LOWER ELKHART RIVER WATERSHED MANAGEMENT PLAN
ELKHART, KOSCIUSKO, AND NOBLE COUNTIES, INDIANA

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1.0 WATERSHED INTRODUCTION

1.1 Watershed Community Initiative

A watershed is the land area that drains to a common point, such as a location on a river. All of the water that falls on a watershed will move across the landscape collecting in low spots and drainageways until it moves into the waterbody of choice. All activities that take place in a watershed can impact the water quality of the river that drains it. What we do on the land, such as constructing new buildings, fertilizing lawns, or growing crops, affects the water and the ecosystem that lives in it. A healthy watershed is vital for a healthy river, and a healthy river can enhance the community and help maintain a healthy local economy. Watershed planning is especially important in that it will help communities and individuals determine how best to preserve water functions, prevent water quality impairment; and produce long-term economic, environmental, and political health.

The Lower Elkhart River Watershed receives water from the Upper Elkhart River Watershed (Figure 1). In total, the Upper Elkhart River Watershed drains 403 square miles. The watershed includes drainage from the Towns of Wolcottville, Millersburg, Rome City, Albion and Cromwell and Cities of Ligonier and Kendallville. The Upper Elkhart River Watershed includes three 10-digit hydrologic unit codes (HUCs): 0405000115 (North Branch Elkhart River), 0405000116 (South Branch Elkhart River) and 0405000118 (Solomon Creek). The Upper Elkhart River Watershed gains water from the North and South Branches of the Elkhart River, which join east of the City of Ligonier to form the mainstem of the Elkhart River. Solomon Creek joins the Elkhart River northeast of New Paris. The Lower Elkhart River Watershed drains an additional 295 square miles and begins south of Goshen near New Paris. The Lower Elkhart River Watershed includes two 10-digit hydrologic unit codes (HUCs): 0405000117 (Turkey Creek) and 0405000119 (Elkhart River) and contains 389 miles of streams. Major tributaries include Turkey Creek, Omar-Neff Ditch, Skinner Ditch, Rock Run Creek, Yellow Creek, and Keiffer Ditch. The Elkhart River continues north and west through the Cities of Goshen and Elkhart to join with the St. Joseph River in downtown Elkhart. The St. Joseph River then flows west and then north into the State of Michigan before emptying into Lake Michigan (Figure 2).

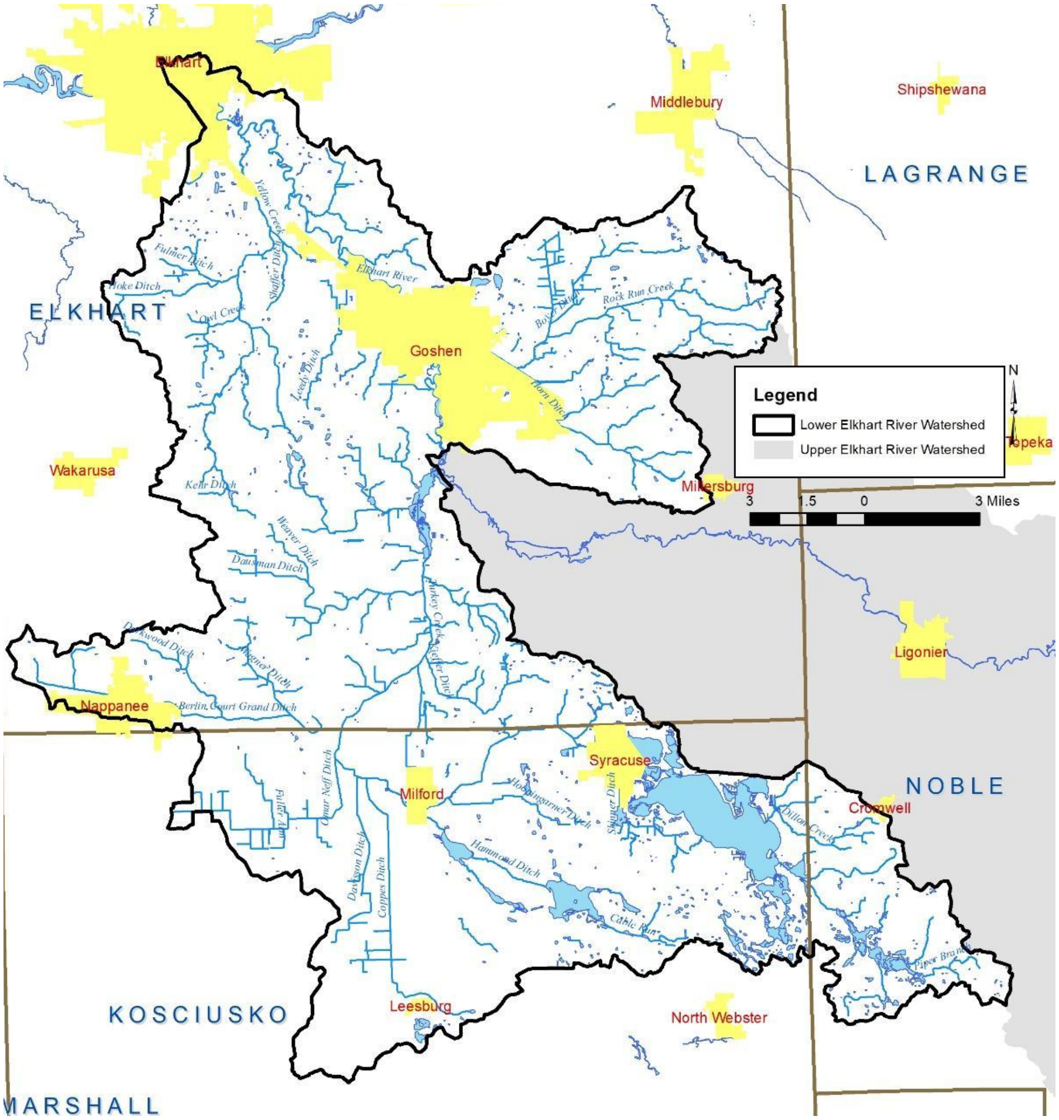

Figure 1. Lower Elkhart River Watershed.

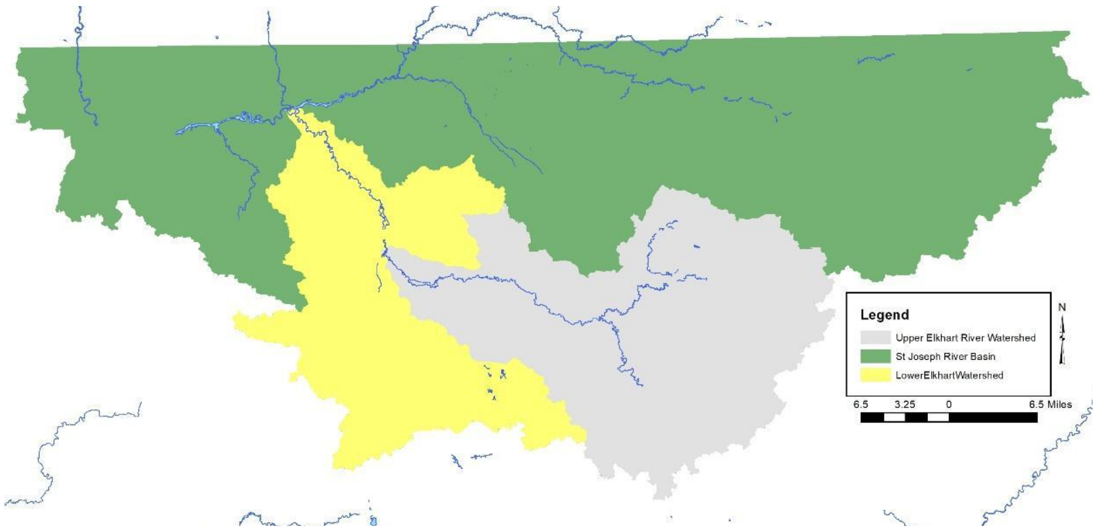

Figure 2. The St. Joseph River Basin highlighting the Lower Elkhart River Watershed.

