *E. coli* levels are reflective of high animal concentration and land application of waste. Although some samples were in exceedance of the SSM value, calculated geometric means used for assessments were meeting WQ standards.

The fish community IBI score for site T01 was 16 (very poor) and the QHEI was 60 (good); while the macro community mIBI score was 26 (poor) and the mQHEI was 51 (good). For site T07 the fish community IBI score was 38 and the QHEI was 61 (good); while the macro community mIBI score was 32 and the mQHEI was 46. Load Duration curves were developed for the subwatershed and are shown on page 97.

TSS concentrations ranged from 3 mg/L to 160 mg/L across 11 sampling events at the upstream site (T01) of the main stem of the East Fork White River, and exceeded the target value 9/11 times. At the downstream site (T07) of the East Fork White River, concentrations ranged from 4.5 to 550 mg/L across 12 sampling events, and exceeded the target value 10/12 times. Given that targets for TSS were violated in excess at sites immediately located upstream and downstream of the subwatershed, it is reasonable to believe that TSS is a prevalent pollutant in the main stem of the East Fork White River throughout Hoffman Run subwatershed. Therefore, a TSS TMDL was developed to address impaired biological communities in this subwatershed.

Based on the water quality duration graphs, it can be concluded that the majority of sources of TSS in this watershed are nonpoint sources that include agricultural practices, streambank erosion, and stormwater run-off. There are approximately 47 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 18 stream miles impaired for biotic communities listed on the 2020 303(d) List of Impaired Waters.

The precipitation graph for these sites shows the stream is susceptible to high loads of TSS from run-off. The stream is consistently in violation of water quality targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for TSS within the watershed.

FIGURE 32 – LOWER EAST FORK WHITE RIVER AT HWY 231 BRIDGE IN HOFFMAN RUN SUBWATERSHED

FIGURE 33 –HOFFMAN RUN SUBWATERSHED 051202081502

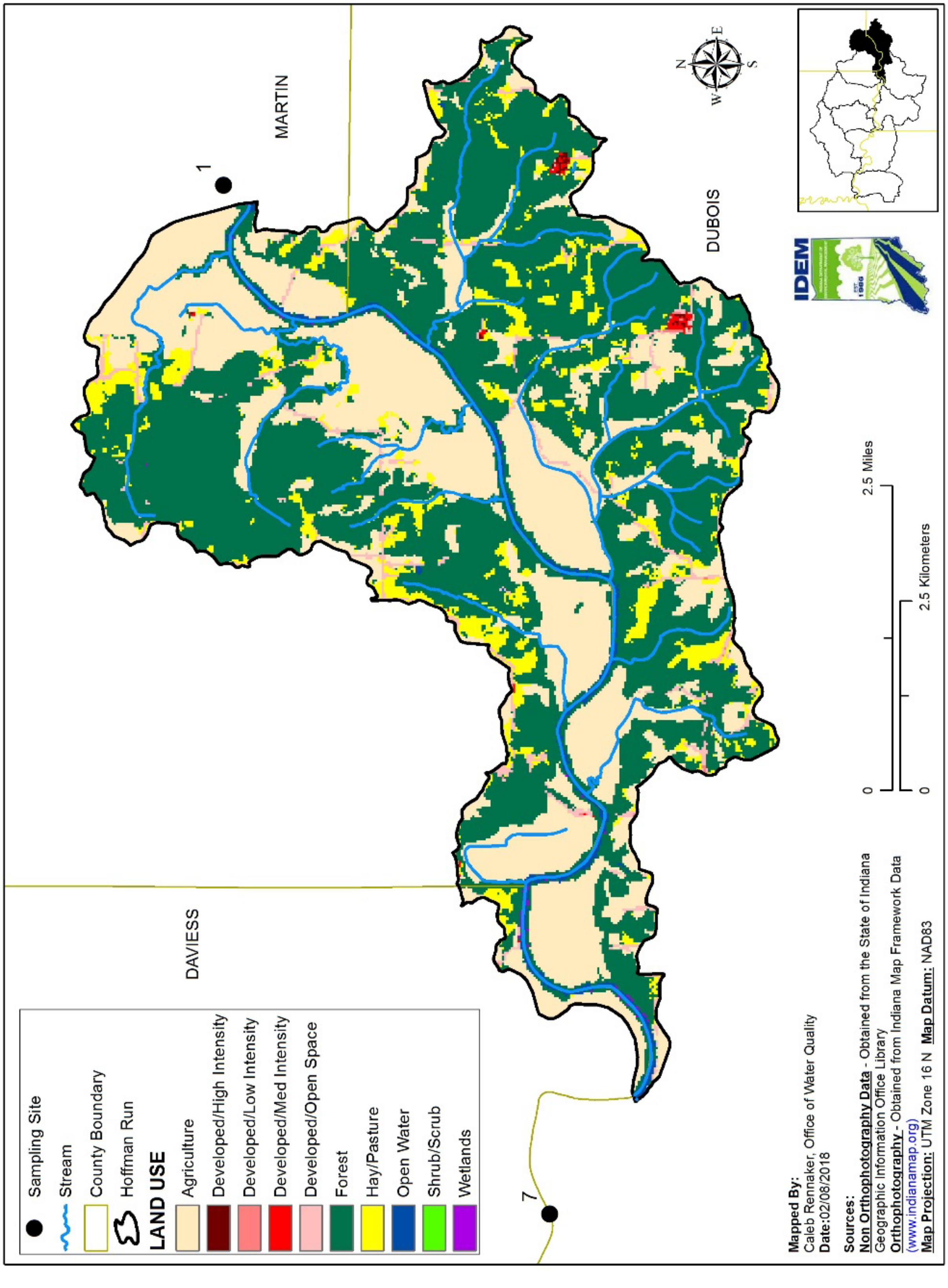


FIGURE 34 –HOFFMAN RUN TSS LOAD DURATION CURVE

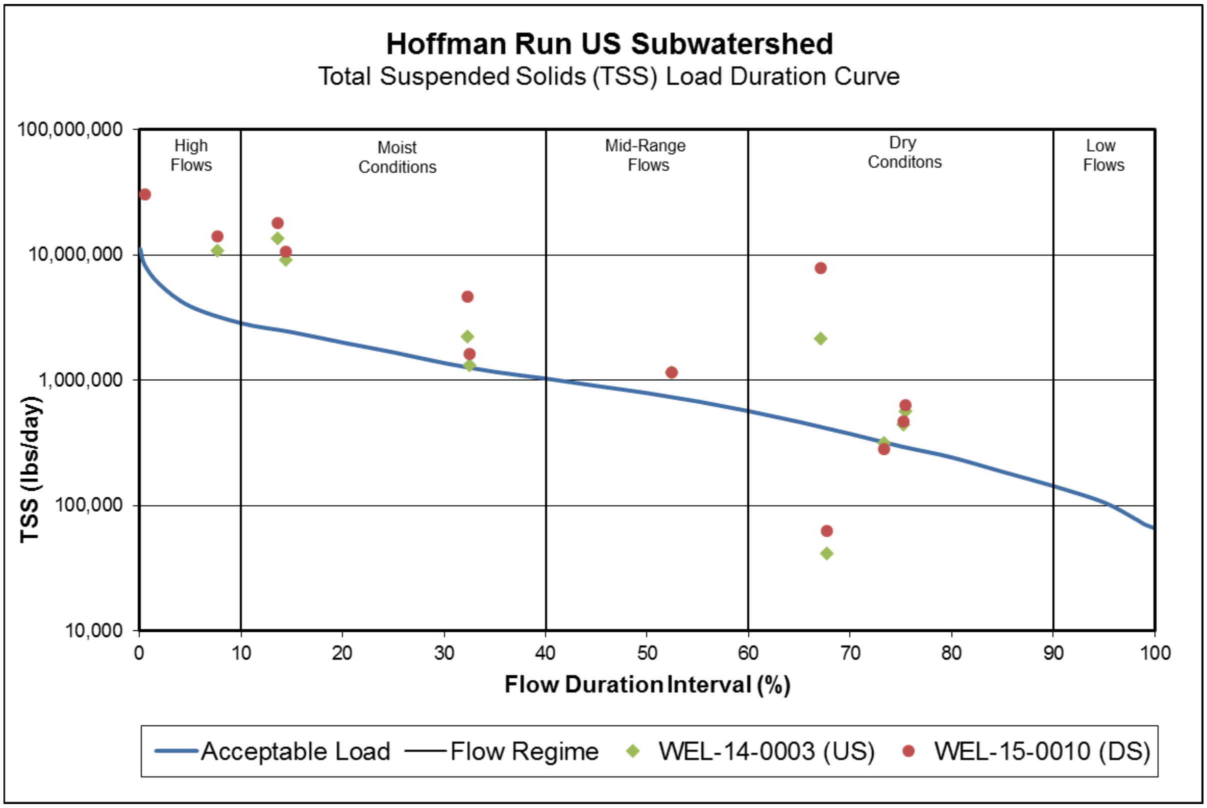
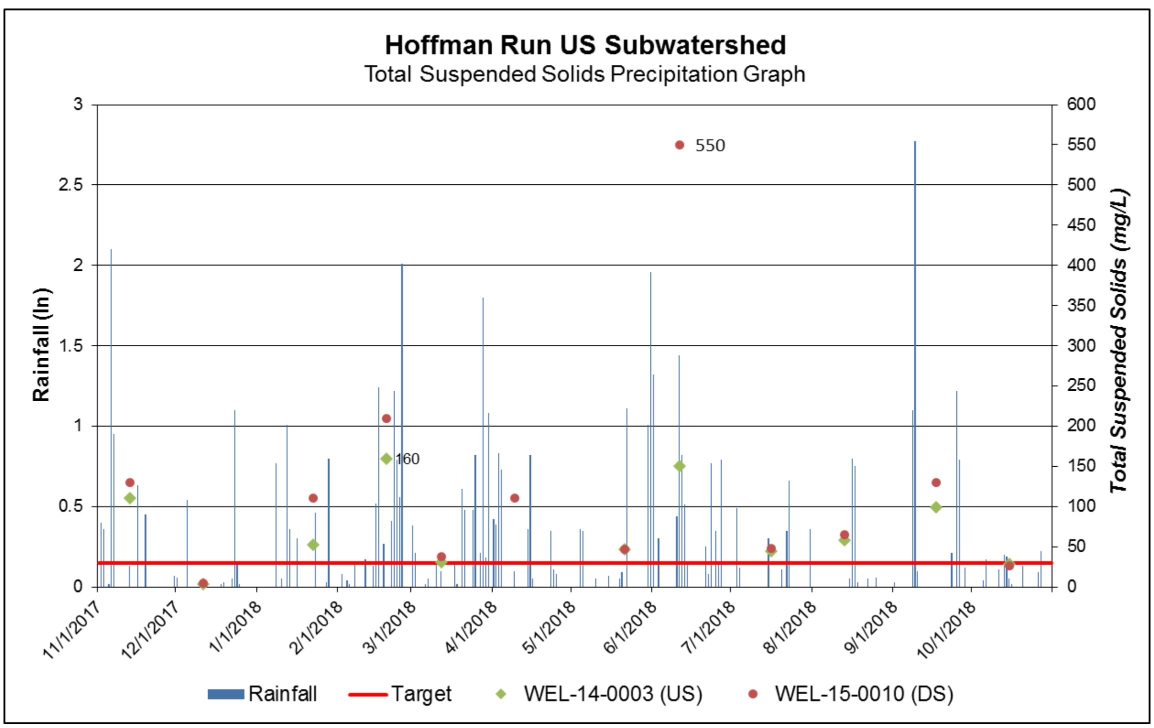


FIGURE 35 – HOFFMAN RUN TSS PRECIPITATION GRAPH



SLATE CREEK – 051202081503

Size and Landuse

Slate Creek's drainage area is the same as its surface area: 18.73 square miles. The subwatershed drains directly into the mainstem of the East Fork White River just north of Jasper, IN. The land use is primarily agriculture (44%), followed by forested land (34%) and hay and pasture (16%). There are no NPDES permitted facilities in the subwatershed.

TABLE # 35 – SLATE CREEK - 051202081503		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	5,227	44%
Developed	746	6%
Forest	4,047	34%
Hay / Pasture	1,935	16%
Open Water	30	0.00%
Shrub / Scrub	0	0.00%
Wetlands	2	0.00%
Total Acres in Subwatershed	11,987	100%

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There are two unincorporated communities in this subwatershed: South Martin and Alfordsville. Alfordsville has a population of under 100 (approximately 40 homes). 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.

Landscape, Soils and Waterways

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.

Livestock and CFOs

With a land use of 16% pastureland, there is a potential for small-scale livestock operations (see page 82). Likewise, 10 of the 33 permitted CFOs are located in this subwatershed.

Water Quality Monitoring

There are three monitoring sites located in this subwatershed, WEL-15-0008(T02) and WEL-15-0007(T04) on Slate Creek and WEL-15-0021(T03) on a tributary of Slate Creek. In 2017-2018 this watershed was sampled 38 times between the three sites resulting in all three failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli*

TABLE # 36 SLATE CREEK (051202081503) TMDL Collected Data										
Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0008	County Road 22	4/9/2018	648.8	44.1	0.92	3.7	7.7	0.078	6	7.41
		5/21/2018	>2419.6	248.1	0.19	0.18	7.51	0.044	11	23.3
		6/11/2018	>2419.6	>2419.6	0.82	21	7.13	0.95	430	429
		7/16/2018	>2419.6	191.8	0.13	0.14	7.55	0.039	7	34.4
		7/17/2018					7.44			31.8
		8/13/2018	>2419.6	435.2	<0.2	0.043	7.66	0.052	18	21.8
		9/17/2018	>2419.6	488.4	0.16	0.18	7.5	0.078	8.5	18.4
		9/24/2018	>241960	15150			7.51			90.6
		10/1/2018	>2419.6	238.2			7.51			15.3
		10/8/2018	21870	66.9			7.52			56.4
		10/15/2018	>2419.6	127.4	0.16	0.67	7.85	0.045	8	13.5
WEL-15-0007	County Road 1250 E	11/13/2017			0.11	8.3	7.38	0.12	4	8
		12/11/2017			<0.2	5.7	7.97	0.059	2.5	6.54
		1/22/2018			0.62	2.9	7.74	0.97	2200	>1000
		2/19/2018			0.18	8.5	7.49	0.14	23	27.1
		3/12/2018			0.13	4.7	7.97	0.09	11	11.4
		4/9/2018	816.4	28.1	0.15	5.5	7.8	0.11	8.5	15.9
		5/21/2018	>2419.6	727	0.31	0.61	7.26	0.083	19	12.6
		6/11/2018	>2419.6	>2419.6	0.87	9.7	7.04	0.11	470	480
		7/16/2018	>2419.6	>2419.6	<0.2	0.67	7.12	0.23	7	5.63
		7/17/2018					7.11			5.65
		8/13/2018	>2419.6	39.9	0.13	0.27	7.38	0.074	8.5	8.58
		9/17/2018	>2419.6	145	0.19	0.99	7.46	0.11	6.5	9.9
		9/24/2018	241960	4550			7.58			126
		10/1/2018	>2419.6	172.3			7.47			8.04
		10/8/2018	>2419.6	42.2			7.48			5.13
		10/15/2018	>2419.6	261.3	<0.2	0.79	7.74	0.056	2.5	4.49
WEL-15-0021	County Road 800 S	4/9/2018	461.1	18.5	<0.2	3.6	7.94	0.045	<5	7.83
		5/21/2018	>2419.6	59.1	0.1	0.071	8.09	0.056	6	4.87
		6/11/2018	>2419.6	>2419.6	0.8	14	6.94	0.33	170	177
		7/16/2018	>2419.6	5.2	<0.2	<0.1	7.61	0.039	11	14.1
		7/17/2018					7.77			10.7
		7/24/2018					8.14			10.6
		9/17/2018	>2419.6	61.2	0.1	<0.1	8.15	0.059	4.5	6.21
		9/24/2018	>2419.6	238.2			7.85			4.81
		10/1/2018	>2419.6	204.6			7.54			5.71
		10/8/2018	>2419.6	185			7.7			4.6
		10/15/2018	>2419.6	1299.7	<0.2	0.41	8.11	0.026	2	2.84

geomean for T02 was 431.86 MPN with 6/10 samples in exceedance of the SSM. Site T04 had a geomean of 262.8 with 5/10 samples in exceedance of the SSM. Finally, site T03 had a geomean of 235.03 with 3/9 samples in exceedance of the SSM. The geomeans from sites T02, T04, and T03 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T02 was 40 (fair) and the QHEI was 52 (good). The macro community mIBI score was 30 (poor) and the mQHEI was 39 (Poor). The fish community IBI score for site T04 was 34 (poor) and the QHEI was 38 (poor). The macro community mIBI score was 38 (fair) and the mQHEI was 48 (poor). The fish community IBI score for site T03 was 30 (poor) and the QHEI was 26 (poor). The macro community mIBI score was 38 (fair) and the mQHEI was 38 (poor). Load Duration curves for the subwatershed were developed and are shown on pages 103-105.

TSS concentrations ranged from 2 mg/L to 2,200 mg/L across 25 sampling events and exceeded the target value four times. Total phosphorus concentrations ranged from 0.026 mg/L to 0.97 mg/L across 25 sampling events and exceeded the target value three times. All stream segments were determined to be impaired for nutrients with total phosphorus being consistently over the target value in those determinations. Additionally, DO was found below WQ standards on multiple occasions on Slate Creek (T04). Given that targets for total phosphorus and TSS were sporadically violated throughout, TMDLs were developed to address the biological communities and DO impairments within the subwatershed. Additionally, high total phosphorus values are also believed to be a primary linkage to the nutrient impairments. Therefore, a TMDL for total phosphorus will also serve to address nutrients impairments in this subwatershed.

Based on the WQ duration graphs, it can be concluded that the majority of *E. coli*, TSS, and total phosphorus sources are nonpoint which include small animal operations; wildlife; animals with direct access to streams; straight-piped, failing septic systems; streambank erosion; and ag practices.

There are approximately 36 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 36 stream miles impaired for *E. coli*, 21 miles impaired for biological communities, 4 miles impaired for dissolved oxygen, and 36 miles impaired for nutrients listed on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, TSS TMDLs were developed to address all impaired biotic communities, and TP TMDLs were developed to address all nutrients impairments. Additionally, both TP and TSS TMDLs will be used to address all DO impairments in the subwatershed.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli*, TSS, and total phosphorus from run-off. The streams are consistently in violation of water quality standards / targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for *E. coli*, TSS, or total phosphorus within the watershed.

FIGURE 36 – COMMUNITY OF ALFORDSVILLE

FIGURE 37 –SLATE CREEK SUBWATERSHED 051202081503

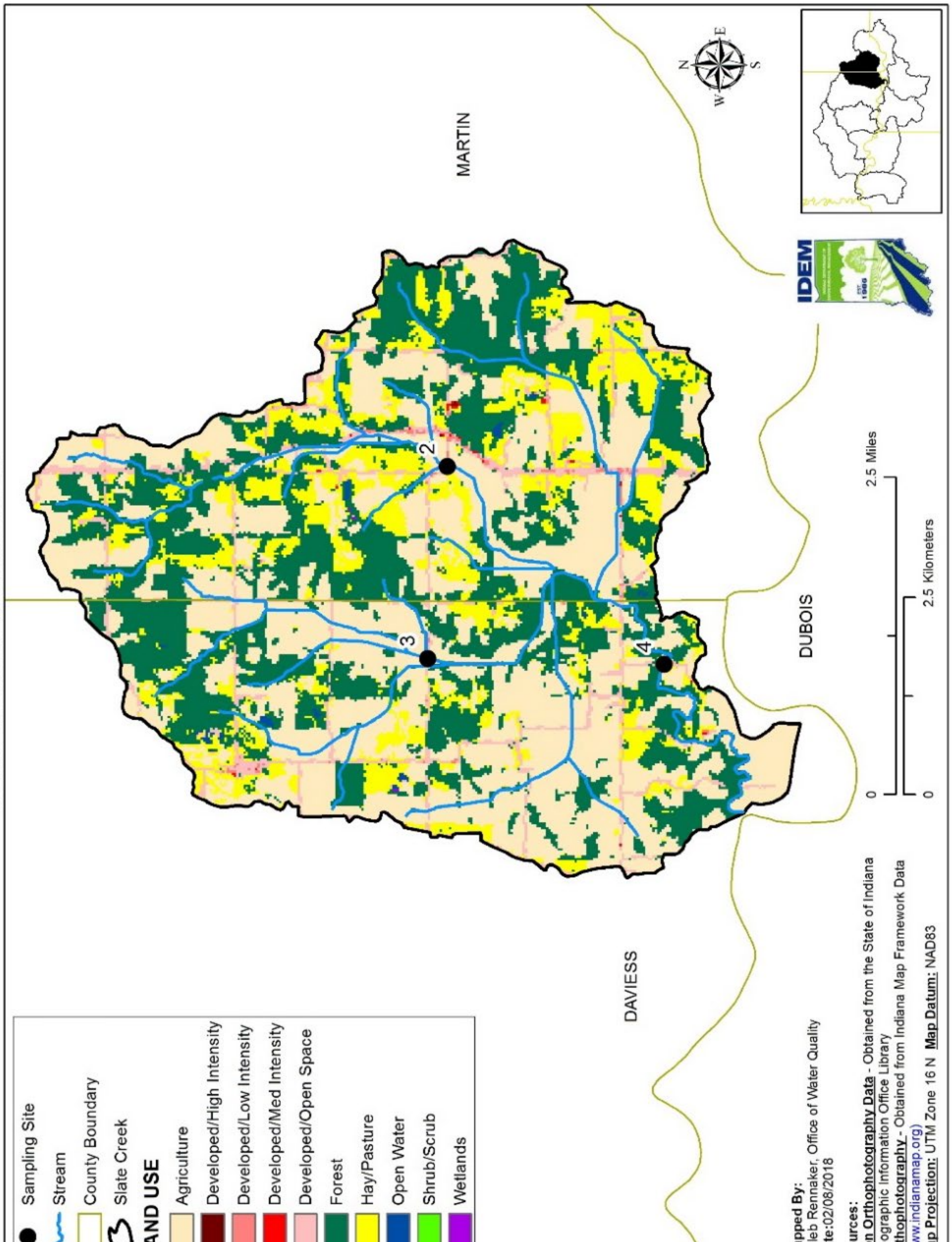


TABLE # 37 SLATE CREEK (051202081503) CHARACTERISTICS					
TMDL Sample Site	WEL-15-0008, WEL-15-0007, WEL-15-0021				
Listed Segments	INW08F3_01; INW08F3_02; INW08F3_03; INW08F3_T1002; INW08F3_T1003; INW08F3_T1004; INW08F3_T1005				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Nutrients [TP], Dissolved Oxygen [TP & TSS]				
CFOs	Josh & Kristi Ausbrooks (Farm ID: 3207), NSL Farms Incorporated (Farm ID: 3554), Matheis Poultry 1 (Farm ID: 3648), Lottes Farms Incorporated (Farm ID: 3930), Slate Creek Farms (Farm ID: 4020), Matheis Poultry 2 (Farm ID: 4447), Zach Taylor (Farm ID: 4856), Kopps Turkey Sales Inc. Caleb Ridge (Farm ID: 6244), White River, LLC Eagle Farms (Farm ID: 6432), Farbest Farms Brooder Hub 2 (Farm ID: 6539)				
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	3.976E+11	1.706E+11	8.063E+10	3.024E+10	1.079E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	4.677E+10	2.007E+10	9.486E+09	3.557E+09	1.269E+09
Future Growth (5%)	2.339E+10	1.003E+10	4.743E+09	1.779E+09	6.344E+08
TMDL = LA+WLA+MOS	**4.677E+11**	**2.007E+11**	**9.486E+10**	**3.557E+10**	**1.269E+10**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	10,530.33	4,518.45	2,135.59	800.85	285.67
WLA	0.00	0.00	0.00	0.00	0.00
MOS (10%)	1,316.29	564.81	266.95	100.11	35.71
Future Growth (10%)	1,316.29	564.81	266.95	100.11	35.71
TMDL = LA+WLA+MOS	**13,162.91**	**5,648.06**	**2,669.49**	**1,001.06**	**357.09**
TMDL Total Phosphorus Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	111.88	48.01	22.69	8.51	3.04
WLA	0.00	0.00	0.00	0.00	0.00
MOS (10%)	13.16	5.65	2.67	1.00	0.36
Future Growth (5%)	6.58	2.82	1.33	0.50	0.18
TMDL = LA+WLA+MOS	**131.63**	**56.48**	**26.69**	**10.01**	**3.57**

FIGURE 38 –SLATE CREEK *E. coli* LOAD DURATION CURVE

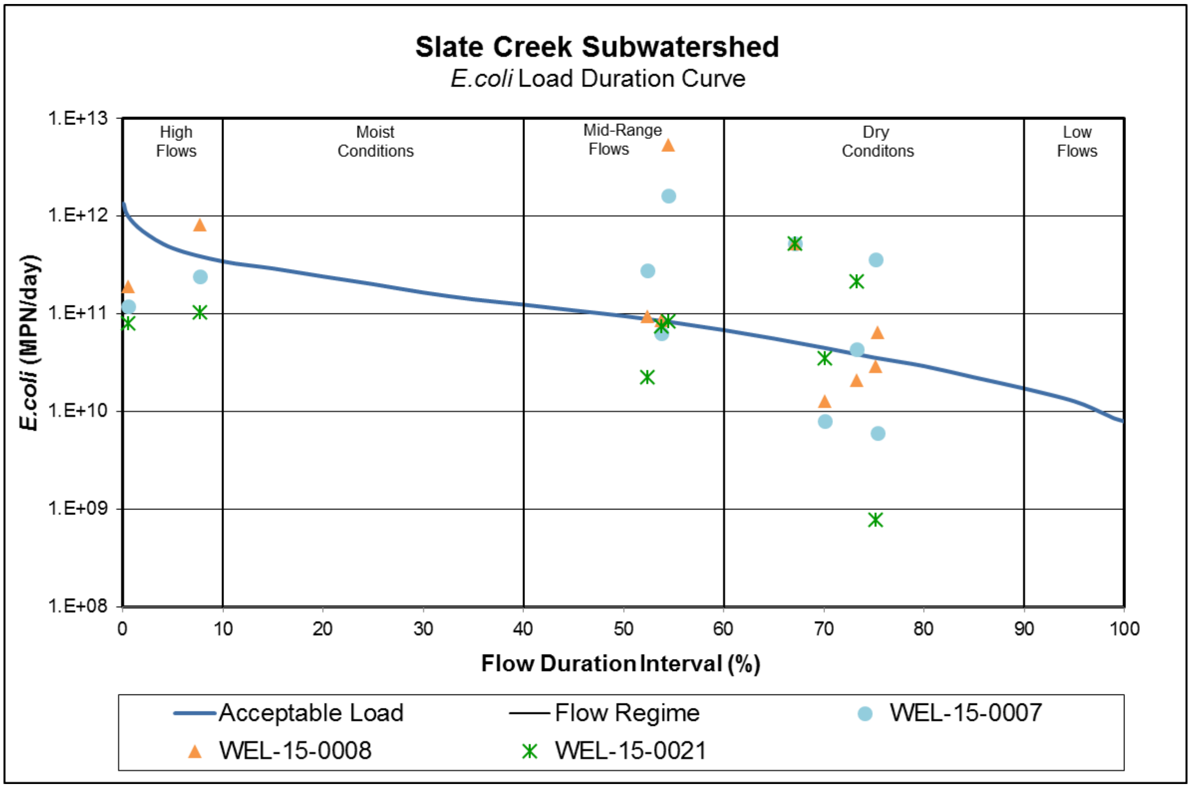


FIGURE 39 –SLATE CREEK *E. coli* PRECIPITATION GRAPH

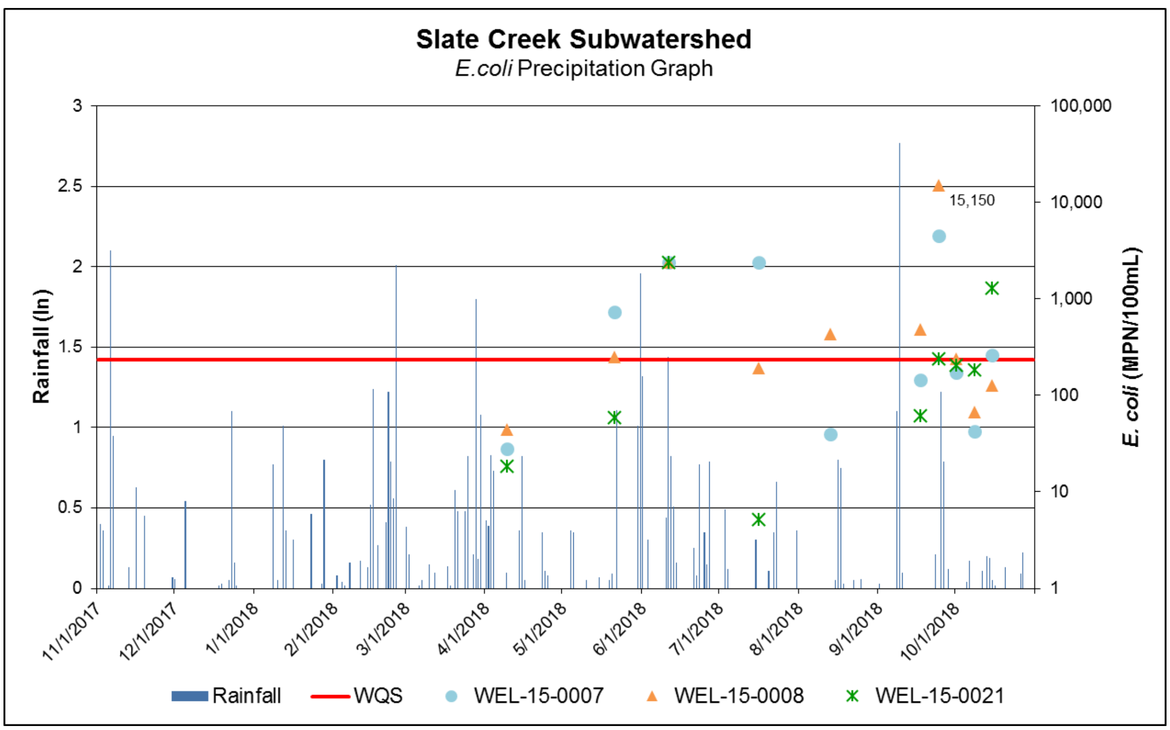


FIGURE 40 –SLATE CREEK TSS LOAD DURATION CURVE

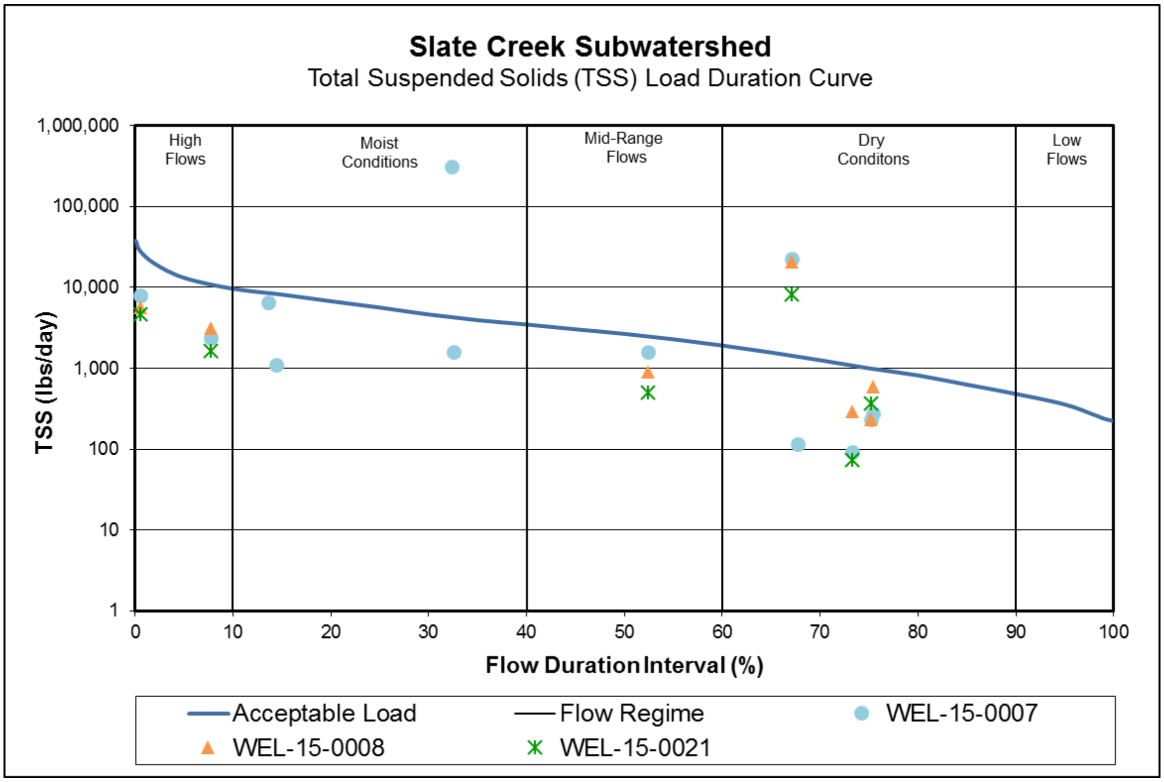


FIGURE 41 –SLATE CREEK TSS PRECIPITATION GRAPH

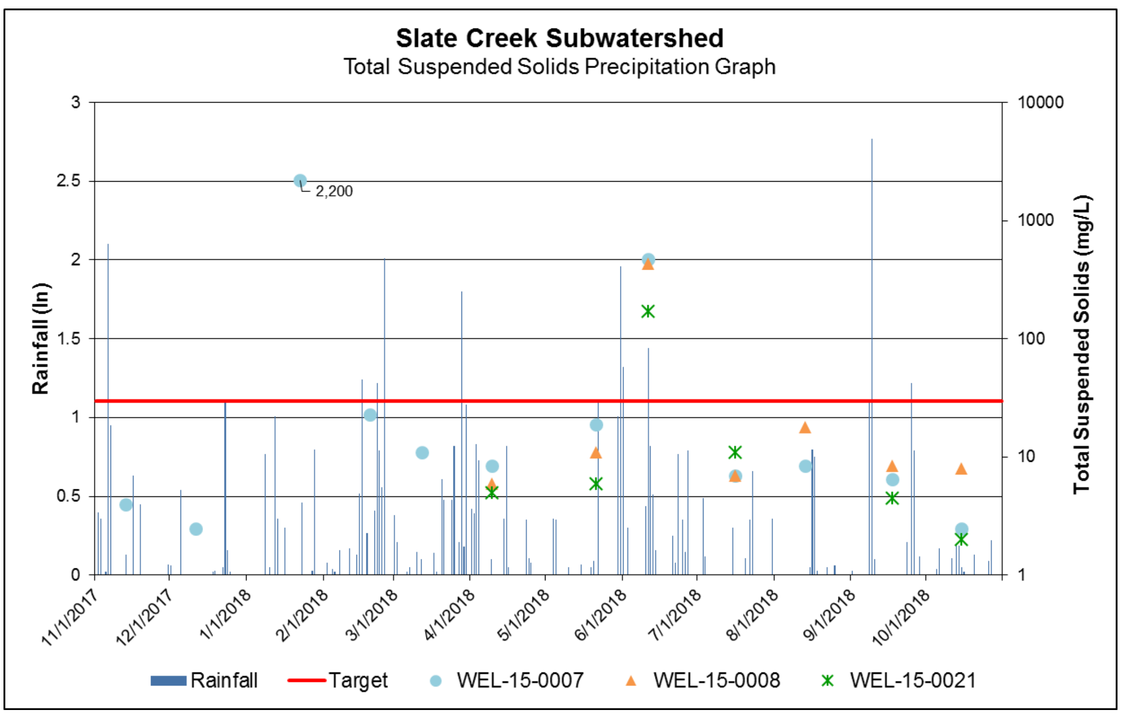


FIGURE 42 –SLATE CREEK TOTAL P LOAD DURATION CURVE

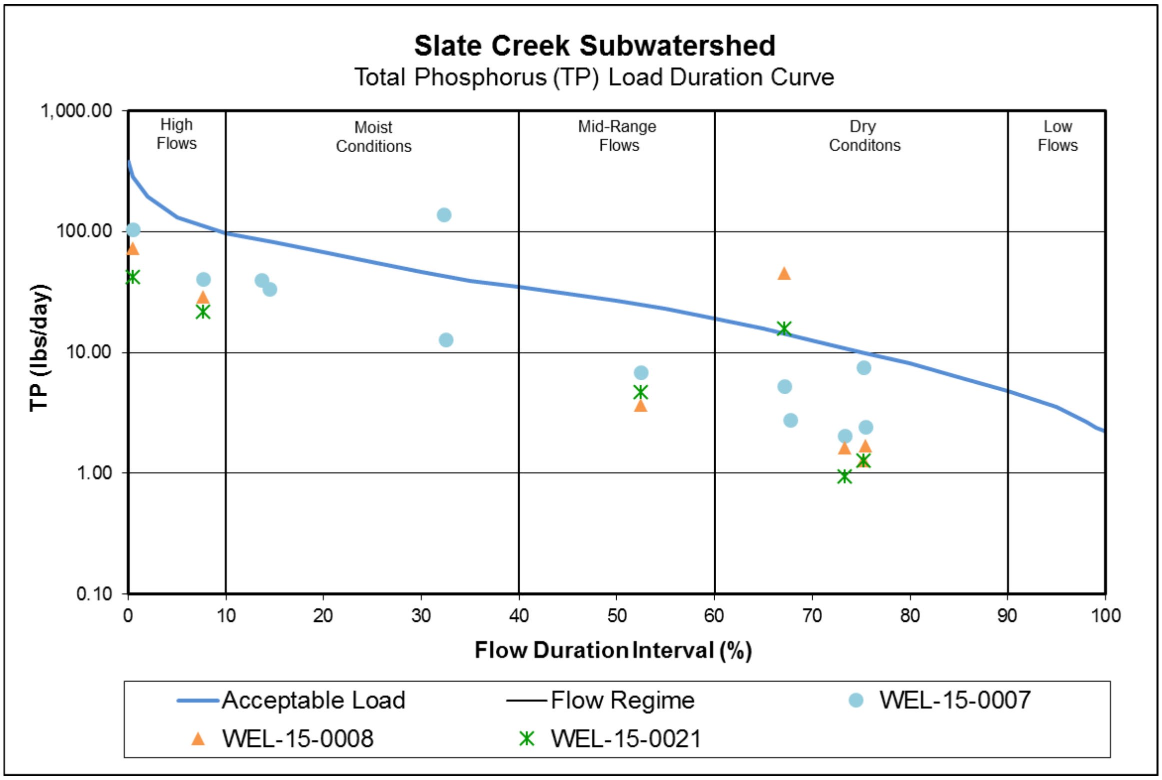
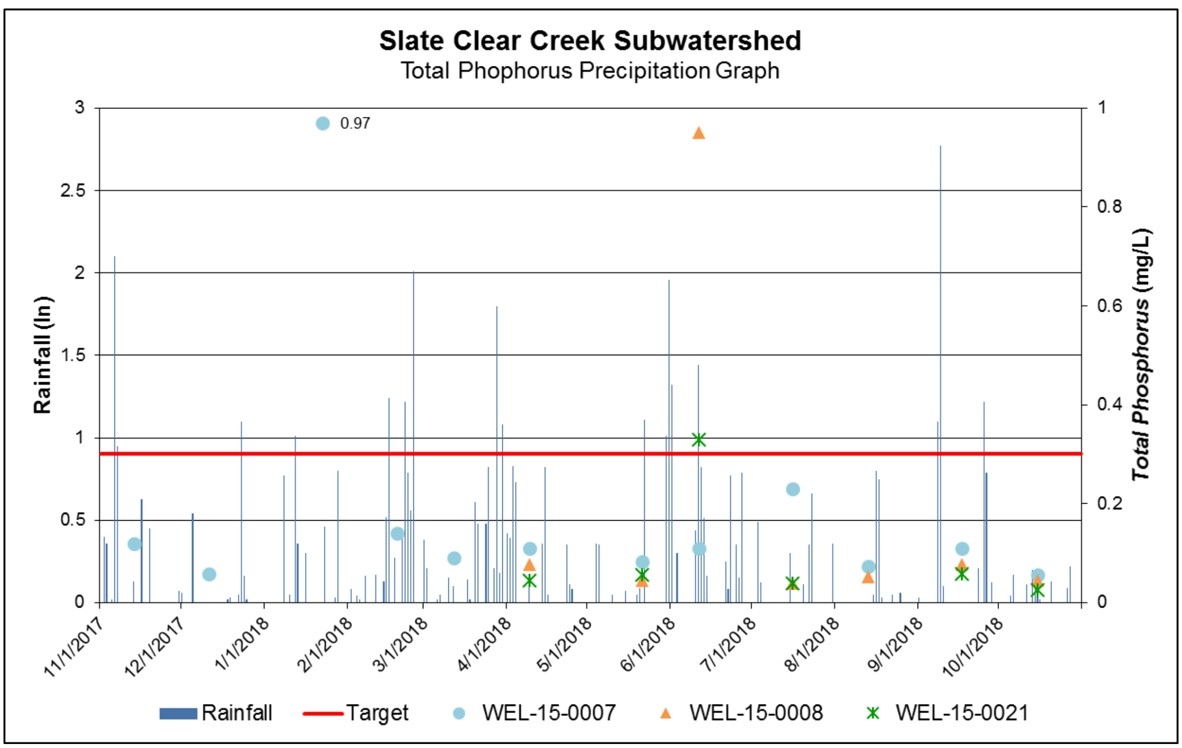


FIGURE 43 –SLATE CREEK TOTAL P PRECIPITATION GRAPH



SUGAR CREEK – 051202081504

Size and Landuse

The Sugar Creek subwatershed drains approximately 5,619 square miles with an actual land area of approximately 24 square miles. Water drains into the East Fork White River in the southern portion of the watershed and continues flowing from east to west. The land use is primarily agriculture (43%), followed by forested land (35%) and hay and pastureland (14%).

TABLE # 38 – SUGAR CREEK - 051202081504		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	6,719	43%
Developed	732	5%
Forest	5,377	35%
Hay / Pasture	2,227	14%
Open Water	368	2%
Shrub / Scrub	4	0.00%
Wetlands	24	0.00%
Total Acres in Subwatershed	15,450	100%

There are two NPDES permitted facilities in the subwatershed which are both coal surface mining operations. Portions of the Peabody Midwest Mining – Viking Mine Corning Pit mine discharge intermittently through outfalls in the northern portion of the watershed. Trust Resources – Vigo Captain Daviess mine maintains a NPDES permit. However, mining operations have not begun at the writing of the WMP, and plans for future mining are still unknown. A list of proposed outfall locations in the current permit indicate discharges to the East Fork White in portions of Sugar Creek.

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There is a small, unincorporated community called Pennyville in the subwatershed. There are about 15 homes in this area along with a church established in 1871. 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.