1.2 Project History

The Lower Elkhart River Project launched in 2021 as a result from a Section 319 grant awarded to update the 2008 Elkhart River Watershed Management Plan (WMP). The Elkhart River Restoration Association (ERRA) identified several changes in the Elkhart River Watershed since the 2008 plan's completion and initiated this effort to address these changes. Since the 2008 WMP was completed, residents from around the watershed's lakes have been converting houses to larger, more permanent structures. Since 2008, 14% of the watershed has been converted from natural (forest, wetland) and agricultural land uses into urban and urbanizing land uses. Concurrently, the density of agricultural land use has also been impacted with permitted confined feeding operation populations increasing nearly 600% over 2008 animal populations. Further, the Indiana Department of Environmental Management lists water quality impairments on the Lower Elkhart River Watershed, including 139.6 miles of elevated pathogen (E. coli), 7.8 miles for nutrient levels, 7.8 miles for low dissolved oxygen levels, 46.9 miles impaired biotic communities, and 9 miles for PCBs in fish tissues. Additionally, nutrients, biotic communities and PCBs in fish tissues impair several watershed lakes.

The update of the Elkhart River Watershed Management Plan was broken into two sections – the Upper Elkhart River Watershed and the Lower Elkhart River Watershed. This plan will address the Lower Elkhart River Watershed, which includes the Turkey Creek drainage. The Lower Elkhart River Watershed includes a variety of land uses including agricultural, forest and natural areas, as well as urban and urbanizing land uses. Much of the watershed is dominated by agricultural land use. Urban and urbanizing land is found adjacent to the many watershed lakes and in its cities and towns including the Cities of Goshen, Nappanee, and Elkhart, and the towns of Leesburg, Milford, and Syracuse. Portions of four MS4s are located within the Lower Elkhart River watershed: Elkhart County, City of Elkhart, City of Nappanee and City of Goshen. Land cover data from 2016 estimates that the watershed is 58% row crop, 9% pasture, 12% forests or wetlands, 3% open water and 17% urban. The Elkhart River Watershed plan (2008) identified improperly functioning/failing septic systems, erosion and sedimentation, pasture runoff, heavily grazed areas, livestock manure, manure fertilizer, livestock access to streams, wastewater treatment plants and wildlife as sources *of E. coli*.

Based on these concerns, the City of Goshen approached community groups and individuals throughout the watershed that might be interested in working with them to assess and improve water quality and quantity within Lower Elkhart River and its tributaries. Identified potential stakeholders included: Elkhart, Kosciusko, and Noble County SWCD and NRCS staff; City of Elkhart, City of Goshen, Indiana Department of Environmental Management; Elkhart, Kosciusko, and Noble County surveyors, parks departments, health departments and Purdue Extension; Goshen College staff; St. Joseph River Basin Commission, and more. This group formed a Steering Committee (Table 1), conducted windshield surveys of the watershed, and held several meetings open to the public in order to generate input in the development of a watershed management plan for Lower Elkhart River Watershed.

1.3 Stakeholder Involvement

Development of a watershed management plan requires input from interested citizens, local government leaders, and water resource professionals. These individuals are required to not only buy into the project and the process but must also become an integral part of identifying the solution(s) which will result in improved water quality and addressed water quantity concerns. The Lower Elkhart River Project will involve stakeholders in the watershed management planning process through a series of public meetings and education and outreach events including windshield surveys, workshops, field days and youth-focused education events.

1.3.1 Steering Committee

Individuals representing the towns and counties within the watershed, environmental groups, natural resource professionals, agricultural and commercial representatives, and private citizens comprise the steering committee. The steering committee will meet quarterly to develop the WMP starting in April 2023. Table 1 identifies the steering committee members and their affiliation.

Table 1. Lower Elkhart River Watershed steering committee members and their affiliation.

Individual	Organization(s) Represented
Sara Peel	Arion Consultants
Daragh Deegan	City of Elkhart
Joe Foy	City of Elkhart MS4
Jason Kauffman	City of Goshen
Aaron Kingsley	City of Goshen Environmental Resilience
Donny Aleo	Elkhart County Parks
Jeff Boyle	Elkhart County Parks
Natasha Kauffman	Elkhart County Planning – Redevelopment Coordinator
Jason Auvil	Elkhart County Planning Manager
John Heiliger	Elkhart MS4
Troy Manges	Elkhart NRCS
	Elkhart Purdue Extension
Philip Barker	Elkhart Surveyor
Jim Hess	Elkhart SWCD
Nancy Brown	ERRA
Jonathan Schramm	Goshen College
Kristi Todd	IDEM

Individual	Organization(s) Represented
Chad Shotter	Kosciusko NRCS
Emily Kreskca	Kosciusko Purdue Extension
Mike Kissinger	Kosciusko Surveyor
Tashina Lahr-Manifold	Kosciusko SWCD
Diane Tulloh	Lake Papakeechie
Norm Lorti	Noble County building inspector
Anita Hess	Noble County commissioner; SJRBC
Justin Stump	Noble County EMA director
Mick Newton	Noble County EMA retired
Teresa Tackett	Noble County planning director
Russell Baker	Noble NRCS
Anne Kline	Noble Purdue Extension
Randy Sexton	Noble surveyor
Stacey McGinnis	Noble SWCD
Kate Barrett	SJRBC
Matt Meersman	SJRBC
Heather Harwood	WACF
Beth Morris	WACF
Invited	Pokagon Band of Potawatomi
invited	Dewart Lake Improvement Association
Jamison Czarneki	City of Elkhart Parks and Recreation
Tanya Heyde	City of Goshen Parks and Recreation
Todd Nunemaker	City of Nappanee Planning/MS4
Jeff Zavatski	Elkhart Environmental Center
Margaret Easton	

1.3.2 Public Meetings

Public participation is necessary for the long-term success of any watershed planning and subsequent implementation effort. One component of public participation for this project was public meetings and listening sessions. The purpose of the public meetings was to provide information on the overall planning effort and its progress; solicit stakeholder input, opinions, and participation; create opportunities for the public to recommend programs, policies, and projects to protect and improve water quality; and build support for future phases of the project.

The public meetings/listening sessions were advertised through press releases distributed to local newspapers in the watershed and via the project website and emails sent to local landowners and conservation partners. The meetings/listening sessions were also advertised through word of mouth as staff from the Soil and Water Conservation Districts put together mailings that advertised the events.

The first public meeting occurred on March 16, 2023 and was hosted as a drop in and chat meeting. Additional details about the meeting will be included in the next draft of the Lower Elkhart River watershed plan.

The second meeting will occur in year two of the project and will include an update on the status of the project and focused on gathering feedback on critical areas, practices selected for implementation and the likelihood of meeting project goals gathered.

1.4 Public Input

Throughout the planning process, project stakeholders, the steering committee, and the general public listed concerns for the Lower Elkhart River Watershed including the Elkhart River, its tributaries, and its watershed. Public and committee meetings were the primary mechanism of soliciting individual concerns. All comments were recorded and included as part of the concern documentation and prioritization process. Concerns voiced throughout the process are listed in Table 2. Similar stakeholder concerns were grouped roughly by topic and condensed by the committee. The order of concern listing does not reflect any prioritization by watershed stakeholders.

Table 2. Stakeholder concerns identified during public input sessions, steering committee meetings and via the watershed inventory process. Note: The order of concern listing does not reflect any prioritization by watershed stakeholders.

Stakeholder Concerns
Falling trees create logjams/dam the river
Recreation - access is needed, recreation should be promoted
Development - too many hard surfaces
Poorly constructed and maintained stormwater management practices
Limited participation by farmers in soil erosion practices
General lack of public awareness about how their activities impact water quality and quantity
Water levels are high - often exceed the 2018 recorded flood level
Floodplain development - used for commercial and residential building sites now and in the future will only cause more flooding
Elevated nutrient levels
Water is brown and cloudy often after rains
We are in the headwaters, our impact to the Elkhart River are not felt locally but we are hopeful in doing our part to address water quality and quantity downstream
Flooding
Slow water movement through the Goshen Dam Pond
Runoff, sedimentation
Goshen dam pond wants to dredge - disagree- maintain natural curves
Protect natural features in the watershed as these help reduce sediment load in the water
Promote quiet recreation - bird watching, canoeing, kayaking
people need to understand the connection up-down stream not just the area nearest them
The river should be used to make money and attract tourists
Logjams
Flooding - our subdivision floods all the time - how can we control it, move water downstream
Livestock access - Rock Run Creek east of Elkhart County fairgrounds, other locations
Wakarusa and other rural Elkhart County sewer system project - how will this impact areas downstream?

Elevated E. coli levels
Oxbow logjam is a major concern, DNR states it is impassable and poses a threat to human safety. Removal options are being discussed.
Streambank erosion is a concern on the Elkhart and tributaries
Flooding – Chicago Avenue flooding was noted with the potential impact of Kroger not rebuilding if flooding in the store occurs again
Changes in drainage pattern – Nappanee used to flow west and now flow east into the Elkhart drainage.
Yellow Creek -fecal matter input, highest of Elkhart County drainages – sewer will be constructed this year.
Goshen Parks used to provide canoe rental but this has been suspended due to the logjam noted above
CR17 will eventually be extended south – this change in pavement may impact impervious surfaces in the Lower Elkhart
Development will continue in rural portions of the watershed – likely subdivisions which will lead to increases in unsewered dense housing. Development in these areas are likely to require more expensive septic options like mound systems
City of Elkhart has stated they will not extend services beyond their boundary, however there are discussions about annexation this year. A map of this should be included in the plan, if/when available
Two TIF districts are located in the lower watershed – Northeastern TIF and one north of Syracuse. Both should be mapped and included in the plan
The Kosciusko County portion of this watershed is pretty sandy – lots of wind erosion, producers often conventional till in the fall in this area
Volume of animal waste produced in the watershed (used in the watershed) is high
Septic limitations due to prevalence of unsuitable soils, lack of maintenance
Excessive sediment load
Problematic siltation issues within the watershed lakes and reservoirs
Stream bank deterioration caused by severe erosion. (refers to general observations of erosion, especially along legal drains)
Interest in making legal drains more natural, install buffer strips between agricultural
Concerns about unregulated drain erosion, working with private landowners
Managing regulated drains to reduce sediment loading (two stage, buffer strip incentives)
Non-point source pollution (agricultural row crop and animal runoff & septic)
Herbicide distribution within lakes to control nuisance weeds, and the concern for responsible vegetation management as it relates to impacts on wildlife
Nutrient loading due to the use of (lawn, agriculture) fertilizers
Vegetation growth due to eutrophication in lakes and streams
Illicit discharges
Mercury and PCBs in fish tissue
Fear of E. coli, perception of health of river, lakes and streams - E coli, cryptosporidium, harmful algal blooms other aquatic health concerns.
Fish consumption advisories
No longer feel safe for recreational swimming - duplicate
Concerned over attempts to make the Elkhart River a legal drain: concern over drainage policy in general

Fallen trees impeding navigable passage throughout the waterways.
Create means of access around fallen snags as opposed to removing them in their entirety
PFAS
Litter along roadsides, urban areas and rural dumping
Long term maintenance of post construction stormwater infrastructure
Drainage for agricultural production (both the positive aspect of achieving appropriate drainage for agriculture and the negative aspect of alteration of the hydrologic system were discussed)
Long-term viability of the watershed as an irrigation source (both surface and ground water quantity issues)
Look at irrigation data/well sensitivity, runoff from irrigated areas
Livestock access to surface waters within the watershed
Culvert sizing creating fish passage concerns, restrictions in flows
Loss of habitat with increased development
Rapid increase in impervious surface in the watershed
Urban Development/encroachment on the floodplain
Combined Sewer Overflows – E. coli, nutrients – long term control – confirm status of Elkhart and Nappanee CSOs
Urban development (whatever anyone wants to do is accepted). Maintain a natural buffer along the water. Need proper planning of developments
Keep Continue sewer development on pace with development - areas that are developed but are not sewered needs to be mapped
Growing Canada goose, mute swan population
Drainage ways that currently have land uses immediately adjacent to their banks would ideally benefit from a vegetated riparian zone buffers (increasing the frequency of filter strips, etc)
Preservation of wetlands upstream, to protect floodplain areas
Blanding's turtles are state endangered and reproduce locally
River otter population increases (need protection) trapping season starts fall 2023
Loss of habitat for ETR species
Invasive species
Fish kills after heavy rains (pollutants in the runoff) – no current evidence of fish kills – leaving but may remove if evidence does not support
State endangered fish and wildlife need habitat protection
Alterations to flood storage and flow conveyance
Impacts of logjams and beaver activities
Evaluate dam removal or dam modifications to assist with upstream and downstream fish passage
Design protected wildlife corridor through the Lower Elkhart Watershed
Levees/canals through Goshen or in other areas are they legal, do they require set back or maintenance activities?

2.0 WATERSHED INVENTORY I: WATERSHED DESCRIPTION

2.1 Watershed Location

The Lower Elkhart River includes two 10-digit hydrologic unit codes (HUCs): 0405000117 (Turkey Creek) and 0405000119 (Elkhart River) and covers portions of Elkhart, Noble and Kosciusko counties (Figure 1). Additionally, the Lower Elkhart River Watershed receives water from the Upper Elkhart River Watershed. In total, the Upper Elkhart River Watershed drains 403 square miles. The Lower Elkhart River Watershed drains an additional 295 square miles and begins south of Goshen near New Paris. Major tributaries include Turkey Creek, Omar-Neff Ditch, Skinner Ditch, Rock Run Creek, Yellow Creek and Keiffer Ditch. The Elkhart River flows north and west through the Cities of Goshen and Elkhart to join with the St. Joseph River in downtown Elkhart. The St. Joseph River then flows west and then north into the State of Michigan before emptying into Lake Michigan.

2.2 Subwatersheds

In total, thirteen 12-digit Hydrologic Unit Codes are contained within the Lower Elkhart River Watershed (Figure 3,Table 3). Each of these drainages will be discussed in further detail under Watershed Inventory II.

Table 3. 12-digit Hydrologic Unit Code (HUC) watersheds in the Upper Elkhart River Watershed.

Subwatershed Name	Hydrologic Unit Code	Area (acres)	Percent of Watershed
Village Lake-Turkey Creek	040500011701	10,172	5.4
Lake Wawasee	040500011702	14,276	7.5
Wabee Lake-Hammond Ditch	040500011703	10,120	5.3
Hoopingarner Ditch-Turkey Creek	040500011704	13,613	7.2
Coppes Ditch-Turkey Creek	040500011705	14,412	7.6
Berlin Ct. Ditch	040500011706	11,899	6.3
Omar-Neff Ditch-Turkey Creek	040500011707	11,982	6.3
Dausman Ditch-Turkey Creek	040500011708	19,014	10
Swoveland Ditch-Turkey Creek	040500011709	11,748	6.2
Hoover Ditch-Rock Run Creek	040500011901	13,673	7.2
Horn Ditch-Rock Run Creek	040500011902	14,153	7.5
Headwaters Yellow Creek	040500011903	21,157	11.2
Goshen Dam Pond-Elkhart River	040500011904	23,262	12.3
	Entire Watershed	**189,481**	**100%**