FIGURE 44 – TYPICAL LANDSCAPE IN SUBWATERSHED

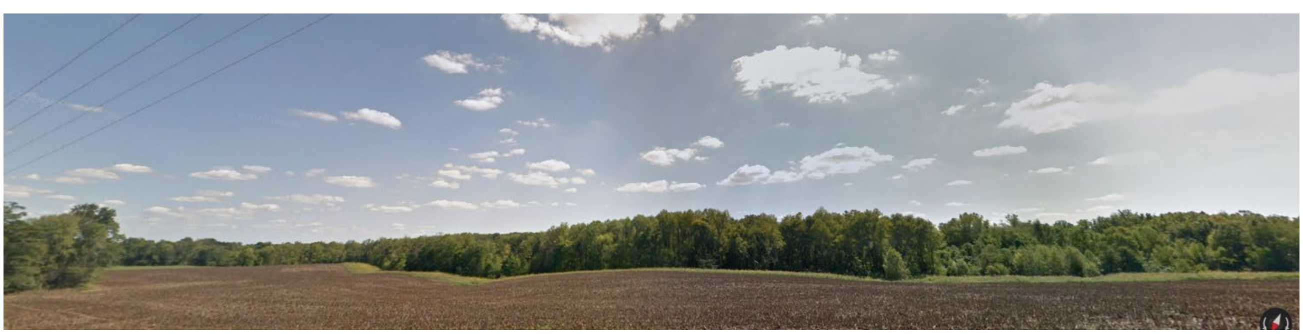
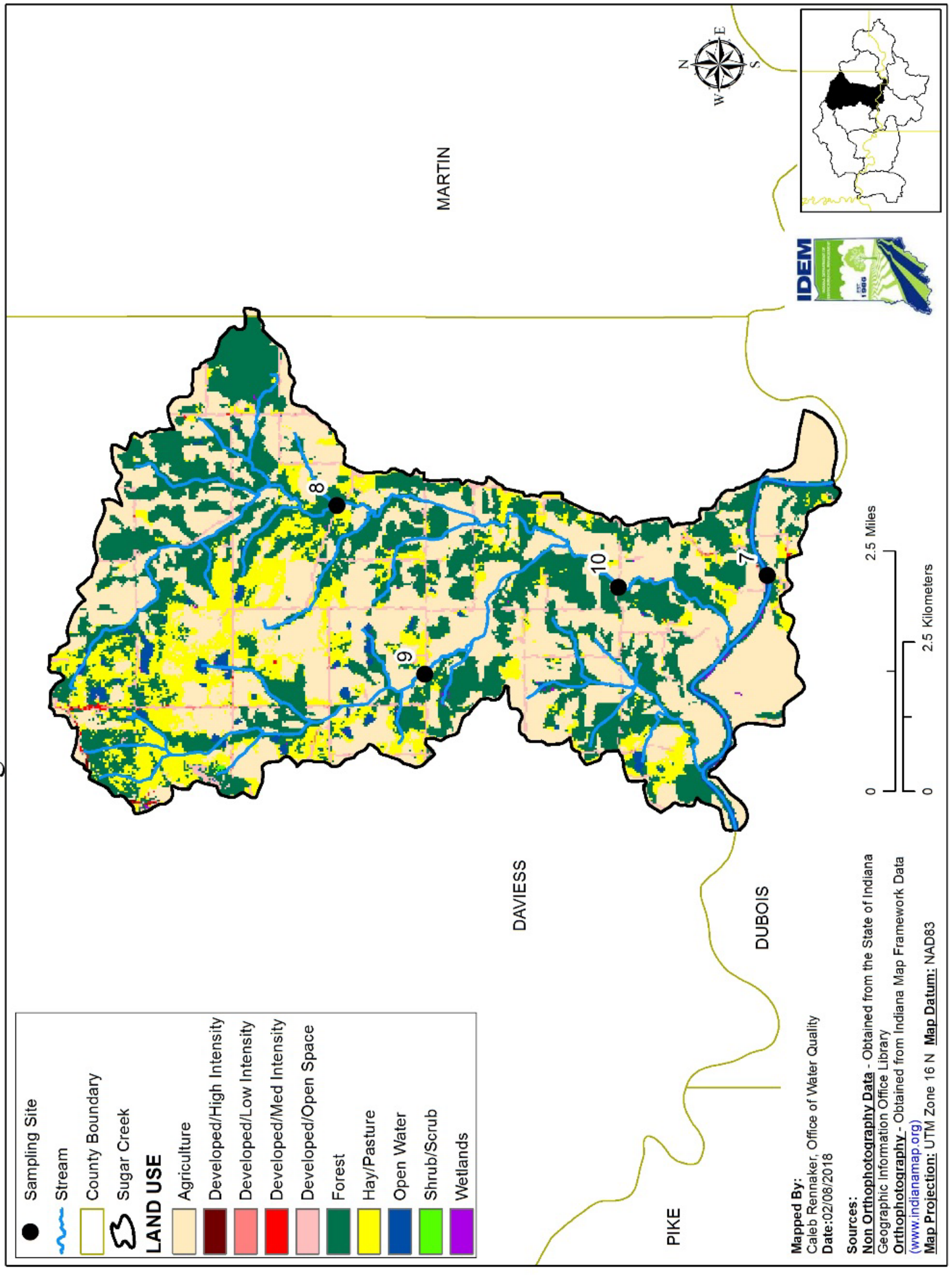


FIGURE 45 –SUGAR CREEK SUBWATERSHED 051202081504



Landscape, Soils and Waterways
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.

Livestock and CFOs
With a land use of 14% pasture land, there is a potential for small-scale livestock operations (see page 82). Three of the 33 permitted CFOs are located in this subwatershed.

Water Quality Monitoring
There are four sites located in this subwatershed, WEL-15-0010 (T07) on the East Fork White River, WEL-15-0018 (T08) and WEL-15-0009 (T10) on Sugar Creek, and WEL-15-0022 (T09) on West Fork Sugar Creek.

In 2017-2018 this watershed was sampled 53 times between the four sites resulting in three of the four sites failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) list of impaired waters. The *E. coli* geomean for T07 on the East Fork White River was 75.46 MPN with 2/10 samples in exceedance of the SSM, and was the only site which did not violate the WQS for *E. coli*.

Site T08 had a geomean of 320.16 with 6/9 samples in exceedance of the SSM, site T09 had a geomean of 233.28 with 4/10 samples in exceedance of the SSM, and site T10 had a geomean of 446.89 with 4/9 samples in exceedance of the SSM. The geomeans from sites T07, T08, T09, and T10 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T07 was 38 (fair) and the QHEI was 61 (good). The macro community mIBI score was 34 (poor) and the mQHEI was 46 (poor). The fish community IBI score for site T08 was 34 (poor) and the QHEI was 57 (good). The macro community mIBI score was 34 (fair) and the mQHEI was 56 (good). The fish community IBI score for site T09 was 46 (fair) and the QHEI was 47 (poor). The macro community mIBI score was 38 (fair) and the mQHEI was 44 (poor). The fish community IBI score for site T10 was 42 (fair) and the QHEI was 51 (good). The macro community mIBI score was 38 (fair) and the mQHEI was 63 (good). Load Duration curves for the subwatershed were developed and are shown on pages 111-112.

TSS concentrations ranged from 2 mg/L to 2,100 mg/L across 36 sampling events and exceeded the target value 14 times. Given that targets for TSS were sporadically violated throughout, a TSS TMDL was developed to address the impaired biological communities within the subwatershed.

Based on the WQ duration graphs and lack of permitted sources, it can be concluded that the majority of pollutant sources are nonpoint sources with some potential inputs from point sources. There are approximately 36 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 38 stream miles impaired for *E. coli* and 20 miles impaired for biological

TABLE # 39 SUGAR CREEK (051202081504) TMDL Collected Data										
Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0009	County Road 900 S	11/13/2017			<0.2	0.4	7.91	0.096	9	13.3
		12/11/2017			<0.2	0.15	8.23	0.19	9	21
		1/22/2018			0.33	1.6	8.03	0.76	2100	>1000
		2/19/2018			<0.2	1.9	7.81	0.12	25	33.8
		3/12/2018			0.1	1.3	7.88	0.062	7.5	11.3
		4/9/2018	613.1	18.7	<0.2	1.2	7.98	0.075	8	13.8
		5/21/2018	>2419.6	344.8	0.32	0.62	7.93	0.055	8	6.65
		6/11/2018	>2419.6	>2419.6	0.55	3	7.46	0.049	1300	>1000
		7/16/2018	>2419.6	184.2	0.11	0.21	7.98	0.029	8	6.14
		7/23/2018					7.75			4.62
		9/17/2018	>2419.6	145	0.15	0.073	8.02	0.053	4	5.22
		9/24/2018	>241960	12110			7.94			108
		10/1/2018	>2419.6	228.2			7.9			6.66
		10/8/2018	>2419.6	290.9			7.85			3.27
		10/15/2018	>2419.6	152.9	<0.2	0.13	7.98	0.04	<5	2.29
WEL-15-0018	County Road 600 S	4/9/2018	1986.3	1046.2	<0.2	1.1	7.95	0.07	5.5	8.93
		5/21/2018	>2419.6	110.6	0.22	0.09	7.58	0.054	2	7.81
		6/11/2018	>2419.6	>2419.6	0.27	3.6	7.3	0.46	480	458
		7/16/2018	>2419.6	579.4	<0.2	<0.1	7.55	0.059	10	5.58
		7/24/2018					7.28			5.46
		7/24/2018					7.88			3.23
		9/17/2018	>2419.6	73.3	0.11	0.073	7.8	0.13	7	3.92
		9/24/2018	>2419.6	1119.9			7.43			17.7
		10/1/2018	>2419.6	129.6			7.49			5.77
		10/8/2018	>2419.6	816.4			7.54			5.92
		10/15/2018	>2419.6	387.3	<0.2	0.069	7.55	0.14	2.5	2.47
WEL-15-0022	County Road 700 S	4/9/2018	1299.7	76.3	<0.2	0.34	8.05	0.067	7.5	13.5
		5/21/2018	>2419.6	160.7	0.2	0.077	7.88	0.041	4.5	7.35
		6/11/2018	>2419.6	>2419.6	0.45	1.2	7.52	0.081	310	240
		7/16/2018	>2419.6	816.4	0.11	0.23	7.66	0.029	7.5	9.03
		7/23/2018					7.62			8.47
		8/13/2018	>2419.6	61.3	<0.2	<0.1	7.66	0.033	4.5	6.2
		9/17/2018	>2419.6	547.5	0.1	0.061	7.83	0.055	8	10.2
		9/24/2018	>2419.6	>2419.6			7.96			38
		10/1/2018	>2419.6	152.9			7.87			7.1
		10/8/2018	>2419.6	40.8			7.74			10.9
		10/15/2018	>2419.6	83.6	<0.2	<0.1	7.8	0.047	<5	3.79

communities listed on the 2020 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biotic communities.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of WQ standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources.

TABLE # 40 SUGAR CREEK (051202081504) CHARACTERISTICS					
TMDL Sample Site	WEL-15-0010, WEL-15-0009, WEL-15-0018, WEL-15-0022				
Listed Segments	INW08F4_01; INW08F4_T1002; INW08F4_T1003; INW08F4_T1004; INW08F4_T1005; INW08F4_T1006				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
NPDES Facilities	Trust Resources – Vigo Captain Daviess Mine (ING040277); Peabody Midwest Mining – Viking Mine Corning Pit (ING040154)				
CFOs	Mehne Farms Inc. (Farm ID: 132), Armes Boys (Farm ID: 4071), For Him Farms (Farm ID: 6832)				
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	5.124E+11	2.199E+11	1.039E+11	3.897E+10	1.390E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	6.028E+10	2.587E+10	1.223E+10	4.585E+09	1.635E+09
Future Growth (5%)	3.014E+10	1.293E+10	6.113E+09	2.292E+09	8.177E+08
Upstream Drainage Input (Slate, Hoffman, Mill)	**1.397E+14**	**5.995E+13**	**2.834E+13**	**1.063E+13**	**3.790E+12**
TMDL = LA+WLA+MOS	**1.403E+14**	**6.021E+13**	**2.846E+13**	**1.067E+13**	**3.807E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	11,219.53	4,814.17	2,276.16	853.56	304.48
WLA	2,352.39	1,009.39	476.28	178.60	63.71
MOS (10%)	1,696.49	727.95	344.05	129.02	46.02
Future Growth (10%)	1,696.49	727.95	344.05	129.02	46.02
Upstream Drainage Input (Slate, Hoffman, Mill)	**3,932,119.47**	**1,687,228.37**	**797,448.53**	**299,043.20**	**106,672.52**
TMDL = LA+WLA+MOS	**3,949,084.38**	**1,694,507.82**	**800,889.08**	**300,333.40**	**107,132.75**
WLA (Individual)					
Trust Resources – Vigo Captain Daviess Mine	1,874.65	804.39	380.19	142.57	50.86
Peabody Midwest Mining – Viking Mine Corning Pit	473.82	203.31	96.09	36.03	12.85
Construction WLA	3.92	1.68	0.00	0.00	0.00

FIGURE 46 –SUGAR CREEK *E. coli* LOAD DURATON CURVE

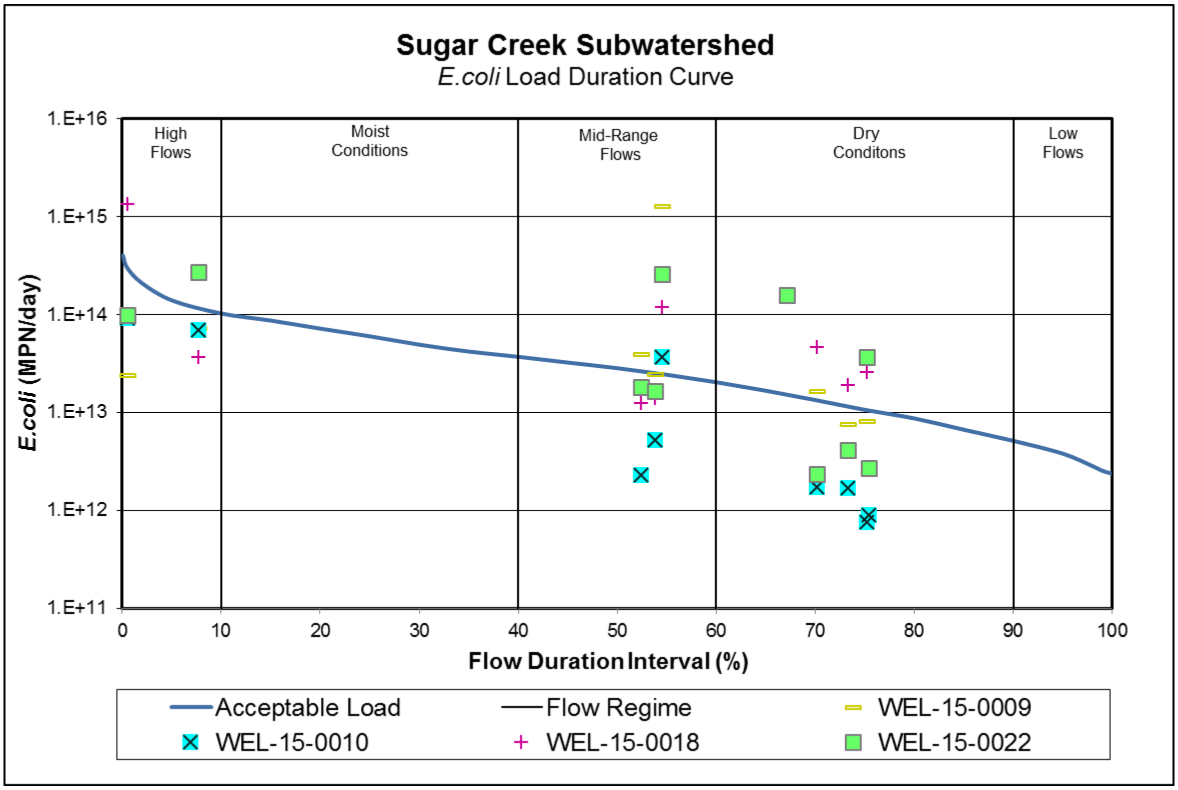


FIGURE 47 –SUGAR CREEK *E. coli* PRECIPITATION GRAPH

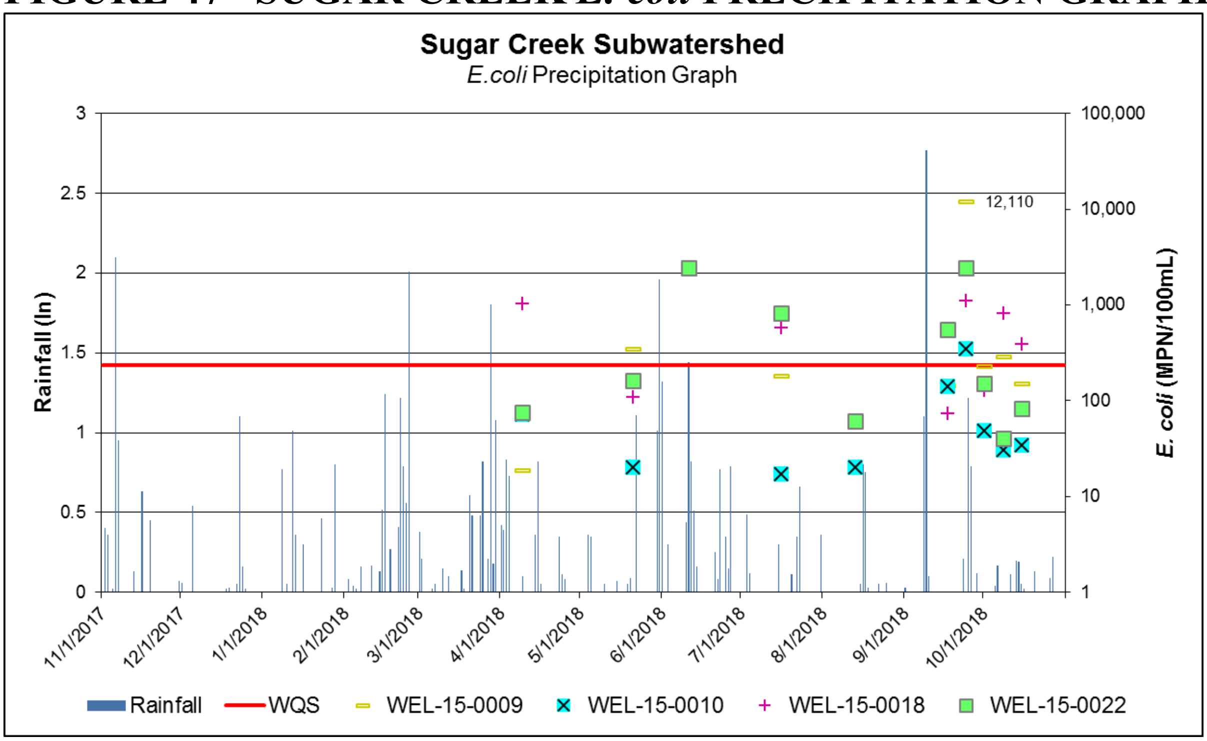


FIGURE 48 –SUGAR CREEK TSS LOAD DURATON CURVE

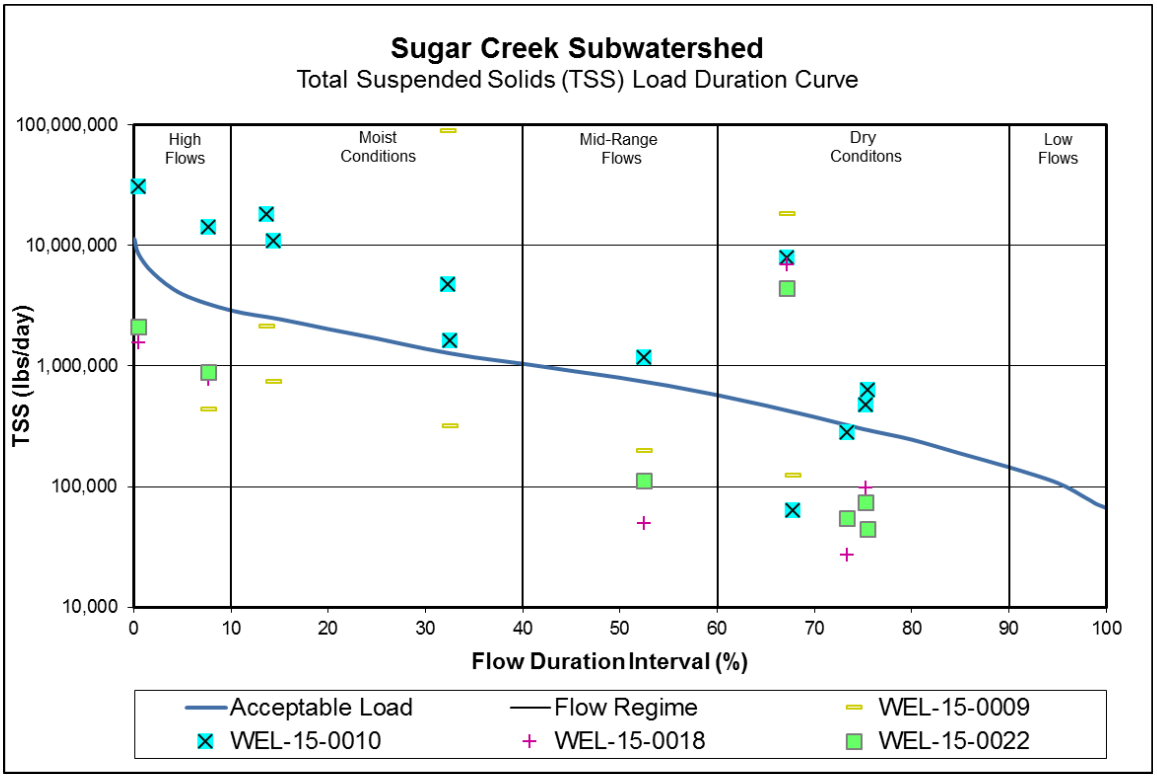
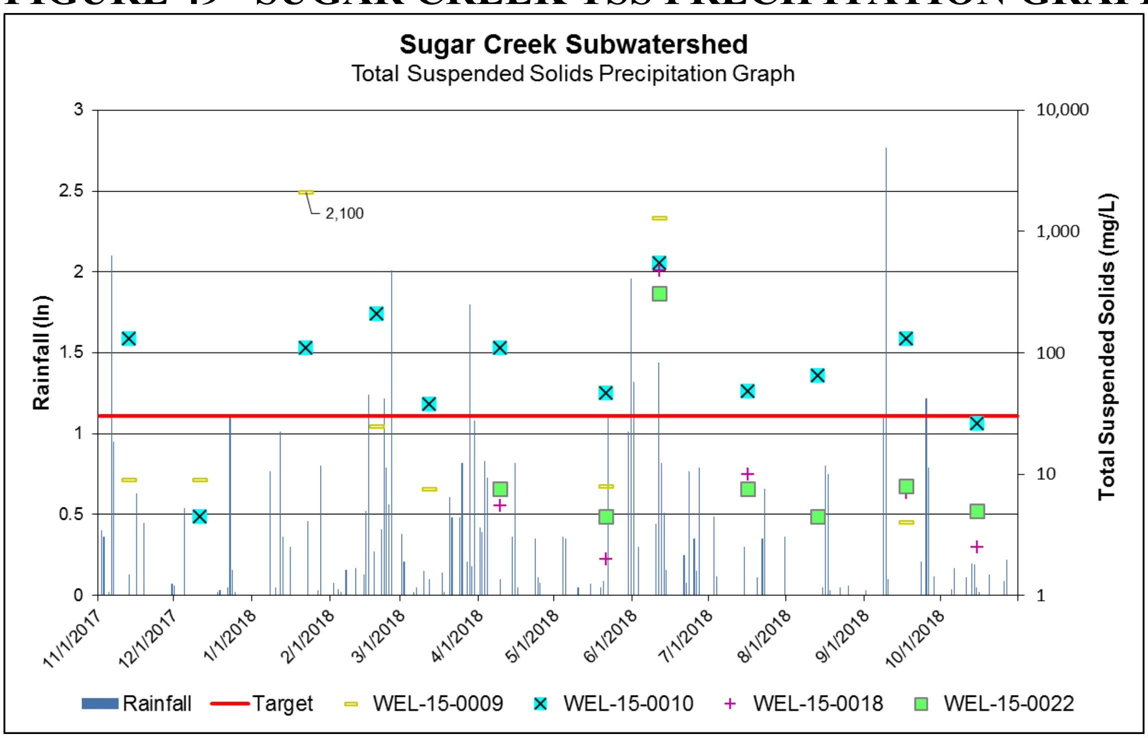


FIGURE 49 –SUGAR CREEK TSS PRECIPITATION GRAPH



DOGWOOD CREEK – 051202081505

Size and Landuse

The Dogwood Lake subwatershed is 16.75 square miles and drains the same area. Dogwood Lake encompasses the majority of the watershed and eventually drains into the East Fork White River in the southern portion of the watershed.

TABLE # 41 - DOGWOOD CREEK - 051202081505		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	2,534	24%
Developed	542	5%
Forest	5,465	51%
Hay / Pasture	885	8%
Open Water	1,258	12%
Shrub / Scrub	<1	0.00%
Wetlands	34	0.00%
Total Acres in Subwatershed	10,719	100%

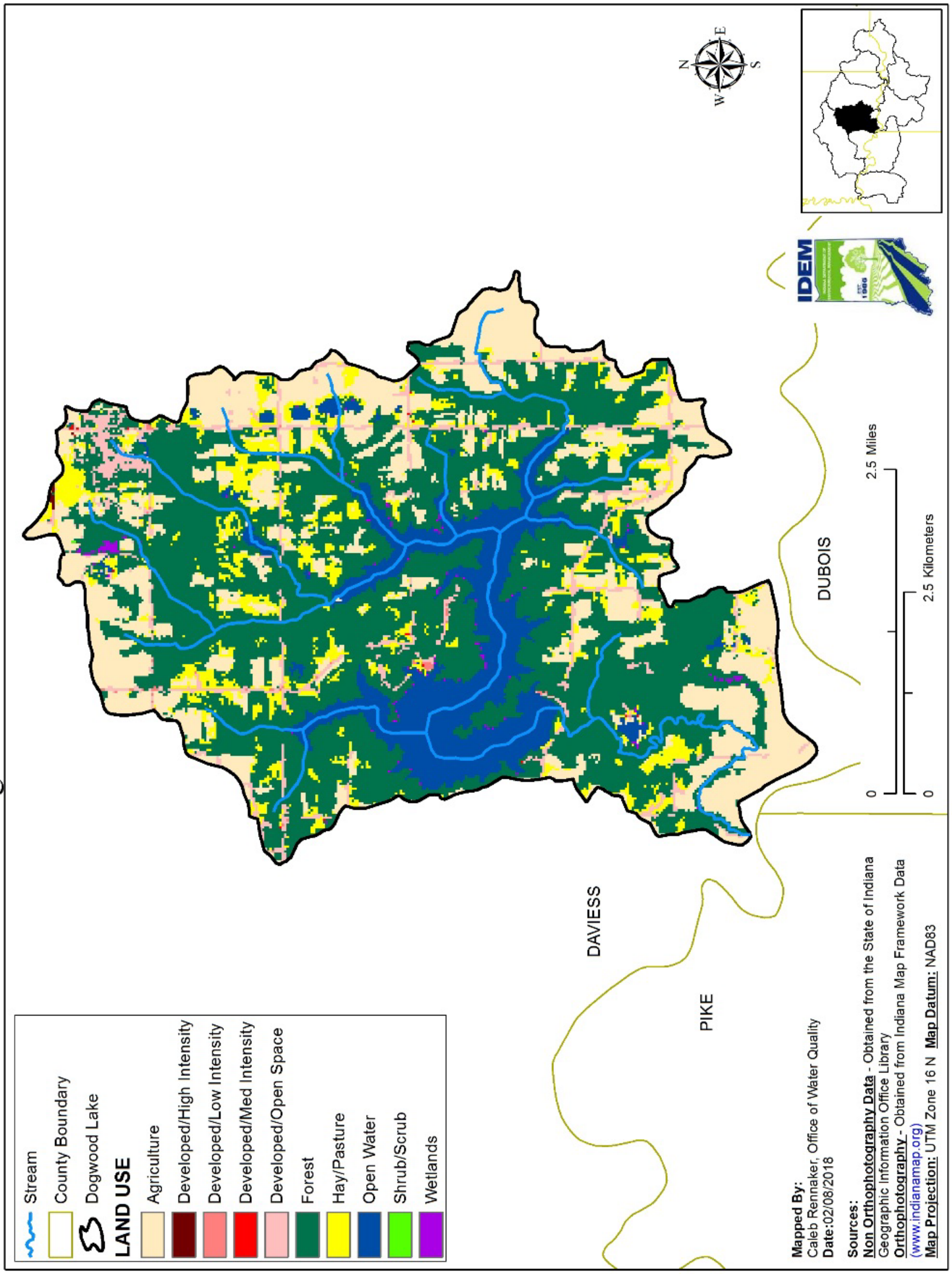
The land use is primarily forest (51%), followed by agriculture (24%) and open water (12%). There are two NPDES permitted facilities in the subwatershed which are both coal surface mining operations. Portions of the Peabody Midwest Mining – Viking Mine Corning Pit mine discharge intermittently through outfalls in the northern portion of the watershed. Trust Resources – Vigo Captain Daviess mine maintains a NPDES permit. However, mining operations have not begun at the time of this document's development, and plans for future mining are still unknown. A list of proposed outfall locations in the current permit indicate discharges to the East Fork White River in portions of this subwatershed.

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There are three small, unincorporated communities in the subwatershed including Corning, Waco and Glendale. Corning is located at a crossroad where the St. Patrick Church and cemetery is located and has less than a dozen homes in the area. Similarly, Waco has the Waco Church of Christ with about ten households in the area. Glendale has slightly more development; however, most of the "homes" are seasonal recreational housing at permanent campgrounds. 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.

FIGURE 50 – UNINCORPORATED TOWN OF GLENDALE

FIGURE 51 –DOGWOOD CREEK SUBWATERSHED 051202081505



Landscape, Soils and Waterways
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.

Livestock and CFOs
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.

Water Quality Monitoring
Due to watershed characteristics and accessibility, there were no sampling sites within this subwatershed. There are currently no known impairments within the subwatershed, therefore no segments are listed on the 303(d) list requiring the development of a TMDL. The majority of the subwatershed is being managed through the Indiana Department of Natural Resources (IDNR) as part of the Glendale Fish and Wildlife Area. As no segments are listed as impaired, no TMDLs were developed for this subwatershed at this time.

TABLE # 42 DOGWOOD LAKE (051202081505)	
TMDL Sample Site	NA
Listed Segments	NA
Listed Impairments [TMDL(s)]	NA
NPDES Facilities	Peabody Midwest Mining – Viking Mine Corning Pit (ING040154); Trust Resources – Vigo Captain Daviess Mine (ING040277)
CAFOs	NA
CFOs	NA

BIRCH CREEK – 051202081506

Size and Landuse

Birch Creek subwatershed drains approximately 5,641 square miles with approximately 22 square miles of land area. The subwatershed drains into the mainstem of the East Fork White just north of Ireland, IN. The land use is primarily agriculture (69%), followed by forested land (17%) and hay/pasture (7%). There are two NPDES facilities located in Birch Creek including Solar Sources Shamrock Mine (ING040210) and Trust Resources–Vigo Captain Daviess Mine (ING040277).

TABLE # 43 – BIRCH CREEK - 051202081506		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	9,632	69%
Developed	752	5%
Forest	2,334	17%
Hay / Pasture	1,039	7%
Open Water	211	2%
Shrub / Scrub	2	0.00%
Wetlands	9	0.00%
Total Acres in Subwatershed	12,523	100%

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. This subwatershed has the unincorporated town of Portersville. Portersville has less than 50 households. 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.

FIGURE 52 – TYPICAL LANDSCAPE IN THE SUBWATERSHED

Landscape, Soils and Waterways

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.

Livestock and CFOs
With a land use of less than 10 percent pastureland a heavy presence of pasture animals is not expected. There are 3 permitted CFOs in the watershed.

Water Quality Monitoring
There are two monitoring sites located in this subwatershed, WEL-15-0013 (T11) and WEL-15-0014 (T12), both established on Birch Creek. In 2017-2018 this watershed was sampled 19 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T11 was 767.69 MPN with 8/9 samples in exceedance of the single sample max; while T12 had a geomean of 279.24 with 3/10 samples in exceedance of the single sample max. The geomeans from sites T11 and T12 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

TABLE # 44 BIRCH CREEK (051202081506) TMDL Collected Data

Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0013	County Road 500 N	4/10/2018	>2419.6	83.3	<0.2	10	7.85	0.11	39	19.1
		5/22/2018	>2419.6	2419.6	0.31	6.9	7.58	0.1	100	46.7
		6/12/2018	>2419.6	>2419.6	0.58	2.5	7.02	0.4	140	151
		7/17/2018			<0.2	7.9	7.64	0.086	24	16.9
		7/18/2018					8.39			11.8
		8/14/2018	>2419.6	980.4	<0.2	2.5	7.65	0.081	27	13.5
		9/18/2018	141360	727	0.13	7.2	7.7	0.23	140	59.5
		9/25/2018	>2419.6	1986.3			7.47			42.7
		10/2/2018	>2419.6	920.8			7.87			32.4
		10/9/2018	>2419.6	410.6			7.88			41.4
		10/16/2018	>2419.6	488.4	0.13	7.3	7.92	0.08	47	25
WEL-15-0014	Porters-ville Road	11/13/2017			<0.2	5.4	7.97	0.13	5.5	13.2
		12/11/2017			<0.2	5	8.57	0.063	5	10.1
		1/22/2018			0.46	2	7.86	1	1300	>1000
		2/19/2018			0.19	7.6	7.68	0.21	24	45.7
		3/12/2018			0.15	6.4	7.79	0.11	11	20
		4/10/2018	2419.6	35	<0.2	4.1	7.88	0.55	20	54.6
		5/22/2018	>2419.6	1553.1	0.27	5.4	7.59	0.17	26	23.8
		6/12/2018	>2419.6	>2419.6	0.7	1.9	7.27	0.26	360	416
		7/17/2018	>2419.6	179.3	0.13	6.8	7.73	0.064	6.5	6.98
		7/18/2018					7.66			7.68
		8/14/2018	>2419.6	129.6	<0.2	4.9	7.62	0.051	7.5	6.33
		9/18/2018	>2419.6	151.5	0.12	3.2	7.73	0.12	17	35.6
		9/25/2018	>2419.6	>2419.6			7.68			30.2
		10/2/2018	>2419.6	172.3			7.76			13.1
		10/9/2018	>2419.6	117.8			7.77			5.37
		10/16/2018	>2419.6	228.2	0.12	6.3	8.1	0.067	<5	6.55

FIGURE 53 –BIRCH CREEK SUBWATERSHED 051202081506

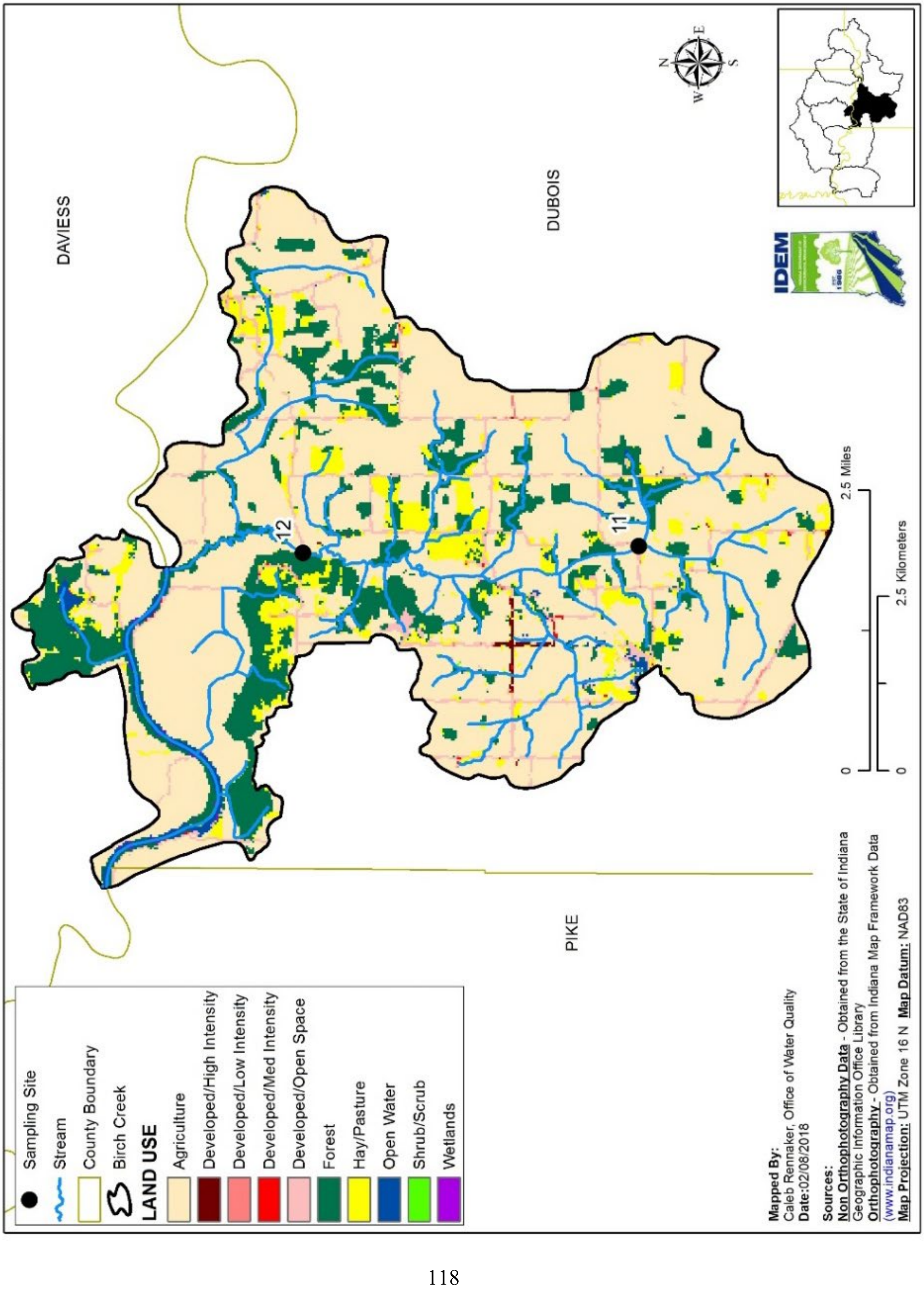


TABLE # 45 BIRCH CREEK (051202081506) CHARACTERISTICS					
Drainage Area	5,641.14 square miles				
Surface Area	21.84 square miles				
TMDL Sample Site	WEL-15-0014, WEL-15-0013				
Listed Segments	INW08F6_T1003, INW08F6_T1006				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
NPDES Facilities	Solar Sources Shamrock Mine (ING040210); Trust Resources – Vigo Captain Daviess Mine (ING040277)				
CFOs	Schnarr Farms (Farm ID: 2723), Edward G Barley (Farm ID: 3025), Luther R Mann (Farm ID: 6221)				
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	4.636E+11	1.989E+11	9.402E+10	3.526E+10	1.258E+10
WLA	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	5.454E+10	2.340E+10	1.106E+10	4.148E+09	1.480E+09
Future Growth (5%)	2.727E+10	1.170E+10	5.530E+09	2.074E+09	7.398E+08
Upstream Drainage Input (Sugar)	**1.403E+14**	**6.021E+13**	**2.846E+13**	**1.067E+13**	**3.807E+12**
TMDL = LA+WLA+MOS	**1.409E+14**	**6.045E+13**	**2.857E+13**	**1.071E+13**	**3.822E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	7,534.00	3,232.75	1,527.92	572.97	204.39
WLA	4,744.83	2,035.95	962.27	360.85	128.72
MOS (10%)	1,534.85	658.59	311.27	116.73	41.64
Future Growth (10%)	1,534.85	658.59	311.27	116.73	41.64
Upstream Drainage Input (Sugar)	**3,949,084.38**	**1,694,507.82**	**800,889.08**	**300,333.40**	**107,132.75**
TMDL = LA+WLA+MOS	**3,964,432.91**	**1,701,093.70**	**804,001.81**	**301,500.68**	**107,549.14**
WLA (Individual)					
Solar Sources Shamrock Mine	4,124.94	1,769.96	836.55	313.71	111.90
Trust Resources – Vigo Captain Daviess Mine	619.89	265.99	125.72	47.14	16.82

The fish community IBI score for site T11 was 40 (fair) and the QHEI was 32 (poor). The macro community mIBI score was 32 (poor) and the QHEI was 41 (poor). The fish community IBI score for site T12 was 44 (fair) and the QHEI was 54 (good). The macro community mIBI score was 38 (fair) and the QHEI was 62 (good). Load Duration curves for the subwatershed were developed and are shown on pages 121-122.

TSS concentrations ranged from less than 5 mg/L to 1,300 mg/L across 19 sampling events within the watershed, and exceeded the target value seven times. Given that targets for TSS were sporadically violated throughout the subwatershed a TSS TMDL was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 54 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 29 stream miles impaired for *E. coli* and 13 miles impaired for biotic communities listed on the 2020 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biological communities in the subwatershed.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources.