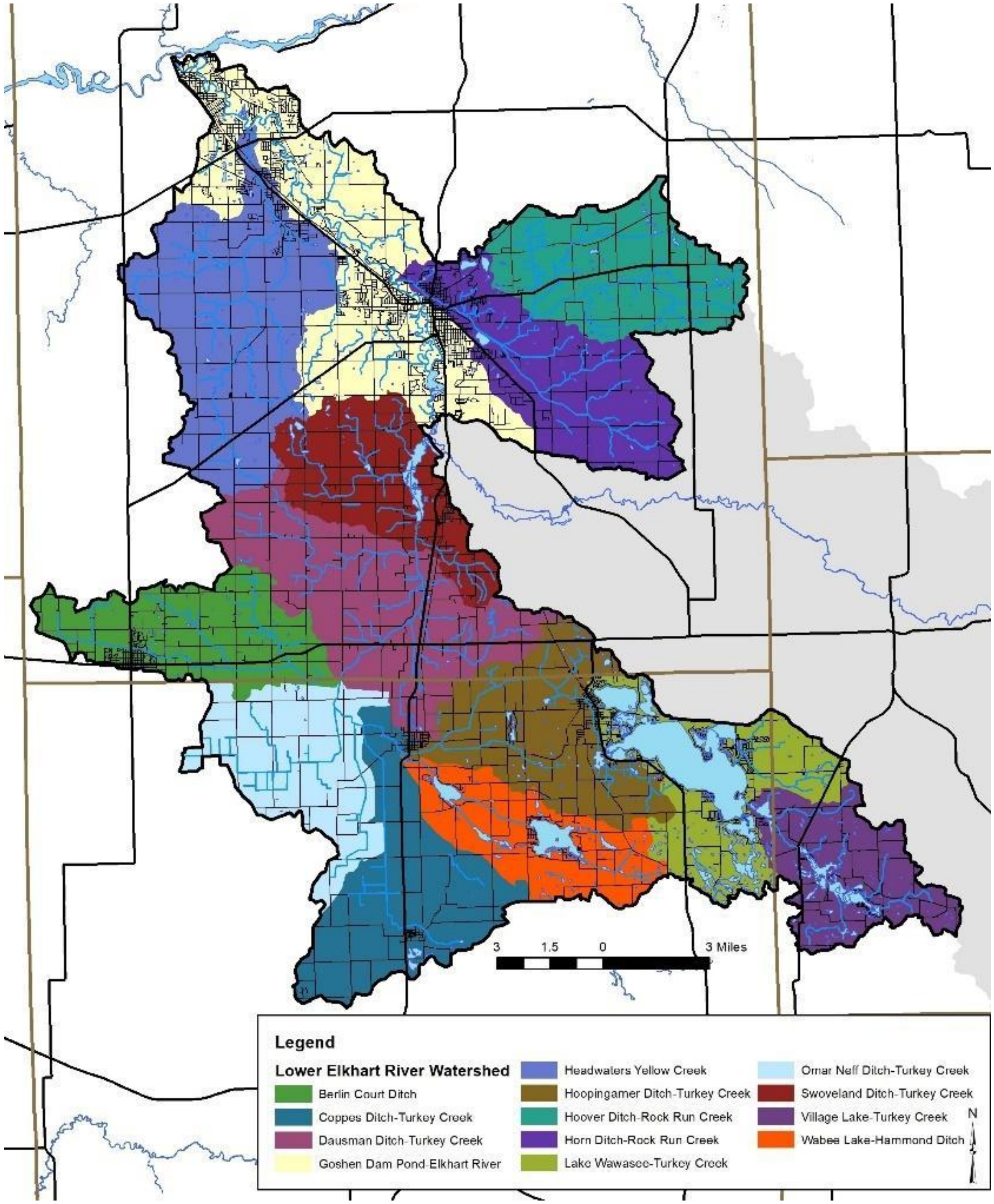

Figure 3. 12-digit Hydrologic Unit Code subwatersheds in the Lower Elkhart River Watershed.

2.3 Climate

In general, Indiana has a temperate climate with warm summers and cool or cold winters. Climate in the Lower Elkhart River Watershed is no different than the rest of the state. There are four seasons throughout the year. The average temperatures measure approximately 71°F in the summer, while low temperatures measure below freezing (25.9°F) in the winter. The growing season typically extends from April through September. On average, 38 inches of precipitation occurs within the watershed per year; approximately 58% of this precipitation falls during the 205-day growing season. Rainfall intensity and timing affect watershed response to precipitation. NOAA's climate at a glance website (1895-present) indicate rainfall varies from 25 to over 50 inches annually (Figure 4). CBBEL calculated the 10-year moving average as between 30 and 40 inches/year for the Upper Elkhart River. These estimates likely hold true to the Lower Elkhart River drainage as well. The Purdue Climate Change Research Center indicates an increase in average annual precipitation of over 4.2 inches/year from 1895 to 2029 (PCCRC, 2019). CBBEL (2020) further notes an increase in heavy rainfall events with one day per year exceeding the 99th percentile in 1900 to more than three days exceeding this level in 2016 (Figure 5). This suggests that more frequent extreme events and larger annual precipitation totals are likely occurring in the entire Elkhart River Basin. This likely results in more water moving through the system which impacts the watershed's lakes, streams and wetlands.

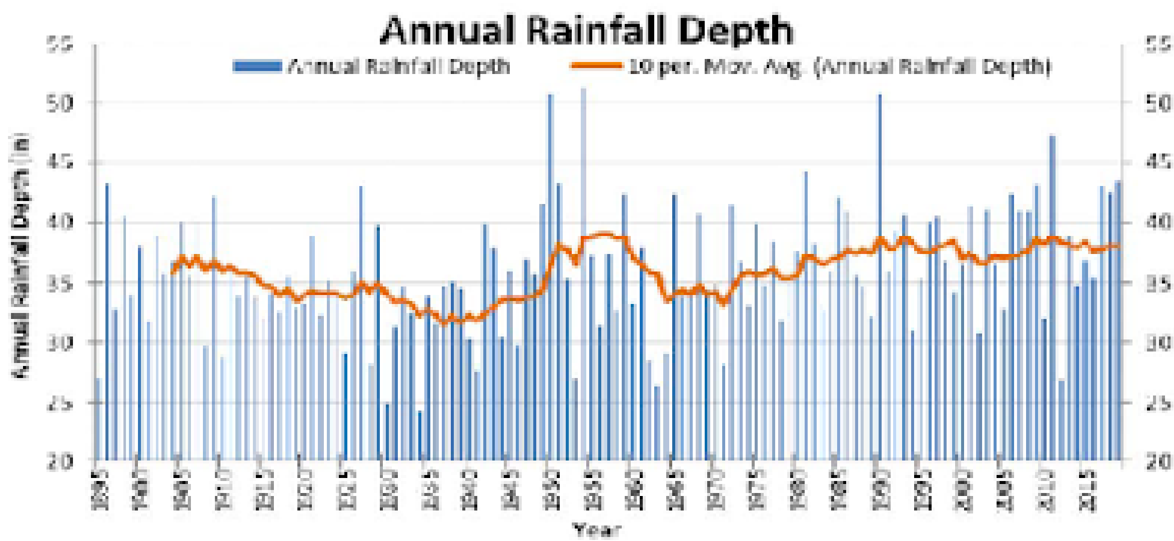

Figure 4. Annual rainfall depth for Noble County (CBBEL, 2020).

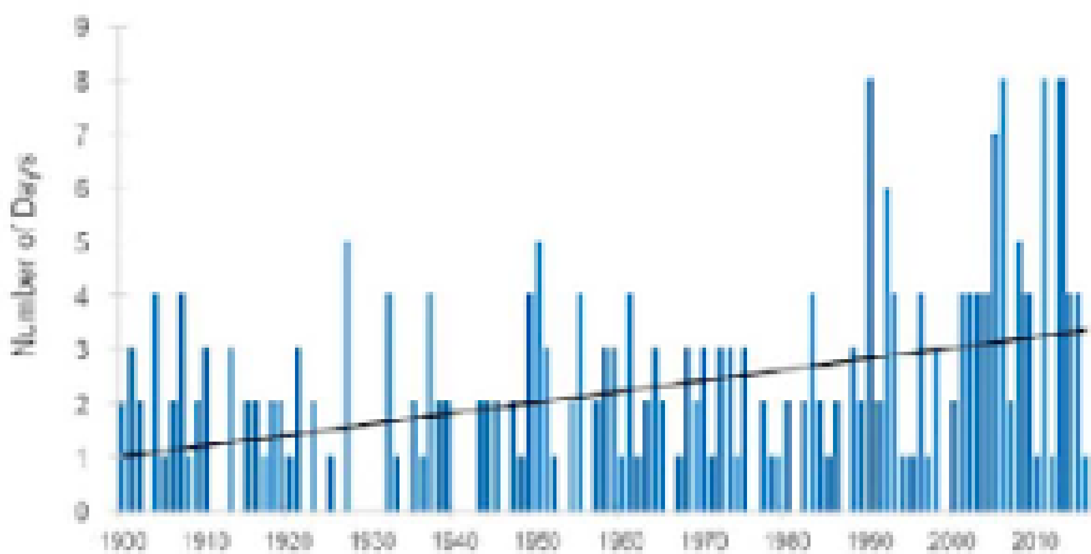

Figure 5. Number of days with extreme precipitation (ie events exceeding 99th percentile for Indiana (PCCRC from CBBEL, 2020).

2.4 Geology and Topography

Bedrock deposits within much of the Lower Elkhart River Watershed are from the Silurian to middle Mississippian age. These deposits consist primarily of layered Paleozoic limestone, dolomite, sandstone, siltstone and shale, which are indicative of ancient inland seas (Clendenon and Beaty, 1987). The bedrock geology of the watershed is comprised of two major types of Devonian Era Shale, either Antrim or Ellsworth, with a small amount of Muscatatuck Group present in the southernmost outcrop of the watershed. Antrim Shale bedrock covers much of the southern portion of the Lower Elkhart River Watershed. The mainstem of the Elkhart River flows through Ellsworth Shale (Figure 6). Most of the Lower Elkhart River Watershed's surface is covered by glacial drift measuring from zero to 200 feet in thickness with deeper drift filling preglacial drainageways. Two distinct glacial stages are represented by the watershed's till and drift deposits. The most recent Wisconsinan drift was deposited by the Ontario-Erie Lobe of the Wisconsinan glacier (Wayne, 1963). Till from the Huron-Erie Lobe is found in the southeastern portion of the watershed, while till from the Saginaw Lobe is widely distributed throughout the watershed. Sand and gravel deposits found along all major and many minor streams originate from the Wisconsinan outwash (Figure 7). Sand and gravel are readily available resources along watershed stream floodplains.

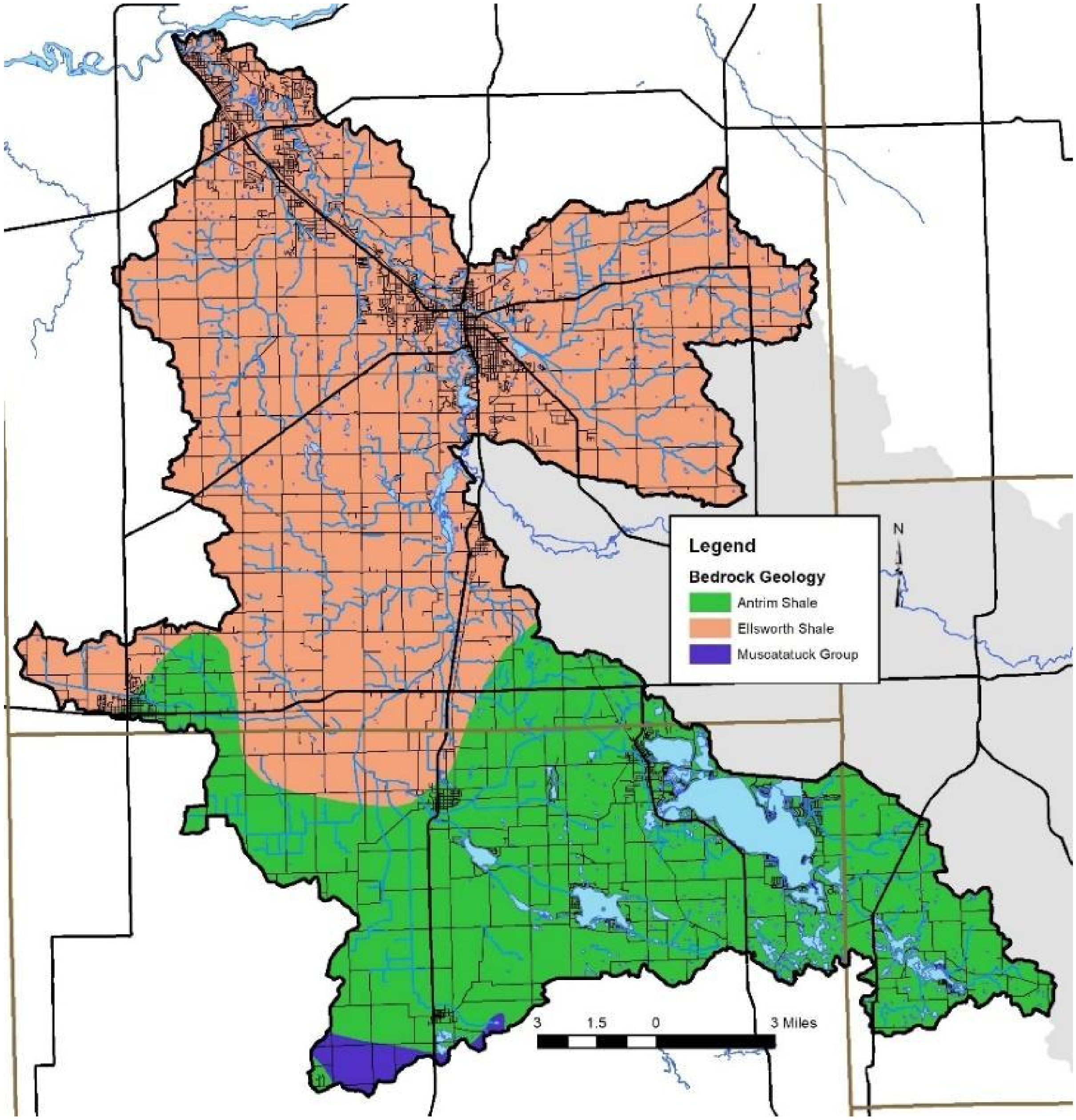

Figure 6. Bedrock in the Lower Elkhart River Watershed.

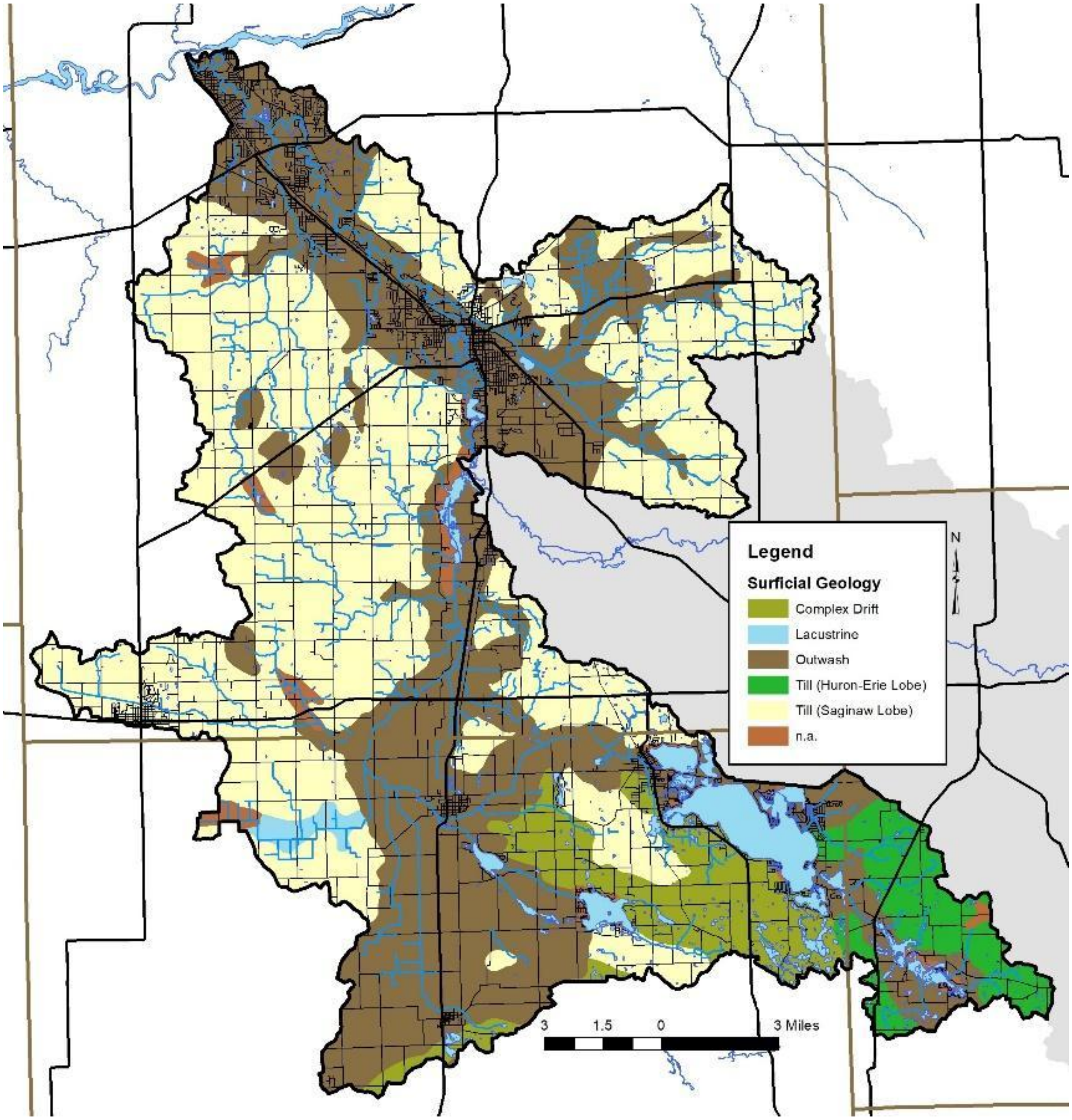

Figure 7. Surficial geology throughout the Lower Elkhart River Watershed.

The topography of the Lower Elkhart River Watershed ranges from flat rolling agricultural fields to undulating hills and valleys (Figure 8). The landscape changes from steeply sloped and rolling terrain in the Rock Run Creek drainage (eastern edge of the watershed) to gently rolling terrain and relatively flat plains along the main stem of the Elkhart River. The lowest elevation (719 feet msl) occurs at the watershed outlet at the St. Joseph River in Elkhart. Steep to rolling terrain is found near Cable Run in the southeastern portion of the watershed, in the Tri-County Fish and Wildlife Area, in an area southwest of Lake Wawasee and Buzzard Hill (elevation 1041 feet) northeast of Milford.