FIGURE 54 – EXAMPLE OF AGRICULTURAL FIELD IN BIRCH CREEK SUBWATERSHED

FIGURE 55 –BIRCH CREEK *E. coli* LOAD DURATION CURVE

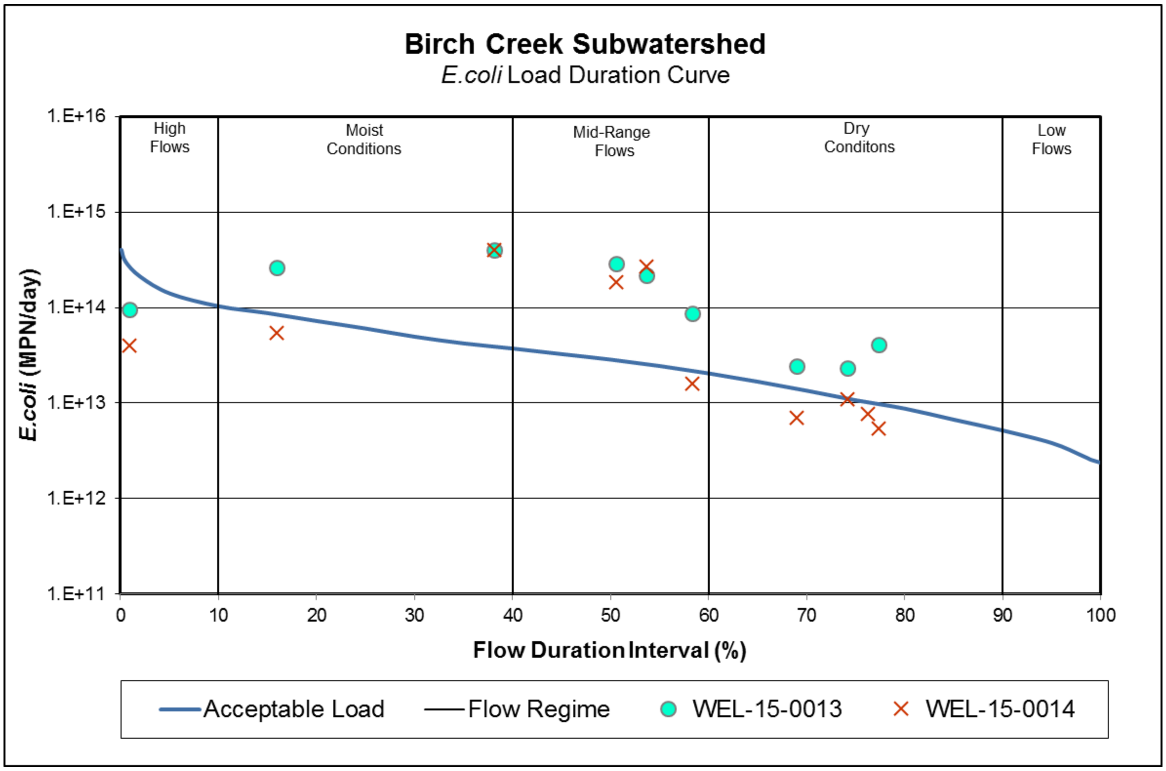


FIGURE 56 –BIRCH CREEK *E. coli* PRECIPITATION GRAPH

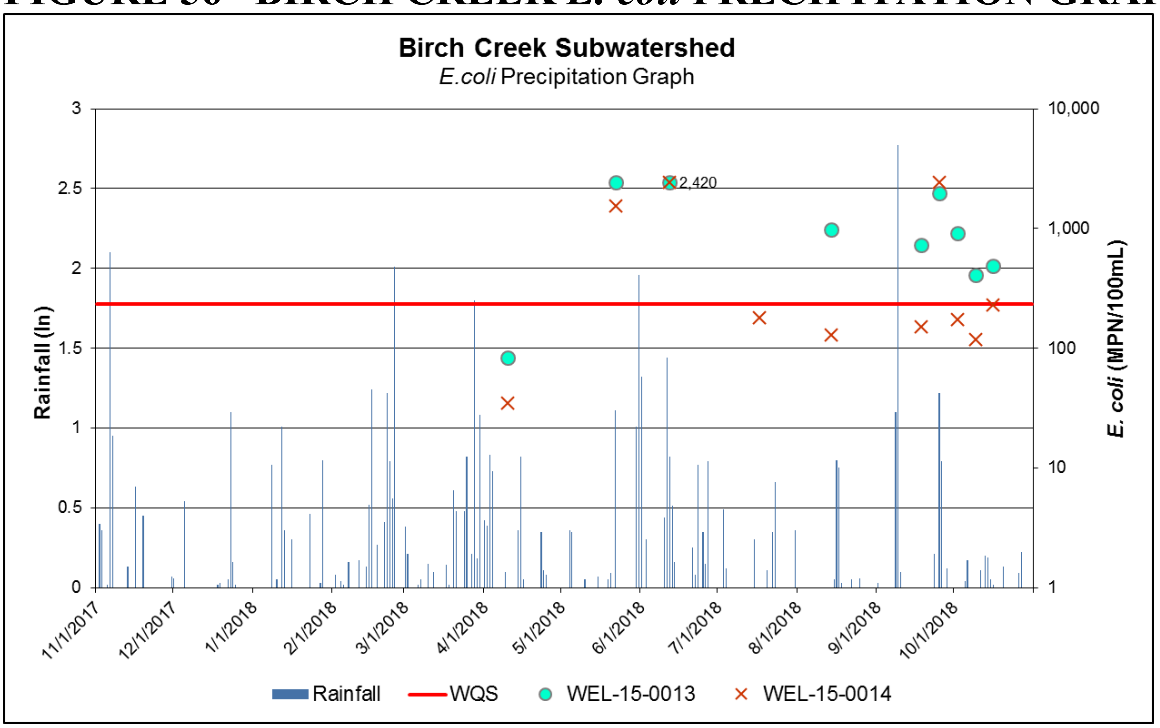


FIGURE 57 –BIRCH CREEK TSS LOAD DURATION CURVE

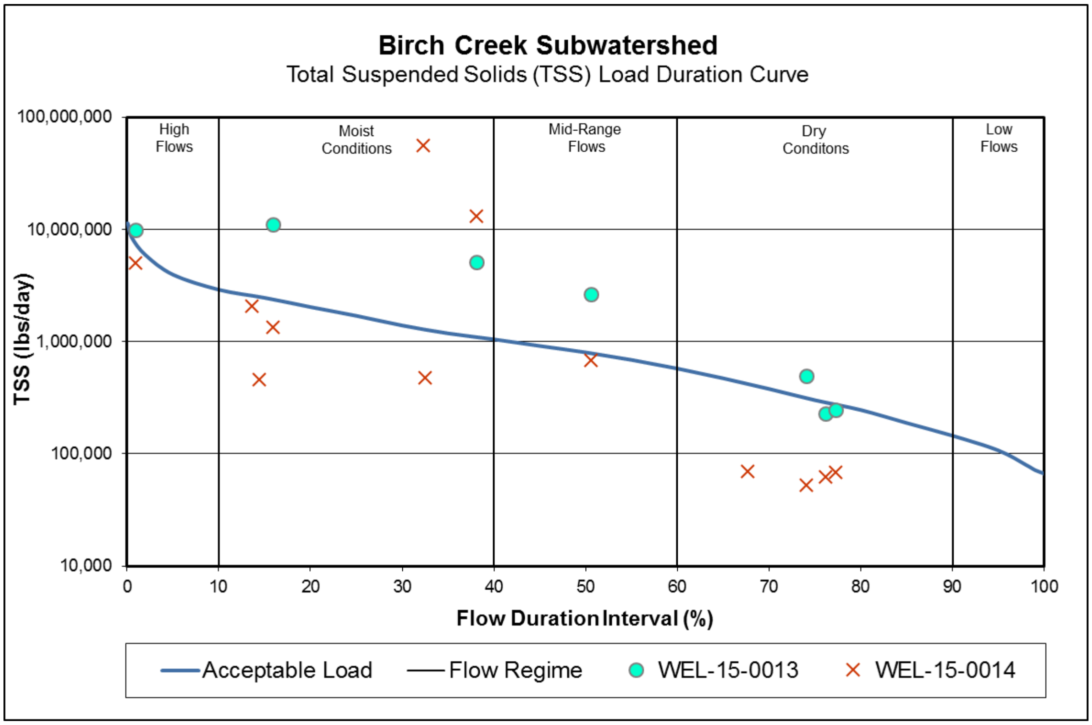
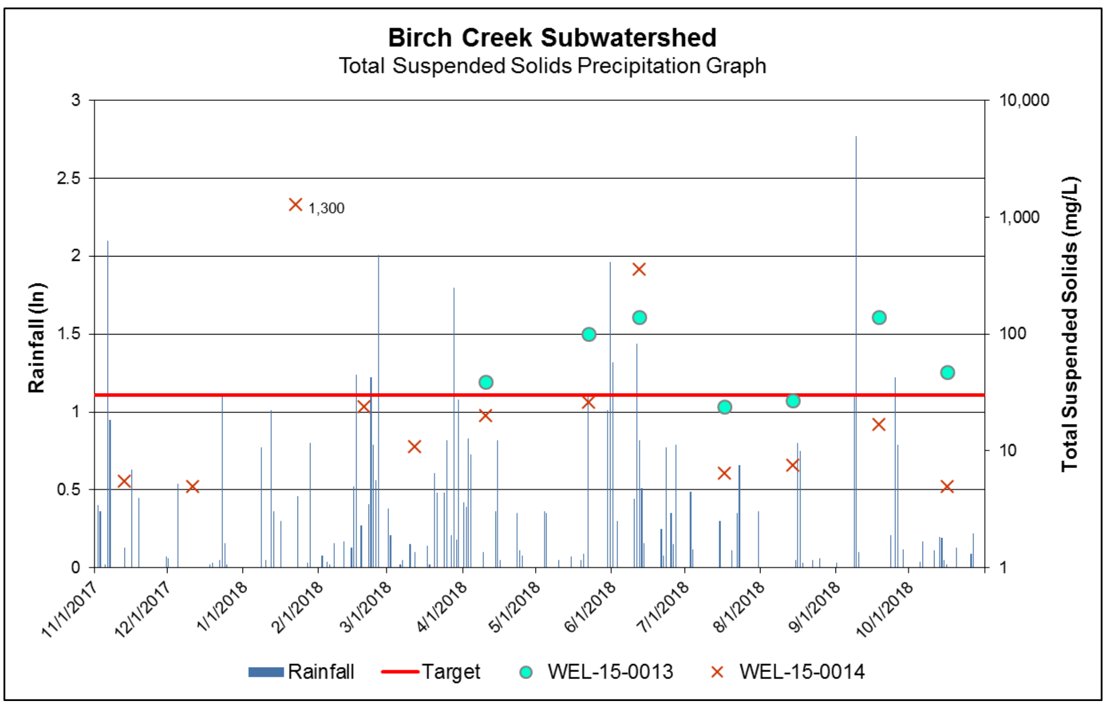


FIGURE 58 –BIRCH CREEK TSS PRECIPITATION GRAPH



AIKMAN CREEK – 051202081507

Size and Landuse

The Aikman Creek subwatershed is 30.41 square miles and drains the same area. The subwatershed drains into the mainstem of the East Fork White River southeast of Washington, IN. The land use is primarily agriculture (54%), followed by forested land (28%) and hay and pasture (11%). There are two NPDES facilities located within the subwatershed including Peabody Midwest Mining – Viking Mine Corning Pit (ING040154) and Solar Sources Cannelburg Mine (ING040026).

TABLE # 46 - AIKMAN CREEK - 051202081507		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	10,598	54%
Developed	1,175	6%
Forest	5,393	28%
Hay / Pasture	2,122	11%
Open Water	159	1%
Shrub / Scrub	1	0.00%
Wetlands	16	0.00%
Total Acres in Subwatershed	12,523	100%

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Aikman Creek subwatershed has the unincorporated town of Cumback. There are approximately 60 households located in that area. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the subwatershed are important to ensure proper function and capacity.

FIGURE 59 – TYPICAL LANDCAPE IN SUBWATERSHED

Landscape, Soils and Waterways

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.

Livestock and CFOs
With a land use of 11% pasture land, there is a potential for small-scale livestock operations (see page 82). In addition, three of the 33 permitted CFOs are located in this subwatershed.

TABLE # 47 AIKMAN CREEK (051202081507) TMDL Collected Data

Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-170-0008	County Road 600 S	11/13/2017			<0.2	1.4	7.81	0.2	9.5	19.2
		12/11/2017			<0.2	0.16	8.53	0.11	2	7.46
		1/22/2018			0.36	3.1	7.77	0.97	2200	>1000
		2/19/2018			0.12	4	7.75	0.2	32	54.6
		3/12/2018			0.1	2.9	7.95	0.086	8	12.6
		4/10/2018	1732.9	43.2	<0.2	1.3	8.07	0.18	20	61.2
		5/22/2018	>2419.6	579.4	0.44	0.3	7.45	0.15	19	35.3
		6/12/2018	>2419.6	>2419.6	0.67	4.5	7.23	0.092	870	677
		7/17/2018	>2419.6	547.5	0.34	1	7.3	0.32	16	49.5
		7/23/2018					7.18			16.1
		7/25/2018					7.45			57.2
		8/14/2018	>2419.6	111.2	<0.2	<0.1	7.75	0.13	12	12.1
		9/18/2018	>2419.6	85.7	0.18	0.35	7.43	0.19	20	11.3
		9/25/2018	>241960	5910			7.56			68.8
		10/2/2018	>2419.6	235.9			7.44			13.9
		10/9/2018	>2419.6	488.4			7.37			6.63
		10/16/2018	>2419.6	105	0.16	0.18	7.96	0.14	6	13.6

Water Quality Monitoring

There is one monitoring site located in this subwatershed which is situated on Aikman Creek, WEL-170-0008 (T16). In 2017-2018 this watershed was sampled at this site 12 times resulting in WQS failures for *E.coli*. The *E. coli* geomean for T16 was 360.95 MPN with 6/10 samples in exceedance of the SSM. The geomean from site T16 was taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. The fish community IBI score for site T16 was 28 (poor) and the QHEI was 41 (poor). The macro community mIBI score was 40 (fair) and the QHEI was 44 (poor). Load Duration curves for the subwatershed were developed and are shown on pages 129-131.

FIGURE 60 –AIKMAN CREEK SUBWATERSHED 051202081507

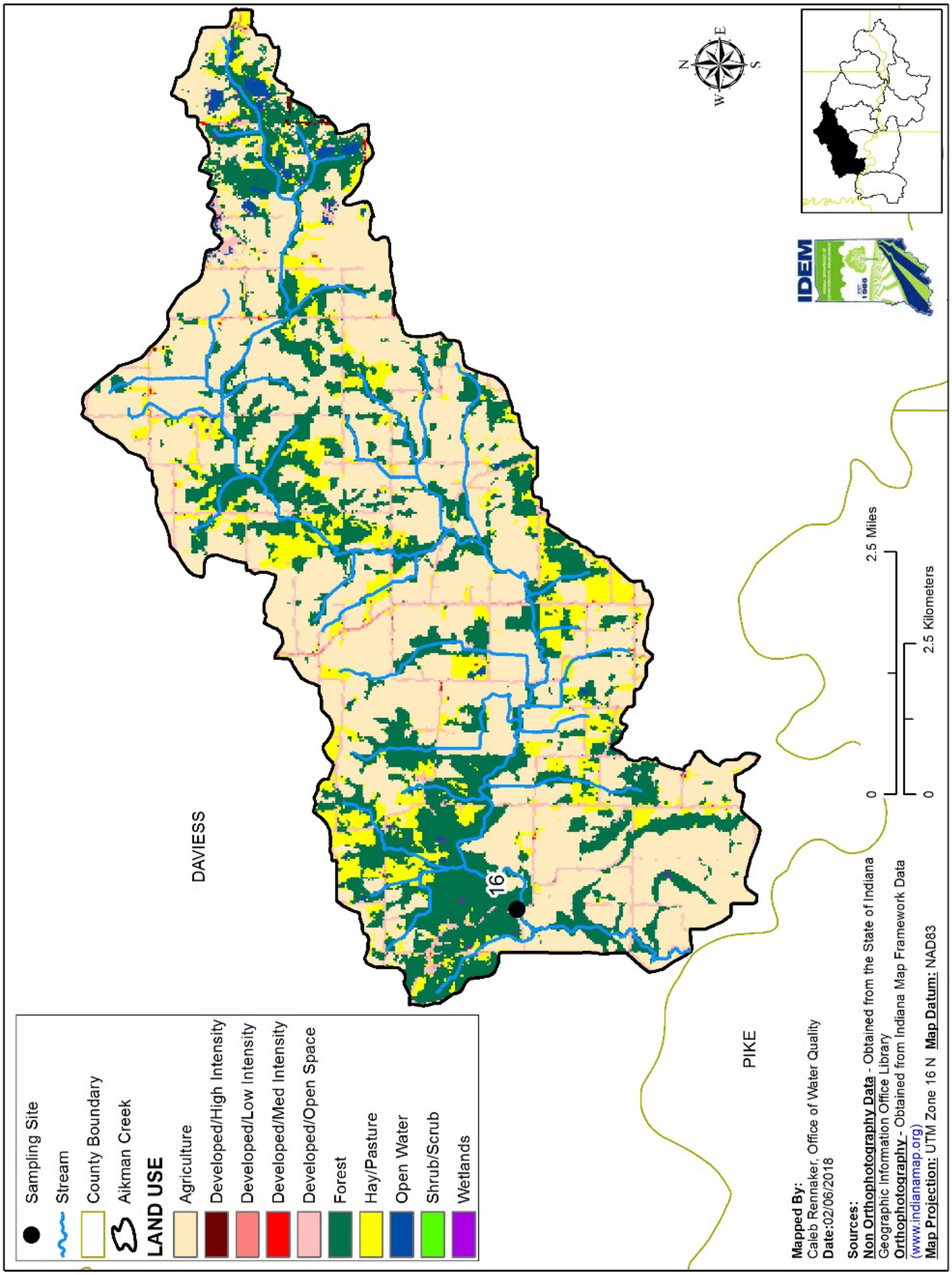


TABLE # 48 AIKMAN CREEK (051202081507) CHARACTERISTICS					
TMDL Sample Site	WEL170-0008				
Listed Segments	INW08F7_02, INW08F7_03, INW08F7_04, INW08F7_05, INW08F7_T1001, INW08F7_T1002, INW08F7_T1003, INW08F7_T1004, INW08F7_T1005, INW08F7_T1006, INW08F7_T1007, INW08F7_T1008, INW08F7_T1009				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Nutrients [TP], DO [TP & TSS]				
NPDES Facilities	Peabody Midwest Mining – Viking Mine Corning Pit (ING040154); Solar Sources Cannelburg Mine (ING040026)				
CFOs	Don Kendall 4 K Swine Inc. Jones Farm (Farm ID: 3961), Mitchell Barber (Farm ID: 6534), Heartland Turkey Farms, LLC (Farm ID: 6965)				
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	6.455E+11	2.770E+11	1.309E+11	4.909E+10	1.751E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	7.594E+10	3.259E+10	1.540E+10	5.775E+09	2.060E+09
Future Growth (5%)	3.797E+10	1.629E+10	7.701E+09	2.888E+09	1.030E+09
TMDL = LA+WLA+MOS	**7.594E+11**	**3.259E+11**	**1.540E+11**	**5.775E+10**	**2.060E+10**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	14,218.01	6,100.79	2,883.87	1,081.45	385.77
WLA	2,879.02	1,235.35	583.47	218.80	78.05
MOS (10%)	2,137.13	917.02	433.42	162.53	57.98
Future Growth (10%)	2,137.13	917.02	433.42	162.53	57.98
TMDL = LA+WLA+MOS	**21,371.28**	**9,170.18**	**4,334.18**	**1,625.32**	**579.77**
WLA (Individual)					
Peabody MW Mining – Viking Mine Corning Pit	1,119.48	480.36	227.03	85.14	30.37
Solar Sources Cannelburg Mine	1,757.52	754.13	356.43	133.66	47.68
Construction WLA	2.02	0.86	0.00	0.00	0.00
TMDL Total Phosphorus Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	181.66	77.95	36.84	13.82	4.93
WLA (Total)	0.00	0.00	0.00	0.00	0.00
MOS (10%)	21.37	9.17	4.33	1.63	0.58
Future Growth (5%)	10.69	4.59	2.17	0.81	0.29
TMDL = LA+WLA+MOS	**213.71**	**91.70**	**43.34**	**16.25**	**5.80**

TSS concentrations ranged from 2 mg/L to 2,200 mg/L across 12 sampling events within the watershed, and exceeded the target value three times. Total phosphorus concentrations ranged from 0.086 mg/L to 0.97 mg/L across 12 sampling events within the watershed and exceeded the target value two times. A stream segment on Aikman Creek (INW08F7_04) within the watershed was in excess of nutrients with total phosphorus being consistently over the target value. Additionally, dissolved oxygen was found below water quality standards on multiple occasions on the same segment. Given that targets for total phosphorus and TSS were sporadically violated throughout the subwatershed TMDLs were developed to address impaired biological communities and dissolved oxygen impairments within the watershed. Additionally, excessive total phosphorus values are also believed to be a primary linkage to the nutrients impairment within the watershed. Therefore, a TMDL for total phosphorus will also serve to address nutrients impairments in this subwatershed.

Based on the water quality duration graphs and limited, it can be concluded that the majority of sources of *E. coli*, TSS, and total phosphorus in this watershed are nonpoint sources that include small animal operations, wildlife, animals with direct access to streams, straight piped, leaking and failing septic systems, streambank erosion, and agricultural practices.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources with some potential inputs from point sources. There are approximately 51 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 51 stream miles impaired for *E. coli,* and 11 miles impaired for biological communities, dissolved oxygen, and nutrients listed on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, TSS TMDLs were developed to address all impaired biotic communities, and TP TMDLs were developed to address all nutrients impairments. Additionally, both TP and TSS TMDLs will be used to address all DO impairments in the subwatershed.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli*, TSS, and total phosphorus from run-off. The stream is consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for *E. coli* or total phosphorus within the watershed.
Along with water quality data collected in Aikman Creek, monitoring staff noted a historic structure located at site WEL170-0008 (T16) which may be impacting stream movement in the subwatershed. Although historical information or ownership of the structure is unknown, it appeared to have a significant impact on flow based on visual observations.

During periods of higher flows, the stream was allowed to move over the structure relatively unimpeded. However, periods of lower flow prevented normal flow of the stream as water was forced under the structure. Although the structure contained drainage pipes underneath, they appeared to become blocked easily by debris (i.e., leaves, sticks, etc.) which further impeded water movement (Figure 52 & 53). Potential impacts of this structure on stream flow, along with meeting the TMDL targets for *E. coli*, total phosphorus and TSS, should be considered in future watershed planning efforts.

FIGURE 61 –AIKMAN CREEK - STRUCTURE AT SITE WEL 170-0008 SHOWING STREAM MOVEMENT AT DOWNSTREAM PORTION

FIGURE 62 –AIKMAN CREEK STRUCTURE AT SITE WEL 170-0008 SHOWING STREAM MOVEMENT UPSTREAM PORTION.

FIGURE 63 –AIKMAN CREEK *E. coli* LOAD DURATION CURVE

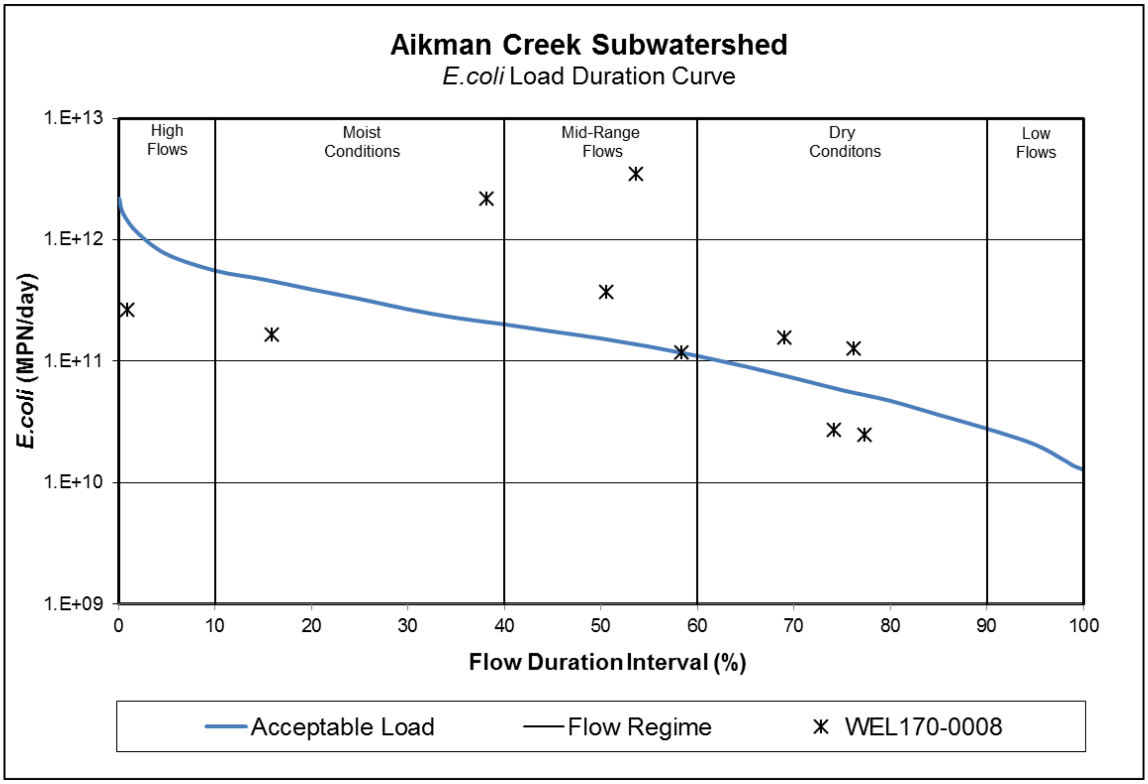


FIGURE 64 –AIKMAN CREEK *E. coli* PRECIPITATION GRAPH

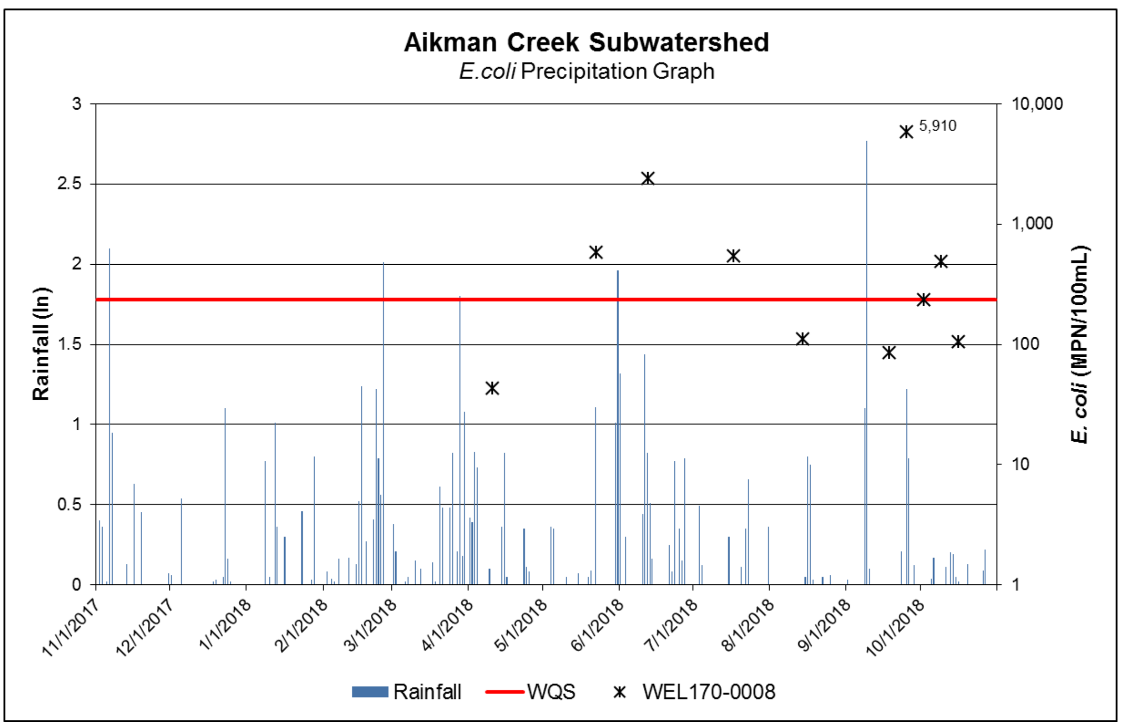


FIGURE 65 –AIKMAN CREEK TSS LOAD DURATION CURVE

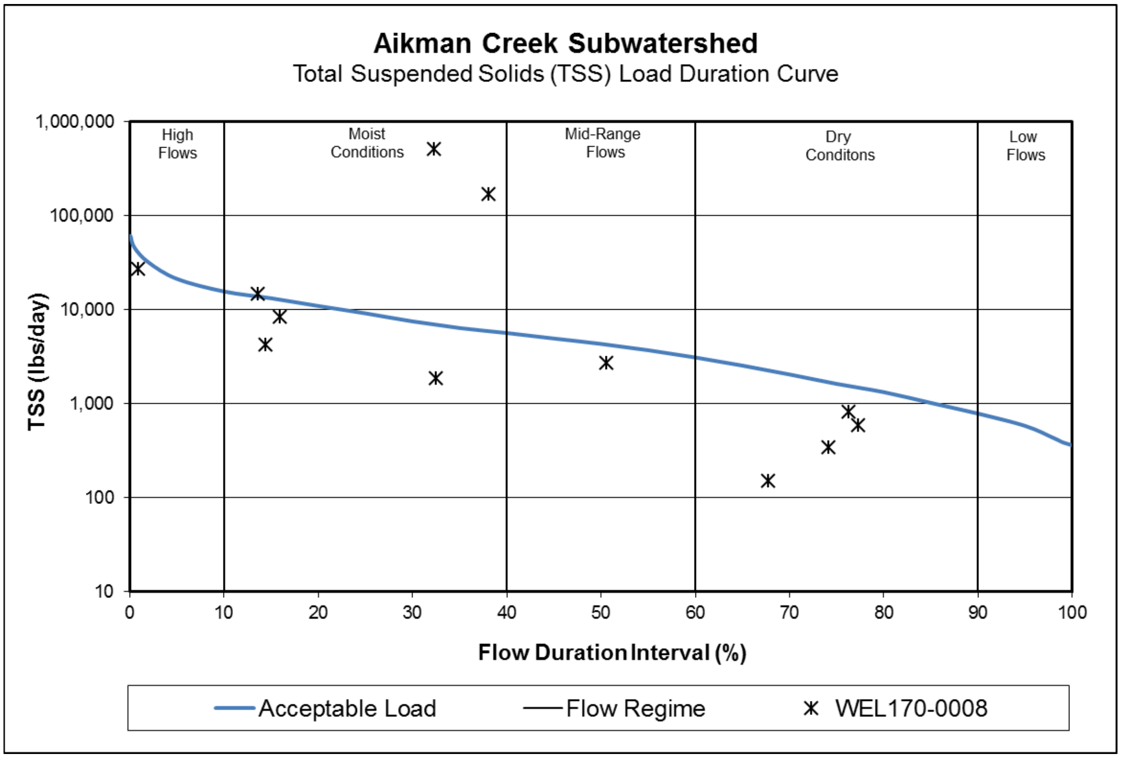


FIGURE 66 –AIKMAN CREEK TSS PRECIPITATION GRAPH

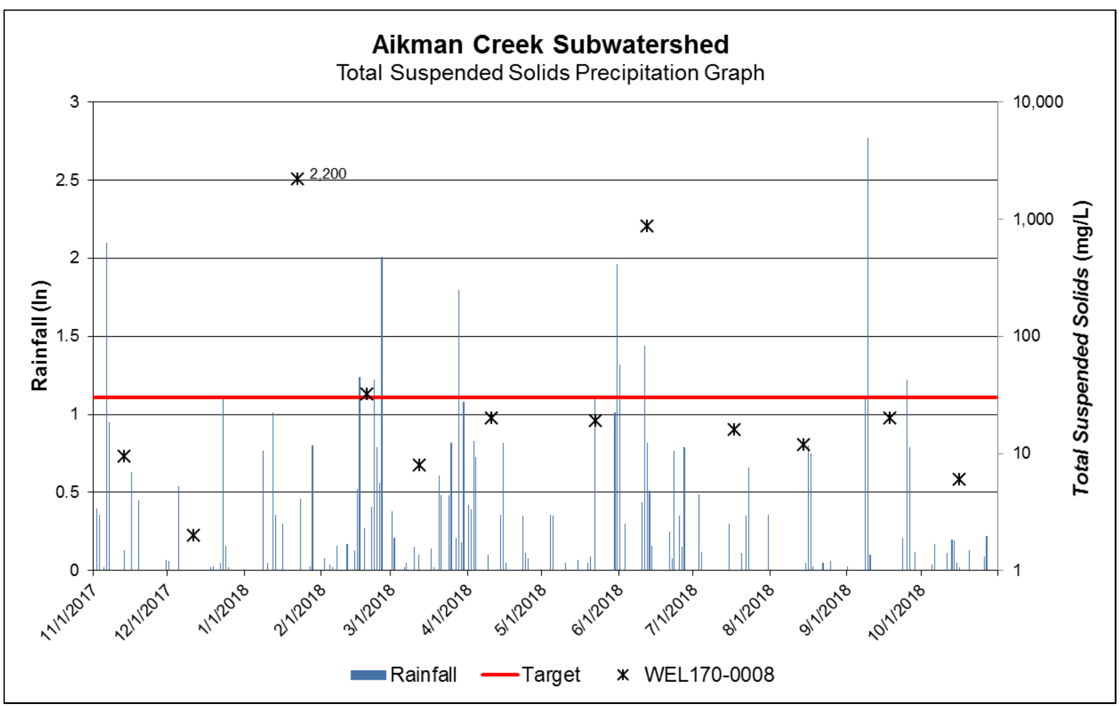


FIGURE 67 –AIKMAN TOTAL P LOAD DURATION CURVE

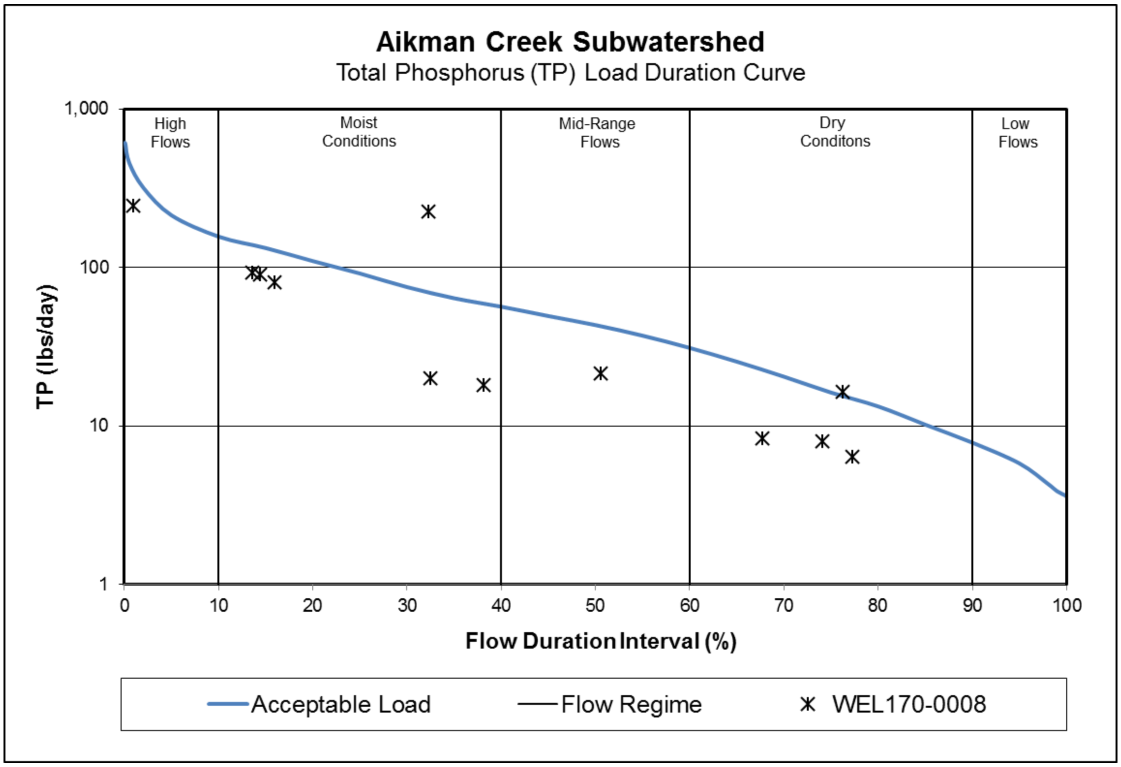
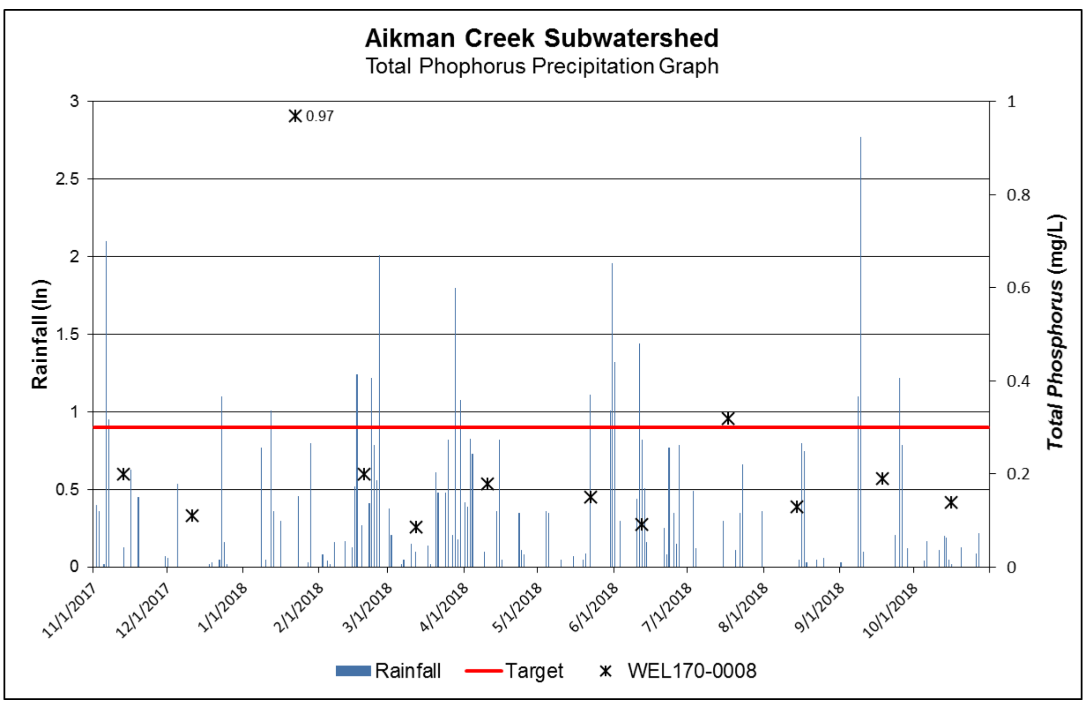


FIGURE 68 –AIKMAN CREEK TOTAL P PRECIPITATION GRAPH



BEAR CREEK – 051202081508

Size and Landuse

The Bear Creek subwatershed drains approximately 5,690 square miles and covers a land area of approximately 33 square miles. The subwatershed drains into the mainstem of the East Fork White River just north of Otwell, IN. The land use is primarily agriculture (59%), followed by forested land (23%) and hay and pastureland (10%). There are two NPDES facilities located within the subwatershed including Otwell Water Corporation Treatment Plant (IN0052086) and Solar Sources Shamrock Mine (ING040210).

TABLE # 49 - BEAR CREEK - 051202081508		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	12,390	59%
Developed	1,179	6%
Forest	4,829	23%
Hay / Pasture	1,983	10%
Open Water	393	2%
Shrub / Scrub	4	0.00%
Wetlands	62	0.00%
Total Acres in Subwatershed	20,840	100%

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There are three unincorporated communities within Bear Creek subwatershed. They include Iva, Hudsonville, and Highbank. Iva has approximately 20 households; Hudsonville approximately 15 and Highbank has only 5 households. 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.

FIGURE 69 – TYPICAL LANDCAPE IN SUBWATERSHED

Landscape, Soils and Waterways

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.

Livestock and CFOs
With a land use of 10% pastureland, there is a potential for small-scale livestock operations (see page 82). In addition, three of the 33 permitted CFOs are located in this subwatershed.

Water Quality Monitoring
There are two monitoring sites located in this subwatershed situated on Bear Creek, WEL-15-0015 (T14), and Beech Creek, WEL-15-0016 (T15). In 2017-2018 this watershed was sampled 22 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T14 was 461.91 MPN with 8/10 samples in exceedance of the SSM; while T15 had a geomean of 698.56 with 8/10 samples in exceedance of the SSM. The geomeans from site T14 and T15 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T14 was 36 (fair) and the QHEI was 55 (good). The macro community mIBI score was 32 (poor) and the QHEI was 50 (poor). The fish community IBI score for site T15 was 44 (fair) and the QHEI was 52 (good). The macro community mIBI score was 34 (poor) and the QHEI was 41 (poor). Load Duration curves for the subwatershed were developed and are shown on pages 137-138.

TSS concentrations ranged from less than 2.5 mg/L to 280 mg/L across 14 sampling events and exceeded the target value four times. Given that targets for TSS were sporadically violated throughout the subwatershed a TMDL for TSS was developed to address the impaired biological communities within the subwatershed.

FIGURE 70 – FLOOD PLAIN AG FIELDS IN SUBWATERSHED

Based on the WQ duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 80 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 30 stream miles impaired for *E. coli* and 25 miles impaired for biological communities listed on the

FIGURE 71 –BEAR CREEK SUBWATERSHED 051202081508

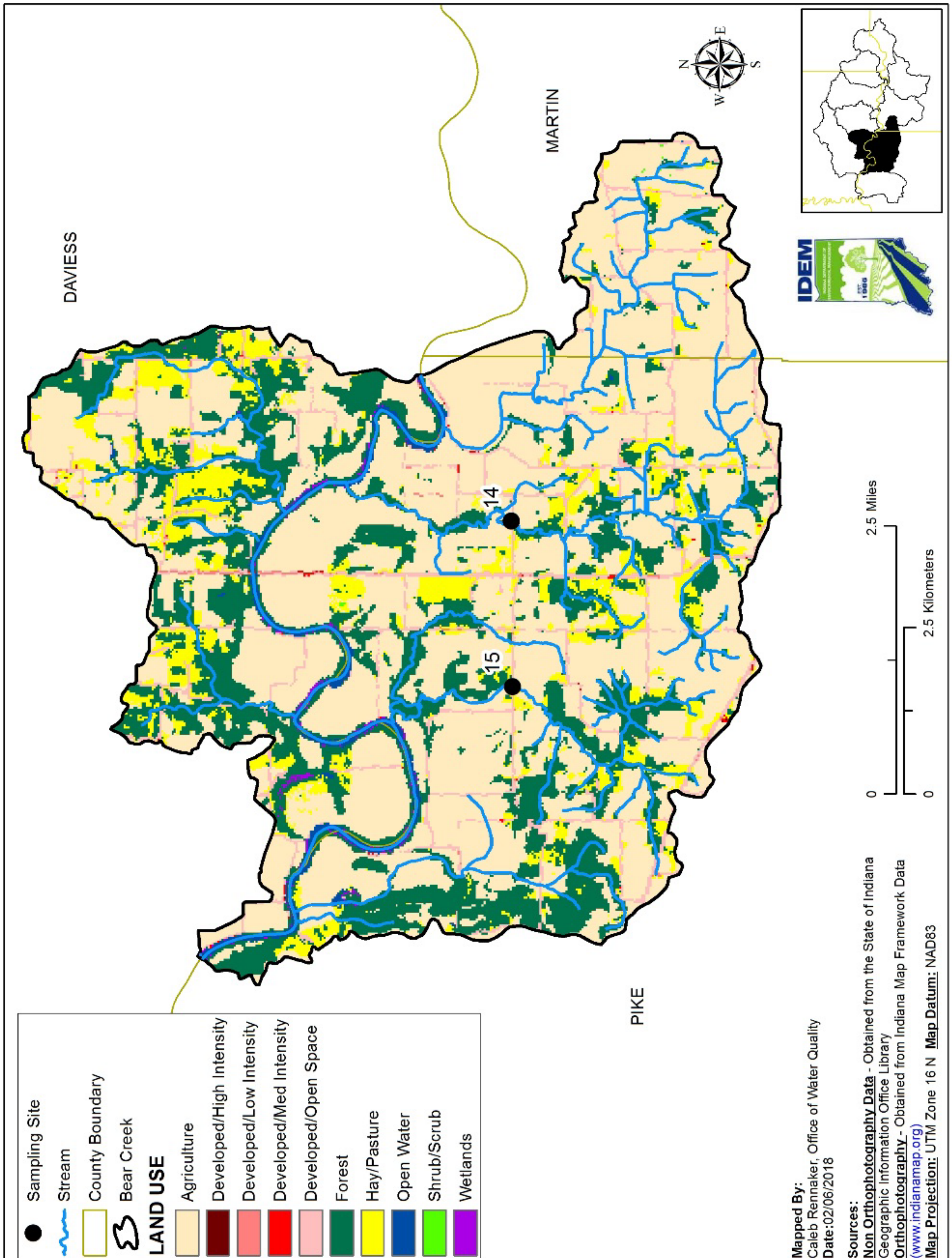


TABLE # 50 BEAR CREEK (051202081508) TMDL Collected Data										
Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0015	County Road 550 N	4/10/2018	>2419.6	410.6	<0.2	4	8.21	0.059	5	7.58
		5/22/2018	>2419.6	>2419.6	2.8	7.6	7.52	0.35	110	179
		6/12/2018	>2419.6	>2419.6	1	3.1	7.15	0.22	280	246
		7/17/2018	>2419.6	387.3	0.12	2.7	7.88	0.071	10	6.74
		7/18/2018					7.78			6.48
		8/14/2018	>2419.6	185	<0.2	2.1	7.99	0.06	6.5	7.53
		9/18/2018	>2419.6	290.9	0.12	2.7	7.86	0.11	7.5	4.47
		9/25/2018	>2419.6	>2419.6			7.53			37.5
		10/2/2018	>2419.6	249.5			7.89			7.22
		10/9/2018	>2419.6	218.7			7.83			4.57
		10/16/2018	>2419.6	547.5	0.11	3.8	8.01	0.062	2.5	3.16
WEL-15-0016	County Road 550 N	4/10/2018	1553.1	86	<0.2	3.1	8.29	0.055	11	8.78
		5/22/2018	>2419.6	>2419.6	0.41	1.4	7.54	0.22	48	71.2
		6/12/2018	>2419.6	>2419.6	1.7	2.3	7.34	0.16	280	245
		7/17/2018	>2419.6	816.4	0.14	2.8	7.8	0.067	29	40.6
		7/18/2018					7.71			28.5
		8/14/2018	>2419.6	198.9	<0.2	2.4	7.95	0.074	15	16.4
		9/18/2018	>2419.6	261.3	0.11	2.5	7.87	0.094	22	24.9
		9/25/2018	>241960	5200			7.64			83.6
		10/2/2018	46110	727			7.85			40.4
		10/9/2018	>2419.6	344.8			7.74			24
		10/16/2018	>2419.6	488.4	0.1	2.6	8.04	0.071	17	22.6

2020 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all IBCs in the subwatershed.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however point sources are not believed to be significant contributors. Livestock with direct access to streams may also resemble point source pollution for *E. coli*.

FIGURE 72 – TYPICAL LANDSCAPE IN SUBWATERSHED

TABLE # 51 BEAR CREEK (051202081508) CHARACTERISTICS					
TMDL Sample Site	WEL-15-0015, WEL-15-0016				
Listed Segments	INW08F8_T1008, INW08F8_T1009, INW08F8_T1010				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
NPDES Facilities	Otwell Water Corporation Treatment Plant (IN0052086); Solar Sources Shamrock Mine (ING040210)				
CFOs	Jay Armes Grain & Livestock (Farm ID: 608), Jackle Farms Inc. (Farm ID: 3033), Aikman Creek, LLC (Farm ID: 4582)				
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	6.916E+11	2.968E+11	1.403E+11	5.261E+10	1.878E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	8.136E+10	3.491E+10	1.650E+10	6.189E+09	2.209E+09
Future Growth (5%)	4.068E+10	1.746E+10	8.251E+09	3.095E+09	1.104E+09
Upstream Drainage Input (Birch, Dogwood)	**1.413E+14**	**6.063E+13**	**2.865E+13**	**1.075E+13**	**3.833E+12**
TMDL = LA+WLA+MOS	**1.421E+14**	**6.098E+13**	**2.882E+13**	**1.081E+13**	**3.855E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	17,561.30	7,535.19	3,561.27	1,335.30	476.14
WLA	756.14	324.84	153.89	58.14	21.18
MOS (10%)	2,289.68	982.50	464.40	174.18	62.16
Future Growth (10%)	2,289.68	982.50	464.40	174.18	62.16
Upstream Drainage Input (Birch, Dogwood)	**3,976,204.33**	**1,706,144.69**	**806,389.10**	**302,395.91**	**107,868.48**
TMDL = LA+WLA+MOS	**3,999,101.13**	**1,715,969.73**	**811,033.06**	**304,137.71**	**108,490.12**
WLA (Individual)					
Otwell Water Corporation	0.67	0.67	0.67	0.67	0.67
Solar Sources Shamrock Mine	755.47	324.17	153.23	57.47	20.51

FIGURE 73 –BEAR CREEK *E. coli* LOAD DURATION CURVE

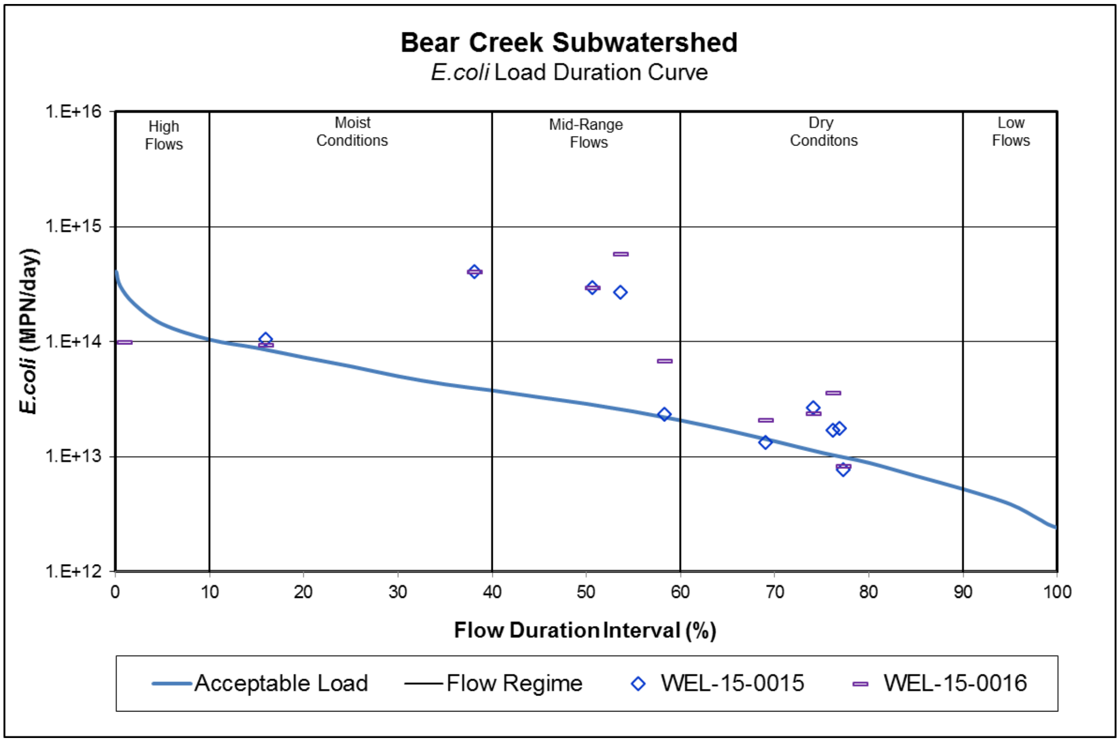


FIGURE 74 –BEAR CREEK *E. coli* PRECIPITATION GRAPH

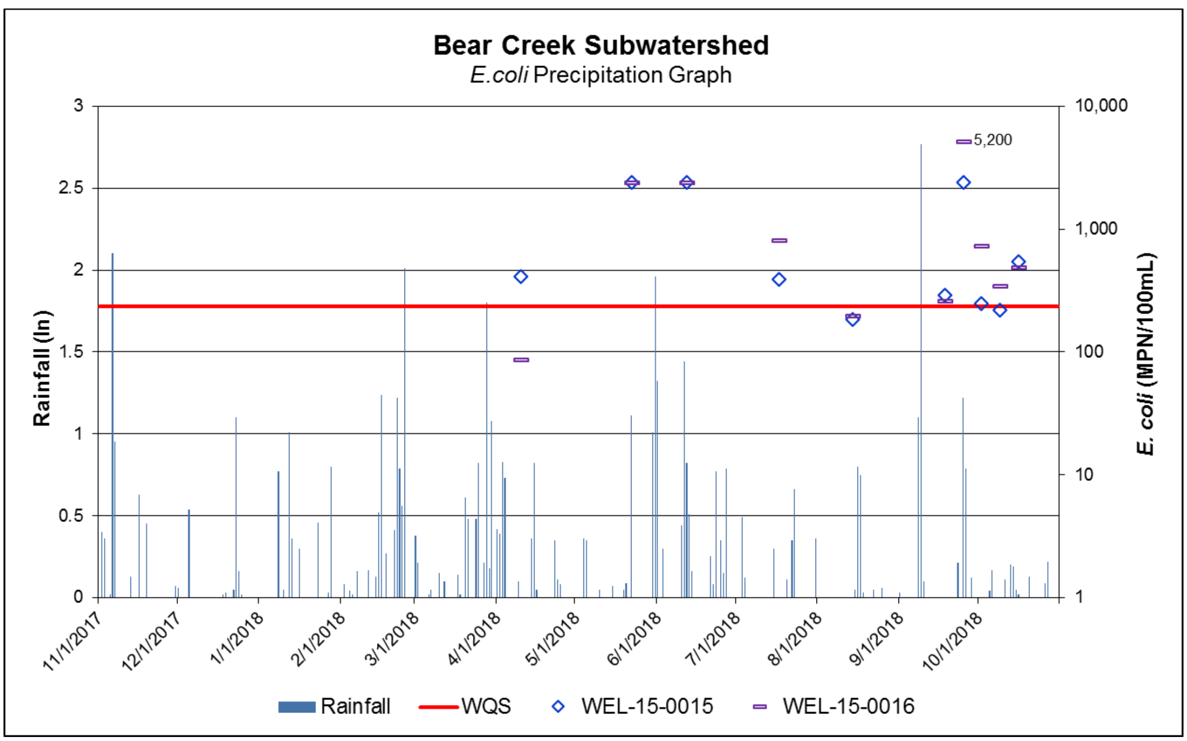


FIGURE 75 –BEAR CREEK TSS LOAD DURATION CURVE

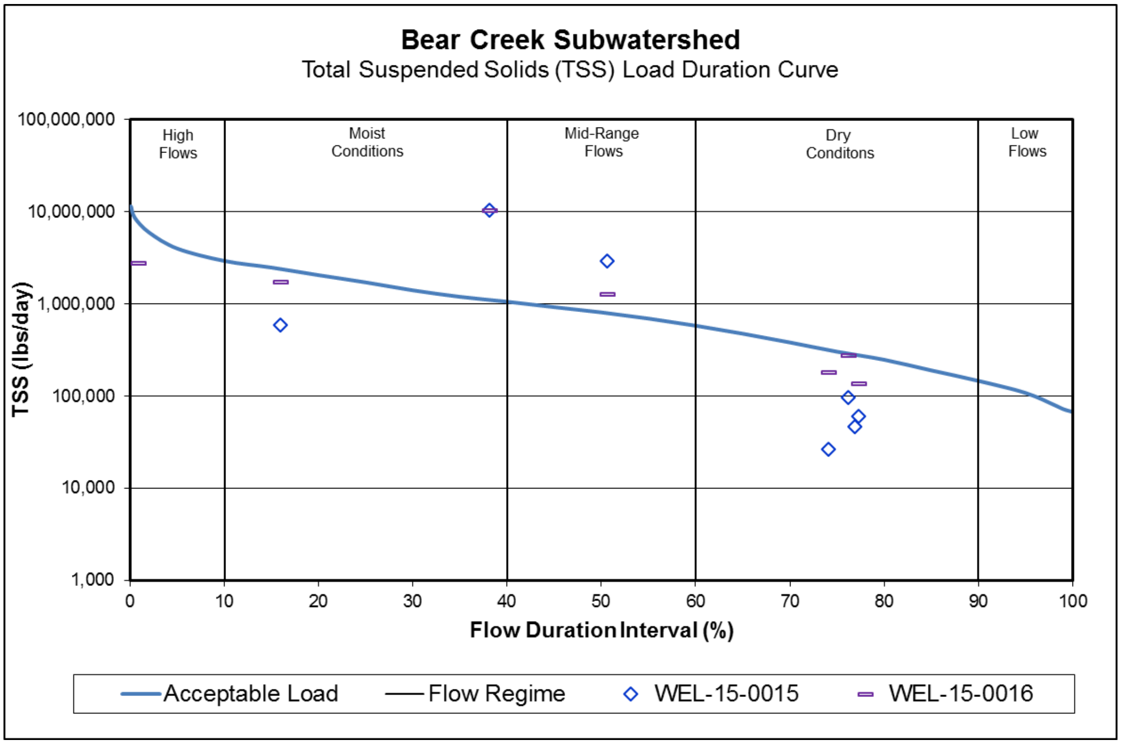
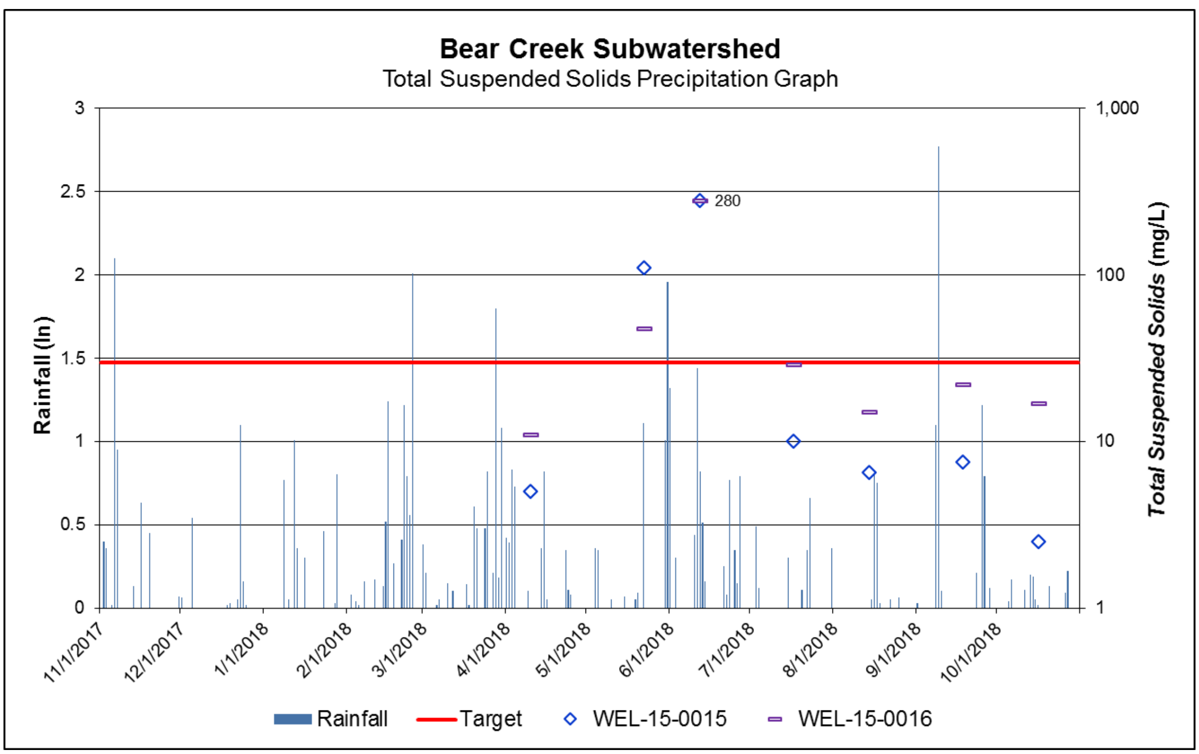


FIGURE 76 –BEAR CREEK TSS PRECIPITATION GRAPH



MUD CREEK – 051202081509

Size and Landuse

The Mud Creek subwatershed drains approximately 5,742 square miles and covers a land area of approximately 21 square miles. The subwatershed drains into the mainstem of the East Fork White River just east of Petersburg, IN. The land use is primarily agriculture (58%), followed by forested land (25%) and hay and pastureland (7%). Solar Sources Charger Mine (ING040129) is the only NPDES facility located within the subwatershed.

TABLE # 52 - MUD CREEK - 051202081509		
Land Use	**Acres**	**% of Subwatershed**
Agriculture	7,797	58%
Developed	809	6%
Forest	3,291	25%
Hay / Pasture	936	7%
Open Water	463	3%
Shrub / Scrub	3	0.00%
Wetlands	67	1%
Total Acres in Subwatershed	13,366	100%

Population and Housing Clusters

The majority of the subwatershed is rural indicating homes pump to on-site septic systems. There are three unincorporated towns in the subwatershed: Alford, Algiers and Rogers. There are approximately 60 households in Alford, approximately 30 in Algiers and approximately 20 in Rogers. 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.

Landscape, Soils and Waterways

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.

Livestock and CFOs

With a land use of less than 10 percent pastureland a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

Water Quality Monitoring

There are two monitoring sites located in this subwatershed which are located on East Fork White River, WEL-15-0020 (T18), and Mud Creek, WEL-15-0017 (T17). In 2017-2018 this watershed

FIGURE 77 – TYPICAL LANDSCAPE IN SUBWATERSHED

was sampled 38 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T18 was 115.82 MPN with 2/10 samples in exceedance of the SSM; while T17 had a geomean of 258.09 with 4/9 samples in exceedance of the SSM. The geomeans from sites T17 and T18 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. The fish community IBI score for site T18 was 16 (very poor) and the QHEI was 54 (good). The macro community mIBI score was 30 (poor) and the QHEI was 54 (good). The fish community IBI score for site T17 was 38 (fair) and the QHEI was 52 (good). The macro community mIBI score was 40 (fair) and the QHEI was 51 (good). Load Duration curves for the subwatershed were developed and are shown on pages 144-145.

TSS concentrations ranged from 4 mg/L to 2,400 mg/L across 29 sampling events and exceeded the target value 15 times. Given that targets for TSS were sporadically violated throughout the subwatershed a TMDL for TSS was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 50 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 21 stream miles impaired for *E. coli* and 1 mile listed for biological communities on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biotic communities in the subwatershed.

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however point sources are not believed to be significant contributors.

FIGURE 78 –MUD CREEK SUBWATERSHED 051202081509

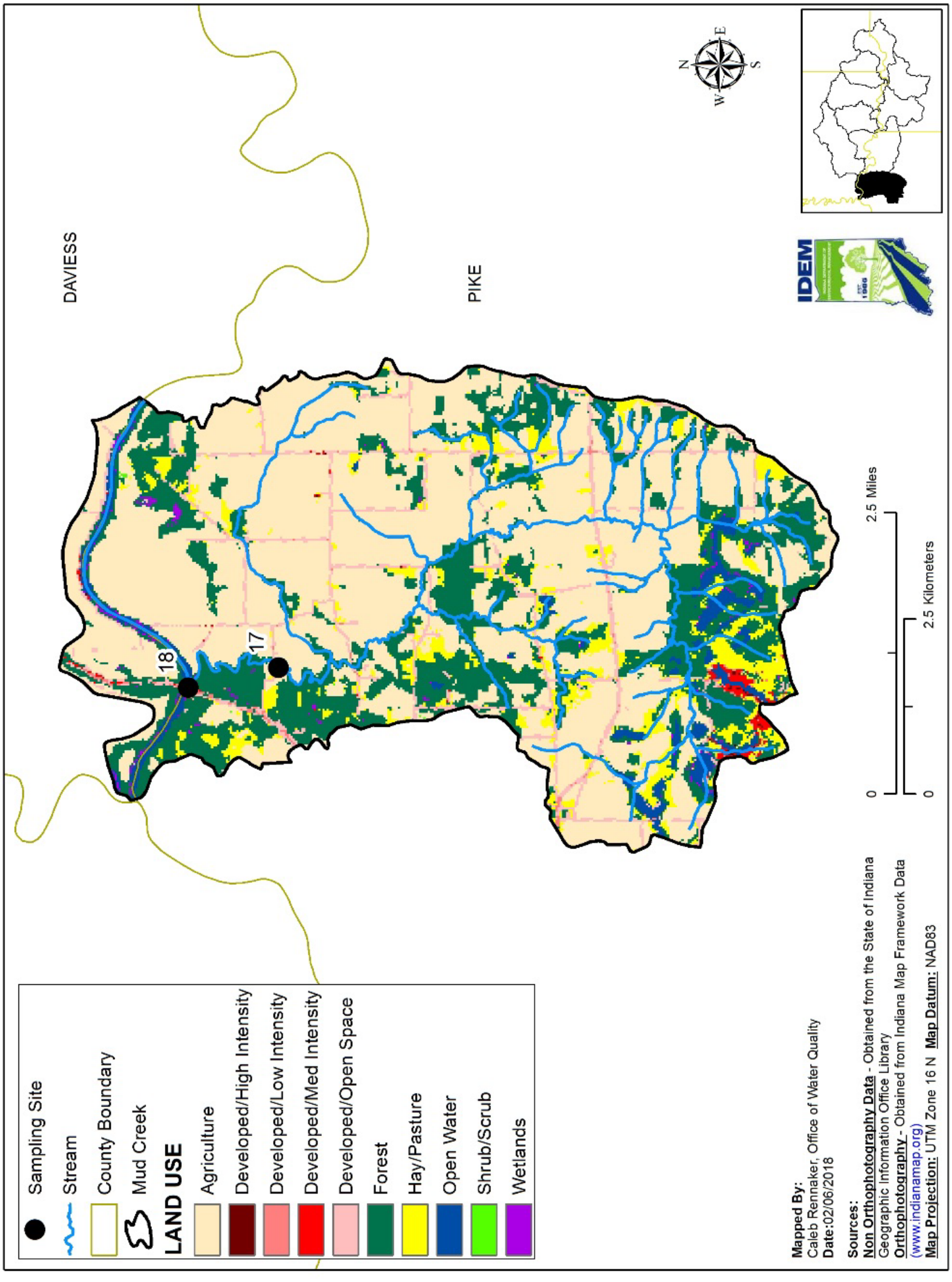


TABLE # 53 MUD CREEK (051202081509) TMDL Collected Data										
Sampling Site	Location	Date	Coliforms (Total)	E. coli	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate + Nitrite (mg/L)	pH	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WEL-15-0020	State Route 57	4/10/2018	1730	20.9	<0.2	0.83	8.19	0.31	87	172
		5/22/2018	>2419.6	63.8	0.11	0.53	8.06	0.081	69	38.8
		6/12/2018	>2419.6	>2419.6	0.32	3.3	7.66	0.13	260	181
		7/17/2018	>2419.6	16.1	<0.2	0.57	8.13	0.053	62	38.4
		8/13/2018					8.49			27.2
		8/14/2018	>2419.6	12	<0.2	0.39	8.34	0.096	75	39.3
		9/18/2018	23590	172.3	0.11	0.71	7.66	0.28	160	81.9
		9/25/2018	>2419.6	2419.6			8.03			48.3
		10/2/2018	>2419.6	77.6			7.97			39.3
		10/9/2018	>2419.6	28.5			8.11			22.8
		10/16/2018	2419.6	22.6	0.12	1.6	8.24	0.093	27	20.9
WEL-15-0017	County Road 725 N	11/13/2017			<0.2	0.87	7.6	0.31	17	43.6
		12/11/2017			<0.2	<0.1	8.11	0.064	4	5.01
		1/22/2018			0.18	1.6	7.88	0.98	2100	>1000
		2/19/2018			0.14	3.7	7.84	0.16	25	32.6
		3/12/2018			0.11	1.9	7.92	0.07	14	20.2
		5/22/2018	>2419.6	365.4	0.24	0.91	7.75	0.1	28	30.7
		6/12/2018	>2419.6	>2419.6	1.5	2.2	7.48	0.11	2400	>1000
		7/17/2018	>2419.6	184.2	0.12	0.21	7.88	0.043	8.5	10.9
		7/19/2018					7.65			7
		8/14/2018	>2419.6	201.4	<0.2	<0.1	7.97	0.048	5	5.49
		9/18/2018	14500	42	<0.2	<0.1	7.72	0.098	9	10.6
		9/25/2018	>241960	3230			7.78			225
		10/2/2018	>2419.6	161.6			7.91			9.6
		10/9/2018	>2419.6	344.8			7.9			7.06
		10/16/2018	2419.6	151.5	0.11	0.074	8.06	0.061	5	8.08

FIGURE 79 – COMMUNITY OF ALFORD

TABLE # 54 MUD CREEK (051202081509) CHARACTERISTICS					
TMDL Sample Site	WEL-15-0020, WEL-15-0017				
Listed Segments	INW08F9_03, INW08F9_T1001				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
NPDES Facilities	Solar Sources Charger Mine (ING040129)				
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	4.432E+11	1.902E+11	8.988E+10	3.371E+10	1.202E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	5.214E+10	2.237E+10	1.057E+10	3.965E+09	1.415E+09
Future Growth (5%)	2.607E+10	1.119E+10	5.287E+09	1.983E+09	7.073E+08
Upstream Drainage Input (Bear, Aikman)	**1.429E+14**	**6.130E+13**	**2.897E+13**	**1.086E+13**	**3.876E+12**
TMDL = LA+WLA+MOS	**1.434E+14**	**6.152E+13**	**2.908E+13**	**1.090E+13**	**3.890E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	11,167.94	4,792.04	2,266.69	850.01	303.21
WLA	571.16	245.08	114.04	42.77	15.25
MOS (10%)	1,467.39	629.64	297.59	111.60	39.81
Future Growth (10%)	1,467.39	629.64	297.59	111.60	39.81
Upstream Drainage Input (Bear, Aikman)	4,020,472.42	1,725,139.91	815,367.24	305,763.03	109,069.89
TMDL = LA+WLA+MOS	**4,035,146.29**	**1,731,436.30**	**818,343.15**	**306,878.99**	**109,467.97**
WLA (Individual)					
Solar Sources Charger Mine	562.32	241.29	114.04	42.77	15.25
Construction WLA	8.84	3.79	0.00	0.00	0.00

FIGURE 80 –MUD CREEK *E. coli* LOAD DURATION CURVE

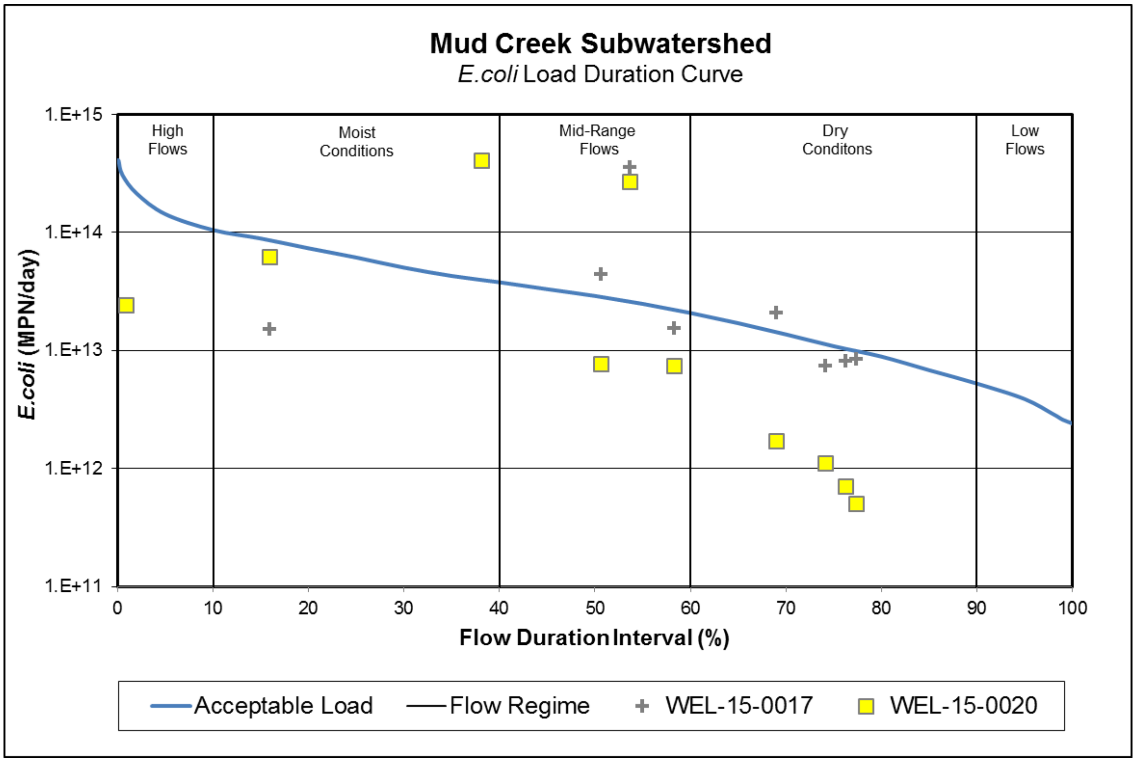


FIGURE 81 –MUD CREEK *E. coli* PRECIPITATION GRAPH

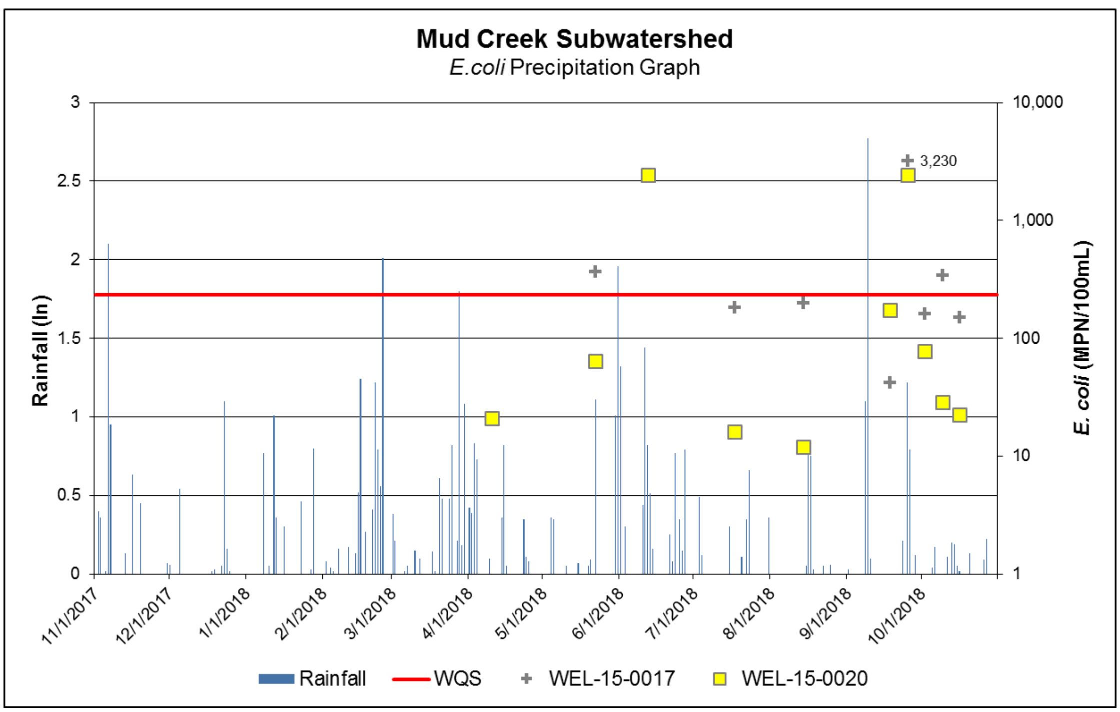


FIGURE 82 –MUD CREEK TSS LOAD DURATION CURVE

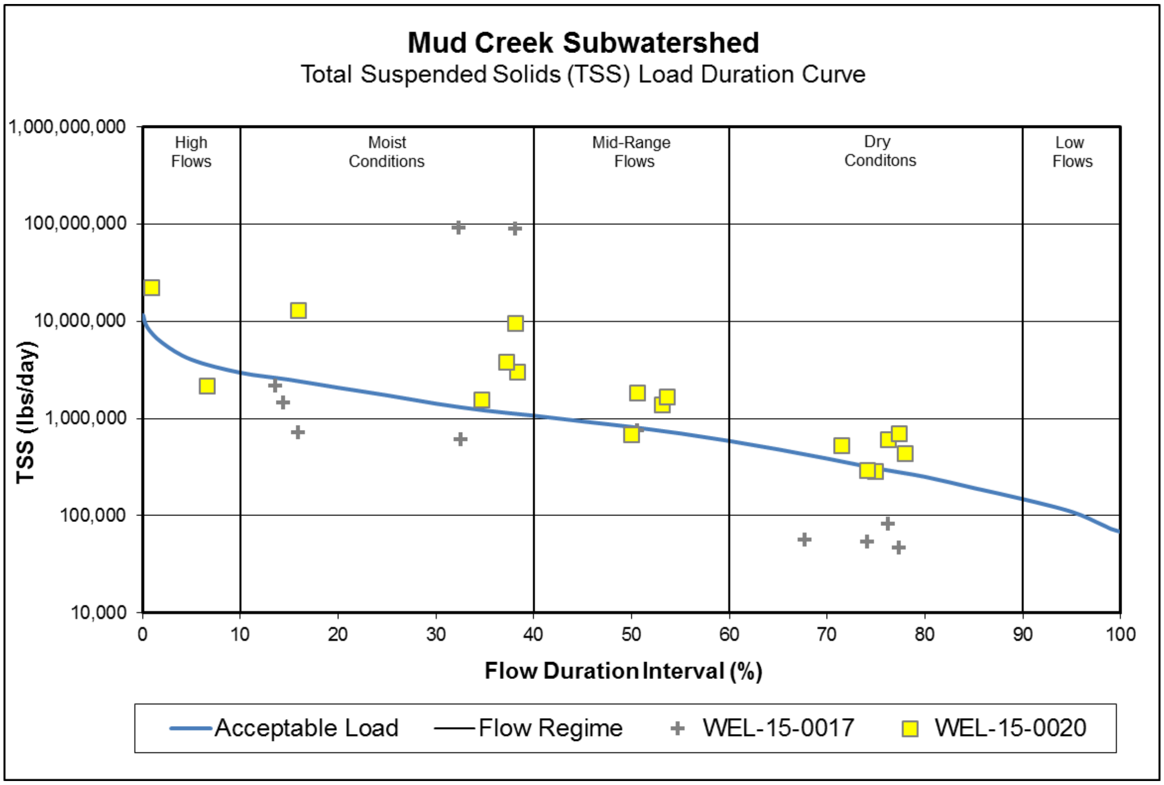
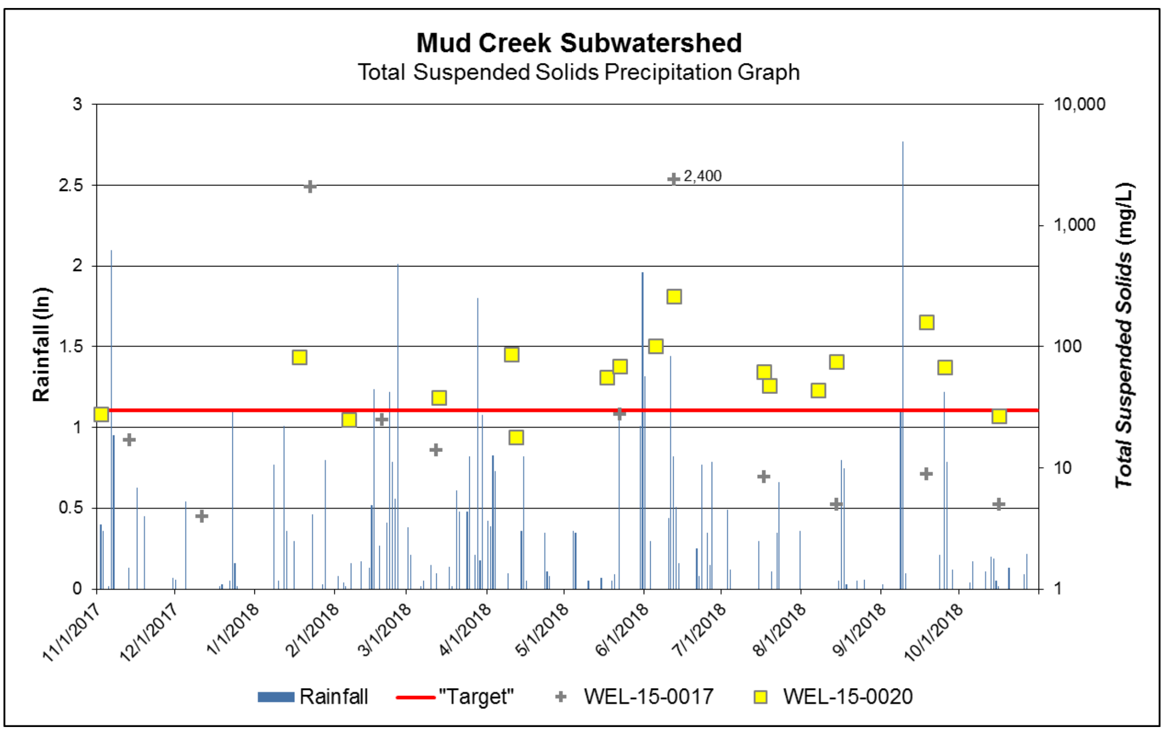


FIGURE 83 –MUD CREEK TSS PRECIPITATION GRAPH



WATERSHED INVENTORY (part three)

15. WATERSHED INVENTORY SUMMARY

In 2017-2018, IDEM collected water monitoring data at 17 sites in the watershed. This data indicated that 16 of the sample sites violated one or more of the Indiana WQ 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, such as wastewater treatment plants (WWTPs), 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, combined feeding operations (CFOs) 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 LEF White, subwatersheds with higher amounts of ag landscape also have the highest average *E. coli* counts. It is therefore possible that land application of manure is contributing to the elevated *E. coli* counts. However, other factors could also explain this correlation, such as failing septic systems along with small unregulated farming operations that allow livestock to have direct access to streams; these subwatersheds also tend to experience lower flows and thus have less dilution. Specific sources of *E. coli* in each impaired waterbody should be further evaluated during WMP implementation activities.

Within the LEF White watershed, subwatersheds with CFOs also have high total phosphorus loads and low dissolved oxygen concentrations. It is therefore possible that field run off is contributing to elevated phosphorus loads resulting in lower DO. However, other factors could also explain this correlation, such as upstream loading, failing septic systems, impeded flow, or tillage practice.

Various subwatersheds in the LEF White watershed have impaired biotic communities (IBC). Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) list, suggests that one or more of the aquatic biological communities 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 LEF White watershed, TSS and total phosphorus have been identified as pollutants in the TMDL development.

The allocation of the allowable loads to individual point sources as well as sources that are not directly regulated is an important step. The recent TMDL (dated 12-16-19) included these allocations, which are presented for each of the 12-digit HUCs containing impairments.

There are seven NPDES permitted facilities located in the LEF White watershed. These facilities include a public water supply facility, surface coal mining operations and the City of Jasper MS4. Of these facilities, two have been found to be in violation of their permit limits for TSS. Although some NPDES facilities have been found to be in violation of their permit limits, the majority of the time discharge effluent from these facilities met WQ standards and/or targets.

There are several types of nonpoint sources located in the LEF White watershed, including unregulated livestock operations, agricultural row crop land use, wildlife, erosion and straight piped, leaking or failing septic systems. 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 total phosphorus. Although Indiana does not have a permitting program for nonpoint sources, many are addressed through voluntary programs intended to reduce pollutant loads, minimize flow, and improve water quality.

16. ANALYSIS OF STAKEHOLDER CONCERNS

The LEF White steering committee developed a list of stakeholders' concerns during the early phase of the LEF White WMP 319 grant. These concerns were voiced by several local stakeholders, producers, county officials, contractors and conservation-minded citizens. Many of these concerns were identified by landowners possessing an extensive knowledge of the historical and recent land uses, while other concerns were based on individual landowners' experiences in their own area.

These concerns were looked at individually to determine whether each concern was supported by data, quantifiable, and whether the concern was outside the project's scope. If there was data to support that concern, the evidence was indicated. The group then decided whether they wanted to focus on the concern. Table 56 on page 148 shows the results on that discussion.

The LEF White Steering Committee noted that even though certain data (high E. coli rate) were indicated in the TMDL study, the stakeholders did not list failing septic systems as one of their natural resource concerns. This may be in part due to the lack of large urban areas (other than Jasper municipality), or perhaps due to lack of education regarding septic system maintenance and failing septic systems. However, high E. coli loads from septics are a concern of the LEF White watershed committee, and therefore was added to the original list of stakeholder resource concerns. However, the solution to failing septic systems lies outside the boundaries of a 319 cost-share program. Financial help for septic system maintenance or repair / upgrades to failing systems is difficult due to funding constraints; but this WMP encourages active promotion of adult education in the matter. The Dubois and Pike County Health Departments are an excellent source of information regarding septic permits and septic maintenance. It is necessary for LEF White watershed groups implementing this WMP to focus on continued education and outreach to initiate failing / antiquated septic improvements throughout the watershed and to enhance understanding of septic maintenance requirements.

IDENTIFY PROBLEMS AND CAUSES

17. PROBLEMS IN WATERSHED

Specific problems were identified relating to each concern the group wished to focus on. As each natural resource concern was discussed and potential problems listed, the committee noticed that several concerns could be grouped together since they shared potential problems. The committee felt that this grouping would help those who seek to implement the WMP in the future. Potential problems are defined as issues that exist due to a concern. Identified problems help clarify which contributing factors can be changed, improved upon, or investigated further. Table 57 on page 149 lists the concerns with corresponding 'problem' explanations.

TABLE # 55 - ANALYSIS OF STAKEHOLDER CONCERNS					
Concern	**Supported by Data?**	**Evidence**	**Quantifiable?**	**Outside Scope of Project?**	**Group wants to focus on?**
Soil Erosion	Yes	TSS data, tillage transects, windshield survey.	Yes	No	Yes
Soil Health, Productivity, Fertility and Organic Matter	Yes	Monitoring data, NRCS input, stakeholder reports.	Yes	No	Yes
Eroding Stream Bank and Bank Stabilization	Yes	IBC data, TSS loads, windshield surveys.	Yes	No	Yes
Flooding and Drainage	No	Well drained floodplains.	No	Yes	No
Water Quality	Yes	WQ monitoring data.	Yes	No	Yes
Livestock Management	Yes	Windshield survey, stakeholder reports, E. coli data.	Yes	No	Yes
Log Jams	Yes	Stakeholder reports.	Yes	Yes	No
Invasive Species	Yes	SWCD staff input, stakeholder reports, windshield surveys.	Yes	No	Yes, as Adult Education only
Precision Ag and Tillage / Chemical Reduction	Yes	Tillage transects, SWCD and NRCS staff input, stakeholder reports.	Yes	No	Yes
Litter, Trash and Illegal Dumping	Yes	Windshield survey, stakeholder reports.	Yes	No	Yes
Wildlife Habitat	Yes	WQ Data, windshield survey, stakeholder reports.	Yes	No	Yes
Wetlands (construction, restoration and enhancement)	Yes	Monitoring data, windshield survey, stakeholder reports.	Yes	No	Yes
Water Retention (WASCOBs)	Yes	Monitoring data, tillage transects, windshield survey, stakeholder reports.	Yes	No	Yes
Pesticides in Surface and Ground Water	No	None collected.	No	Yes	No
Excessive Nutrients in Surface and Ground Water	Yes	Total P data, tillage transect.	Yes	No	Yes
Waste Management	Yes	E. coli data, tillage transect, stakeholder reports.	Yes	No	Yes
Forestry (TSI)	Yes	TSS data, tillage transect, windshield survey, stakeholder reports.	Yes	No	Yes
Air Pollution	No	None collected.	No	Yes	No
Petroleum, Heavy Metals, etc. in Surface and Ground Water	No	None collected.	No	Yes	No
Outdoor Recreation	Yes	Monitoring data, stakeholder reports, Glendale FWS staff.	Yes	No	Yes
Insufficient Water	No	None collected.	No	Yes	No
Failing and Antiquated Septics / Septic Maintenance	Yes	E. coli data, Health Dept. staff, rural population data.	No	No	Yes, as adult education only.

TABLE # 56 – POTENTIAL PROBLEMS FROM CONCERNS	
CONCERNS	**PROBLEMS**
Soil erosion / health, sediment / nutrient loading, livestock management, need for precision ag tillage / chemical reductions, forestry (TSI), eroding streambanks, bank stabilization, WQ issues, WASCOBs and water retention basins.	High turbidity / large amts of sediment transported into streams
	Exceeded WQ targets for TSS, nutrients
	Impaired biological populations / communities
Soil erosion / health, sediment / nutrient loading, need tillage reductions, WQ issues.	Lack of consistent cover crop and no-till practices leading to increase in sediment and nutrient loads
Soil erosion /health, sediment / nutrient loading, livestock management, WQ issues.	Livestock allowed stream access and lack of rotational grazing leading to increase in sediment and nutrient loads
Education and outreach, soil erosion and soil health, sediment and nutrient loading, need for precision ag tillage / chemical reductions, forestry (TSI), WQ issues.	Lack of soil health / soil fertility education resulting in increase of sediment and nutrient loads.
	Lack of soil health benefits awareness.
Soil erosion / health, sediment / nutrient loading, need for precision ag chemical usage, WQ issues.	Farming up to edge stream/lack of field borders and filter strips leading to increase in sediment and nutrient loads.
Eroding streambanks, need for bank stabilization, lack wildlife habitat, WQ issues.	Eroding streambanks leading to increase in TSS.
	Streambanks needing stabilization
Lack of sufficient wetlands, WQ issues.	Lack of sufficient wetlands to reduce nutrient and sediment loads.
Outdoor recreation, failing septic systems, lack of septic maintenance, manure/mortality waste management, WQ issues	Exceeded WQ targets for *E. coli*
Failing septic systems, lack of septic maintenance, WQ issues.	Lack of public awareness on septic system maintenance leading to increase in E. coli / nutrient loads.
	Older homes without leach field or with pipes directly to ditch
	Antiquated systems prohibitively expensive to repair / replace
Manure and mortality waste management, WQ issues	Improper manure /mortality waste application (4Rs) leading to increase in nutrient loads.
	Improper manure / mortality storage leading to increase nutrient loads.
Manure and mortality waste management, precision ag chemical reductions, WQ issues	Lack of ed regarding 4Rs *(right product, right time, right rate, right place)* leading to increase in sediment / nutrient loads.
Illegal dumping/roadside litter, WQ issues.	Illegal dumping sites / roadside litter observed by stakeholders
Invasive terrestrial plant species.	Invasive terrestrial plant species found along roadways and ditchbanks and within wooded lands. Invasive plants being sold at local retail outlets and planted by homeowners.
Lack of high-quality wildlife habitat / degraded and low-quality riparian zones, water quality issues.	Lack of high-quality wildlife habitat.
	Degraded and low-quality riparian zones leading to increase in sediment and nutrient loads.
Education and Outreach	Lack of public awareness
	Lack of high-quality education workshops and opportunities
	Lack of attendance at educational events.
	Disregard of consequences of actions.