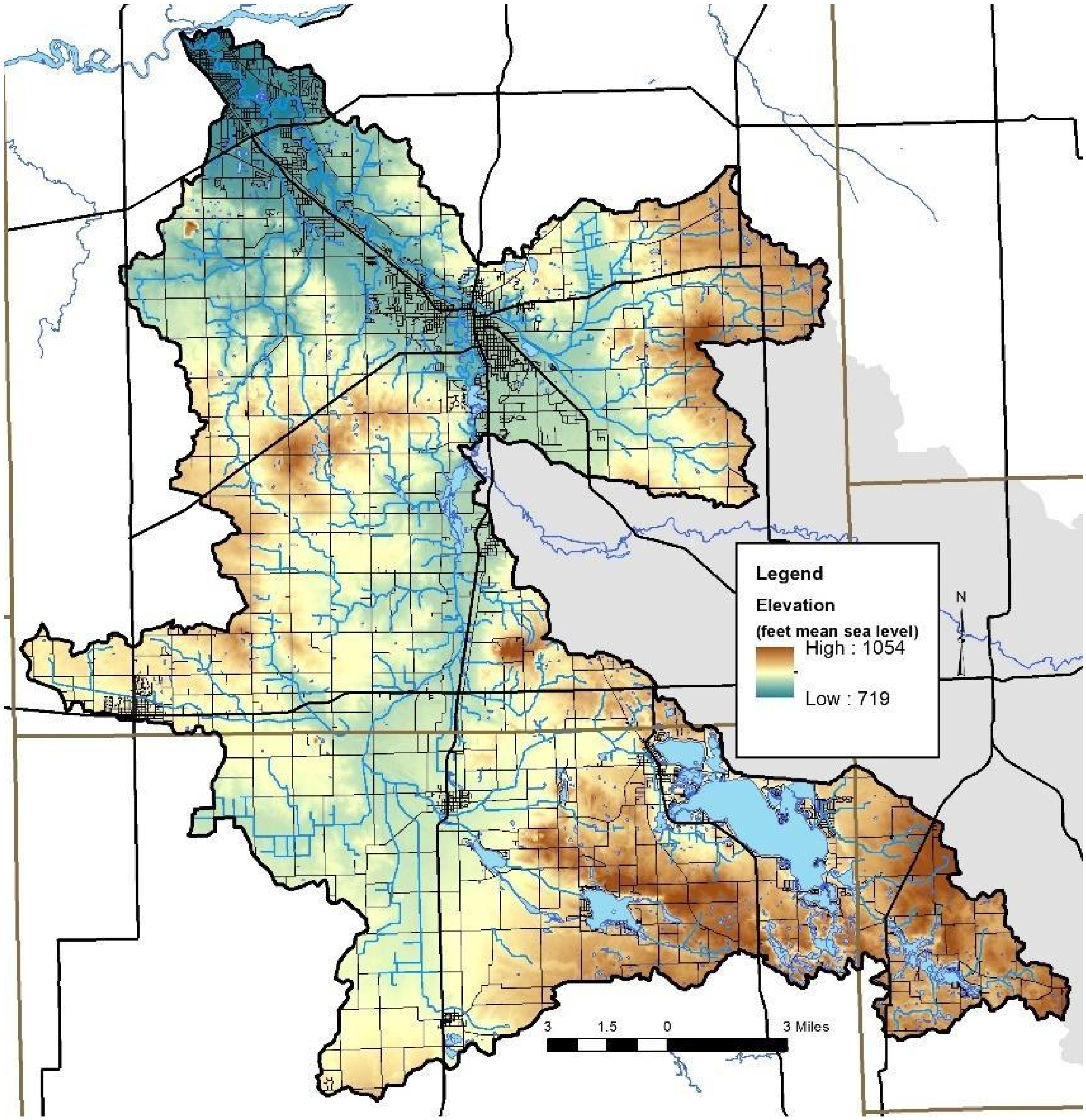

Figure 8. Surface elevation in the Lower Elkhart River Watershed.

2.5 Soil Characteristics

There are hundreds of different soil types located within the Lower Elkhart River Watershed. These soil types are delineated by their unique characteristics. The types are then arranged by relief, soil type, drainage pattern, and position within the landscape into soil associations. These associations provide the overall characteristics across the landscape. Soil associations are not used at the individual field level for decision making. Rather, the individual soil types are used for field-by-field management decisions. Some specific soil characteristics of interest, including septic limitations and soil erodibility, for watershed and water quality management are detailed below.

2.5.1 Hydrologic Soil Group

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and runoff characteristics during periods of prolonged wetting. Approximately half of the Lower Elkhart River Watershed is covered by well-drained soils from materials weathered from shale, siltstone and limestone. These moderately deep to deep soils are found on moderately sloping to steeply sloped land. Within floodplains, somewhat poorly drained to well-drained soils are located within river deposits on nearly level land. Soils are classified by the NRCS into four hydrologic soil groups based on the soil's runoff potential (Table 4). The majority of the watershed is covered by category D soils (25%) followed by category B soils (24%), category C soils (22%) and category A soils (21%). While the majority of soils are nearly evenly split by B and D soil types, the location of each hydrologic soil group is important. C and D soils dominate the western portions of the watershed, whereas B soils dominate around Dewart Lake (Figure 9). Category B soil is moderately deep and well drained, while Category C soils are finer and allow for slower infiltration. Category A soils are abundant in the northern section of the watershed and along Turkey Creek. Elkhart County's hydrologic soils are dominated by D soils, likely due to the predominance of glacial drift in this portion of the watershed. While this soil type has the slowest infiltration rates, Elkhart County is also significantly lower in elevation than the rest of the watershed. In these areas, D soils are slow infiltration soils, where flooding can regularly occur. This means that regular flooding is likely in this portion of the watershed.

Table 4. Hydrologic soil group summary.

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

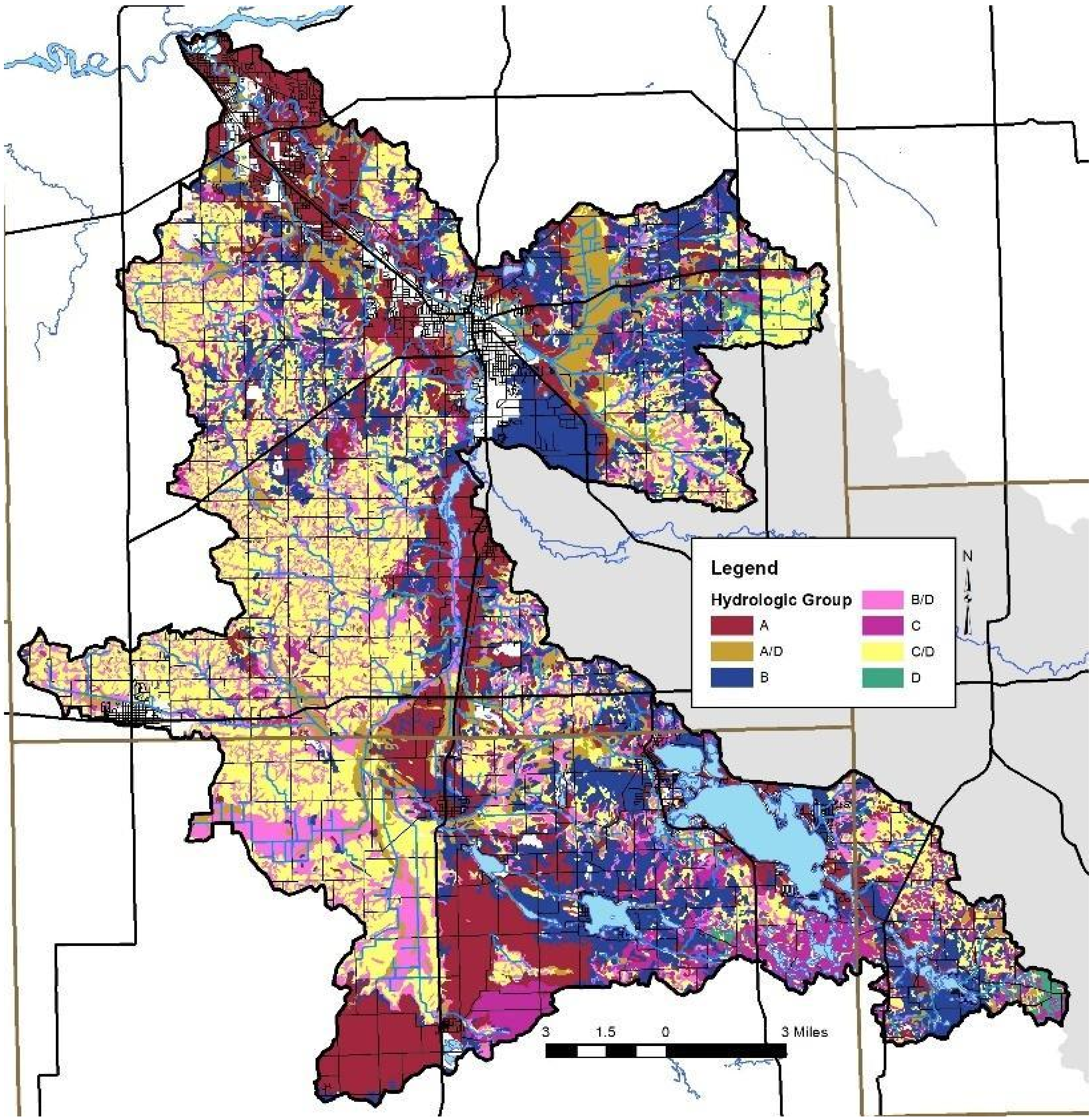

Figure 9. Hydrologic Soil Groups in the Lower Elkhart River Watershed.