18. POTENTIAL CAUSES FOR PROBLEMS IN WATERSHED

After identifying specific problems, the potential causes for each specific problem was determined. Table # 57 on page 150 links stakeholder concerns to known water quality problems and their potential causes. A "cause" is an event, agent, or series of actions that can produce a problem.

TABLE # 57 IDENTIFICATION OF POTENTIAL CAUSES IN RELATION TO PROBLEMS	
Problem	**Potential Cause(s)**
High turbidity / sediment transported to streams	WQ target for TSS exceeded, soil erosion; need for streambank stabilization, need for field borders and grassed waterways.
WQ targets for TSS exceeded	Excess run-off occurs, transporting sediment into streams, land and livestock management methods need improvement to address exceeded targets.
WQ targets for NO2/NO3 exceeded	Excess run-off occurs, transporting nutrients into streams, land and livestock management methods need improvement, substandard septic systems.
WQ targets for Total Phosphorus exceeded	Excess run-off occurs, transporting nutrients into streams, land and livestock management methods need improvement, substandard septic systems
Impaired biological populations / communities	Water quality targets for TSS exceeded, lack of buffers, riparian areas, wetlands; nutrient loading to streams.
Cover crops and no till not utilized	Lack of information, lack of soil health education, lack of seed availability, adverse weather conditions, producer doesn't own no-till equipment, prohibitive costs of cover crops, fear of cover crop termination difficulty, forgone income.
Livestock with stream access and lack of rotational grazing	Producers use ditch / stream to water / cool cattle; prohibitive cost of fencing cattle out of stream and building HUAP; prohibitive cost of additional fencing and watering system with rotational grazing.
Lack of soil health / soil fertility education	Lack of understanding of the soil science behind soil fertility (such as Cation Exchange Capacity), lack of soil health education, producers busy schedule prohibits soil workshop attendance.
Lack of soil health benefits awareness	Cover crop soil health benefit involves years of inputs before yield increase (increase in net profit) is realized; need scientific data to back claims, need peer sharing of realized soil health benefits from BMPs.
Lack of education regarding 4Rs	WQ targets exceeded for N and P, land and livestock management methods need improvement.
Farming up to edge of stream / lack of field boarders and filter strips	WQ target for TSS and nutrients exceeded, lack of field buffers and filter strip, lack of riparian areas and wetlands; need for streambank stabilization, forgone income.
Eroding streambanks	WQ target for TSS and nutrients exceeded, lack of field buffers and filter strip, lack of riparian areas and wetlands; need for streambank stabilization, forgone income.
Streambanks needing stabilization	WQ target for TSS and nutrients exceeded, lack of field buffers and filter strip, lack of riparian areas and wetlands; need for streambank stabilization, forgone income.
Lack of sufficient wetlands	WQ targets for TSS and nutrients exceeded, wetlands drained and converted to ag lands, need for wetland restoration and improvements for improved WQ

Problem	Potential Cause(s)
WQ targets for E.coli exceed	Excess untreated run-off occurs from unmaintained septic systems, land and livestock management methods need improvement, public lacks awareness. Septic system updates/repairs are cost prohibitive.
Lack of public awareness on septic system maintenance	WQ targets for E. coli and nutrients exceeded, education and awareness needed for routine maintenance of septic systems; updates, repairs, improvements to failing / older septics often cost-prohibitive.
Older homes w/o leach field or with pipes directly to ditch	WQ targets for E. coli and nutrients exceeded, education and awareness needed for routine maintenance of septic systems; updates, repairs, improvements to failing / older septics often cost-prohibitive.
Antiquated systems prohibitively expensive to repair / replace	WQ targets for E. coli and nutrients exceeded, education and awareness needed for routine maintenance of septic systems; updates, repairs, improvements to failing / older septics often cost-prohibitive.
Improper manure / mortality storage	WQ targets for E. coli and nutrients exceeded, lack of equipment and facilities, needed improvements in management, education and awareness of impact on water quality, proper storage impeded by weather /finances.
Improper manure / mortality application	WQ targets for E. coli and nutrients exceeded, lack of equipment and facilities, needed improvements in management, education and awareness of impact on water quality, proper application impeded by weather /finances.
Illegal dumping sites / roadside litter	Roadside litter / illegal dumping of household trash throughout watershed.
Invasive plant species being sold at local retail outlets	Invasive plant species are sold at retail outlets (such as callary pear, burning bush and Japanese honeysuckle). If producer adds grass waterway, native species often are not considered or planted as part of the plan. Same with field borders.
Lack of high-quality wildlife habitat	WQ target for TSS exceeded, soil erosion; need for streambank stabilization, need for field borders /grassed waterways, need for riparian zones with native species.
Degraded and low-quality riparian zones	Lack of field borders and filter strips, riparian trees removed due to shading on crops decreasing yield, forgone income, streambank erosion, need for streambank stabilization, need riparian zones with native species.
Lack of public awareness	Information is not as available / visible as it could be at this time; funding for outreach is often lacking / low interest and attendance at educational events.
Lack of frequent, high-quality education workshops and opportunities.	A soil health expo is not enough - high quality, nationally-known speakers are required to draw producers / stakeholders to the event. Venues are often difficult to secure. Food (cost-prohibitive) is often needed to ensure high attendance.
Lack of attendance at educational events.	Stakeholders such as ag retailers often don't attend due to getting time off work. Producers only attend when PARP credits are offered which lengthens the meeting, raise the cost of meeting and requires partnership with Purdue ext. staff.
Disregard of consequences (effect on WQ) of actions	Misunderstanding of water cycle. Disregard of consequences of actions (such as roadside litter and it's degrading habitat and WQ).

IDENTIFY SOURCES AND CALCULATE LOAD

19. POTENTIAL SOURCES FOR POLLUTANTS

The identified problems and potential causes were paired with potential sources and specific subwatersheds where these issues are most prevalent. Table 58 on page 152 shows the potential sources and suspect watersheds.

TABLE # 58 – POTENTIAL SOURCES AND SUSPECT WATERSHEDS			
Problem	**Potential Cause(s)**	**Potential Source(s)**	**Watershed(s)**
High turbidity / sediment transported into streams	TSS target exceeded, soil erosion; need for streambank stabilization, field borders and grassed waterways.	Conventional tilled fields, roadside ditches not seeded after maintenance, removal of riparian areas, ≈208 stream miles with insufficient buffers, HEL acres.	Aikman, Mud, Slate and Sugar
WQ targets for TSS exceeded	Run-off transporting sediment, land and livestock management methods need improvement	Conventional tilled fields, roadside ditches not seeded after maintenance, removal of riparian areas, ≈208 stream miles lack sufficient buffers, HEL acres.	Aikman, Mud, Slate and Sugar
WQ targets for NO2/NO3 Exceeded	Run-off transporting nutrients into streams, land and livestock management methods need improvement, substandard septics.	Ag fertilizer used without NMP, antiquated septics, lack of buffers on 50% of streams, livestock with access to streams, water data exceeding WQ target.	Aikman, Mud, Slate and Sugar
WQ targets for Total Phosphorus exceeded	Run-off transporting nutrients into streams, land and livestock management methods need improvement, substandard septics	Ag fertilizer used without NMP, lack of buffers on 50% of streams, livestock with access to streams, antiquated septics, water data exceeded WQ target.	Aikman, Mud, Slate and Birch
Impaired biological populations / communities	TSS target exceeded, lack of buffers, riparian areas, wetlands; nutrient loading to streams.	Embedded stream substrates, 50% of streams lack buffer; lack of shade/cover; removal of riparian areas, lack of wetlands.	All but Mill and Dogwood
Cover crops and no till not utilized	Lack of information, soil health ed and seed availability, adverse weather, producer doesn't own right equipment, prohibitive costs of cover crops, fear of termination difficulty, forgone income.	Daviess Co - 1,443 soybean acres conventional tilled; Dubois Co - 3,041 corn acres and 460 soybean acres conventional tilled; Pike Co - 833 soybean acres and 632 corn acres conventional tilled. Dubois only 17% of corn acres with living cover; Daviess only 13%; Pike only 8% and Martin only 3 %	All but Dogwood
Livestock with stream access and lack of rotational grazing	Producers use ditch or stream to water / cool cattle; prohibitive cost of fencing out of stream and building HUAP; prohibitive cost of additional fencing and watering system with rotational grazing.	Livestock with access to streams.	All but Dogwood
Farming up to edge of stream / lack of field borders and filter strips Eroding streambanks Streambanks needing stabilization	TSS and nutrient targets exceeded, lack of field buffers and filter strip, lack of riparian areas and wetlands; need for streambank stabilization, forgone income.	50% of streams lack buffer, ≈208 stream miles	All but Dogwood
Lack of sufficient wetlands	TSS and nutrient targets exceeded, wetlands drained and converted to ag lands, need for wetland restoration and improvements for improved WQ	Indiana originally 25% wetland, now only 4% wetland; wetlands drained and used for agricultural production.	All subwatersheds
WQ targets for E.coli exceed	Run-off from unmaintained septic, land and livestock management methods need improvement, public lacks awareness. Septic updates/repairs are cost prohibitive.	Manure used as fertilizer without NMP, livestock with access to stream, antiquated septics, lack of buffers and wetlands for filtering, water monitoring data exceeded WQ targets.	Mill, Birch and Bear
Older homes w/o leach field or with pipes directly to ditch	E. coli and nutrient targets exceeded, updates, repairs, improvements to failing / older septics often cost-prohibitive.	Approximately 6,154 living in rural areas of watershed without wastewater services, many in older homes. Dubois Health Dept reports all of Haysville is on older, non-permitted on-site systems.	All Subwatersheds
Antiquated systems prohibitively expensive to repair / replace	E. coli and nutrient targets exceeded, updates, repairs, improvements to failing / older septics often cost-prohibitive.	Cost of new on-site septic systems varies dependent of size of home and soil conditions, but approximately $5,000 to $25,000.	All Subwatersheds
Improper manure / mortality waste storage	E. coli and nutrient targets exceeded, lack of equipment and facilities, needed improvements in management, education and awareness of impact on WQ, proper storage impeded by weather /finances.	33 CFOs located in the watershed, 13,149 hay and pasture acres located in the watershed.	Sugar, Birch, Bear, Mud

Problem	Potential Cause(s)	Potential Source(s)	Watershed(s)
Improper manure / mortality waste application	E. coli and nutrient targets exceeded, lack of equipment and facilities, needed improvements in management, education and awareness of impact on WQ, proper application impeded by weather /finances.	33 CFOs located in the watershed, 13,149 hay and pasture acres located in the watershed.	Sugar, Birch, Bear, Mud
Lack of high-quality wildlife habitat	TSS target exceeded, soil erosion; need for streambank stabilization and field borders /grassed waterways, need for riparian zones with native species.	Lack of high-quality riparian / wetland areas, embedded stream substrate (from excess sediment), low habitat index scores.	All Subwatersheds
Degraded and low-quality riparian zones	Lack of field borders/filter strips, riparian trees removed due to shading on crops decreasing yield, forgone income, streambank erosion, need for streambank stabilization and riparian zones with native species.	Lack of high-quality riparian areas, embedded stream substrate (from excess sediment), loss of revenue/income from setting planting back from creek edge, 50% of streams lack buffer, ≈208 stream miles	All Subwatersheds
Illegal dumping sites / roadside litter	Roadside litter / illegal dumping of household trash throughout watershed.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Invasive plant species being sold at local retail outlets	Invasive plant species are sold at retail outlets. Native species not considered or planted as part of a conservation plan.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of public awareness on septic system maintenance	E. coli and nutrient targets exceeded, education and awareness needed for routine maintenance of septic systems.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of soil health / soil fertility education	Lack of understanding of the soil science behind soil fertility (such as Cation Exchange Capacity), lack of soil health education, producers busy schedule prohibits soil workshop attendance.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of soil health benefits awareness	Cover crop soil health benefit involves years of inputs before yield increase (increase in net profit) is realized; need scientific data to back claims, need peer sharing of realized soil health benefits from BMPs.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of education regarding 4Rs	WQ targets exceeded for N and P, land and livestock management methods need improvement.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of public awareness	Information is not as available / visible as it could be at this time; funding for outreach is often lacking / low interest and attendance at educational events.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of frequent, high-quality education workshops and opportunities.	A soil health expo is not enough - high quality, nationally-known speakers are required to draw producers / stakeholders to the event. Venues are often difficult to secure. Food (cost-prohibitive) is often needed to ensure high attendance.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Lack of attendance at educational events.	Stakeholders such as ag retailers often don't attend due to getting time off work. Producers only attend when PARP credits are offered which lengthens the meeting, raise the cost of meeting and requires partnership with Purdue ext. staff.	N/A - Sources not required for administrative and social problems.	All Subwatersheds
Disregard of consequences (effect on WQ) of actions	Misunderstanding of water cycle, disregard of consequences of actions (such as roadside litter and it's degrading habitat and WQ).	N/A - Sources not required for administrative and social problems.	All Subwatersheds

20. CURRENT LOADS FOR EACH POLLUTANT

Load Calculations Introduction

IDEM states that "*a load, in terms of water quality, is the amount of a pollutant carried by a particular waterbody within a particular timeframe such as 'tons of nitrogen per year'. A loading of pollutants may be caused by humans or occur naturally, entering the water from run-off, ground water, pipes or the air in the form of wet deposition, such as rain or snow, as well as dry deposition.*

IDEM further differentiates between loads and concentrations stating "*pollutant concentration refers to the amount of a pollutant in a defined volume of water (such as milligrams of nitrogen per liter of water); whereas loads are an equalizer that addresses how much pollution is being contributed by one stream compared to another. This is important, especially when pollutants are being contributed by both large and small streams that can be flowing fast or slow. Waterbodies carrying the same concentration of pollutant, but that differing in hydrology, may have drastically different loadings.*

This makes sense when one realizes the difference between Stream A with 500 mg/L nitrogen but no flow, and Stream B with 5 ppm nitrogen and 38 cfs flow. Stream A may have a higher concentration, but it has no load; whereas Stream B has a low concentration but does have a load of 5,380 ppm/sec. As IDEM states, "*Load calculations can be obtained by multiplying concentration by discharge (flow).*"

Loads are important in watershed management plans, because U.S. EPA requires pollutant levels be reported in terms of loads. Even so, concentrations are generally used as thresholds because water samples are reported in terms of concentrations with a known level of precision and accuracy. IDEM further states that "*loads can help us to compare dissimilar streams to determine which stream segment or tributary is contributing the most pollution in a system. This allows restoration efforts to be focused in areas that are in most need. When examined seasonally or under various flow conditions, pollutant loads can help to identify sources of pollutants.*"

Estimating current loading using recent data is as simple as multiplying concentration x flow. This, of course, is an instantaneous reading and needs to be calculated periodically throughout the year and under various flow conditions to gain a more reliable estimate of load for the year. It is also interesting to consider the points along the watershed where monitoring is occurring.

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 (http://mrcc.isws.illinois.edu/CLIMATE/). Climate data from Station USC00128036 located in Shoals, IN was used for climate analysis of the LEF White River Watershed. Monthly data from 1908 - 2018 were available at the time of analysis. In general, the climate of the region is continental with hot, humid summers and cold winters. From 2008 to 2018, the average winter temperature in Shoals was 35.2°F and the average summer temperature was 72.7°F. The average growing season (consecutive days with low temp greater than or equal to 32 degrees) is 183 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of run-off on water quality. From 2008 to 2018, the annual average precipitation in

Shoals at Station USC00128036 was approximately 52.5 inches, including approximately 13.1 inches on average of total annual LEF White River snowfall.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of stormwater on the LEF White watershed. Using data from USC00128036 during 2008 to 2018, 82 % of the measurable precipitation events were low intensity (i.e., < 0.2 inches), while 4 % of the measurable precipitation events were greater than one inch.

Understanding when precipitation events occur helps in the linkage analysis (see page 155-157), which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the LEF White watershed occurs between the months of March and May.

TMDL's Subwatershed Drainage Areas

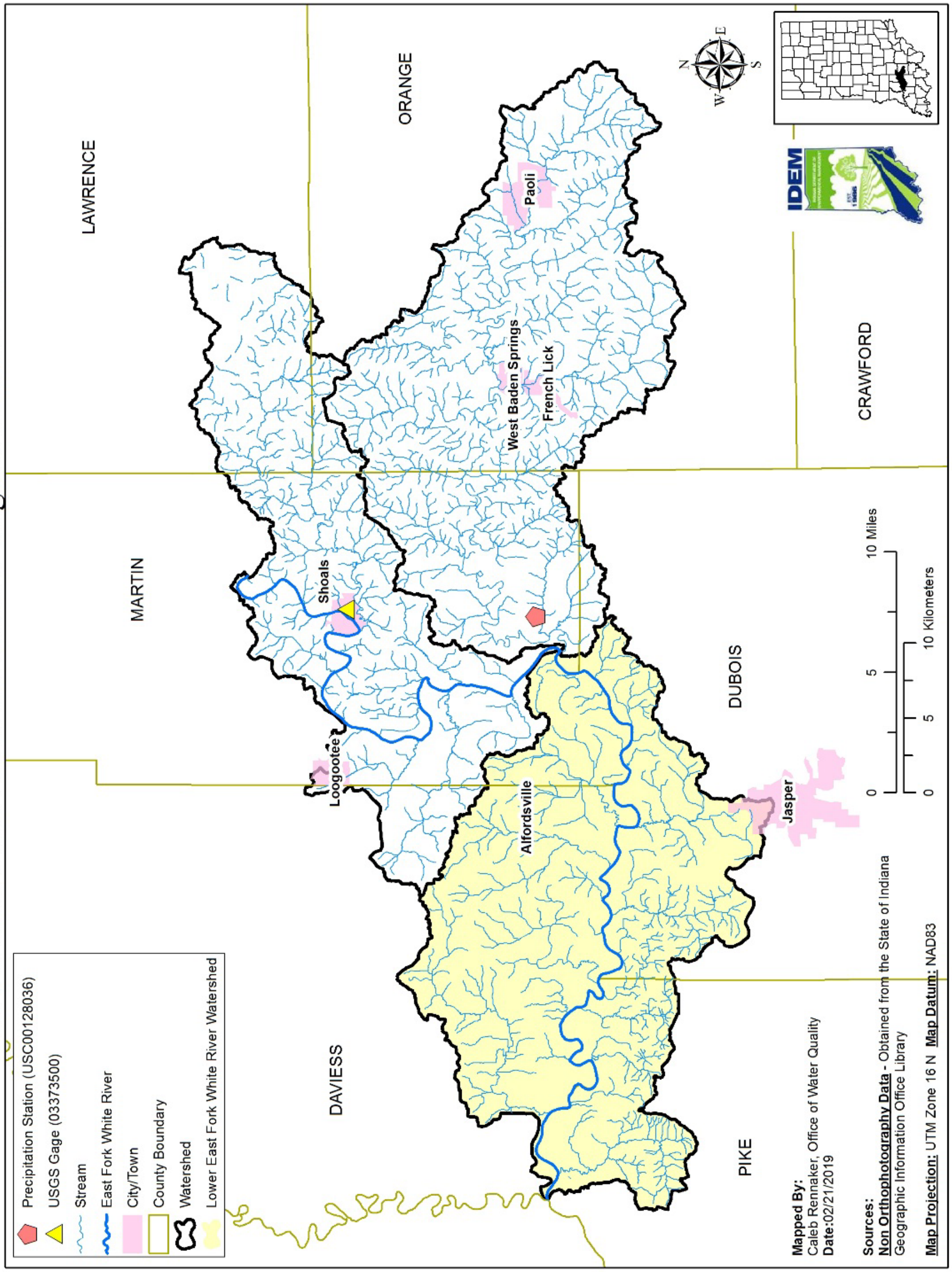
The IDEM TMDL based load calculations on the drainage area for each of the 12-digit HUC subwatersheds. The information contained in Table 59 below is the foundation for the technical calculations of the TMDL report. This table will help watershed stakeholders look at the smaller subwatersheds within the LEF White and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

TABLE # 59 –TMDL's 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**
Mill Creek	051202081501	19.57	9.43%	19.57	0.34%
Hoffman Run	051202081502	22.42	10.81%	5,556.86	96.78%
Slate Creek	051202081503	18.73	9.03%	18.73	0.33%
Sugar Creek	051202081504	24.13	11.63%	5,619.3	87.87%
Dogwood Lake	051202081505	16.75	8.08%	16.75	0.29%
Birch Creek	051202081506	21.84	10.53%	5,641.14	98.25%
Aikman Creek	051202081507	30.41	14.66%	30.41	0.53%
Bear Creek	051202081508	32.57	15.70%	5,690.47	99.11%
Mud Creek	051202081509	21.0	10.12%	5,741.76	100.0%

TMDL's Calculated Target Loads

The target load is the pollutant load of a stream which meets the applicable WQ standards or targets. Table 24 on page 76 lists WQ standards / targets. One way to figure target loads is to use the acceptable standard or recommended value and stream flow data. Stream flow x the standard for the pollutant gives the daily target load for the subwatershed, which can then be calculated into the annual target load. Target loads were calculated in the TMDL completed by IDEM. This next section explains the TMDL calculations for target (allowable) loads.

FIGURE 84 –LEF WHITE FLOW GAGE AND CLIMATE STATION



TMDL's Allowable Loads Calculations with Load Duration Curve Approach
To determine allowable loads for the TMDL, IDEM used 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 WQ 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 WQ 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 WQ 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 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.

TABLE # 60 – RELATIONSHIP BETWEEN LOAD DURATION CURVE ZONES AND CONTRIBUTING SOURCES

Note: The potential relative importance of source area to contribute loads under given hydrologic condition are shown as follows: H = High; M = Medium; L = Low)

	Duration Curve Zone				
Contributing Source Area	**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			

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 60 above summarizes the general relationship between the five hydrologic conditions 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.

TMDL's Stream Flow Estimates
Daily stream flows are necessary to implement the load duration curve approach. Load duration assessment locations in the LEF White River watershed were chosen based on the location of the impaired stream segments and the availability of water quality samples to estimate existing loads. The USGS Site assignment for the development of the Load Duration Curve was Gage 03373500 located on the East Fork White at Shoals, Indiana. Records from this gage ranging from 2008-2018 were used.

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 03373500 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 LEF White watershed.

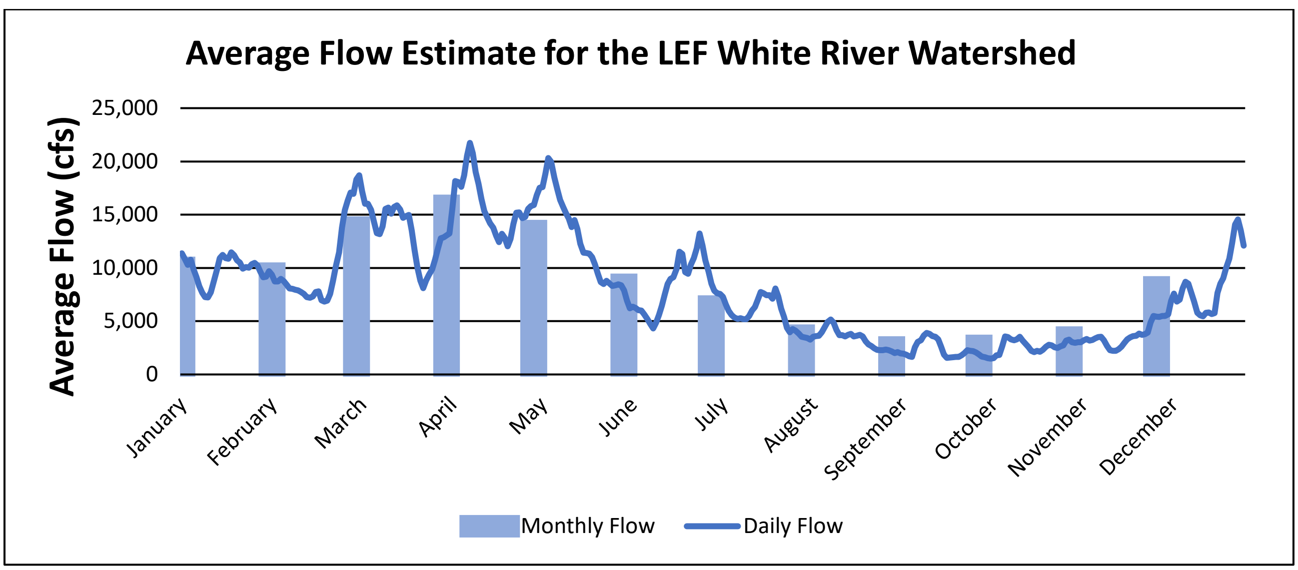
Flows were estimated using the following equation:

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

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

FIGURE 85 –AVERAGE FLOW ESTIMATE 2008-2018



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 # 61 - LOAD DURATION CURVE KEY FLOW PERCENTILE ESTIMATES						
	Drainage Area (sq. miles)	Flow Duration Exceedance Interval Flows (cfs)				
Subwatershed		High (5%)	Moist (25%)	Mid-Range (50%)	Dry (75%)	Low (95%)
Mill Creek	19.57	85	36	17	6	2
Hoffman Run	5,556.86	24,136	10,356	4,895	1,836	655
Slate Creek	18.73	81	35	16	6	2
Sugar Creek	5,619.3	24,407	10,473	4,950	1,856	662
Dogwood Lake	16.75	73	31	15	6	2
Birch Creek	5,641.14	24,502	10,513	4,969	1,863	665
Aikman Creek	30.41	132	57	27	10	4
Bear Creek	5,690.47	24,716	10,605	5,013	1,880	671
Mud Creek	5,741.76	24,939	10,701	5,058	1,897	677

TMDL's Margin of Safety

Section 303(d) of the Clean Water Act and 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."* 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). The recent LEF White TMDL that is being used to write this WMP used both an implicit and explicit MOS. An implicit MOS was used by applying a couple of conservative assumptions. A moderate explicit MOS was applied by reserving ten 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.

TMDL's Future Growth Calculations

Population trends are indicating that this watershed has been increasing (Table 15 page 47) over the past two decades; uncertainty in future populations in the LEF White watershed led IDEM to allocate 5% of the loading capacity toward future growth in the TMDL. IDEM anticipated 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% 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 LEF White 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% of the loading capacity to address increased sediment loads from future contributors.

TMDL's Linkage Analysis of Data

A linkage analysis connects the observed water quality impairment to what has caused that impairment. An essential component of developing the TMDL was establishing a relationship between the source loadings and the resulting water quality. Potential point and nonpoint sources were inventoried and water quality data within the LEF White watershed were discussed in the TMDL. The report evaluated which of the various potential sources was most likely to be contributing to the observed water quality impairments.

The load duration curves illustrate WQ standards and target value violations during all flow ranges that occurred during sampling events. (Sampling sites are shown on Figure 22, page 69). A discussion of sampling sites in each subwatershed and information tables providing summaries of each subwatershed are shown on pages 81-145. The subwatershed tables provided a summary, including impaired segment AUID, drainage area, sampling sites, listed segments, land use, NPDES facilities, MS4 community, CSO communities, CFOs, and CAFOs, as well as LAs, WLAs, and 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 pollutants of concern concentrations.

Load duration curves were created for each subwatershed in the LEF White watershed that were sampled by IDEM in 2017-2018. The load duration curve method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint). (See load duration curve discussion beginning on page 157.)

To further investigate sources, water quality precipitation graphs were created in the TMDL. 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 Shoals, IN and managed by the Midwestern Regional Climate Center. (see map on page 156.)

21. LOAD REDUCTION NEEDED

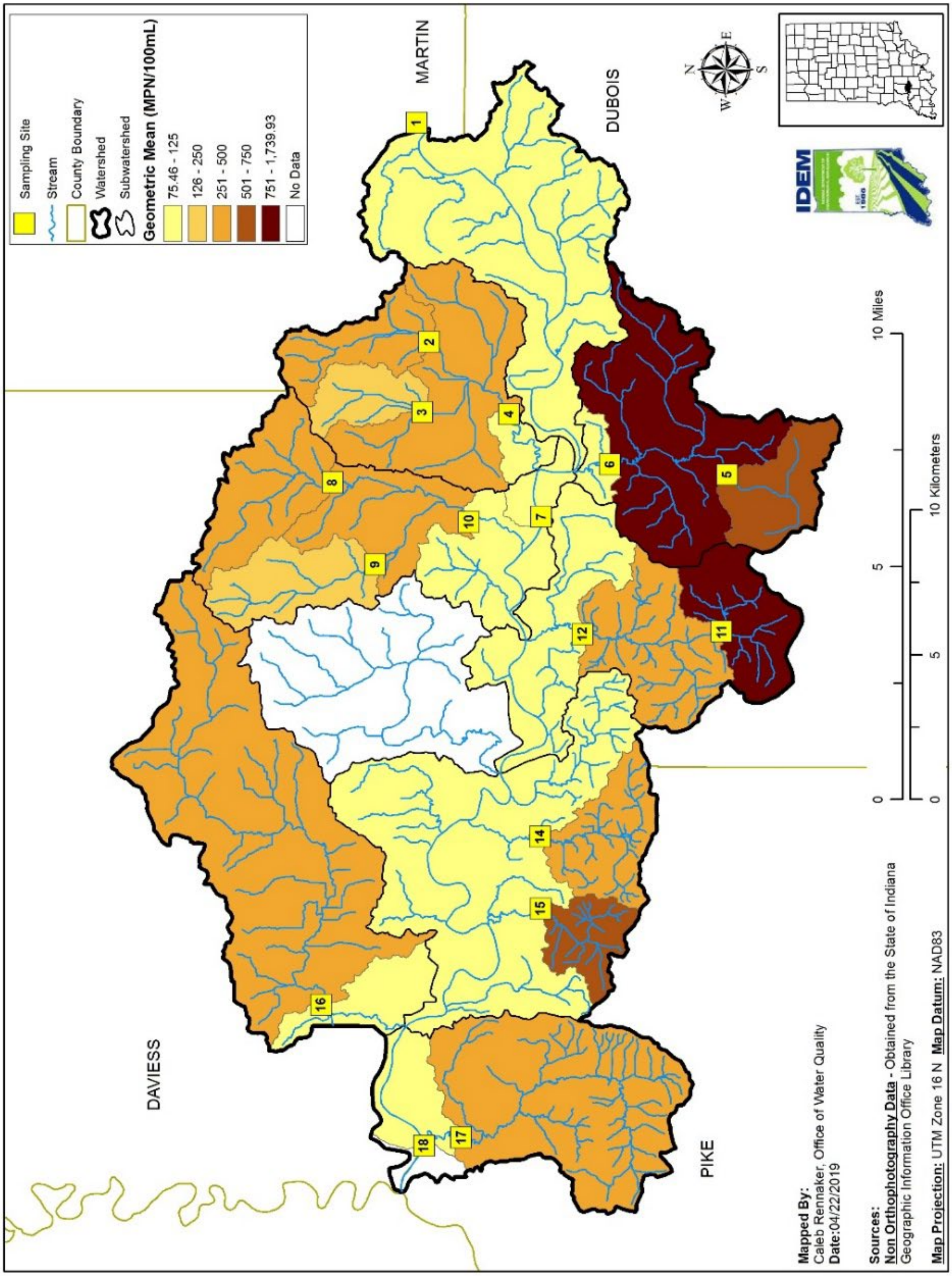
Pathogen data within the LEF White watershed is summarized in Table 62 on page 162 and shown on Figure 86 page 163. The summary displays the maximum concentrations at all impaired stations along with the reduction needed to meet the TMDL. Current data sampled in November 2017 through October 2018 by IDEM were used for the TMDL analysis. The percent reductions were calculated as follows:

$$\% \text{ Reduction} = \frac{\text{Observed Concentration} - \text{Target value or Water Quality Standard}}{\text{Observed concentration}}$$

TABLE # 62 – Summary of LEF White Pathogen Data by Subwatershed										
Subwatershed	Station #	AUID	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Geomean (#/ 100 mL)	Single Sample Maximum (#/ 100 mL)	Percent Reduction Based on Geomean (125/ 100mL)	Percent Reduction Based on SSM (235/100mL)
					125	235				
Mill Creek	WEL-15-0011 (T05)	INW08F1_01	4/9/18-10/15/18	10	50	40	722.1	51,720	82.69	99.55
	WEL-15-0012 (T06)	INW08F1_03	5/21/18-10/15/18	9	100	100	1,739.93	41,060	92.82	99.43
Hoffman Run (US)	WEL-14-0003 (T01)	INW08E7_01	5/21/18-10/15/18	9	11.11	11.11	41.46	1,732.9	0	86.44
Slate Creek	WEL-15-0008 (T02)	INW08F3_02	4/9/18-10/15/18	10	80	60	431.86	15,150	71.06	98.45
	WEL-15-0007 (T04)	INW08F3_03	4/9/18-10/15/18	10	70	50	262.8	4,550	52.44	94.84
	WEL-15-0021 (T03)	INW08F3_T1002	4/9/18-10/15/18	9	55.56	33.33	235.03	>2,419.6	46.82	>90.29
Sugar Creek	WEL-15-0010 (T07) [Hoffman Run (DS)]	INW08F4_01	4/9/18-10/15/18	10	30	20	75.46	>2,419.6	0	90.29
	WEL-15-0018 (T08)	INW08F4_T1004	4/9/18-10/15/18	9	77.78	66.67	320.16	>2,419.6	60.96	>90.29
	WEL-15-0022 (T09)	INW08F4_T1006	4/9/18-10/15/18	10	60	40	233.28	>2,419.6	>46.42	>90.29
	WEL-15-0009 (T10)	INW08F4_T1003	4/9/18-10/15/18	9	88.89	44.44	446.89	12,110	72.03	98.06
Dogwood Lake	WEL-15-0019 (T13)	INW08F5_02	ND	ND	ND	ND	ND	ND	ND	ND
Birch Creek	WEL-15-0013 (T11)	INW08F6_T1006	4/10/18-10/16/18	9	88.89	88.89	767.69	2,419.6	83.72	90.29
	WEL-15-0014 (T12)	INW08F6_T1003	4/10/18-10/16/18	10	80	30	279.24	>2,419.6	>55.24	>90.29
Aikman Creek	WEL170-0008 (T16)	INW08F7_04	4/10/18-10/16/18	10	60	60	360.95	5,910	65.37	96.02
Bear Creek	WEL-15-0015 (T14)	INW08F8_T1008	4/10/18-10/16/18	10	100	80	461.91	>2,419.6	>72.94	>90.29
	WEL-15-0016 (T15)	INW08F8_T1010	4/10/18-10/16/18	10	90	80	698.56	5,200	82.11	95.48
Mud Creek	WEL-15-0020 (T18)	INW08F9_03	4/10/18-10/16/18	10	30	20	115.82	>2,419.6	0	>90.29
	WEL-15-0017 (T17)	INW08F9_T1001	5/22/18-10/16/18	9	88.89	44.44	258.09	3,230	51.57	92.72

ND = No Data; SSM= Single Sample Maximum

FIGURE 86 – *E. coli* CONCENTRATIONS IN LEF WHITE



Chemistry data within the LEF White watershed is summarized on Table 63 below and shown on Figure 87 and 88 on pages 165-166. The table displays the maximum concentrations at all impaired stations along with the reduction needed to meet the TMDL. Current data (TSS, Nutrients, DO) sampled in November 2017 through October 2018 by IDEM were used for the TMDL analysis. The percent reductions were calculated as follows:

$$\% \text{ Reduction} = \frac{\text{Observed Concentration} - \text{Target value or Water Quality Standard}}{\text{Observed concentration}}$$

Figure 87 on page 165 shows Total P Concentrations in LEF White while Figure 88 on page 166 show TSS Concentrations in LEF White.

TABLE # 63 – Summary of LEF White Chemistry Data by Subwatershed

Subwatershed	Sampling Station (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
Mill Creek	WEL-15-0011 Site 5	INW08F1_01	0.19	NA	67	55.22%	6.17	NA
	WEL-15-0012 Site 6	INW08F1_03	0.66	54.55%	1,100	97.27%	5.0	NA
Hoffman Run (Upstream)	WEL-14-0003 Site 1	INW08E7_01	0.27	NA	160	81.25%	5.37	NA
Slate Creek	WEL-15-0008 Site 2	INW08F3_02	0.95	68.42%	430	93.02%	6.04	NA
	WEL-15-0007 Site 3	INW08F3_03	0.97	69.07%	2,200	98.64%	3.34	19.76%
	WEL-15-0021 Site 4	INW08F3_T1002	0.33	9.10%	170	82.35%	5.71	NA
Sugar Creek	WEL-15-0010 Site 7 [Hoffman Run (DS)]	INW08F4_01	0.33	9.10%	550	94.55%	5.84	NA
	WEL-15-0018 Site 8	INW08F4_T1004	0.46	34.78%	480	93.75%	4.65	NA
	WEL-15-0022 Site 9	INW08F4_T1006	0.081	NA	310	90.32%	5.18	NA
	WEL-15-0009 Site 10	INW08F4_T1003	0.76	60.52%	2,100	98.57%	7.03	NA
Dogwood Lake	NA	NA	NA	NA	NA	NA	NA	NA
Birch Creek	WEL-15-0013 Site 11	INW08F6_T1006	0.4	25%	140	78.57%	6.28	NA
	WEL-15-0014 Site 12	INW08F6_T1003	1.0	70%	1,300	97.69%	4.4	NA
Aikman Creek	WEL170-0008 Site 16	INW08F7_04	0.97	69.07%	2,200	98.64%	2.76	44.93%
Bear Creek	WEL-15-0015 Site 14	INW08F8_T1008	0.35	14.29%	280	89.29%	5.27	NA
	WEL-15-0016 Site 15	INW08F8_T1010	0.22	NA	280	89.29%	4.52	NA
Mud Creek	WEL-15-0020 Site 18	INW08F9_03	0.31	3.23%	260	88.46%	5.85	NA
	WEL-15-0017 Site 17	INW08F9_T1001	0.98	69.39%	2,400	98.75%	6.15	NA

FIGURE 87 – TOTAL P CONCENTRATIONS IN LEF WHITE

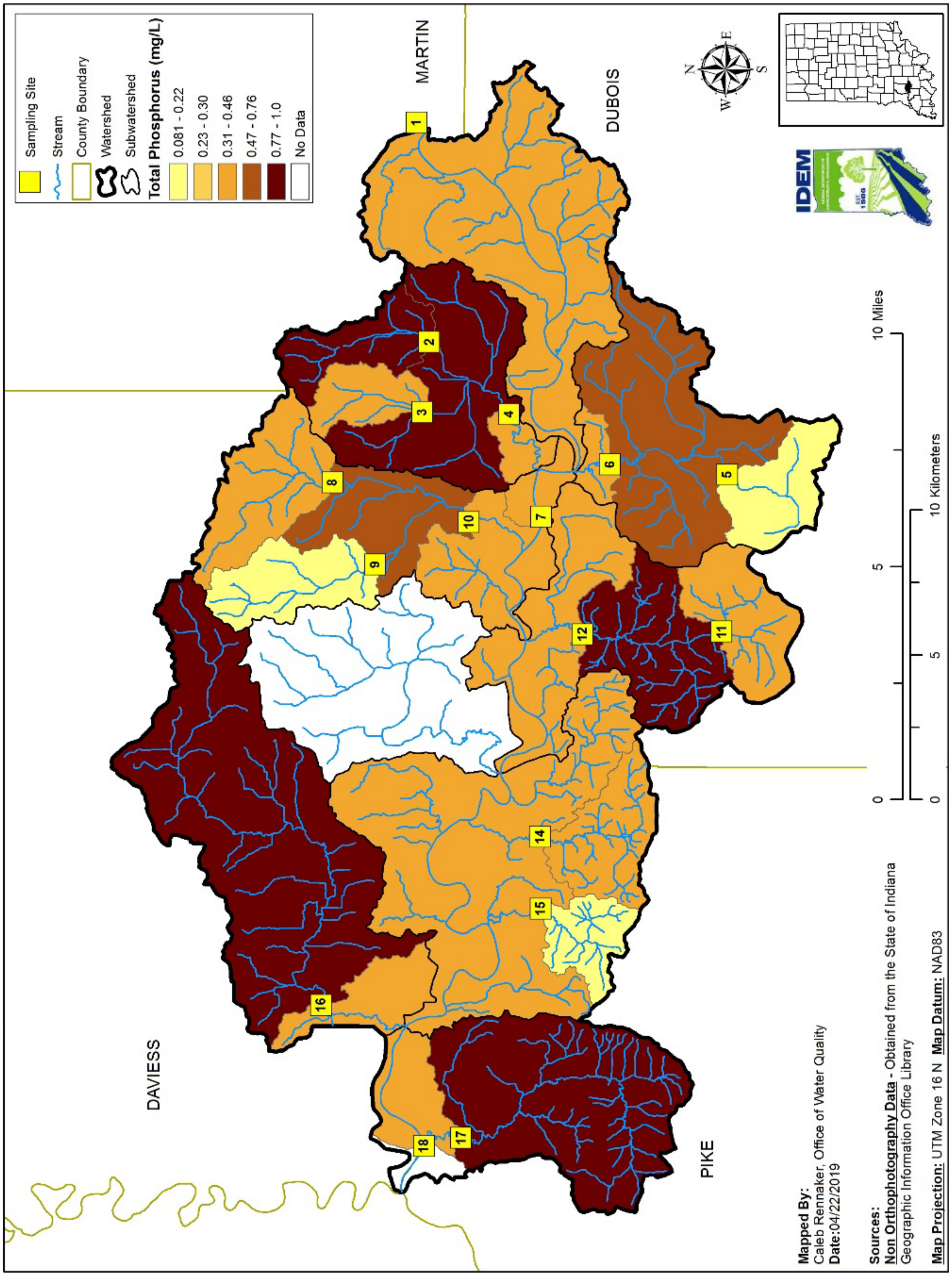
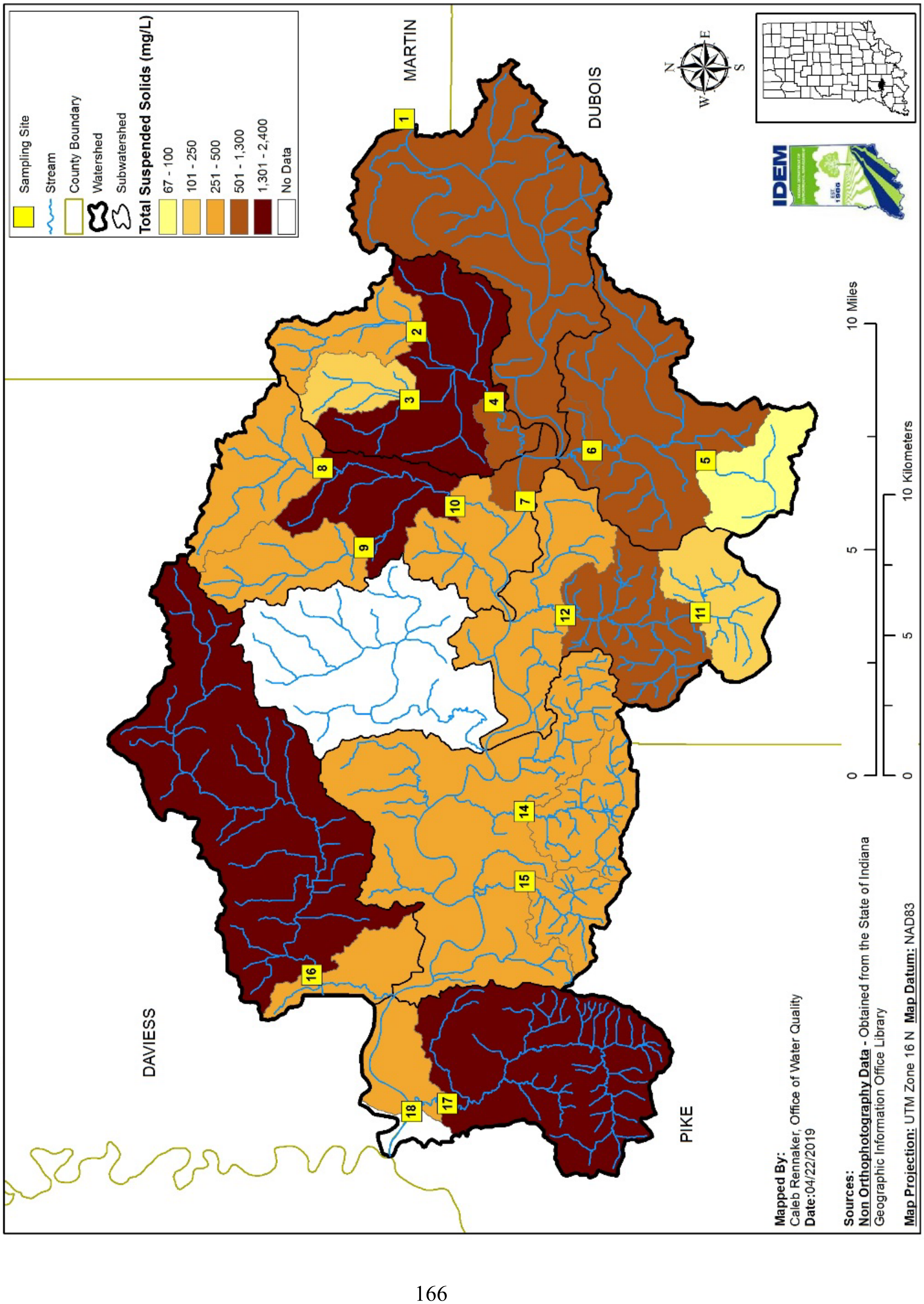


FIGURE 88 – TSS CONCENTRATIONS IN LEF WHITE



Mines Compliance and TSS

The five industrial dischargers associated with active mining activities (Solar Sources Charger Mine, Solar Sources Shamrock Mine, Solar Sources Cannelburg Mine, Peabody Midwest Viking Corning Pit, and Trust Resources Vigo Captain Daviess Mine) are potential sources of TSS.

Trust Resources Vigo Captain Daviess Mine has not currently began mining operations. However, they have been issued permits, and provided a list of outfall locations. The WLA for this facility was estimated by using the total permitted area in absence of bonded acreage data which likely overestimates the actual disturbed area. The discharges at these facilities are the result of stormwater that is collected at the facility and discharged via the permitted discharge pipe. These discharges are permitted by rule under the general permit rule 327 IAC 15-7. 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 are suspended. Individual WLAs for mining facilities are based on a permit limit of 70 mg/L daily max for TSS, and are implemented through compliance with their NPDES permit.

Table 64 on pages 167-168 presents a summary of permit compliance for NPDES facilities in the LEF White watershed for the five-year period of 2014-2018.

TABLE # 64 – Summary of Inspections and Permit Compliance 2014-2018

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Violations for the Last Five Years			
					Permit Feature	Year	Parameter	Exceedance
Mill Creek	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hoffman Run	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slate Creek	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sugar Creek	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Sugar Creek	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	NA	NA	NA	NA
Sugar Creek	Solar Sources Inc. – Cannelburg Mine	ING040026	Sugar Creek	Inspected by IDNR: 2018: 3 times 2017: 3 times 2016: 4 times 2015: 4 times 2014: 4 times	NA	NA	NA	NA
Dogwood Lake	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Mud Creek/Dogwood Lake	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	038 038	2016 2016	total Iron (as Fe) TSS	Daily Avg: 82% Daily Avg: 40%

TABLE # 64 – Summary of Inspections and Permit Compliance 2014-2018								
Subwatershed	**Facility Name**	**NPDES Permit Number**	**Stream**	**Inspections for the Last Five Years**	**Violations for the Last Five Years**			
					Permit Feature	**Year**	**Parameter**	**Exceedance**
Birch Creek	Solar Surces Inc. – Shamrock Mine	ING040210	Birch Creek	Inspected by IDNR: 2018: 2 times 2017: 4 times 2016: 5 times 2015: 2 times 2014: 4 times	004 005 005 006 010 010	2015 2015 2018 2015 2015 2016	total Iron (as Fe) pH pH TSS pH pH	Daily Avg: 7% Daily Max: 2% Daily Max: 8% Daily Avg: 3% Daily Max: 1% Daily Max: 7%
Aikman Creek	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Aikman Creek	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	011 011	2016 2017	total Iron (as Fe) total Iron (as Fe)	Daily Avg: 49% Daily Avg: 33%
	Solar Sources Inc. – Cannelburg Mine	ING040026	Aikman Creek	Inspected by IDNR: 2018: 3 times 2017: 3 times 2016: 4 times 2015: 4 times 2014: 4 times	NA	NA	NA	NA
Bear Creek	Otwell Water Corp.	IN0052086	Bear Creek	12/12/17: Violations observed 7/8/16: Satisfactory 1/12/15: Violations observed	N/A	N/A	N/A	N/A
	Solar Sources Inc. – Shamrock Mine	ING040210	Tributary of E Fork White River	Inspected by IDNR: 2018: 2 times 2017: 4 times 2016: 5 times 2015: 2 times 2014: 4 times	N/A	N/A	N/A	N/A
Mud Creek	Solar Sources Mining, LLC – Charger Mine	ING040129	Mud Creek	Inspected by IDNR: 2018: 6 times 2017: 5 times 2016: 13 times 2015: 7 times 2014: 10 times	N/A	N/A	N/A	N/A

Biological Data
Sampling performed by IDEM in July and August 2018 documented widespread biological impairments in the LEF White watershed as summarized in Table 65 below. Fish community sampling took place at 17 sample sites in the LEF White watershed. Sampling data indicated that the overall biological integrity of the LEF White watershed was fair. Sampling resulted in 11 of the 17 sites failing established criteria for aquatic life support for fish and/or macroinvertebrates.

TABLE # 65 – IBC Stream Segments from 2018 Data									
SW	**Sampling Site**		**Stream Name**	**Score**	**Integrity Class**	**QHEI**	**Score**	**Integrity Class**	**QHEI**
	Site #	**Station ID**		**mIBI**	**mIBI**	**mIBI**	**IBI**	**IBI**	**IBI**
Mill Creek	T05	WEL-15-0011	Mill Creek	38	Fair	43	44	Fair	46
	T06	WEL-15-0012	Mill Creek	38	Fair	52	46	Good	60
Hoffman Run US	T01	WEL-14-0003	East Fork White River	26	Poor	51	16	Very Poor	60
Slate Creek	T02	WEL-15-0008	Slate Creek	30	Poor	39	40	Fair	52
	T04	WEL-15-0007	Slate Creek	38	Fair	48	34	Poor	48
	T03	WEL-15-0021	Tributary of Slate Creek	38	Fair	38	30	Poor	26
Sugar Creek	T07	WEL-15-0010	East Fork White River	32	Poor	46	38	Fair	61
	T08	WEL-15-0018	Sugar Creek	34	Poor	56	34	Poor	57
	T09	WEL-15-0022	West Fork Sugar Creek	38	Fair	44	46	Good	47
	T10	WEL-15-0009	Sugar Creek	38	Fair	63	42	Fair	51
Birch Creek	T11	WEL-15-0013	Birch Creek	32	Poor	41	40	Fair	32
	T12	WEL-15-0014	Birch Creek	38	Fair	62	44	Fair	54
Aikman Creek	T16	WEL170-0008	Aikman Creek	40	Fair	44	28	Poor	41
Bear Creek	T14	WEL-15-0015	Bear Creek	32	Poor	50	36	Fair	55
	T15	WEL-15-0016	Beech Creek	34	Poor	41	44	Fair	52
Mud Creek	T18	WEL-15-0020	East Fork White River	30	Poor	54	16	Very Poor	54
	T17	WEL-15-0017	Mud Creek	40	Fair	51	38	Fair	52

Notes: SW = Subwatershed, 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 Summary of Protocols: Probability Based Site Assessment. (IDEM, 2005). Values in red indicate scores which are not supportive of a healthy aquatic community.

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.

- Total phosphorus can cause excessive plant production resulting in increased turbidity, decrease dissolved oxygen levels, and cause greater fluctuations in diurnal dissolved oxygen and pH levels resulting in lower stream diversity.

Attaining the TSS and total phosphorus target values will address the causes of IBC impairments.

LOAD CALCULATIONS PER SAMPLE SITE

IDEM's TMDL water monitoring data, stream flow data and load calculations previously reported on pages 146-162 only focused on total phosphorus, total suspended solids, and *E.coli* for each of the subwatersheds. Therefore, it was determined to calculate stream flow, nutrient and sediment loads and reductions per sample site. Analysis of sample site data would include nitrogen, which was not a part of the TMDL load duration curve calculations, as well as TSS, total phosphorus, and *E. coli*. It was determined that reviewing data in this manner (per sample site and with the addition of N) could help identify more accurately the critical areas in the LEF White, especially after comparing the data with the TMDL results.

SAMPLE SITE LOAD CALCULATIONS

Since the TMDL water monitoring data contained some sample sites on the main stem of the LEF White River and some sample sites on subwatershed tributaries, the drainage area ***per sample site*** was first calculated in acres and square miles using the measuring tool in IndianaMaps. This is an important aspect of calculating sediment and nutrient loads from the water grab samples per sample site, since stream flow data was not collected at the sample site. Instead, the USGS in-stream gage in Shoals, Indiana was used to mathematically calculate the flow at the sites. See page 84 for more information on the gage at Shoals.

Table 66 on page 171 shows the latitude and longitude of each site, as well as the portion of the watershed or subwatershed represented by that sample site in acres and square miles. When the sample site was in the subwatershed, this is simply a measurement of the drainage basin for that sample site. When the sample site was on the main stem, the subwatershed drainage represented was added to the main stem drainage from upstream.

Site 1 occurs at the start of the LEF White watershed and thus represents all the upstream drainage, but none of the LEF White drainage or impact on data being reviewed for this WMP. Site 1 represents the 5,533.58 square miles of upstream drainage, including Driftwood, Flatrock-Haw, Upper East Fork White as well as Muscatatuck (see page 15).

Site 18 occurs near the mouth of the LEF White as it leaves the Mud Creek subwatershed. At this sample site, 19.9 square miles of the total 21.0 square miles of Mud Creek are represented, as well as all the upstream drainage. Thus, site 18 is a good representation of all of the LEF White this WMP covers as well as the entire upstream drainage; a total of 5,739.9 sq. miles.

Site 7 is on the mainstem at Portersville Bridge and represented only 1.7 sq. miles of Sugar Creek subwatershed, but all of Hoffman Run, Mill Creek and Slate Creek subwatersheds as well as the 5,533.58 sq. miles from upstream. Thus Site 7 represents 5,596 square miles of drainage.

TABLE # 66 –LEF WHITE REPRESENTATIVE DRAINAGE AREAS BY SITE						
Site #	**12-digit HUC at site location**	**Name of Subwatershed**	**Lat / Long of Site**	**Portion of Subwatershed Represented (acres)**	**Portion of Subwatershed Represented (sq. miles)**	**Total sq. mile drainage at site**
1	051202081502	Prior to Hoffman Run (main stem)	38.54118771, -86.8176927	0	0	5,533.58
2	051202081503	Slate Creek	38.5372791, -86.90454648	2,686.1	4.2	4.2
3	051202081503	Slate Creek	38.53954972, -86.93251145	1,807.9	2.8	2.8
4	051202081503	Slate Creek	38.51250174, -86.93335027	11,360.5	17.8	17.8
5	051202081501	Mill Creek	38.44462742, -86.9572646	3,016.3	4.7	4.7
6	051202081501	Mill Creek	38.55422248, -86.99274895	11,732.2	18.37	18.37
7	051202081504	Sugar (main stem)	38.50249408, -86.97378035	1,108.7	1.7	5,596
8	051202081504	Sugar Creek	38.56749827, -86.9603095	3987.2	6.2	6.2
9	051202081504	Sugar Creek	38.48120673, -86.9532425	3,196.2	5.0	5.0
10	051202081504	Sugar Creek	38.52499172, -86.97601645	7,451.2	11.63	11.63
11	051202081506	Birch Creek	38.44632961, -87.01927685	3,380.9	5.3	5.3
12	051202081506	Birch Creek	38.48970169, -87.02040567	8,283.1	12.9	12.9
14	051202081508	Bear Creek	38.50282544, -87.10058146	3,226.3	5.0	5.0
15	051202081508	Bear Creek	38.5026304, -87.12903192	1,966.4	3.1	3.1
16	051202081507	Aikman Creek	38.57095187, -87.167232939	17,036	18.62	18.62
17	051202081509	Mud Creek	38.52720513, -87.2197717	11,437.7	17.9	17.9
18	051202081509	Mud (main stem)	38.53880862, -87.22310507	12,762.6	19.9	5,741

Each sites' EPA assigned ID, name, location in the county and AUID for the 303(d) list is on page 68.

STREAM FLOW @ USGS GAGE USED FOR STREAM FLOW AT SITE
Stream flow data was not collected at each sample site for the TMDL. Therefore, stream flow data was extrapolated from the USGS in stream gage # 03373500 near Shoals, Indiana; using the same formula as the TMDL:

$$\text{Sample Site Stream Flow} = \frac{\text{Drainage area of Sample Site}}{\text{Drainage area of In-Stream Gage}} \times \text{Stream Flow at Gage}$$

STREAM FLOW X CONCENTRATION = DAILY LOADS
To convert daily stream flow and daily concentrations into a daily load is merely a mathematical calculation. The stream flow on day of sample x that day's pollutant concentration gives the daily load readings for that site on that day.

DAILY LOADS INTO ANNUAL LOADS

A variable was used to convert mg/L into lbs./year and colonies/100 mL into colonies/day using the following calculations. For E. coli, the cfu/mL were converted to colonies per day by multiplying stream flow x that day's reading x the constant 24,465,888 which is derived as follows:

$$\square\ \frac{\text{colonies}}{\text{100 mL}} \times \square\ \frac{\text{cf}}{\text{sec}} \times \frac{\text{1000 mL}}{\text{L}} \times \frac{\text{28.317 L}}{\text{cubic ft}} \times \frac{\text{86,4000 sec}}{\text{day}} = \square\ \text{colonies/day}$$

For nutrient and sediment loads, sample site data were converted from mg/L to pounds (lbs.) per year by multiplying stream flow x that day's reading for TSS, P and N x the constant 196.46108064 which was derived from the following equation:

$$\square\ \frac{\text{mg}}{\text{L}} \times \square\ \frac{\text{cf}}{\text{sec}} \times \frac{\text{3,153,600 sec}}{\text{year}} \times \frac{\text{28.317 L}}{\text{cubic ft}} \times \frac{\text{0.0000022 lbs.}}{\text{mg}} = \square\ \text{lbs. / yr.}$$

SITE'S DRAINAGE ACRES AND WEIGHTED LOAD

The drainage area of the sampling site was then compared to the actual subwatershed acres and the annual loads were weighted to correctly represent the 12-digit HUC and not just the sampling site's drainage acres.

For all but Hoffman subwatershed, weighted loads were calculated by first averaging together the annual loads calculated from each sampling event, then weighting the load as follows:

$$\text{Subwatershed average load} = \frac{\text{sampling site average annual load}}{\text{drainage acres of sampling site}} \times \text{Subwatershed drainage acres.}$$

When subwatersheds had one sample site (example Aikman), the one weighted load was recorded on Table 67 on page 173. When the subwatersheds had more than one sample site (example Slate), the weighted loads from all sampling sites were averaged prior to being recorded on Table 67.

For Hoffman Run, load calculations took into consideration the fact that Sample Site 7 was downstream of the actual subwatershed. Water monitoring data from Site 7 were used which includes 5,533.58 sq. miles prior to LEF White watershed, plus 18.73 sq. miles from Slate, 19.57 sq. miles from Mill as well as 1.7 sq. miles from Sugar in addition to the 22.42 sq. miles of Hoffman for a total of 5,596 sq. miles. A constant of .004006433167 (22.42 / 5596) was used to convert the data to be representative of just Hoffman subwatershed. That data was then listed in Table 67 on page 173.

With the table, it is clear to see the subwatersheds more in need of intervention. The information in the table can be compared with the maps on pages 157,159 and 160 which visually represent the same data collected and reported in IDEM's TMDL.

TABLE # 67 – Subwatershed Loads and Reductions Needed				
HUC	**P (lbs./yr.)**	**N (lbs./yr.)**	**TSS (lbs./yr.)**	**E. coli (colonies/day)**
051202081501 Mill Creek				
Current Load	742	28,256	406,670	2.19 E+12
Target Load	1690	5633	56,325	1.65 E+11
Reduction Needed	0	22,623	350,345	2.02 E+12
0512020081502 Hoffman Run				
Current Load	29,356	140,298	14,592,329	1.93 E+12
Target Load	30,407	101,355	1,013,552	2.97 E + 12
Reduction Needed	0	38,943	13,578,777	0
051202081503 Slate Creek				
Current Load	847	28,654	449,340	3.88 E+11
Target Load	1,971	6,568	65,684	1.92 E+11
Reduction Needed	0	22,086	383,656	1.96 E+11
051202081504 Sugar Creek				
Current Load	1,005	8,303	684,025	6.64 E+11
Target Load	2,587	8,622	86,219	2.52 E+11
Reduction Needed	0	0	597,806	4.12 E+11
051202081505 Dogwood Lake				
Current Load				
Target Load				
Reduction Needed				
051202081506 Birch Creek				
Current Load	2,107	54,633	879,105	5.27 E+11
Target Load	2,092	6,975	69,746	2.04 E+11
Reduction Needed	15	47,658	809,359	3.23 E+11
051202081507 Aikman Creek				
Current Load	2,536	24,194	2,341,388	7.28 E+11
Target Load	2,968	9,895	98,947	2.90 E+11
Reduction Needed	0	14,299	2,242,441	4.38 E+11
051202081508 Bear Creek				
Current Load	1,197	42,372	523,086	5.91 E+11
Target Load	2,836	9,455	94,546	2.77 E+11
Reduction Needed	0	32,918	428,540	3.14 E+11
051202081509 Mud Creek				
Current Load	1,846	8,089	1,920,925	3.49 E+11
Target Load	1,533	5,178	51,775	1.52 E+11
Reduction Needed	293	2,912	1,869,150	1.97 E+11

SET GOALS AND IDENTIFY CRITICAL AREAS
22. WATER QUALITY IMPROVEMENT GOAL STATEMENTS
The LEF White steering committee and the Pike SWCD have developed this WMP and it is assumed that the Pike County SWCD will pursue a 319 grant to further implement this plan. However, it is possible that another entity may seek and secure grant or private funding to implement this plan. When speaking of goals and management of future implementation of LEF White WMP, this document will use the language of "grant administrator" to refer to the point person or entity.

The following goals are arranged in various steps, based on the list of Stakeholder Concerns (Table 56, page 148), along with the collected water monitoring data and pollutant loads. The goals represented in this WMP reflect an adaptive resource management approach to load reductions throughout the entire LEF White watershed, by first focusing on the three subwatersheds in Tier One category for more short-term load reduction goals. Mid-term goals will focus on Tier One and Tier Two subwatersheds; while long-term goals will focus on all the critical Tiers of the LEF White River Watershed. See critical map on page 175 for subwatersheds listed by Tiers and page 178-179 for how data was ranked to determine critical subwatershed tiers.

Short Term Load Reduction Goals would include:
1. Reduce sediment loads by at least 10% (1,089 tons) within the next 5 years.
2. Reduce nutrient loads by at least 10% (37,444 lbs.) within the next 5 years.
3. Reduce E. coli loads by 5% (195 E+11colonies) within the next 5 years.
4. Research funding opportunities to implement BMPs and update WQ monitoring data.

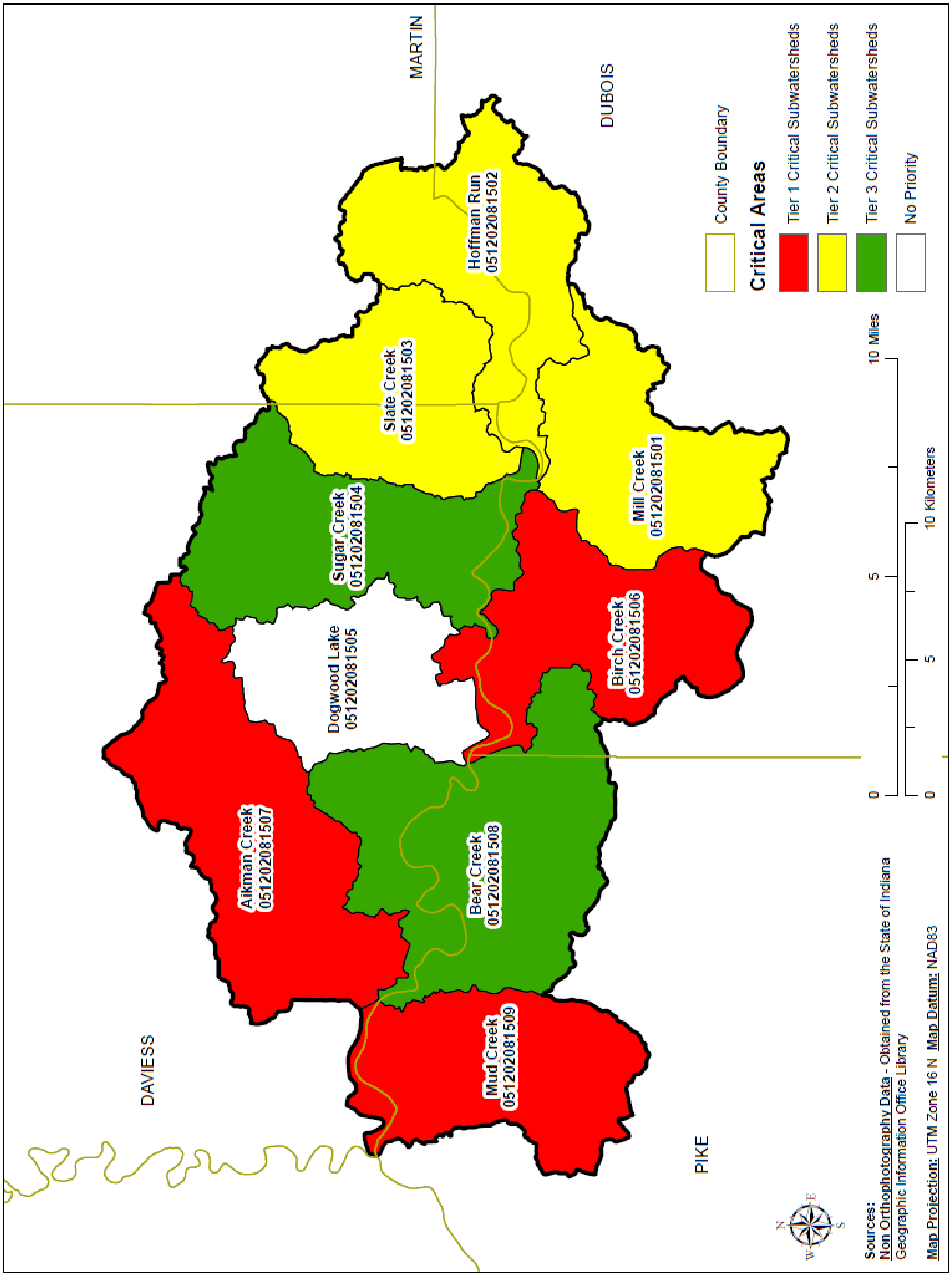
Mid-Term Load Reduction Goals would include:
1. Review past work and assess for changes that need to be made. Make adjustments as needed.
2. Reduce sediment loads by at least 20% (2,179 tons) within the next 10 years.
3. Reduce nutrient loads by at least 20% (74,887 lbs.) within the next 10 years.
4. Reduce E. coli loads by 10% (736.7 E+11 colonies) within the next 10 years.
5. Research funding opportunities to implement BMPs and update WQ monitoring data.

Long-Term Load Reduction Goals for Lower East Fork White Watershed
1. Review past work and assess for changes that need to be made. Make adjustments as needed.
2. Reduce sediment loads by at least 80% (8,719 tons) in LEF White within the next 10-25 years.
3. Reduce nutrient loads by at least 80% (299,548 lbs.) in LEF White within the next 10-25 years.
4. Reduce E. coli loads by 40% (2,946 E + 12) in LEF White within the next 10-25 years.
5. Research funding opportunities to implement BMPs and update WQ monitoring data.

Habitat and Biological Goals
1. Continue to promote programs and conservation practices that establish riparian corridor, wetland habitat and field buffers and filter strips.
2. Document CQHEI and PTI score improvements on 80% of sites in the next 20 years.

Administrative Goals
1. Continue to pursue advantageous partnerships and additional funding sources in order to make improvements throughout LEF White and surrounding watersheds in the future.
2. Continue to promote a variety of BMPs that will help bring about long-term behavioral changes, better land management, and continued conservation throughout the region.

FIGURE 89 – CRITICAL SUBWATERSHEDS



ADAPTIVE RESOURCE MANAGEMENT OF LEF WHITE WMP

As with any goal-based project, an adaptive resource management approach should be used for the LEF White WMP. The grant administrator should work to implement the WMP by aggressively pursuing the goals of the WMP with an adaptive management perspective. This means looking periodically and repetitively at past decisions and adjusting course as deemed necessary. At a minimum, work in the watershed and WMP goals should be reviewed every 5 years.

Adaptive resource management means decisions should meet one or more resource management objective (either passively or actively); while obtaining information needed to improve future management decisions. Thus, this tool gives those working on the implementation of the WMP a way to reach short-term goals and milestones while also gaining knowledge to improve management in the future.

This is one reason mid-term goals start with review and adjust. The first 5 years of implementation of the WMP should enlighten grant administrators through success and failures as to the most pressing needs or changes in the watershed that are not evident (and can't be predicted) at the writing on this WMP. Likewise, for long-term goals, since there is a greater stretch of time (10-25 years), there should be an interim review process around the at the 10-year, 15-year and 20-year mark to further adapt to the needs of the LEF White. It is even likely that there will be a need to revise the WMP prior to long-term goals being implemented. Implementation of the WMP is a learning process in which the grant administrator will have to grow and adjust each year of implementation to best meet long-term goals and outcomes. Adaptive resource management allows the project to proceed in the face of uncertainty, with an aim to reduce uncertainty over time through frequent review and examination. In this way, there is an increase likelihood that the LEF White project will achieve full success.

23. INDICATORS TO MEASURE PROGRESS

To achieve these goals within the stated time frames, objectives have been highlighted. These objectives will provide a clear outline for the best methods to be utilized to accomplish the previously stated goals. Success will be measured by monitoring the indicators listed in the tables.

TABLE # 68 – REDUCE TSS LOADS BY 10% IN 5 YRS in Tier 1 Critical Subwatersheds 20% IN 10 YRS in Tier 1 and 2 Critical Subwatersheds 80% IN 15-20 YEARS across entire LEF White	
OBJECTIVES	**INDICATORS**
Implement 319, LARE, CWI and other cost-share programs to put erosion-reducing BMPs in place.	▪ Tabulate # of BMPs implemented using cost-share program ▪ Measure sediment load reductions for each installed BMP using StepL or Region 5 model. ▪ Continue monitoring turbidity at each site in both high and low flow events, to track improvements. ▪ Continue annual macroinvertebrate monitoring to track success. ▪ Conduct CQHEI at each monitoring site no less than every 3 years to track improvements ▪ Track number of event attendees. ▪ Tillage transects will show increased acreage utilizing cover crops and / or no-till practices.
Promote CRP, WRP, CREP, and programs designed to establish buffers.	
Educate the public about the amount of soil that can be lost from land if reduced tillage is not practiced; promote conservation practices.	
Continue to conduct annual spring tillage transects and fall cover crop transect in Daviess, Dubois, Martin and Pike Counties.	
Work with partners to pool resources for BMP implementation, future water monitoring, and / or widespread public education.	

TABLE # 69 REDUCE NUTRIENT LOADS BY 10% IN 5 YRS in Tier 1 Critical Subwatersheds 20% IN 10 YRS in Tier 1 and 2 Critical Subwatersheds 80% IN 15-25 YEARS across entire LEF White	
OBJECTIVES	**INDICATORS**
Implement 319, LARE, CWI and other cost-share programs to put erosion-reducing BMPs in place.	▪ Tabulate # of BMPs implemented using cost-share program ▪ Measure nutrient load reductions for each installed BMP using StepL or Region 5 model. ▪ Collect total N and P samples using Hoosier Riverwatch methods or lab analysis to indicate improvements. ▪ Continue annual macroinvertebrate monitoring to track success. ▪ Conduct CQHEI at each monitoring site no less than every 3 years to track improvements ▪ Track number of event attendees. ▪ Tillage transects will show increased acreage utilizing cover crops and / or no-till practices.
Promote CRP, WRP, CREP, and programs designed to establish buffers.	
Educate the public about nutrient management strategies; promote conservation practices.	
Continue to conduct annual spring tillage transects and fall cover crop transect in Daviess, Dubois, Martin and Pike Counties.	
Work with partners to pool resources for BMP implementation, future water monitoring, and / or widespread public education.	

TABLE # 70 REDUCE *E. coli* LOADS BY
5% IN 5 YRS in Tier 1 Critical Subwatersheds
10 % IN 10 YRS in Tier 1 and 2 Critical Subwatersheds
40% IN 15-25 YEARS across entire LEF White

OBJECTIVES	INDICATORS
Implement 319, LARE, CWI and other cost-share programs for BMPs that emphasize livestock management such as restricting access to streams and rotational grazing / pasture improvements.	▪ Tabulate # of BMPs implemented using cost-share program ▪ Measure load reductions for each installed BMP using StepL or Region 5 model. ▪ More producers restricting livestock from stream access. ▪ Collect E coli samples using Hoosier Riverwatch methods or lab analysis to track improvements. ▪ Track number of event attendees. ▪ Number of residences upgrading on-site septic systems as indicated by permitting trends.
Promote CRP, WRP, CREP, and programs designed to establish buffers.	
Work with Health Dept. to educate the public regarding septic system maintenance and to promote awareness of impacts of failing systems.	
Continue to conduct annual spring tillage transects and fall cover crop transects in Daviess, Dubois, Martin and Pike Counties.	
Work with partners to pool resources for BMP implementation, future water monitoring, and / or widespread public education.	

TABLE # 71
PROMOTE BMPs AND EDUCATE PUBLIC

OBJECTIVES	INDICATORS
Promote CRP, WRP, CREP, and programs designed to establish buffers.	▪ Track participants in programs such as CRP, CREP, WRP. ▪ Track number of attendees at events and field days as well as social media and website traffic. ▪ Secure continued funding for increased BMP implementation.
Educate the public about buffers, filter strips, grassed waterways, wetlands; promote conservation practices that enhance stream habitat.	
Create, maintain and frequently update a website for the watershed; use Facebook, twitter, Flickr and other social media sites to promote the project and increase attendance at educational events.	
Work with partners to pool resources for workshops, field days, and other public education events.	
Work with local Health Departments and on-site waste system companies to education rural households on septic maintenance and to help identify failing or antiquated systems.	

TABLE # 72 HABITAT AND BIOLOGICAL IMPROVEMENTS	
OBJECTIVES	INDICATORS
Implement 319, LARE, CWI and other cost-share programs for BMPs that address water quality and improved habitat.	▪ Tabulate # of BMPs implemented using cost-share program ▪ Measure load reductions for each installed BMP using StepL or Region 5 model. ▪ More producers restricting livestock from stream access. ▪ Less stream miles in need of buffers. ▪ Improved riparian zones. ▪ Track number of event attendees. ▪ Hoosier Riverwatch data should reflect improved habitat with improved CQHEI scores. ▪ Hoosier Riverwatch macroinvertebrate data should indicate improved pollution tolerance index. ▪ Tillage transects will show habitat improvements throughout watershed.
Promote CRP, WRP, CREP, and programs designed to establish buffers.	
Educate the public about no-till and cover crop practices and streambank protection; promote conservation practices that enhance stream habitat.	
Continue to conduct annual spring tillage transects and fall cover crop transect in Daviess, Dubois, Martin and Pike Counties.	

24. CRITICAL AREAS TO TARGET IMPLEMENTATION

IDEM's TMDL report identified which locations could most benefit from focus on implementation activities. These areas throughout the LEF White watershed are referred to as critical areas. It also provided recommendations on the types of implementation activities, including best management practices (BMPs) that key implementation partners in the LEF White watershed may consider to achieve the pollutant load reductions calculated for each subwatershed.

Tables 73,74, and 75 on pages 179-180 show IDEM's TMDL critical conditions for three parameters for each of the subwatersheds. These conditions may indicate potential critical areas, then BMPs can be identified which have a high degree of effectiveness to achieve the *E. coli*, TSS, and total phosphorus load reductions in those subwatersheds deemed most critical.

TABLE # 73 – CRITICAL CONDITIONS for *E. coli* PARAMETERS

Subwatershed (HUC)	Critical Condition				
	High	Moist	Mid-Range	Dry	Low
Mill Creek (051202081501)	89%	--	99%	90%	--
Hoffman Run (Plaster Creek) (051202081407)	NA	--	NA	78%	--
Slate Creek (051202081503)	26%	--	96%	90%	--
Sugar Creek (051202081504)	66%	--	90%	90%	--
Dogwood Lake (051202081505)	--	--	--	--	--
Birch Creek (051202081506)	NA	90%	90%	66%	--
Aikman Creek (051202081507)	NA	89%	95%	56%	--
Bear Creek (051202081508)	38%	90%	94%	63%	--
Mud Creek (051202081509)	NA	90%	92%	4%	--

TABLE # 74 – CRITICAL CONDITIONS FOR TMDL TOTAL P PARAMETERS					
	Critical Condition				
Subwatershed (HUC)	High	Moist	Mid-Range	Dry	Low
Mill Creek (051202081501) 9.6	NA	40%	NA	NA	--
Hoffman Run (Plaster Creek) (051202081407) 0	NA	NA	NA	NA	--
Slate Creek (051202081503) 12.8	NA	58%	NA	6%	--
Sugar Creek (051202081504) 6.8	NA	34%	NA	NA	--
Dogwood Lake (051202081505) 0	--	--	--	--	--
Birch Creek (051202081506) 17.8	41%	48%	NA	NA	--
Aikman Creek (051202081507) 9.8	NA	49%	NA	NA	--
Bear Creek (051202081508) 2.2	NA	NA	11%	NA	--
Mud Creek (051202081509) 8.8	3%	41%	NA	NA	--

TABLE # 75 – CRITICAL CONDITIONS FOR TMDL TSS PARAMETERS					
	Critical Condition				
Subwatershed (HUC)	High	Moist	Mid-Range	Dry	Low
Mill Creek (051202081501) 36.6	NA	96%	NA	87%	--
Hoffman Run (Plaster Creek) (051202081407) 37.8	70%	79%	36%	74%	--
Slate Creek (051202081503) 38.2	NA	98%	NA	93%	--
Sugar Creek (051202081504) 55.8	74%	96%	15%	94%	--
Dogwood Lake (051202081505) 0	--	--	--	--	--
Birch Creek (051202081506) 39.2	19%	95%	68%	14%	--
Aikman Creek (051202081507) 19.6	NA	98%	NA	NA	--
Bear Creek (051202081508) 32	NA	89%	71%	NA	--
Mud Creek (051202081509) 54.6	65%	99%	54%	55%	--

TMDL AND SAMPLE SITE DATA COMPARISON TO SET CRITICAL SUBWATERSHEDS
However, for the purpose of this WMP, it is necessary to establish set critical areas across the entire watershed in light of all the collected WQ data, including looking at N, habitat and biological data.

Thus, it is necessary to prioritize goals by focusing on a few subwatersheds in short-term goals (to be Tier 1 subwatersheds). Then, once efforts and resources are exhausted and there is a loss of return in time and investment, move to the next few subwatersheds with mid-term goals (to be Tier 2 subwatersheds). Subsequently, efforts should move to the long-term goals (Tier 3 subwatersheds).

Since one subwatershed is critical for TSS load reductions and another is critical for E. coli load reductions, it can be difficult to establish which subwatersheds should be focused on first. To help assess the data and "see" which subwatershed should be in Tier 1, 2 and 3 respectively; subwatersheds were ranked in each of the data categories, with the highest scoring subwatershed being considered the most critical. When all the rankings were added together, it becomes evident which subwatersheds are in most need of intervention. Table 76 showcases the ranking of the subwatersheds.

TABLE # 76 – DATA RANKING TO DETERMINE CRITICAL SUBWATERSHEDS								
SUBWATERSHED / HUC	P	N	TSS	E. coli	mIBI	IBI	TMDL	TOTAL / RANK
Mill Creek 051202081501	2	6	2	9	5	3	8	35 / TIER 2
Hoffman Run 051202081407	2	8	9	2	8	2	2	33 / TIER 2
Slate Creek 051202081503	2	5	3	3	9	9	5	36 / TIER 2
Sugar Creek 051202081504	2	2	5	7	2	8	4	30 / TIER 3
Dogwood Lake 051202081505	1	1	1	1	1	1	1	7 / non-critical
Birch Creek 051202081506	8	9	6	6	4	5	9	47 / TIER 1
Aikman Creek 051202081507	2	4	8	8	6	6	5	39 / TIER 1
Bear Creek 051202081508	2	7	4	5	7	4	3	32 / TIER 3
Mud Creek 051202081509	9	3	7	4	3	7	5	38 / TIER 1

Based on all the data collected by IDEM staff during the writing of the TMDL, it was determined that the following subwatersheds should be ranked into the listed three critical tiers to help focus the BMP implementation efforts in a way to accomplish the desired goals.

Tier 1 Critical Subwatersheds : Birch, Aikman, and Mud
Tier 2 Critical Subwatersheds: Mill, Hoffman and Slate
Tier 3 Critical Subwatersheds: Bear and Sugar

CHOOSE MEASURES / BMPS TO APPLY

25. MEASURES AND BMPS TO ADDRESS GOALS

Several conservation programs are currently available through NRCS, FSA, DNR and ISDA to help remediate some of the LEF White watershed resource concerns. These agencies offer cost-share programs such as EQIP with financial incentives for the implementation of conservation BMPs. Best management practices such as nutrient management, heavy use area protection, exclusion fence and rotational grazing, precision agriculture and no-till planter upgrades, water and sediment control basins (WASCOBs), cover crops, and grassed waterways have all been recognized by those in watershed work as possible remediation measures.

There are several IDEM-approved BMP's that would be appropriate to address the goals of this WMP and to address pollutant load reductions desired. Numerous agricultural BMPs are ideal conservation practices for the problems cited in the Tier 1 critical subwatersheds and include, but are not limited to:

- cover crops and critical area seeding
- nutrient management
- exclusion fence, HUAP, and prescribed grazing
- filter strips, grassed waterways, and WASCOBs
- precision agriculture upgrades, no-till planter upgrades

Many of these BMPs include secondary associated practices, such as subsurface drainage or underground outlets. These practices are designed to be implemented in conjunction with similar

BMPs as a part of a comprehensive systems approach to conservation throughout the watershed.

The NRCS practice numbers for these related practices are listed under the main BMP description on Table 79 (first column). Detailed descriptions and specifications can be found in the NRCS FOTG (Field Office Technical Guide) for Daviess, Dubois, Martin and Pike Counties @ https://efotg.sc.egov.usda.gov/#/details.

IDEM-approved BMPs had load reductions estimated using the Region 5 and Step L pollutant load tools, with minor adjustments made to reflect the soil loss estimated for the watershed area according to the NRCS RUSLE soil loss equation and current tillage transect data which estimates soil loss per acre to be in the range of 1.2 to 6.8 tons/acre/year, depending on land use.

As conservation practices are implemented throughout the watershed, grant administrators can calculate pollutant load reductions quarterly or annually using the Step L and Region 5 load reduction tools. A 319 grant requires quarterly reports to IDEM as well as monthly updates to stakeholders and SWCD board of supervisors. A final report is due at the end of all 319 grants that gives a total pollutant load reduction achieved. Pollutant loads can be tabulated into a comprehensive format so that progress can be tracked and to verify when pollutant load reduction goals are achieved. The verifying of load reductions plays into the adaptive resource management process described earlier on page 165. As stakeholders review pollutant load reductions from BMP implementation, they are obtaining the information needed to improve future management decisions. Grant administrators and stakeholders can learn from successes, failures, challenges and triumphs and make adaptive resource management decisions based on knowledge gain to best work toward the WMP goals. As short-term (5 year) goals are reached, grant administrators and stakeholders can move toward mid-term and long-term goals, adapting decisions based on what has been learned.

26. LOAD REDUCTION EXPECTED FOR EACH BMP

There are several BMPs approved by IDEM that result in load reductions and improved water quality. Table 79 is a list of potential IDEM-approved BMPs and the potential load reductions for each. The LEF White steering committee discussed this list and selected those that had the greatest potential for adoption by producers in the Tier One subwatersheds. Those proposed Tier 1 BMPs are listed in Table 78. The selection decisions were possible due to previous work in the LEF White and contact with stakeholders and producers interested in improving water quality through conservation measures. For the short-term goals, BMPs will be targeted at the three critical subwatersheds in Tier One. As work in the watershed continues, mid-term goals in Tier Two subwatershed can be implemented along with continuing work in Tier One. For long-term goals, the entire LEF White watershed will be targeted.

All load reductions and cost-estimates in Tables 78 and 79 were calculated using the best approved methods and tools. At the time of writing this WMP, an online E. coli load reduction tool was in the early stages of development by IDEM. Those who seek to implement this WMP should research the availability of and use of this load reduction tool to accurately calculate E.coli load reductions resulting from BMP installation. Step L and Region 5 do include reduction efficiencies for septic system maintenance, livestock access restriction, or pasture management. When applicable tools for estimating and calculating E.coli load reductions are made available to the public in the future, adaptive resource management techniques should be used to reevaluated and updated this WMP.

The BMP's proposed for achieving load reductions on Table 78 (page 184) are not required to be implemented exactly as the quantities suggest. These are merely suggestions based on the experience and knowledge of the LEF White steering committee who volunteer and work in the watershed. With "boots on the ground", the LEF White steering committee are knowledgeable of portions of subwatersheds that are lacking certain conservation practices. These BMPs are simply proposed solutions for achieving the WMP's goals and will act as a guideline.

These BMPs were chosen based on the likelihood of adoption as well as current stakeholder interest, and the local expertise of the watershed coordinator and the LEF White steering committee. Practices such as cover crops, no-till planter upgrades, forage and biomass planting, and WASCOBs have been adopted by local producers in past 319 programs in adjacent watersheds and continue to generate interest throughout the LEF White watershed.

The proposed combinations of BMPs in Table 79, could lead to pollutant load reductions that the grant administrators find are reaching the short-term goals. As mentioned earlier, adaptive resource management techniques will help grant administrators adjust and tweak the program. It may be deemed necessary to stray from the proposed list on Table 78 and seek other IDEM-approved BMPs from Table 79.

The ultimate BMP promotion would be a conservation "systems approach". Several practices, such as prescribed grazing and equipment modifications will have load reductions every year after implementation; however, for the purposes of these estimates, will only be counted singly. Likewise, a reduced-till producer who purchases no-till equipment and begins a systematic change to no-till farming will have a life-long effect on the watershed, as the same acreage year after year is no longer disturbed. However, for the purposes of these estimates, BMP practices such no-till equipment will only be counted singly. Thus, in Table 78, when cover crops are listed as potential BMP and a set number of acres are listed, those acres can be planted at any time in the 5-year spread, such as 1,200 acres in a year or 600 acres in two years.

BMP adoption and success is closely tied to the participation of local producers. Continued promotion and conservation planning with a 'systems approach' will be necessary for the successful installation of load-reducing BMPs in the future. Many of the proposed conservation practices are popular or easy to implement and are listed on the suggested BMP table (Table 78). However, WMP implementation is not limited to these few suggestions. Table 79 is a more extensive listing of IDEM approved BMPs.