2.5.2 Soil Erodibility

Soils that move from the landscape to adjacent waterbodies result in degraded water quality, limited recreational use, and impaired aquatic habitat and health. Soils carry attached nutrients and pesticides, which can result in impaired water quality by increasing plant and algae growth or even killing aquatic life. The ability and/or likelihood for soils to move from the landscape to waterbodies are rated by the Natural Resources Conservation Service (NRCS). The NRCS uses soil texture and slope to classify soils into those that are considered highly erodible, potentially highly erodible, and not highly erodible. The classification is based on an erodibility index which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss T value or tolerance value. The T value is the maximum annual rate of erosion that can occur for a particular soil type without causing a decline in long-term productivity.

Watershed stakeholders are concerned about soil erosion. As detailed above, soils which have high erodibility index values are those that are located on steep slopes and are easily moved by wind, water, or land uses. Figure 10 details locations of highly erodible soils within the Lower Elkhart River Watershed. Highly erodible soils cover 31% of the watershed or 59,509 acres. Highly erodible soils are found throughout the watershed with lesser amounts in the western portion of the watershed in Kosciusko County and along the mainstem of the Elkhart River.

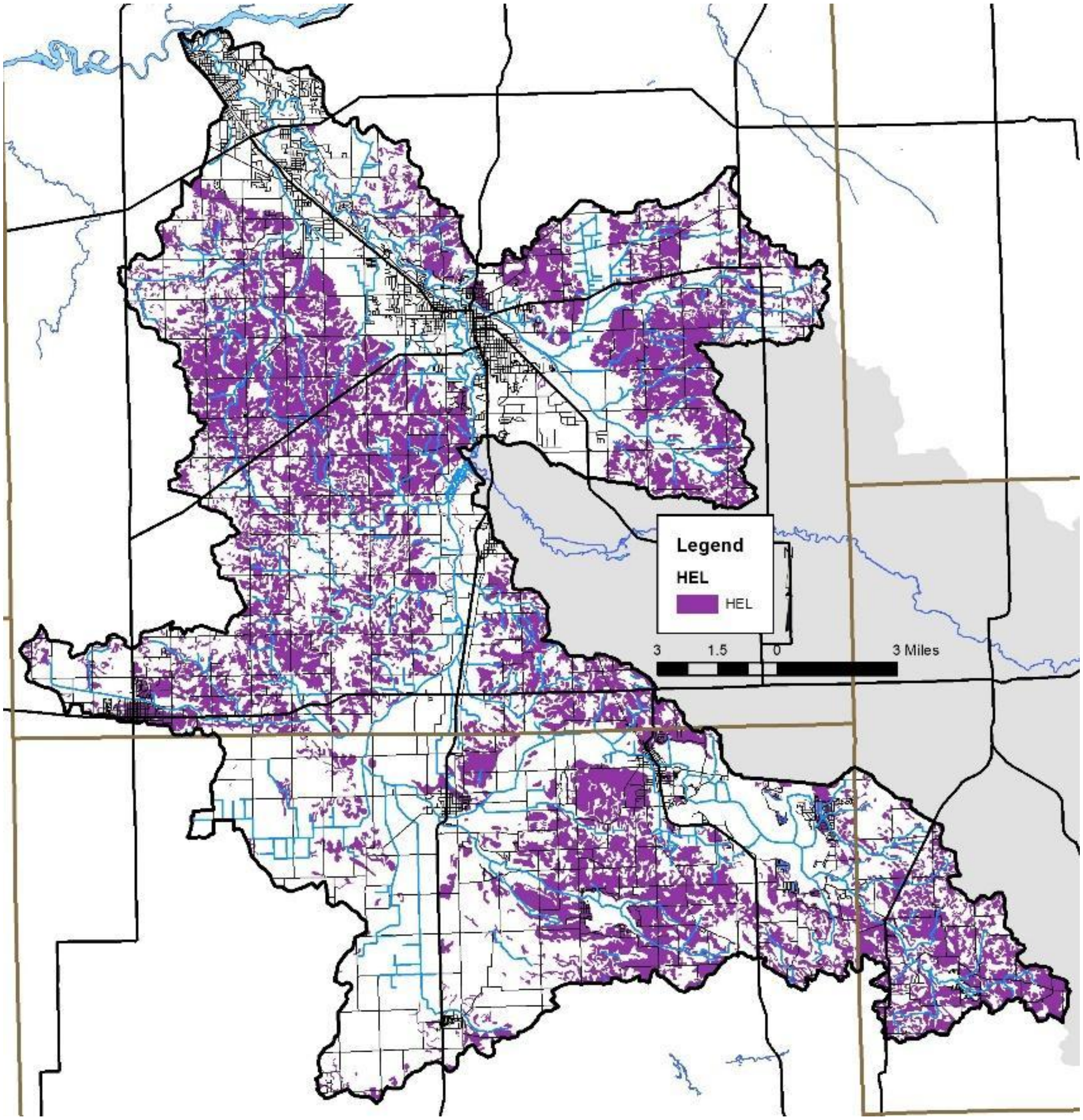

Figure 10. Highly erodible land in the Lower Elkhart River Watershed.

2.5.3 Hydric Soils

Hydric soils are those which remain saturated for a sufficient period of time to generate a series of chemical, biological, and physical processes. The oxidation and reduction of iron in the soil, or "redox", causes color changes characteristic of prolonged fluctuations in the water table. After undergoing these processes, the soil maintains the resultant characteristics even after draining or use modification occurs. Approximately 30,473 acres (16%) of the watershed is covered by hydric soils (Figure 11). While much of Elkhart County has limited hydric soils. They are relatively dense in Kosciusko County portion of the watershed. As these soils are considered to have developed under wetland conditions, they are a good indicator of historic wetland locations and therefore will be revisited in the land use section.