Long-term strategies for BMP implementation throughout the LEF White watershed are highly dependent on continued promotion of conservation practices in the future. An adaptive resource management approach will need to be applied, starting with Tier One critical areas first. Initial implementation efforts during the first five years of the project will also help encourage widespread continuous adoption of many beneficial cropping practices such as cover crops, no-till, filter strips, and nutrient management. In this expansive manner, goals can realistically be achieved, though difficult to track with exactitude. Future water monitoring may be necessary to verify the extent to which pollutant loads have been reduced.

Table # 77 – Suggested BMPs for Critical Subwatersheds					
Short-Term (5 year) Goals					
Suggested BMP	**UNIT**	**Estimated COST**	**N Reduction lbs. / yr.**	**P Reduction lbs. / yr.**	**Sediment Reduction tons/ yr.**
Cover Crops	1,200 acres	$48,000	10,080	11,520	600
Tillage Management / Upgrades	500 acres	$20,000	6,000	1,500	500
WASCOBs	1 structure	$25,000	50	50	5
Field Border / Filter Strip	50 linear ft	$30,000	1,175	410	15
Grassed Waterway	500 linear ft	$3,000	50	50	50
Forage and Biomass Planting	50 acres	$12,500	650	350	25
Livestock Watering Facility	one structure	$1,500	340	60	1.35
HUAP	100 sq. ft.	$500	400	200	5
TOTAL REDUCTION WITH IMPLEMENTED BMPS			**18,745**	**14,140**	**1,201**

The BMPs suggested in Table 77 can be implemented relatively easily in critical subwatersheds.

The cover crops and tillage management can be focused on the subwatersheds where extensive agricultural fields are planted. Cover crops and reduced tillage practices can assist producers in managing nutrient and pesticide applications as fields stay green throughout the winter months, and producers determine to plant their cash crops into the cover crops rather than till prior to planting.

Livestock and HUAP can be targeted to conservation minded livestock producers.

The field borders and filter strips can be targeted to producers that are farming near streambanks in need of buffers.

Table # 78 IDEM-Approved BMPs Information						
NRCS Practice Number and BMP or Measure	**Critical Areas**	**WQ Concern (Reason Critical**	**Estimated Load Reduction for BMP**			**Estimated Cost / Unit**
			Nitrogen lbs./yr.	**Phosphorus lbs./yr.**	**Sediment tons/yr.**	
472 - Access Control **382 –** Fence linear feet)	(All) Aikman, Birch and Mud	TSS, Nutrients, E. Coli, Habitat, Bio	8.9	3.1	0.1	$2 / linear ft.
528 / 516 / 558 - Prescribed Grazing, Pasture Seeding (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, E. coli, Habitat, Bio.	40	30	0.6	$26 / acre
575 / 578– Animal Trails and Walkways (linear feet)	(All) Aikman, Birch and Mud	TSS, Nutrients, E. coli, Habitat, Bio.	8.9	3.1	0.1	$2 / linear ft.
340 – Cover Crops (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	8.4	9.6	0.5	$40 / acre
327 / 635 – Conservation Cover (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	8.4	9.6	0.5	$40 / acre
342 – Critical Area Planting (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	23.5	8.2	1.0	$500-$2,000 / acre
362 / 606 - Diversion (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	11	4.3	0.2	$ 4 / ft.
386 / 393 / 332 – Field Border / Filter Strip (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	23.5	8.2	0.3	$ 600 / ft.
512 - Forage and Biomass Planting (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	13	7	0.5	$ 100 - $250 / acre
410 – Grade Stabilization Structure (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	2	1	1	$ 50 - $650 / structure
412 – Grassed Waterway (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	0.1	0.1	0.1	$ 6 / ft.
560 / 561 HUAP /Access Protection (sq. ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	4	2	0.05	$ 500 - $2,500 / structure
590- Nutrient Management Plan (single plan / per acre)	(All) Aikman, Birch and Mud	Nutrients, Habitat, Bio	12	n/a	n/a	$ 11 - $30 / acre
345 / 585 – Residue and Tillage Management - Mulch /Strip Till (per acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	10	2	1	$ 40 / acre
329 / 585 – Residue and Tillage Management - No-till (per acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	12	3	1	$ 40 / acre
391 / 390 / 395 Riparian Buffer, Forest, Herbaceous (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	12	6	1	$ 700 - $2,000 / acre
580- Streambank and Shoreline Protection (linear ft.)	(All) Aikman, Birch and Mud	TSS, Habitat, Bio	8.9	3.1	.2	$ 50 / ft.
554 / 587 / 606 / 620 – Drainage Water Management and Water Control Structure (single structure)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	.52	.41	.96	$ 2,000 / structure
600 / 606 / 620 – Terrace (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	26.5	10.4	0.2	$ 3 / ft.
612 / 338 – Tree and Shrub Establishment (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	11.4	4.4	0.5 / acre	$ 700 / acre
638 / 606 / 620 WASCOB (linear ft.)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	0.1	.01	.01	$ 2,000-$25,00 per WASCOB system
614 / 533 / 516 / 574 / 642 – Watering Facility (single structure)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	340	60	1.35	$ 1,500-$8,000 per structure
656 / 658 / 659 / 657 – Wetland Creation, Enhancement, Restoration (acre)	(All) Aikman, Birch and Mud	TSS, Nutrients, Habitat, Bio	9	5	2	$ 400-$5,000 per acre

ACTION REGISTER AND SCHEDULE

27. OBJECTIVES TO ACHIEVE GOALS

To make successful strides toward accomplishing the WMP's goals, and to help lead in the implementation of the WMP, a list of objectives needed have been described in the following action register. The LEF White steering committee and other interested parties can use this Action Register as a tool to track progress. It will also serve as a reference document to periodically consult throughout the project to ensure that all goals will be met in a timely fashion.

GOALS

Short Term Load Reduction Goals for Tier One Subwatersheds would include:
1. Reduce sediment loads by at least 10% in each subwatershed within the next 5 years.
2. Reduce nutrient loads by at least 10% in each subwatershed within the next 5 years
3. Reduce E. coli loads by 5% in each subwatershed within the next 5 years
Mid Term Load Reduction Goals for Tier One and Two Subwatersheds would include:
4. Review past work and assess for changes that need to be made. Make adjustments as needed.
5. Reduce sediment loads by at least 20% in each subwatershed within the next 10 years.
6. Reduce nutrient loads by at least 20% in each subwatershed within the next 10 years
7. Reduce E. coli loads by 10% in each subwatershed within the next 10 years
Long-Term Load Reduction Goals for LEF White Subwatershed
8. Review past work and assess for changes that need to be made. Make adjustments as needed.
9. Seek funding opportunities to implement BMPs and update WQ monitoring data.
10. Reduce sediment loads by 80% in each subwatershed within the next 10-25 years.
11. Reduce nutrient loads by 80% in each subwatershed within the next 10-25 years.
12. Reduce E. coli loads by 40% in each subwatershed within the next 10-25 years.
Habitat and Biological Goals
13. Continue to promote programs and conservation practices that establish riparian corridor, wetland habitat and field buffers and filter strips.
14. Document CQHEI and PTI score improvements on 80% of sites in the next 20 years.
Administrative Goals
15. Continue to pursue advantageous partnerships and additional funding sources in order to make improvements throughout LEF White and surrounding watersheds in the future.
16. Continue to promote a variety of BMPs that will help bring about long-term behavioral changes, better land management, and continued conservation throughout the region.

Organizations and partners listed below are not technically obligated to fulfill requirements as stated. This list is intended to serve as a guideline for current and future steering committee members and other project associates. This Action Register is based on the likelihood of a partnership as well as the group's current interest and involvement at the time of this writing.

Table # 79 – LEF WHITE Action Register for TSS

Goals 1, 5 and 15– Reduce TSS by 10% in the next 5 years and 80% within the next 20-25 years.

Problem Statement: TSS pollutant loads exceed water quality targets.

Objective(s)	Target Audience	Milestone(s)	Cost	Partners and Technical Assistance	Goal Indicator
Implement cost-share program to implement BMPs.	Landowners, Stakeholders, Agricultural Producers, General Public	Develop cost-share program as well as potential participants contact list. Achieve short-term load reduction goal for Tier 1 critical areas. (10% in 5 yrs.) Achieve mid-term load reduction goal for Tier 1 /Tier 2 critical areas. (20% in 10 yrs.) Achieve long-term load reduction goal in all watersheds (80% in 20-25 yrs.)	$2,000 to promote; $240,000 to implement	Partners include steering committee, SWCD board of supervisors, DNR, ISDA, TNC, Hoosier Riverwatch volunteers, Glendale FWS staff, seed and implement dealers, and NRCS. Technical Assistance includes NRCS, ISDA, TNC, local agronomist, Purdue Extension, Hoosier Riverwatch staff	Number of BMPs implemented and participating producers. Sediment load reductions calculated for each BMP. Continued turbidity monitoring; macro, CQHEI and WQI monitoring.
Seek funding source to promote buffer establishment.		Acquire funding and match sources through grant applications and cross-promotion of programs. (5 and 10 year goals)	$100-$500 per acre		Increased # BMPs implemented throughout watershed; increased load reductions; movement toward goal.
Conduct spring and fall tillage transects.		Record tillage transect data and compare records each year. (5, 10, 15, 20, 25 year goal).	$500		Transects reflecting increased cover crop and no-till acres; fewer conventional tilled acres.
Educate public about soil erosion and conservation practices.		Newsletter articles, website updates, brochures distributed, advertise cost-share program, workshops and field days. (Annual goal of 3 x per year)	$2,500		Number of publications distributed, number of individuals on contact list, increased web traffic, attendance at events.
Pool resources with partners for BMP, monitoring and education.		Field day to highlight BMPs, assist with partner workshops and events, acquire additional funding through partnerships. (5-10 year goals)	$1,500		Track attendance at events, observe social media traffic, additional funding secured through CWI, LARE or other sources.

Table # 80 – LEF WHITE Action Register for Nutrients

Goals 2, 6 and 11 – Reduce Nutrient Loads by 10% in the next 5 years and 80% within the next 20-25 years.

Problem Statement: Nutrient pollutant loads exceed water quality targets.

Objective(s)	Target Audience	Milestone(s)	Cost	Partners and Technical Assistance	Goal Indicator
Implement cost-share program to implement BMPs.	Landowners, Stakeholders, Agricultural Producers, General Public	Develop cost-share program as well as potential participants contact list. Achieve short-term load reduction goal for Tier 1 critical areas. (10% in 5 yrs.) Achieve mid-term load reduction goal for Tier 1 /Tier 2 critical areas. (20% in 10 yrs.) Achieve long-term load reduction goal in all watersheds (80% in 20-25 yrs.)	$2,000 to promote; $240,000 to implement	Partners include steering committee, SWCD board of supervisors, DNR, ISDA, TNC, Hoosier Riverwatch volunteers, Glendale FWS, seed and implement dealers, and NRCS. Technical Assistance includes NRCS, ISDA, TNC, local agronomist, Purdue Extension, Hoosier Riverwatch staff	Number of BMPs implemented and participating producers. Total P load reductions calculated for each BMP. N load reductions calculated for each BMP Continued water monitoring; macro, CQHEI and WQI monitoring.
Seek funding source to promote buffer establishment.		Acquire funding and match sources through grant applications and cross-promotion of programs. (5 and 10 year goals)	$100-$500 per acre		Increased # BMPs implemented throughout watershed; increased load reductions; movement toward goal.
Conduct spring and fall tillage transects.		Record tillage transect data and compare records each year. (5, 10, 15, 20, 25 year goal).	$500		Transects reflecting increased cover crop and no-till acres; fewer conventional tilled acres.
Educate public about soil erosion and conservation practices.		Newsletter articles, website updates, brochures distributed, advertise cost-share program, workshops and field days. (Annual goal of 3 x per year)	$2,500		Number of publications distributed, number of individuals on contact list, increased web traffic, attendance at events.
Pool resources with partners for BMP, monitoring and education.		Field day to highlight BMPs, assist with partner workshops and events, acquire additional funding through partnerships. (5-10 year goals)	$1,500		Track attendance at events, observe social media traffic, additional funding secured through CWI, LARE or other sources.

Table # 81 – LEF WHITE Action Register for E. coli					
Goals 3, 7 and 12 – Reduce E. coli Loads by 5% in the next 5 years and 40% within the next 20-25 years.					
Problem Statement: E. coli pollutant loads exceed water quality targets.					
Objective(s)	Target Audience	Milestone(s)	Cost	Partners and Technical Assistance	Goal Indicator
Promote, and when possible fund, conservation practices that emphasize livestock management and implement suggested BMPs when possible.	Landowners, Stakeholders, Agricultural Producers, General Public	Develop cost-share program as well as potential participants contact list. Achieve short-term load reduction goal for Tier 1 critical areas. (2% in 5 yrs.) Achieve mid-term load reduction goal for Tier 1 /Tier 2 critical areas. (4% in 10 yrs.) Achieve long-term load reduction goal in all watersheds (6% in 20-25yrs.)	$2,000 to promote; $200,000 to implement	Partners include steering committee, SWCD board of supervisors, DNR, ISDA, TNC, Hoosier Riverwatch volunteers, Glendale FWS staff, seed and implement dealers, and NRCS. Technical Assistance includes NRCS, ISDA, TNC, local agronomist, Purdue Extension, Hoosier Riverwatch staff, soil scientist, Health Dept. staff	Number of BMPs implemented and participating producers. When possible, calculate E. coli loads and compare to baseline data. Continued water monitoring; macro, CQHEI and WQI monitoring.
Seek funding source to promote buffer establishment.		Acquire funding and match sources through grant applications and cross-promotion of programs. (5 and 10 year goals)	$100-$500 per acre		Increased BMPs implemented throughout watershed; increased load reductions; movement toward goal.
Work with contractors and Health Dept. to promote septic system education		Produce and distribute septic maintenance brochures at events, county fairs, and field days. (Annual goal of 3 x year).	$500		Increased number of residences with upgraded septic systems as indicated per permits.
Educate stakeholders about livestock and pasture management and applicable conservation practices.		Newsletter articles, website updates, brochures distributed, advertise cost-share program, workshops and field days. (Annual goal of 3 x per year)	$2,500		Number of publications distributed, number of individuals on contact list, increased web traffic, attendance at events.
Pool resources with partners for BMP, monitoring and education.		Field day to highlight BMPs, assist with partner workshops and events, acquire additional funding through partnerships. (5-10 year goals)	$1,500		Track attendance at events, observe social media traffic, additional funding secured through CWI, LARE or other sources.

Table # 82 – LEF WHITE Action Register for Riparian and Macros					
Goals 13 and 14 – Promote Riparian and Wetland Habitat to Improve CQHEI and PTI Scores					
Problem Statement: Lack of quality riparian areas with CQHEI and PTI scores below targets.					
Objective(s)	Target Audience	Milestone(s)	Cost	Partners and Technical Assistance	Goal Indicator
Implement 319, CWI and other cost-share programs to implement BMPs that enhance riparian and wetland habitat.	Landowners, Stakeholders, Agricultural Producers, General Public, county officials	Develop cost-share program as well as potential participants contact list. (5-10 year goals) Achieve goal for improved CQHEI and PTI scores within next 20 years.	$2,000 to promote; $100,000 to implement	Partners include steering committee, SWCD board of supervisors, DNR, ISDA, TNC, Hoosier Riverwatch volunteers, Glendale FWS staff, seed and implement dealers, and NRCS. Technical Assistance includes NRCS, ISDA, TNC, local agronomist, Purdue Extension, Hoosier Riverwatch staff, soil scientist, Health Dept. staff	Number of BMPs implemented and participating producers. Continued sediment monitoring to show reduction; macro, CQHEI and WQI scores improve.
Promote CRP, WRP, CREP and other cost-share programs designed to improve riparian and wetland habitat.		New landowners enroll in buffer programs, implement over 2,000 ft. new filter strips in watershed. (5-10 year goals)	$5,000		Sediment load reductions as a result of BMP implementation; macro, CQHEI and WQI scores improve.
Pool resources with partners and pursue additional funding for BMPs monitoring and education.		Assist with partner field days, acquire additional funding sources through partnerships. (5,10,15,20,25 year goals)	$1,500		Track attendance at events, observe social media traffic, additional funding secured through CWI, LARE or other sources, additional BMPs implemented.
Educate public and stakeholders about wetlands, buffers, and streambank conservation.		Newsletter articles, website updates, brochures distributed, advertise cost-share program, workshops and field days. (Annual goal of 3 x per year)	$2,500		Number of publications distributed, number of individuals on contact list, increased web traffic, attendance at events.
Conduct tillage transect in spring and fall.		Record tillage transect data and compare records each year. (5,10,15,20,25 year goalsl)	$500		Transects reflecting increased cover crop and no-till acres; fewer conventional tilled acres.

Table # 83 – LEF WHITE Action Register for BMP Funding and Partnerships					
Goals 9, 15 and 16 – Purse Partnerships and Additional Funding to Promote BMPs					
Problem Statement: Lack of conservation awareness; need for continued funding to promote BMPs					
Objective(s)	Target Audience	Milestone(s)	Cost	Partners and Technical Assistance	Goal Indicator
Improve WQ through better habitats and land management; target non-point sources	Landowners, Stakeholders, Agricultural Producers, General Public, County Officials	Update social media and website with information and statistics to encourage stakeholders to "follow" and to increase "hits". (Quarterly goal)	$250	Partners include steering committee, SWCD board of supervisors, DNR, ISDA, TNC, Hoosier Riverwatch volunteers, Glendale FWS staff, seed and implement dealers, and NRCS. Technical Assistance includes NRCS, ISDA, TNC, local agronomist, Purdue Extension, Hoosier Riverwatch staff, soil scientist, Health Dept. staff	Increased traffic on website and social media; public interest in land management solutions.
Encourage new producers to enroll in cost-share program.		Promote cost-share programs and conservation practices at workshops, field days, county fairs and meetings. (annual goal of 3 x year)	$200		New BMPs installed, pollutant load reductions tabulated, new farmers develop new land management habits.
Pursue mutually beneficial partnerships with local organizations.		Recruit additional steering committee members; stay connected with Glendale FWS staff. (Quarterly goal)	$250		New stakeholders attend meetings.
Educate producers about the benefits of BMPs and conservation.		Organize small group (coffee shop) meetings of producers to discuss BMP challenges and successes and new technology. (Annual goal of 2 x year)	$2,000 to promote; $100,000 for BMPs		Number of small group meetings; number attending the meetings; new BMP installation and pollutant load reductions tabulated.

28. INTERIM MEASURABLE MILESTONES

As grant administrators work toward accomplishing the WMP's goals through BMP implementation and education and outreach, adaptive resource management techniques will be used to measure goals and milestones and adjust accordingly. Measurable milestones can be found for each goal in Tables 80-84. After the short-term goals are targeted in the first 5 years of implementing the WMP, stakeholders in the watershed will focus on mid-term milestones of 10 years, and then move toward long-term goals of 15-25 years. Interim review of goals at 15 years as part of the adaptive resource management approach is critical to the success of the project. Decisions based on past experiences will help stakeholders adjust mid-term, interim and long-term goals. For more on adaptive resource management, see page 176.

29. ESTIMATED FINANCIAL COST

The cost of each BMP is listed as an estimated cost. Table 78 lists a selection of BMPs costing an estimated $140,500. Objectives to help reach the goals of the WMP will be accomplished with grant funding such as 319 grants, CWI grants, LARE grants or foundation grants secured through partners such as TNC. Stakeholders, partners and producers as well as staff will provide match dollars and in- kind services. The estimated cost of each objective is listed in the tables 80-84.

30. POSSIBLE PARTNERS

Possible partners for LEF White watershed goals include Pike County SWCD board of supervisors and office staff; Daviess County SWCD board of supervisors and office staff; Dubois County SWCD board of supervisors and office staff; faithful Lower East Fork White steering committee members particularly The Nature Conservancy and Brad Smith; the Dubois County Health Dept. and Shawn Werner; Pike County Health Dept. and Amanda Howald; several producers in the watershed; and concerned involved citizens and conservation minded stakeholders. Finding the right group of people who are committed to improving water quality and who are willing to volunteer themselves to the effort is the key to the success of this project.

31. TECHNICAL ASSISTANCE NEEDED

Indiana is unique in that it has the Indiana Conservation Partnership (ICP) which is comprised of eight Indiana agencies and organizations that share a common goal of promoting conservation. The mission of the ICP is to provide technical, financial, and educational assistance needed to implement economically and environmentally compatible land and water stewardship decisions, practices and technologies. Those eight agencies include the USDA Natural Resource Conservation Service, USDA Farm Service Agency, Indiana State Dept. of Agriculture, IDEM, Indiana Dept. of Natural Resources, State Soil Conservation Board, the Indiana Association of Soil and Water Conservation, and Purdue University Extension. These eight have a formal memorandum of agreement signed January 2010, which ensures collaboration and assistance between each.

Through the ICP, technical assistance needed to implement the WMP is ensured from NRCS technical staff, NRCS District Conservationist, ISDA and ISDA resource specialist, Purdue Extension staff, and the IDEM watershed specialist. In addition, Daviess, Dubois, Martin and Pike, County SWCDs have solid working relationships with soil scientists, Health Dept. staff, The Nature Conservancy, local agronomists, and Hoosier Riverwatch staff. Having this kind of expertise and commitment to improve water quality in each partner is key to the success of this project.

Federal Programs that can be sought include Clean Water Act Section 319 grants; USDA's Conservation Stewardship Program (CSP); USDA's Conservation Reserve Program (CRP); USDA's Conservation Reserve Enhancement Program (CREP); USDA's Environmental Quality Incentives Program (EQIP); USDA's Farmable Wetlands Program; USDA's Conservation Technical Assistance (CTA) and USDA's Watershed Surveys and Planning among several other programs such as Healthy Forests Reserve Program. State programs are available as well including CWI (Clean Water Indiana) and LARE (Lake and River Enhancement) grants.

TRACKING EFFECTIVENESS

32. STRATEGY TO TRACK EFFECTIVENESS

To determine the overall success and effectiveness of the LEF White Watershed Management Plan over time, milestones must be recorded for future reference.

Tracking Effectiveness of BMPs

To tabulate total load reductions, each BMP associated with 319 funding or other watershed initiative funded projects will be tracked and evaluated by the grant administrator. Depending on the type of BMP installed, a load reduction calculation will be determined using programs such as StepL, Region5, or another approved option. Any of the local county SWCD's present in the watershed may work to implement this WMP or entities interested in water quality in the watershed. Whomever is implementing the WMP will be responsible for calculating and recording the load reductions for each installed BMP as well as overall load reductions for each critical area as time passes.

If the local SWCD is implementing the WMP, load reduction summaries will be provided in annual updates at steering committee meetings, the county SWCD monthly board of supervisors' meetings; as well as at the IASWCD Annual Meetings usually held in January in Indianapolis. In addition, load reduction accomplishments will be highlighted in the all implementation grants' final reports.

Table 78 in this WMP provides information regarding the cost per unit for implementing each BMP, as well as the calculable load reduction for each practice. The load reductions listed are estimates ran through the Region 5 Model. They can only be considered estimates as variables such as soil types for cover crops and slopes / lengths of grassed waterways and WASCOBs are not known and were therefore estimated. The actual load reduction for a project can vary once the project's true and accurate numbers are put into the Region 5 model; or if another load reduction calculation model is used. However, for this WMP, an average was used to provide a fair representation of an estimate load reduction for each BMP. The cost of each BMP is listed as well and is estimated costs per unit. However, the BMPs provided are merely suggestions for guidance when working towards reducing pollutant loads in tier one critical areas (short-term) as well as throughout the entire LEF White watershed (long-term).

The grant administrators can hire a watershed coordinator to oversee the cost-share aspect of any 319 implementation grant secured, though NRCS District Conservationist, NRCS Conservation Technical Team, ISDA Resource Specialists, and other partner personnel may assist with conservation planning, inventory and evaluations, engineering designs, and verification of proper installation.

IDEM 319 funding requirements state that grant applications can only be considered from a municipality, county government, state government, federal government, college/university or a nonprofit 501(c)3. Whether a 319 grant is pursued by Daviess, Dubois, Martin or Pike SWCDs (or some other entity) is yet to be known; however, whomever pursues the grant will be the entity to issue payments and track financial records accordingly.

Water Quality Monitoring
It is known that ongoing water monitoring involving laboratory analysis is often cost-prohibitive. However, stakeholders in the watershed can seek out partnerships with agencies such as The Nature Conservancy to obtain additional funding for periodic lab analyses of water samples in the LEF White.

IDEM fixed station monitoring will be conducted monthly at the pour point for the watershed. IDEM probabilistic monitoring will occur at random selected locations within the East Fork White once every 9 years, and IDEM performance monitoring will occur once sufficient BMP implementation has occurred in the critical areas or once other monitoring has indicated possible improvement in water quality.

Hoosier Riverwatch monitoring will be conducted at the pour points of the Tier 1 critical areas once every 5 years to supplement IDEM monitoring data. HRW monitoring will focus on monitoring macros, CQHEI, turbidity, temperature, pH, flow, and DO. Monitoring results will be compared to data collected during the IDEM baseline monitoring/TMDL project to indicate when performance monitoring is warranted and when water quality improvements have occurred. Monitoring results will also be used to determine when adaptive management needs to occur and when the Watershed Management plan needs to be revised.

The Hoosier Riverwatch loaner kit is available and can be utilized on a regular basis. Monitoring using the HRW loaner kit has been occurring in this watershed since 2005 and no doubt will continue, on a routine basis, with those in the community who are already trained and who understand the program. These dedicated volunteers will continue monitoring for the foreseeable future, as long as HRW continues to offer the free testing supplies.

If a 319 grant is awarded to implement this WMP, then those administering the grant can ensure the continued routine monitoring of the 17 sites in this WMP. Water quality monitoring, assessment of macroinvertebrates and update of CQHEI scores will be a means to assist in management of goals, including establishment of milestones and adaptively changing goals accordingly.

If monitoring ceases, it can be resumed, with comparisons being drawn from the baseline data collected for this WMP. Additionally, other agencies may be monitoring in the area, and partnerships can be cultivated that will result in the sharing of mutually beneficial data.

Social Indicators

Social indicators are difficult milestones as they are often gradual and vague in nature. However, the LEF White watershed has the local SWCDs and the ICP partnership (see page 192) that are dedicated to fostering positive changes when it comes to conservation. Attendance is tracked at SWCD and ICP events and first-time attendees are often noted.

Other tangible ways to observe social indicators include periodic windshield surveys and the fall and spring tillage transects. Attendance at conservation field days, events, fair booths, planter clinics, and annual meetings can indicate interest in conservation as well as social media and online activity observed by ‘hits’ as well as the number of ‘followers’ on Facebook, Twitter, and Flickr. A database of contacts can be maintained, and periodic email updates may be sent. Traffic and inquiries in the USDA service center will also be noted when it comes to specific inquiries related to LEF White watershed resource concerns.

Tracking of Administrative Successes

Administrative successes can be tracked by the goals and milestones clearly outlined in tables in this WMP. Those implementing the WMP can use the Action Register as a guideline when devising strategies for achieving the stated LEF White watershed goals.

If funding for implementation is secured, the grant administrator will be chiefly responsible for tracking and reporting all administrative successes, including load reductions, number of BMPs successfully installed, match/in-kind contributions, database of contacts, online media, and event participation/attendance. The grant administrator will also be responsible for the comprehensive final report expected at the conclusion of each 319 grant.

33. FUTURE WMP EVALUATIONS AND REVISIONS

This WMP is intended to be a resource for interested parties, now and in the future. Data collected via monitoring is funding-dependent; the data collected for this LEF White Watershed Management Plan was completed by IDEM's TMDL and was to establish baseline pollutant loads that would allow the LEF White Steering Committee to prioritize critical areas and make decisions regarding the most efficient courses of action. Monitoring, using Hoosier Riverwatch, should be done a routine basis, along with an annual macroinvertebrate assessment and the CQHEI updated every three years, to supplement data collected for this WMP. Additional water monitoring with lab analysis may take place in the future, if funding permits.

This plan is designed to provide a comprehensive overview of the resource concerns observed within the LEF White watershed at the time of this writing. It may be adapted as future needs require and should be revised when critical areas, load reductions, and/or land uses are believed to have changed significantly in any way. This WMP should be reevaluated every three years and revised after a maximum of 25 years have elapsed. All grant administrators should use adaptive resource management techniques to properly implement this WMP and should look to revise this Watershed Management Plan when changes in the LEF White (or changes in EPA or IDEM rules) deem it necessary to do so.

Any questions regarding this document may be directed to:

Pike County SWCD
2101 E Main Street
Petersburg, IN 47567

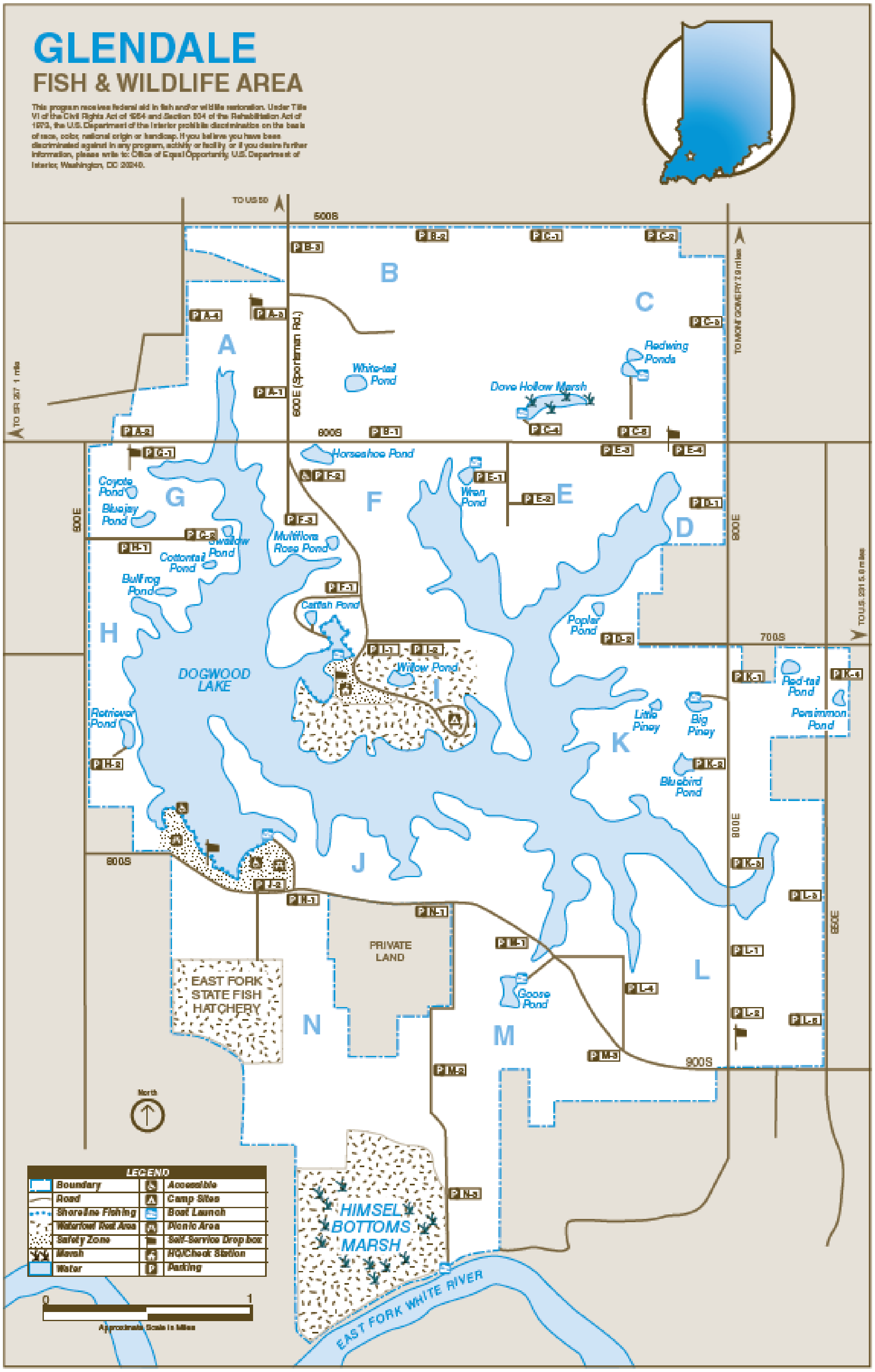
Appendix A

HEL/Potential HEL Total Acres in the Lower East Fork White River Watershed

Map Symbol	HEL/Potential HEL Soil Types	Acres
AbqD3	Adyeville silt loam, 12 to 18 percent slopes, severely eroded	15
AciG	Adyeville-Tipsaw complex, 20 to 60 percent slopes	65
AdA	Alford silt loam, 0 to 2 percent slopes	2
AdB2	Alford silt loam, 2 to 6 percent slopes, eroded	829
AdC2	Alford silt loam, 6 to 12 percent slopes, eroded	521
AfB	Alford silt loam, 2 to 6 percent slopes	380
AfC2	Alford silt loam, 6 to 12 percent slopes, eroded	265
AfE2	Alford silt loam, 15 to 25 percent slopes, eroded	198
AgrB	Apalona-Zanesville silt loams, 2 to 6 percent slopes	1,481
AgrC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	747
AgrC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	356
AgyB	Apalona-Udorthents complex, 2 to 6 percent slopes	2
AlB2	Alford silt loam, 2 to 6 percent slopes, eroded	946
AlC2	Alford silt loam, 6 to 12 percent slopes, eroded	240
AlC3	Alford silt loam, 6 to 12 percent slopes, severely eroded	184
AlD2	Alford silt loam, 12 to 18 percent slopes, eroded	40
AlD3	Alford silt loam, 12 to 18 percent slopes, severely eroded	357
AlE2	Alford silt loam, 18 to 25 percent slopes, eroded	85
AlE3	Alford silt loam, 18 to 25 percent slopes, severely eroded	15
AmoC2	Alvin-Bloomfield loamy fine sands, 4 to 10 percent slopes, eroded	46
AmoE	Alvin-Bloomfield loamy fine sands, 15 to 35 percent slopes	65
AnB	Alvin fine sandy loam, 2 to 6 percent slopes	561
AoC	Alvin-Bloomfield complex, 6 to 15 percent slopes	926
Ar	Armiesburg silty clay loam, occasionally flooded	6
Ba	Bartle silt loam	3,092
Bg	Belknap silt loam, frequently flooded	1,220
BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	248
BgeAW	Birds silt loam, 0 to 1 percent slopes, occasionally flooded, very brief duration	12
Bh	Birds silt loam, occasionally flooded	69
Bk	Birds silt loam, frequently flooded	170
BlB	Bloomfield loamy fine sand, 2 to 6 percent slopes	90
BlC	Bloomfield loamy fine sand, 6 to 12 percent slopes	295
BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	113
BlF	Bloomfield loamy fine sand, 18 to 35 percent slopes	680
Bo	Bonnie silt loam, frequently flooded	1,496
Bu	Burnside silt loam, occasionally flooded	160
CcB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded	375
CcC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	685
CcC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded	1,791
CcD2	Cincinnati silt loam, 12 to 18 percent slopes, eroded	1,070
CcD3	Cincinnati silt loam, 12 to 18 percent slopes, severely eroded	2,262
Ch	Chagrin silt loam, frequently flooded	694
CktF	Chetwynd loam, 18 to 35 percent slopes	9
ClF	Chetwynd silt loam, 25 to 50 percent slopes	45
Cu	Cuba silt loam, frequently flooded	1,060
CwaAH	Cuba silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	22
DbA	Dubois silt loam, 0 to 2 percent slopes	406
DuA	Dubois silt loam, 0 to 2 percent slopes	2,528
DuB	Dubois silt loam, 2 to 6 percent slopes	175
EkA	Elkinsville silt loam, 0 to 2 percent slopes	82
FaB	Fairpoint silt loam, reclaimed, 1 to 15 percent slopes	7,432
FbC	Fairpoint-Bethesda complex, 8 to 15 percent slopes	227
FbG	Fairpoint-Bethesda complex, 25 to 70 percent slopes	326
GacAW	Gatchel loam, 1 to 3 percent slopes, occasionally flooded, very brief duration	218
GbF	Gilpin-Berks complex, 25 to 50 percent slopes	560

Map Symbol	HEL/Potential HEL Soil Types	Acres
GlD2	Gilpin silt loam, 12 to 18 percent slopes, eroded	1,207
GlD3	Gilpin silt loam, 12 to 18 percent slopes, severely eroded	1,637
GlE	Gilpin silt loam, 18 to 25 percent slopes	969
GlE3	Gilpin silt loam, 18 to 25 percent slopes, severely eroded	142
GnE	Gilpin silt loam, 15 to 30 percent slopes	75
GnE3	Gilpin silt loam, 15 to 25 percent slopes, severely eroded	32
GoF	Gilpin-Berks complex, 20 to 50 percent slopes	1,368
GuD	Gilpin-Orthents complex, 12 to 25 percent slopes	7
HbB	Haubstadt silt loam, 1 to 6 percent slopes	1,367
HcgAH	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	24
HcgAW	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	4
Hd	Haymond silt loam, frequently flooded	6,988
HeA	Henshaw silt loam, 0 to 3 percent slopes	147
HkE2	Hickory silt loam, 18 to 25 percent slopes, eroded	1,119
HkF	Hickory silt loam, 18 to 50 percent slopes	1,126
HoA	Hosmer silt loam, 0 to 2 percent slopes	748
HoB2	Hosmer silt loam, 2 to 6 percent slopes, eroded	9,608
HoB3	Hosmer silt loam, 2 to 6 percent slopes, severely eroded	207
HoC2	Hosmer silt loam, 6 to 12 percent slopes, eroded	507
HoC3	Hosmer silt loam, 6 to 12 percent slopes, severely eroded	2,795
HoD2	Hosmer silt loam, 12 to 18 percent slopes, eroded	636
HoD3	Hosmer silt loam, 12 to 18 percent slopes, severely eroded	1,733
IoA	Iona silt loam, 0 to 2 percent slopes	115
IvA	Iva silt loam, 0 to 2 percent slopes	1,805
IvB2	Iva silt loam, 2 to 4 percent slopes, eroded	21
JoA	Johnsburg silt loam, 0 to 2 percent slopes	32
Ln	Lindside silt loam, frequently flooded	487
MaB2	Markland silt loam, 2 to 6 percent slopes, eroded	119
MaD2	Markland silt loam, 6 to 18 percent slopes, eroded	57
MbC3	Markland silty clay loam, 6 to 15 percent slopes, severely eroded	69
MdvC3Q	Markland silty clay loam, 6 to 15 percent slopes, severely eroded, rarely flooded	17
Mg	McGary silt loam	190
MgA	McGary silt loam, 0 to 2 percent slopes	595
MrcG	Minnehaha parachannery silty clay loam, 35 to 75 percent slopes	33
MuA	Muren silt loam, 0 to 2 percent slopes	10
NaeB	Nawakwa silt loam, 2 to 8 percent slopes	189
NaeD	Nawakwa silt loam, 8 to 20 percent slopes	500
NaeF	Nawakwa silt loam, 20 to 35 percent slopes	116
NbhAH	Newark silt loam, 0 to 2 percent slopes, frequently flooded	589
NeD3	Negley loam, 12 to 18 percent slopes, severely eroded	833
NeF	Negley loam, 18 to 50 percent slopes	464
NgC2	Negley silt loam, 6 to 12 percent slopes, eroded	883
NgD2	Negley silt loam, 12 to 18 percent slopes, eroded	553
No	Nolin silt loam, frequently flooded	1,553
NprAH	Nolin silt loam, 0 to 2 percent slopes, frequently flooded	556
OrD	Orthents, 6 to 25 percent slopes	353
OtA	Otwell silt loam, 0 to 2 percent slopes	1,549
OtB	Otwell silt loam, 2 to 6 percent slopes	2,448
OtC2	Otwell silt loam, 6 to 12 percent slopes, eroded	1,028
OtC3	Otwell silt loam, 6 to 12 percent slopes, severely eroded	1,655
OtD3	Otwell silt loam, 12 to 18 percent slopes, severely eroded	1,265
PaB	Parke silt loam, 2 to 6 percent slopes	603
PaC2	Parke silt loam, 6 to 12 percent slopes, eroded	745
PaC3	Parke silt loam, 6 to 12 percent slopes, severely eroded	14
PaD2	Parke silt loam, 12 to 18 percent slopes, eroded	47
PaD3	Parke silt loam, 12 to 18 percent slopes, severely eroded	324
PbbC2	Parke silt loam, 6 to 12 percent slopes, eroded	58
PbbD2	Parke silt loam, 12 to 18 percent slopes, eroded	72
PcB	Pekin silt loam, 2 to 6 percent slopes	127

Map Symbol	HEL/Potential HEL Soil Types	Acres
PcrB	Pekin silt loam, 2 to 6 percent slopes	39
Pe	Peoga silt loam	257
PeB	Pekin silt loam, 2 to 6 percent slopes, rarely flooded	54
PeC2	Pekin silt loam, 6 to 12 percent slopes, eroded, rarely flooded	30
Pg	Peoga silt loam	2,623
PkA	Pike silt loam, 0 to 2 percent slopes	1,063
PkB	Pike silt loam, 2 to 6 percent slopes	782
PlfB	Pike silt loam, 2 to 6 percent slopes	109
PpD3	Pike silt loam, 12 to 18 percent slopes, severely eroded	359
PrA	Princeton fine sandy loam, 0 to 2 percent slopes	261
PrB	Princeton fine sandy loam, 2 to 6 percent slopes	245
PrB2	Princeton fine sandy loam, 2 to 6 percent slopes, eroded	382
PrC	Princeton fine sandy loam, 6 to 12 percent slopes	332
PrC2	Princeton fine sandy loam, 6 to 12 percent slopes, eroded	194
PrD2	Princeton fine sandy loam, 12 to 18 percent slopes, eroded	293
PrF	Princeton fine sandy loam, 20 to 60 percent slopes	307
PryB	Potawatomi silt loam, 1 to 3 percent slopes	19
ReA	Reesville silt loam, 0 to 2 percent slopes	143
Sf	Steff silt loam, frequently flooded	506
SfvB2	Shircliff silty clay loam, 2 to 6 percent slopes, eroded	22
So	Stendal silt loam, frequently flooded	343
Sr	Stendal silt loam, frequently flooded	1,436
St	Stendal silt loam, frequently flooded	3,302
StaAW	Steff silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	69
StdAW	Stendal silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	62
Sw	Stonelick fine sandy loam, frequently flooded	72
SyB2	Sylvan silt loam, 2 to 6 percent slopes, eroded	164
SyC3	Sylvan silt loam, 6 to 12 percent slopes, severely eroded	141
SyF	Sylvan silt loam, 25 to 50 percent slopes	17
TlA	Tilsit silt loam, 0 to 2 percent slopes	12
TlB	Tilsit silt loam, 2 to 6 percent slopes	886
Vg	Vigo silt loam	501
Wa	Wakeland silt loam, frequently flooded	6,625
WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	577
WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	320
WeC2	Wellston silt loam, 6 to 12 percent slopes, eroded	183
WeC3	Wellston silt loam, 6 to 12 percent slopes, severely eroded	7
WeD2	Wellston silt loam, 12 to 18 percent slopes, eroded	1,275
WeD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	1,171
WeE	Wellston silt loam, 15 to 30 percent slopes	746
WeF	Wellston silt loam, 25 to 35 percent slopes	121
WhfB	Wellston silt loam, 2 to 6 percent slopes	24
WhfC2	Wellston silt loam, 6 to 12 percent slopes, eroded	861
WhfD2	Wellston silt loam, 12 to 18 percent slopes, eroded	377
WhfD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	1,156
WokAH	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	307
WokAW	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	235
WpfG	Wellston-Tipsaw-Adyeville complex, 18 to 70 percent slopes	144
WpnE	Wellston-Adyeville complex, 12 to 30 percent slopes	2,622
WprAH	Wirt loam, 0 to 2 percent slopes, frequently flooded, brief duration	360
ZaB2	Apalona-Zanesville silt loams, 2 to 6 percent slopes, eroded	1,277
ZaC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	1,551
ZaC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	757
ZaD2	Zanesville silt loam, 12 to 18 percent slopes, eroded	6
ZaD3	Zanesville silt loam, 12 to 18 percent slopes, severely eroded	49
ZnC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	2,049
ZnC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	46
	Total	**126,337**



GLENDALE
FISH & WILDLIFE AREA
TO US 50
500S
600S
700S
800S
900S
600E (Sportsman Rd.)
500E
800E
850E
A
B
C
D
E
F
G
H
I
J
K
L
M
N
White-tail Pond
Redwing Ponds
Dove Hollow Marsh
Horseshoe Pond
Wren Pond
Coyote Pond
Bluejay Pond
Swallow Pond
Cottontail Pond
Multiflora Rose Pond
Bullfrog Pond
Catfish Pond
Willow Pond
Poplar Pond
DOGWOOD LAKE
Retriever Pond
Little Piney
Big Piney
Red-tail Pond
Persimmon Pond
Bluebird Pond
PRIVATE LAND
EAST FORK STATE FISH HATCHERY
Goose Pond
HIMSEL BOTTOMS MARSH
EAST FORK WHITE RIVER
North
LEGEND
Boundary
Road
Shoreline Fishing
Waterfowl Rest Area
Safety Zone
Marsh
Water
Accessible
Camp Sites
Boat Launch
Picnic Area
Self-Service Drop box
HQ/Check Station
Parking
0
1
Approximate Scale in Miles

ADDITIONAL OPPORTUNITIES

Wetland trapping is available through drawing only. Ask for details.

A dog training area is provided in section F (see map).

Additional hunting opportunities include: dove and waterfowl hunts by drawings and put-and-take pheasant hunts. Advance registration is required for turkey hunting.

Glendale FWA provides 121 camping sites and a comfort station, no reservations are needed. Boat rental and picnic areas are provided.

Accessible hunting areas and fishing piers are available. Ask for details.

Berries, nuts and mushrooms may be gathered from the property.

East Fork State Fish Hatchery is located at Glendale FWA.

FUNDING FOR FISH AND WILDLIFE

The DNR Division of Fish & Wildlife sells hunting, fishing, and trapping licenses. All revenue is used for managing fish and wildlife resources in Indiana. No license money goes into the state general fund.

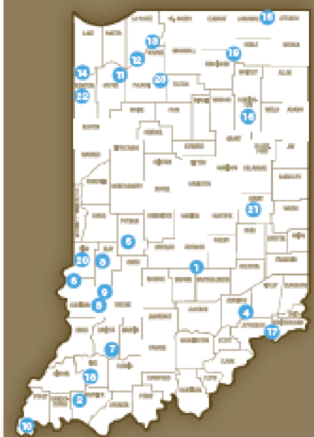
The Division also receives money from the federal Sport Fish and Wildlife Restoration programs (sometimes referred to as Dingell-Johnson and Pittman-Robertson funds). The funds are derived from excise taxes levied on sporting arms and ammunition, bows and arrows, fishing equipment and motor boat fuel. The funds are then returned to state fish and wildlife agencies using a formula that in part is based on the number of fishing and hunting license buyers.

FOR MORE INFORMATION

WRITE: DNR Division of Fish & Wildlife
402 W. Washington Street, W273
Indianapolis, IN 46204
CALL: (317) 232-4200
ONLINE: dnr.IN.gov

wildlife.IN.gov
ONLINE HUNTING TRAPPING AND FISHING LICENSES

INDIANA FISH AND WILDLIFE AREAS



1. Atterbury
2. Blue Grass
3. Chinook
4. Crosley
5. Deer Creek
6. Fairbanks Landing
7. Glendale
8. Goose Pond
9. Hillenbrand
10. Hovey Lake
11. Jasper-Pulaski
12. Kankakee
13. Kingsbury
14. LaSalle
15. Pigeon River
16. J.E. Roush
17. Splinter Ridge
18. Sugar Ridge
19. Tri-County
20. Wabashiki
21. Wilbur Wright
22. Willow Slough
23. Winamac

DNR Indiana Department of Natural Resources

GLENDALE
FISH & WILDLIFE AREA

6001 E. 600 S | Montgomery, IN 47558
(812) 644-7711 | wildlife.IN.gov

Glendale Fish and Wildlife Area is dedicated to providing quality hunting and fishing opportunities while maintaining 8,060 acres of land and over 1,400 acres of lakes and impoundments.

HISTORY

Acquisition of the land, which comprises Glendale Fish and Wildlife Area (FWA) began in 1956, and land purchases were made through the 1960s. Several minor purchases were made in the 1970s. The construction of the dam that formed Dogwood Lake began in 1963 and was completed in 1965. The lake was renovated in 1978 and restocked with fish in 1979. Average depth of Dogwood Lake is 8 feet.

Most revenues used in land acquisition, development, operation and maintenance of Glendale FWA are derived from the sale of hunting, fishing and trapping licenses. Funds are also received from the federal Pittman-Robertson and Dingell-Johnson programs to aid fish and wildlife restoration. These funds are derived from taxes levied on sport hunting and fishing equipment. Indiana hunters and fishermen are proud to provide this property for the enjoyment of all.

RULES AND REGULATIONS

In addition to state fish and wildlife laws, this property is governed by posted regulations affecting the public use of lands and facilities owned, leased or licensed by the Department of Natural Resources.

Posted Areas
Safety zones, refuges, waterfowl resting and other restricted areas are marked with appropriate signs. PLEASE READ AND OBEY ALL SIGNS.

Violations
Violation of any law, rule or regulation governing this property may be cause for forfeiting your hunting, fishing, or visiting privileges on this area.

Responsibility
The Department of Natural Resources Division of Fish and Wildlife will not be held responsible for any accidents or deaths occurring from the use of these facilities.

Permits
In addition to a hunting and/or fishing license the following permits are required:

- Permission to hunt during the day on Glendale Fish and Wildlife Area must be obtained before entering the field. Daily hunt permit cards must be in possession of the hunter and recorded through established self-service procedures outlined at the check station. Self-service drop boxes are located on the property for your convenience.
- Night and predator hunting is only permitted by daily permit cards from the property manager.
- A permit from the fish and wildlife headquarters is required to enter the waterfowl resting areas.
- Collecting permits are required from the property manager or IDNR for the collection of anything except nuts, berries and mushrooms.

Camping
Camping, picnicking, and open campfires are allowed in designated areas only. Unloaded firearms, unstrung bows and arrows, and air guns may be possessed, but not used in camping and picnic areas. All weapons, except validly licensed handguns, must be stored or carried in a case, or locked within a vehicle while in these areas. No swimming is allowed.

Traffic
Traffic on public roads through the area is governed by state and county laws. Traffic over service roads and trails, except by authorized vehicles, is restricted to walking.

FISHING

Glendale Fish and Wildlife Area provides over 1,400 acres of available water — 22 ponds and Dogwood Lake.

No check-in is required for fishing. Some areas including Dogwood Lake are restricted or closed during waterfowl seasons. Ask at headquarters for restrictions.

Primary species include catfish, crappie, bluegill, redear and large mouth bass.

Dove Hollow Marsh, Dogwood Lake and the White River have concrete boat ramps. Big Piney, Horseshoe Pond, Redwing Pond and Wren Pond have gravel boat ramps.

There is no motor size restriction for Dogwood Lake but boat speed is limited to 10 mph or less. All other small impoundments are restricted to oars or trolling motors only.

Horseshoe Pond and Dogwood Lake have disability accessible fishing piers.

Shoreline fishing and fishing piers are located on Dogwood Lake (see map).

See posted signs for large mouth bass size limits on Dogwood Lake. There is a 14-inch minimum size limit for largemouth bass on all small impoundments. All other size and bag limits apply.

HUNTING

Deer, quail, rabbit, squirrel, snipe, dove, woodcock, waterfowl and wild turkey are common at Glendale Fish and Wildlife Area.

Check-in is required. All hunting seasons and bag limits apply. Special hunts include dove and waterfowl hunts by drawing; advance registration is required for spring wild turkey and put-and-take pheasant hunts.

Area F is designated for dog training.

WILDLIFE WATCHING

8,060 acres of upland game habitat, marshes, shallow impoundments, a 1,400-acre lake and small woodlots attract songbirds, woodpeckers, red-tailed hawks, osprey, bald eagles and a wide variety of waterfowl.

CAMPING

Campground includes 67 Class A sites with electrical outlets and 54 Class B sites. Some campsites have fire rings. Firewood is sold at the boat rental concessions. Camping is open all year on a first-come, first-served basis. A picnic area is also available.

The comfort station, located in the campgrounds, provides heated showers and flush toilets. It is open from April 1 to Oct. 31.

Boat rental is located southwest of the check station.

APPENDIX C

Rural and Urban Household Density in the Lower East Fork White River 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)
Mill Creek	Dubois	19.56	2,156	1,298	858	**43.9**	**66.4**
	Total	**19.56**	**2,156**	**1,298**	**858**		
Hoffman Run	Daviess	0.41	0	0	0	**7.4**	**0.0**
	Dubois	11.74	129	0	129		
	Martin	10.27	38	0	38		
	Total	**22.42**	**167**	**0**	**167**		
Slate Creek	Daviess	8.6	94	40	54	**10.2**	**2.1**
	Martin	10.13	137	0	137		
	Total	**18.73**	**231**	**40**	**191**		
Sugar Creek	Daviess	22.54	120	0	120	**5.9**	**0.0**
	Dubois	1.58	22	0	22		
	Martin	0.01	0	0	0		
	Total	**24.13**	**142**	**0**	**142**		
Dogwood Lake	Daviess	16.75	60	0	60	**3.6**	**0.0**
	Total	**16.75**	**60**	**0**	**60**		
Birch Creek	Daviess	1.84	2	0	2	**9.2**	**0.0**
	Dubois	19.96	200	0	200		
	Pike	0.04	0	0	0		
	Total	**21.84**	**202**	**0**	**202**		
Aikman Creek	Daviess	30.41	402	0	402	**13.2**	**0.0**
	Total	**30.41**	**402**	**0**	**402**		
Bear Creek	Daviess	9.7	115	0	115	**10.2**	**0.0**
	Dubois	3.01	19	0	19		
	Pike	19.86	199	0	199		
	Total	**32.57**	**333**	**0**	**333**		
Mud Creek	Daviess	1.18	0	0	0	**10.2**	**0.0**
	Pike	19.7	213	0	213		
	Total	**20.88**	**213**	**0**	**213**		

APPENDIX D

Indiana County Endangered, Threatened and Rare Species List
County: Daviess

Species Name	Common Name	FED	STATE	GRANK	SRANK
Insect: Plecoptera (Stoneflies)					
Acroneuria ozarkensis	Ozark stone		SE	G2	S1
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma torulosa	Tubercled Blossom	LE	SX	GX	SX
Fusconaia subrotunda	Longsolid	C	SX	G3	SX
Lampsilis abrupta	Pink Mucket	LE	SX	G2	SX
Lampsilis ovata	Pocketbook		SSC	G5	S2
Obovaria retusa	Ring Pink	LE	SX	G1	SX
Obovaria subrotunda	Round Hickorynut	C	SE	G4	S1
Pleurobema clava	Clubshell	LE	SE	G1G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema plenum	Rough Pigtoe	LE	SE	G1	S1
Pleurobema rubrum	Pyramid Pigtoe		SX	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Simpsonaias ambigua	Salamander Mussel	C	SSC	G3	S2
Theliderma cylindrica	Rabbitsfoot	LT	SE	G3G4	S1
Mollusk: Gastropoda					
Catinella gelida	Frigid ambersnail			G1Q	SH
Insect: Ephemeroptera (Mayflies)					
Pseudiron centralis	White Crabwalker Mayfly		SE	G5	S1
Siphloplecton interlineatum	Flapless Cleft-footed Minnow Mayfly		ST	G5	S2
Fish					
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Etheostoma maculatum	Spotted Darter		SSC	G2G3	S2S3
Amphibian					
Lithobates areolatus circulosus	Northern Crawfish Frog		SE	G4T4	S2
Reptile					
Crotalus horridus	Timber Rattlesnake		SE	G4	S2
Terrapene carolina carolina	Eastern Box Turtle		SSC	G5T5	S3
Terrapene ornata ornata	Ornate Box Turtle		SE	G5T5	S1
Bird					
Circus hudsonius	Northern Harrier		SE	G5	S2
Haliaeetus leucocephalus	Bald Eagle		SSC	G5	S2
Ixobrychus exilis	Least Bittern		SE	G4G5	S3B
Lanius ludovicianus	Loggerhead Shrike		SE	G4	S3B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Tyto alba	Barn Owl		SE	G5	S2

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting

State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list

GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank

SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List

County: Daviess

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mammal					
Lasiurus borealis	Eastern Red Bat		SSC	G3G4	S4
Lasiurus cinereus	Hoary Bat		SSC	G3G4	S4
Myotis lucifugus	Little Brown Bat	C	SE	G3	S2
Myotis septentrionalis	Northern Long Eared Bat	LT	SE	G1G2	S2S3
Myotis sodalis	Indiana Bat	LE	SE	G2	S1
Nycticeius humeralis	Evening Bat		SE	G5	S1
Perimyotis subflavus	Tricolored Bat		SE	G2G3	S2S3
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Callirhoe triangulata	clustered poppy-mallow		SE	G3	S1
Carex lupuliformis	false hop sedge		ST	G4	S2
Carex oklahomensis	Oklahoma sedge		SE	G4	S1
Carya pallida	sand hickory		SE	G5	S1
Chelone obliqua var. speciosa	rose turtlehead		WL	G4T3	S3
Cornus amomum ssp. amomum	silky dogwood		SE	G5	S1
Cyperus pseudovegetus	green flatsedge		ST	G5	S3
Dichanthelium yadkinense	Yadkin panic-grass		SE	G5T4Q	S1
Fimbristylis puberula	Carolina fimbry		SE	G5	S1
Gaura filipes	slender-stalked gaura		SE	G5	S2
Gymnopogon ambiguus	broadleaf beardgrass		SX	G4	SX
Heterotheca camporum var. camporum	hairy golden-aster		ST	G5TNR	S3
Hypericum adpressum	creeping St. John's-wort		SE	G3	S1
Hypericum gymnanthum	clasping-leaved St. John's-wort		SE	G4	S1
Hypericum virgatum	coppery St. John's-wort		ST	G4?	S2
Isoetes melanopoda	blackfoot quillwort		ST	G5	S2
Juncus scirpoides	scirpus-like rush		ST	G5	S2
Mecardonia acuminata	striped hedge hyssop		SE	G5	S1
Monarda bradburiana	eastern bee-balm		SE	G5	S1
Penstemon tubaeflorus	tube penstemon		SE	G5	S1
Rhexia mariana var. mariana	Maryland meadow beauty		ST	G5T5	S1
Rorippa aquatica	lake cress		SE	G4?	S1
Rudbeckia fulgida var. fulgida	orange coneflower		WL	G5T4?	S3
Sabatia campanulata	slender marsh pink		SX	G5	SX
Schoenoplectiella hallii	Hall's bulrush	C	SE	G2G3	S1
Trichostema dichotomum	forked bluecurl		WL	G5	S3
High Quality Natural Community					
Forest - floodplain wet	Wet Floodplain Forest		SG	G3?	S3
Wetland - flat sand	Sand Flat		SG	G2	S1
Wetland - seep circumneutral	Circumneutral Seep		SG	GU	S1

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List

County: Dubois

Species Name	Common Name	FED	STATE	GRANK	SRANK
Crustacean: Malacostraca					
Orconectes indianensis	Indiana Crayfish		SR	G3	S2
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma torulosa	Tubercled Blossom	LE	SX	GX	SX
Fusconaia subrotunda	Longsolid	C	SX	G3	SX
Obovaria retusa	Ring Pink	LE	SX	G1	SX
Obovaria subrotunda	Round Hickorynut	C	SE	G4	S1
Pleurobema clava	Clubshell	LE	SE	G1G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema rubrum	Pyramid Pigtoe		SX	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Ellipluran: Collembola					
Pseudosinella fonsa	Fountain Cave Springtail		ST	G3G4	S2
Sinella cavernarum	A Springtail		WL	G5	S3
Insect: Odonata (Dragonflies & Damselflies)					
Gomphus hybridus	Cocoa Clubtail		SE	G4	S2
Fish					
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Etheostoma maculatum	Spotted Darter		SSC	G2G3	S2S3
Amphibian					
Acris blanchardi	Blanchard's Cricket Frog		SSC	G5	S4
Ambystoma barbouri	Streamside Salamander	C	SSC	G4	S3
Necturus maculosus	Common mudpuppy		SSC	G5	S2
Reptile					
Agkistrodon piscivorus leucostoma	Western Cottonmouth		SE	G5T5	S1
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Bird					
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Buteo platypterus	Broad-winged Hawk		SSC	G5	S3B
Cistothorus platensis	Sedge Wren		SE	G5	S3B
Haliaeetus leucocephalus	Bald Eagle		SSC	G5	S2
Helmitheros vermivorus	Worm-eating Warbler		SSC	G5	S3B
Ixobrychus exilis	Least Bittern		SE	G4G5	S3B
Lanius ludovicianus	Loggerhead Shrike		SE	G4	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List

County: Dubois

Species Name	Common Name	FED	STATE	GRANK	SRANK
Pandion haliaetus	Osprey		SSC	G5	S1B
Rallus elegans	King Rail		SE	G4	S1B
Setophaga cerulea	Cerulean Warbler		SE	G4	S3B
Setophaga citrina	Hooded Warbler		SSC	G5	S3B
Tyto alba	Barn Owl		SE	G5	S2
Mammal					
Myotis lucifugus	Little Brown Bat	C	SE	G3	S2
Perimyotis subflavus	Tricolored Bat		SE	G2G3	S2S3
Sorex hoyi	Pygmy Shrew		SSC	G5	S2
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Asplenium bradleyi	Bradley's spleenwort		SE	G4	S1
Carex atlantica ssp. capillacea	Howe's sedge		SE	G5T5?	S1
Crataegus viridis var. viridis	green hawthorn		ST	G5T5	S2
Hottonia inflata	featherfoil		ST	G4	S2
Hymenocallis occidentalis	Carolina spider-lily		WL	G4?	S3
Itea virginica	Virginia willow		SE	G4	S1
Limnobium spongia	American frog's-bit		SE	G4	S1
Linum striatum	ridged yellow flax		WL	G5	S3
Oxalis illinoensis	Illinois woodsorrel		WL	G4Q	S3
Passiflora incarnata	purple passion-flower		WL	G5	S3
Poa paludigena	bog bluegrass		ST	G3G4	S3
Ranunculus laxicaulis	Mississippi buttercup		SE	G5?	S1
Rudbeckia fulgida var. fulgida	orange coneflower		WL	G5T4?	S3
Scutellaria parvula var. australis	southern skullcap		WL	G4T4?	S2
Spiranthes vernalis	grassleaf ladies'-tresses		WL	G5	S3
Strophostyles leiosperma	slick-seed wild-bean		WL	G5	S3
Styrax americanus	American snowbell		ST	G5	S3
Thyrsanthella difformis	climbing dogbane		ST	G4G5	S3
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry Shawnee Hills	Shawnee Hills Dry Upland Forest		SG	GNR	S2
Forest - upland dry-mesic Shawnee Hills	Shawnee Hills Dry-mesic Upland Forest		SG	GNR	S3
Forest - upland mesic Shawnee Hills	Shawnee Hills Mesic Upland Forest		SG	GNR	S3
Forest - upland mesic Southern Bottomlands	Southern Bottomlands Mesic Upland Forest		SG	GNR	S1
Forest - upland mesic Southwestern Lowlands	Southwestern Lowlands Mesic Upland Forest		SG	GNR	S1
Primary - cliff sandstone	Sandstone Cliff		SG	GU	S3

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List
County: Dubois

Species Name	Common Name	FED	STATE	GRANK	SRANK
Wetland - seep acid	Acid Seep		SG	GU	S1
Wetland - swamp forest	Forested Swamp		SG	G2?	S2

Indiana County Endangered, Threatened and Rare Species List
County: Martin

Species Name	Common Name	FED	STATE	GRANK	SRANK
Insect: Plecoptera (Stoneflies)					
Acroneuria ozarkensis	Ozark stone		SE	G2	S1
Platyhelminthes (Flatworms)					
Sphalloplana weingartneri	Weingartner's Cave Flatworm		WL	G4	S3
Diplopoda					
Conotyla bollmani	Bollman's Cave Milliped		WL	G5	S3
Crustacean: Malacostraca					
Orconectes inermis inermis	A Troglobitic Crayfish		WL	G5T4	S3
Mollusk: Bivalvia (Mussels)					
Arcidens confragosus	Rock Pocketbook			G4	S2
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma rangiana	Northern Riffleshell	LE	SE	G1	S1
Epioblasma torulosa	Tubercled Blossom	LE	SX	GX	SX
Epioblasma triquetra	Snuffbox	LE	SE	G3	S1
Fusconaia subrotunda	Longsolid	C	SX	G3	SX
Ligumia recta	Black Sandshell		SSC	G4G5	S2
Obovaria retusa	Ring Pink	LE	SX	G1	SX
Obovaria subrotunda	Round Hickorynut	C	SE	G4	S1
Plethobasus cyphyus	Sheepnose	LE	SE	G3	S1
Pleurobema clava	Clubshell	LE	SE	G1G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema plenum	Rough Pigtoe	LE	SE	G1	S1
Pleurobema rubrum	Pyramid Pigtoe		SX	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Simpsonaias ambigua	Salamander Mussel	C	SSC	G3	S2
Theliderma cylindrica	Rabbitsfoot	LT	SE	G3G4	S1
Toxolasma lividus	Purple Lilliput	C	SSC	G3Q	S2
Villosa lienosa	Little Spectaclecase		SSC	G5	S3
Ellipluran: Collembola					
Isotoma truncata	Truncated Springtail		SE	GNR	S1
Onychiurus casus	Fallen Springtail		WL	GNR	S4
Pseudosinella collina	Hilly Springtail		SR	GNR	S2?
Sinella cavernarum	A Springtail		WL	G5	S3
Insect: Coleoptera (Beetles)					
Dryobius sexnotatus	Six-banded Longhorn Beetle		ST	GNR	S2
Insect: Ephemeroptera (Mayflies)					
Ephemerella excrucians	Lowlands Spiny Crawler Mayfly		WL	G5	S3
Labiobaetis longipalpus	Big River Small Minnow Mayfly			G4	S2

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List

County: Martin

Species Name	Common Name	FED	STATE	GRANK	SRANK
Raptoheptagenia cruentata	Predaceous Flat-headed Mayfly		WL	G4	S3
Spinadis simplex	Wallace's Deepwater Mayfly		SE	G2G4	S2
Arachnida					
Hesperochernes mirabilis	Southeastern Cave Pseudoscorpion		WL	G5	S4
Fish					
Acipenser fulvescens	Lake Sturgeon		SE	G3G4	S1
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Etheostoma maculatum	Spotted Darter		SSC	G2G3	S2S3
Amphibian					
Hemidactylium scutatum	Four-toed Salamander		SSC	G5	S2
Necturus maculosus	Common mudpuppy		SSC	G5	S2
Reptile					
Crotalus horridus	Timber Rattlesnake		SE	G4	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Pseudemys concinna concinna	Eastern River Cooter		SE	G5T5	S1
Terrapene carolina carolina	Eastern Box Turtle		SSC	G5T5	S3
Bird					
Accipiter striatus	Sharp-shinned Hawk		SSC	G5	S2B
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Antrostomus vociferus	Whip-poor-will		SSC	G5	S4B
Buteo platypterus	Broad-winged Hawk		SSC	G5	S3B
Chordeiles minor	Common Nighthawk		SSC	G5	S4B
Haliaeetus leucocephalus	Bald Eagle		SSC	G5	S2
Helmitheros vermivorus	Worm-eating Warbler		SSC	G5	S3B
Lanius ludovicianus	Loggerhead Shrike		SE	G4	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Pandion haliaetus	Osprey		SSC	G5	S1B
Setophaga cerulea	Cerulean Warbler		SE	G4	S3B
Setophaga citrina	Hooded Warbler		SSC	G5	S3B
Tyto alba	Barn Owl		SE	G5	S2
Mammal					
Myotis lucifugus	Little Brown Bat	C	SE	G3	S2
Myotis septentrionalis	Northern Long Eared Bat	LT	SE	G1G2	S2S3
Myotis sodalis	Indiana Bat	LE	SE	G2	S1
Neotoma magister	Allegheny Woodrat		SE	G3G4	S2
Perimyotis subflavus	Tricolored Bat		SE	G2G3	S2S3
Sorex fumeus	Smoky Shrew		SSC	G5	S2

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List
County: Martin

Species Name	Common Name	FED	STATE	GRANK	SRANK
Spilogale putorius	Eastern Spotted Skunk		SX	G4	SX
Vascular Plant					
Calamagrostis porteri ssp. porteri	Porter's reedgrass		SE	G4T4	S1
Carex timida	timid sedge		SE	G2G4	S1
Caulophyllum giganteum	giant blue cohosh		SE	G4G5	SU
Cheilanthes lanosa	hairy lipfern		ST	G5	S3
Chelone obliqua var. speciosa	rose turtlehead		WL	G4T3	S3
Crataegus chrysocarpa	fireberry hawthorn		SE	G5	S1
Crepidomanes intricatum	weft fern		SE	G4G5	SU
Dichanthelium yadkinense	Yadkin panic-grass		SE	G5T4Q	S1
Hydrastis canadensis	golden seal		WL	G3G4	S3
Juglans cinerea	butternut		ST	G3	S2
Luzula acuminata var. acuminata	Hairy Woodrush		SE	G5T5	S1
Nothoscordum bivalve	crow-poison		ST	G4	S3
Panax quinquefolius	American ginseng		WL	G3G4	S3
Potamogeton epihydrus	nuttall pondweed		SE	G5	S1
Trichostema dichotomum	forked bluecurl		WL	G5	S3
Trifolium reflexum var. glabrum	buffalo clover		SE	G3G4T2T4Q	S1
Vandenboschia boschiana	filmy fern		SE	G4	S1
Vittaria appalachiana	Appalachian vittaria		ST	G4	S2
Woodwardia areolata	netted chainfern		ST	G5	S3
High Quality Natural Community					
Barrens - bedrock sandstone	Sandstone Glade		SG	G2	S1
Forest - floodplain mesic	Mesic Floodplain Forest		SG	G3?	S1
Forest - upland dry Shawnee Hills	Shawnee Hills Dry Upland Forest		SG	GNR	S2
Forest - upland dry-mesic Shawnee Hills	Shawnee Hills Dry-mesic Upland Forest		SG	GNR	S3
Forest - upland mesic Shawnee Hills	Shawnee Hills Mesic Upland Forest		SG	GNR	S3
Primary - cliff sandstone	Sandstone Cliff		SG	GU	S3
Wetland - seep acid	Acid Seep		SG	GU	S1
Other Significant Feature					
Geomorphic - Nonglacial Erosional Feature - Water Fall and Cascade	Water Fall and Cascade			GNR	SNR

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List

County: Pike

Species Name	Common Name	FED	STATE	GRANK	SRANK
Insect: Plecoptera (Stoneflies)					
Acroneuria ozarkensis	Ozark stone		SE	G2	S1
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma torulosa	Tubercled Blossom	LE	SX	GX	SX
Fusconaia subrotunda	Longsolid	C	SX	G3	SX
Obovaria subrotunda	Round Hickorynut	C	SE	G4	S1
Pleurobema clava	Clubshell	LE	SE	G1G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema plenum	Rough Pigtoe	LE	SE	G1	S1
Pleurobema rubrum	Pyramid Pigtoe		SX	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Simpsonaias ambigua	Salamander Mussel	C	SSC	G3	S2
Theliderma cylindrica	Rabbitsfoot	LT	SE	G3G4	S1
Insect: Coleoptera (Beetles)					
Dynastes tityus	Unicorn Beetle		SR	GNR	S2
Insect: Ephemeroptera (Mayflies)					
Pseudiron centralis	White Crabwalker Mayfly		SE	G5	S1
Siphloplecton interlineatum	Flapless Cleft-footed Minnow Mayfly		ST	G5	S2
Fish					
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Amphibian					
Acris blanchardi	Blanchard's Cricket Frog		SSC	G5	S4
Lithobates areolatus circulosus	Northern Crawfish Frog		SE	G4T4	S2
Reptile					
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Terrapene carolina carolina	Eastern Box Turtle		SSC	G5T5	S3
Bird					
Accipiter striatus	Sharp-shinned Hawk		SSC	G5	S2B
Asio flammeus	Short-eared Owl		SE	G5	S2
Buteo platypterus	Broad-winged Hawk		SSC	G5	S3B
Circus hudsonius	Northern Harrier		SE	G5	S2
Falco peregrinus	Peregrine Falcon		SSC	G4	S2B
Gallinula galeata	Common gallinule		SE	G5	S3B
Haliaeetus leucocephalus	Bald Eagle		SSC	G5	S2
Ictinia mississippiensis	Mississippi Kite		SSC	G5	S1B
Ixobrychus exilis	Least Bittern		SE	G4G5	S3B

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List
County: Pike

Species Name	Common Name	FED	STATE	GRANK	SRANK
Lanius ludovicianus	Loggerhead Shrike		SE	G4	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Nycticorax nycticorax	Black-crowned Night-heron		SE	G5	S1B
Rallus elegans	King Rail		SE	G4	S1B
Setophaga cerulea	Cerulean Warbler		SE	G4	S3B
Tyto alba	Barn Owl		SE	G5	S2
Vermivora chrysoptera	Golden-winged Warbler	C	SE	G4	S1B
Mammal					
Lasiurus borealis	Eastern Red Bat		SSC	G3G4	S4
Myotis septentrionalis	Northern Long Eared Bat	LT	SE	G1G2	S2S3
Myotis sodalis	Indiana Bat	LE	SE	G2	S1
Nycticeius humeralis	Evening Bat		SE	G5	S1
Perimyotis subflavus	Tricolored Bat		SE	G2G3	S2S3
Sylvilagus aquaticus	Swamp Rabbit		SE	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Catalpa speciosa	northern catalpa		ST	G4?	S3
Chelone obliqua var. speciosa	rose turtlehead		WL	G4T3	S3
Cyperus pseudovegetus	green flatsedge		ST	G5	S3
Didiplis diandra	water-purslane		SE	G5	S1
Diodia virginiana	buttonweed		WL	G5	S3
Echinodorus berteroi	tall bur-head		SE	G5	S1
Hottonia inflata	featherfoil		ST	G4	S2
Itea virginica	Virginia willow		SE	G4	S1
Ludwigia decurrens	primrose willow		WL	G5	S3
Mikania scandens	climbing hempweed		SE	G5	S1
Phacelia covillei	buttercup scorpionweed		SE	G3	S1
Phacelia ranunculacea	blue scorpionweed		SE	G4	S1
Potamogeton pusillus	slender pondweed		WL	G5	S2
Rhexia mariana var. mariana	Maryland meadow beauty		ST	G5T5	S1
Sagittaria australis	longbeak arrowhead		ST	G5	S3
Selaginella apoda	meadow spike-moss		WL	G5	S1
Styrax americanus	American snowbell		ST	G5	S3
Thyrsanthella difformis	climbing dogbane		ST	G4G5	S3
Vitis palmata	catbird grape		ST	G4	S3
Wisteria frutescens	American wisteria		ST	G5	S3
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list
GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank
SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; G4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

Indiana County Endangered, Threatened and Rare Species List
County: Pike

Species Name	Common Name	FED	STATE	GRANK	SRANK
Forest - upland dry-mesic Southwestern Lowlands	Southwestern Lowlands Dry-mesic Upland Forest		SG	GNR	S1
Forest - upland mesic Southwestern Lowlands	Southwestern Lowlands Mesic Upland Forest		SG	GNR	S1

APPENDIX E – CFOs in the LEF White Watershed listed by Subwatershed

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type /Permitted #
Mill Creek	1245	T & J Hoffman Farm, LLC	Dubois	Nursery Pigs: 500 Finishers: 1,200
	3884	Mill Creek Farms	Dubois	Nursery Pigs: 500 Finishers: 1,000 Sows: 230 Beef Cattle: 230
	4542	Haysville Mill Farm Incorporated	Dubois	Turkeys: 45,250
	4923	Mike Haase	Dubois	Nursery Pigs: 280 Finishers: 374 Sows: 80
	6296	Weisheit Brothers Farm	Dubois	Nursery Pigs: 1.100 Finishers: 1,600 Sows: 390 Beef Cattle: 50
	6535	Fuhrman Farms	Dubois	Turkeys: 47,400
Hoffman Run	880	Ronald D Divine	Martin	Finishers: 2,480
	2794	Deer Run	Dubois	Layers: 874,110
	3745	Wabash Valley Produce Incorporated Sky View Farm	Dubois	Pullets: 896,896
	3749	D C Poultry Incorporated	Dubois	Turkeys: 54,000
	6446	Farbest Farms Brooder 1	Dubois	Turkeys: 74,800
Slate Creek	3207	Josh & Kristi Ausbrooks	Martin	Finishers: 840
	3554	NSL Farms Incorporated	Martin	Finishers: 4,000
	3648	Matheis Poultry 1	Martin	Layers: 100,000
	3930	Lottes Farms Incorporated	Martin	Finishers: 4,400 Turkeys: 28,000
	4020	Slate Creek Farms	Daviess	Nursery Pigs: 2,600 Finishers: 1,100 Beef Cattle: 230
	4447	Matheis Poultry 2	Martin	Layers: 100,000
	4856	Zach Taylor	Martin	Finishers: 800
	6244	Kopps Turkey Sales Incorporated Caleb Ridge	Martin	Turkeys: 54,000
	6432	White River, LLC Eagle Farms	Martin	Finishers: 20,000

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type /Permitted #
	6539	Farbest Farms Brooder Hub 2	Martin	Turkeys: 99,802
Sugar Creek	132	Mehne Farms Incorporated	Dubois	Finishers: 1,500 Beef Cattle: 500 Beef Calves: 200
	4071	Armes Boys	Daviess	Finishers: 1,200
	6832	For Him Farms	Daviess	Turkeys: 60,000
Birch Creek	2723	Schnarr Farms	Dubois	Nursery Pigs: 1,000 Finishers: 750
	3025	Edward G Barley	Dubois	Finishers: 1,400
	6221	Luther R Mann	Dubois	Nursery Pigs: 550 Finishers: 650 Sows: 250 Boars: 16
Aikman Creek	3961	Don Kendall 4 K Swine Incorporated Jones Farm	Daviess	Finishers: 900
	6534	Mitchell Barber	Daviess	Turkeys: 30,000
	6965	Heartland Turkey Farms, LLC	Daviess	Poults: 40,000
Bear Creek	608	Jay Armes Armes Grain & Livestock	Daviess	Nursery Pigs: 1,015 Finishers: 5,000
	3033	John F Jackle Jackle Farms Incorporated	Dubois	Nursery Pigs: 240 Finishers: 1,080
	4582	Aikman Creek, LLC	Daviess	Turkeys: 54,000

APPENDIX F

Table 1: Hydric Soils by Subwatershed in the Lower East Fork White River Watershed

Subwatershed	Map Symbol	Hydric Soil Types	Acres
Mill Creek	Ba	Bartle silt loam	31
	Bo	Bonnie silt loam	433
	DuA	Dubois silt loam, 0 to 2% slope	993
	DuB	Dubois silt loam, 2 to 6% slope	80
	JoA	Johnsburg silt loam	30
	MgA	McGary silt loam	195
	Mo	Montgomery silty clay loam	100
	No	Nolin silt loam	26
	OtA	Otwell silt loam	734
	Pg	Peoga silt loam	1,345
	Ph	Petrolia silty clay loam	30
	Sf	Steff silt loam	183
	St	Stendal silt loam	1,436
		Total	**5,615**
Hoffman Run	Ba	Bartle silt loam	30
	BgeAH	Birds silt loam	214
	BgeAW	Birds silt loam	5
	Bo	Bonnie silt loam	5
	Ch	Chagrin silt loam	412
	JoA	Johnsburg silt loam	1
	MgA	McGary silt loam	39
	NbhAH	Newark silt loam	589
	No	Nolin silt loam	556
	NprAH	Nolin silt loam	420
	Pg	Peoga silt loam	2
	Ph	Petrolia silty clay loam	15
	Sf	Steff silt loam	68
	St	Stendal silt loam	62
	StdAW	Stendal silt loam	376
	WaaAH	Wakeland silt loam	323
	WaaAW	Wakeland silt loam	32
	ZcaAQ	Zipp silty clay	87
		Total	**3,237**
Slate Creek	Ba	Bartle silt loam	75
	BgeAH	Birds silt loam	33
	BgeAW	Birds silt loam	7
	Bo	Bonnie silt loam	3
	MikAQ	McGary silty clay loam	1
	Sr	Stendal silt loam	1,067
	WaaAH	Wakeland silt loam	254
	WaaAW	Wakeland silt loam	288
	ZcaAQ	Zipp silty clay	4
		Total	**1,733**

Subwatershed	Map Symbol	Hydric Soil Types	Acres
Sugar Creek	Ba	Bartle silt loam	72
	Bo	Bonnie silt loam	12
	Ch	Chagrin silt loam	127
	Mg	McGary silt loam	55
	No	Nolin silt loam	256
	Ph	Petrolia silty clay loam	33
	Sr	Stendal silt loam	319
	Vg	Vigo silt loam	268
	Wa	Wakeland silt loam	669
		Total	**1,810**
Dogwood Lake	Ba	Bartle silt loam	1,427
	Mg	McGary silt loam	20
	Po	Petrolia silty clay loam	137
	Vg	Vigo silt loam	187
	Wa	Wakeland silt loam	777
		Total	**2,548**
Birch Creek	Ba	Bartle silt loam	43
	Bo	Bonnie silt loam	106
	Ch	Chagrin silt loam	153
	DuA	Dubois silt loam	1,416
	DuB	Dubois silt loam	67
	MgA	McGary silt loam	87
	Mo	Montgomery silty clay loam	8
	No	Nolin silt loam	562
	OtA	Nolin silty clay loam	786
	Pg	Otwell silt loam	1,239
	Ph	Peoga silt loam	541
	Sf	Petrolia silty clay loam	188
	St	Steff silt loam	1,306
	Wa	Stendal silt loam	42
		Total	**6,543**
Aikman Creek	Ay	Ayrshire fine sandy loam	26
	Ba	Bartle silt loam	1,106
	IvA	Iva silt loam	1,320
	Ly	Lyles loam	45
	Mg	McGary silt loam	115
	Mo	Montgomery silty clay loam	320
	Pe	Peoga silt loam	14
	Po	Petrolia silty clay loam	289
	Sr	Stendal silt loam	45
	Vg	Vigo silt loam	46
	Wa	Wakeland silt loam	3,340
		Total	**6,666**
Bear Creek	AoC	Alvin-Bloomfield complex	525
	Ay	Ayrshire fine sandy loam	43

Subwatershed	Map Symbol	Hydric Soil Types	Acres
	Ba	Bartle silt loam	306
	Bb	Beaucoup silty clay loam	71
	Bg	Belknap silt loam	91
	Bh	Birds silt loam	44
	Bk	Birds silt loam	163
	Bo	Bonnie silt loam	46
	Ch	Chagrin silt loam	3
	DbA	Dubois silt loam	406
	DuA	Dubois silt loam	119
	DuB	Elkinsville silt loam	29
	EkA	Haymond silt loam	61
	Hd	Iva silt loam	473
	IvA	Lindside silt loam	92
	Ln	Markland silty clay loam	415
	MbC3	McGary silty clay loam	35
	MgA	Montgomery silty clay	137
	Mt	Nolin silt loam	92
	No	Nolin silty clay loam	988
	OtA	Otwell silt loam	29
	Pe	Peoga silt loam	64
	Pg	Petrolia silty clay loam	37
	Ph	Petrolia silty clay loam	229
	Pm	Reesville silt loam	45
	Po	Steff silt loam	70
	ReA	Stendal silt loam	85
	Sf	Wakeland silt loam	45
	So	Alvin-Bloomfield complex	266
	Sr	Ayrshire fine sandy loam	4
	St	Bartle silt loam	184
	Wa	Beaucoup silty clay loam	1,399
		Total	**6,594**
Mud Creek	AoC	Alvin-Bloomfield complex	401
	Ar	Armiesburg silty clay loam	6
	Ay	Ayrshire fine sandy loam	136
	Ba	Bartle silt loam	1
	Bb	Beaucoup silty clay loam	74
	Bg	Belknap silt loam	1,129
	Bh	Birds silt loam	25
	Bk	Birds silt loam	7
	Bo	Bonnie silt loam	212
	EkA	Elkinsville silt loam	21
	Hd	Haymond silt loam	278
	Ln	Lindside silt loam	72
	MbC3	Markland silty clay loam	34
	MgA	McGary silty clay loam	136
	Mt	Montgomery silty clay	24

Subwatershed	Map Symbol	Hydric Soil Types	Acres
	No	Nolin silty clay loam	552
	Pe	Peoga silt loam	179
	Ph	Petrolia silty clay loam	138
	Pm	Petrolia silty clay loam	13
	Po	Reesville silt loam	109
	ReA	Steff silt loam	58
	Sf	Stendal silt loam	23
	So	Wakeland silt loam	77
	Wa	Alvin-Bloomfield complex	399
		Total	**4,103**

RESOURCES and REFERENCES:

Indiana State Department of Health – Environmental Public Health, Diseases Involving Sewage, Rev. 10/5/09 on the web @ http://www.in.gov/isdh/22963.htm

Indiana State Department of Health – Epidemiology Resource Center, Quick Facts on E coli. For more information, refer to http://www.cdc.gov/ecoli/.

Watershed Management Plan for Turtle Creek Watershed, Turman Creek Watershed and Kelly Bayou Watershed; West Central Indiana Watershed Alliance, Sullivan County SWCD, Sullivan, Indiana, December 2015.

Acronyms List

AFO	Animal Feeding Operation
AMD	Acid Mine Drainage
AML	Acid Mine Lands
AUIDs	Assessment Unit Identifications
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CFO	Confined Feeding Operation
CFU	Colony Forming Unit
CQHEI	Citizens Qualitative Habitat Evaluation Index
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWI	Clean Water Indiana
DMR	Data Monitoring Report
DO	Dissolved Oxygen
DOR	Division of Reclamation
EQIP	Environmental Quality Incentives Program
FOTG	Field Office Technical Guide
FSA	Farm Service Agency
EPA	United States Environmental Protection Agency
FWA	Fish and Wildlife Area
FWS	United States Fish and Wildlife Service
GIS	Geographical Information System
HEL / HES	Highly Erodible Lands / Highly Erodible Soils
HRW	Hoosier RiverWatch
HUC	Hydrological Unit Code
IAC	Indiana Administrative Code
IASWCD	Indiana Association of Soil and Water Conservation Districts
IBC	Impaired Biotic Community
IBI	Indices of Biotic Integrity
ICP	Indiana Conservation Partnership
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IKC	Indiana Karst Conservancy
ISDA	Indiana State Department of Agriculture
ISDH	Indiana State Department of Health
LARE	Lake and River Enhancement Program
LAs	Load Allocations
LEF White	Lower East Fork White River Watershed
LUST	Leaking Underground Storage Tank
mIBI	Macroinvertebrate Indices of Biotic Integrity
MOS	Margin of Safety
MS4	Municipal Separate Stormwater Sewer System
NPDES	National Pollution Discharge Elimination System

NRCS	Natural Resources Conservation Service
NMP	Nutrient Management Plan
NWI	National Wetland Inventory
ppm	Parts per Million
PWS	Public Water Source
QAPP	Quality Assurance Project Plan
SMCRA	Surface Mining Control and Reclamation Act
SSM	Single Sample Maximum
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Loads
TNC	The Nature Conservancy
TSS	Total Suspended Solids
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WASCoB	Water and Sediment Control Basin
WLAs	Waste Load Allocations
WMP	Watershed Management Plan
WQ	Water Quality