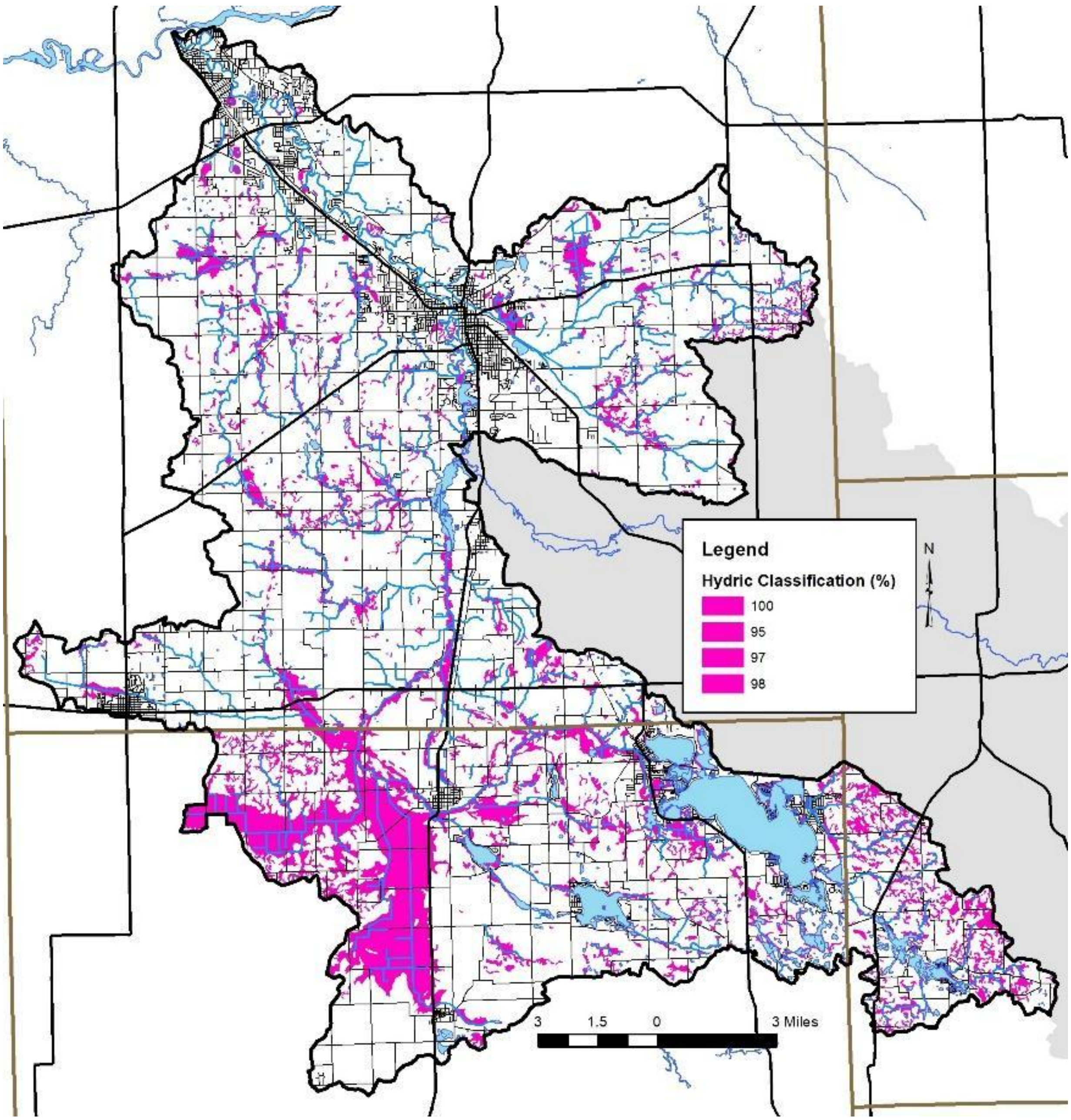

Figure 11. Hydric soils in the Lower Elkhart River Watershed.

2.5.4 Tile-Drained Soils

Soils drained by tile drains cover 72,844 acres or 38% of the Lower Elkhart River Watershed as estimated utilizing methods details in Sugg, 2007. This method of drainage is widely used in row crop agricultural settings within the watershed and has become even more intensively used within the last ten years. This results in altered hydrology, allowing the water to drain from the landscape more quickly to improve conditions for farming, but also potentially exacerbating downstream flooding and incising streams which cuts them off from their natural floodplains. In these areas, materials such as nutrients applied to agricultural soils are directly transported downstream, bypassing natural features such as filter strips that might otherwise filter out or assimilate nutrients. As the demands of production on each acre of land increases more tile is put in, typically in a network or series as extensive as 30 to 50 foot spacing between tiles. Impacts to stream water quality can be reduced by the use of tile control structures and drainage water management. CBBEL (2020) notes that successful agriculture in naturally poorly drained watersheds requires good drainage or the installation of tile drains. This means water more quickly escapes the landscape which in turn means the stream channel receives water more quickly. Coupling the high infiltration rates of soils in the watershed with tile drainage allows more water to infiltrate or soak into the ground rather than runoff as overland flow (CBBEL, 2020). A majority of tile-drained soils are located along the western portion of the watershed in northern Kosciusko County and in much of Elkhart County. Tile-drained soils can also be found in Noble County (Figure 12). Most of these areas are relatively flat where drainage augmentation is required to move water from agricultural fields in order to produce row crops. In these areas, materials applied to agricultural soils are directly transported to downstream waterbodies.

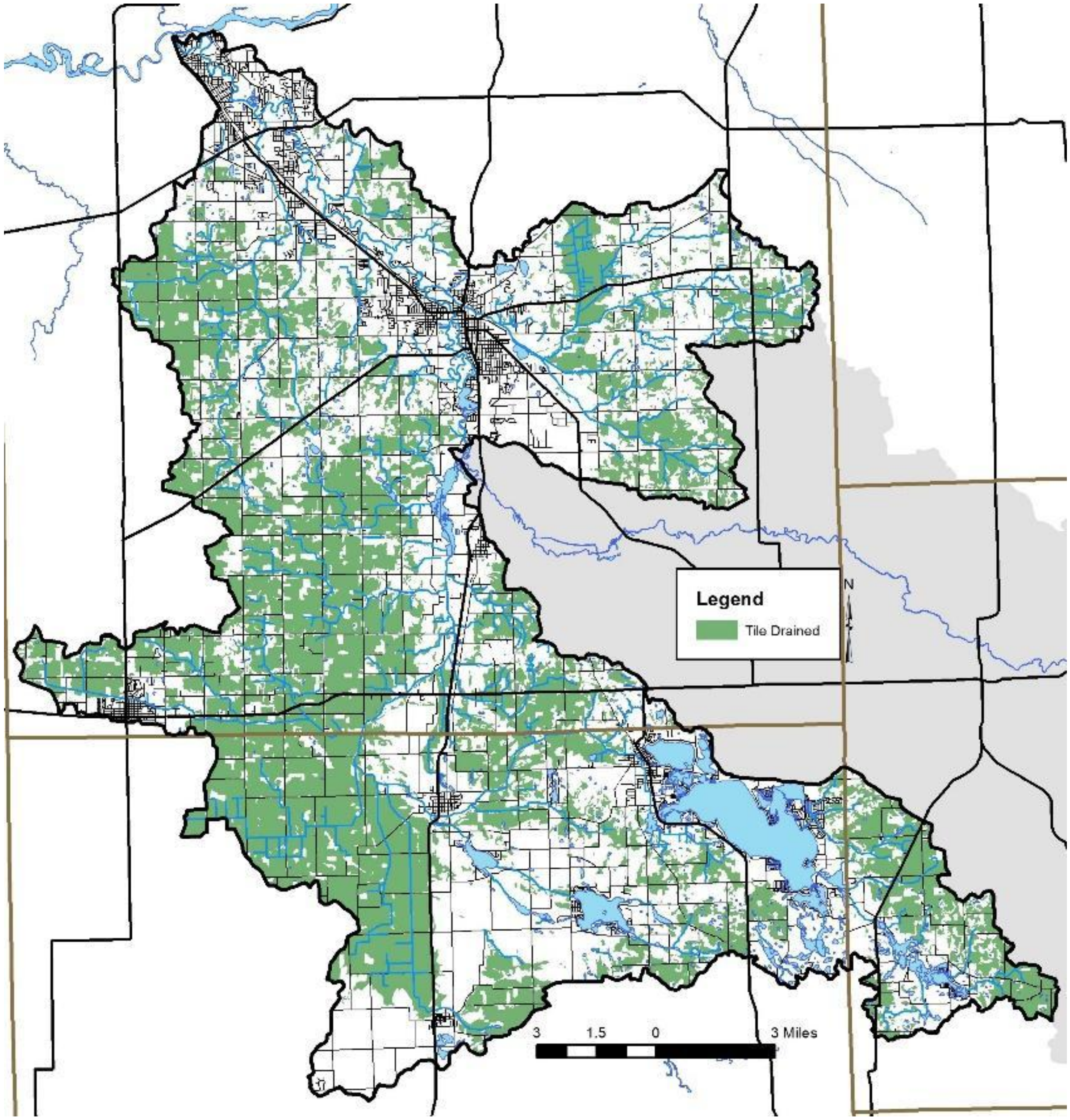

Figure 12. Tile-drained soils in the Lower Elkhart River Watershed.

2.6 Wastewater Treatment

2.6.1 Soil Septic Tank Suitability

Throughout Indiana, households depend upon septic tank absorption fields in order to treat wastewater. Seven soil characteristics, including position in the landscape, soil texture, slope, soil structure, soil consistency, depth to limiting layers and depth to seasonal high water table, are utilized to determine suitability for on-site septic treatment. Septic tanks require soil characteristics that allow for gradual movement of wastewater from the surface into the groundwater. A variety of characteristics limit the ability for soils to adequately treat wastewater. High water tables, shallow soils, compact till, and coarse soils all limit soils abilities in their use as septic tank absorption fields. Specific system modifications are necessary to adequately address soil limitation; however, in some cases, soils are too poor for treatment and therefore prove inadequate for use in septic tank absorption fields.

Until 1990, residential homes located on 10 acres or more and occurring at least 1,000 feet from a neighboring residence were not required to comply with any septic system regulations. In 1990, a new septic code corrected this loophole. Current regulations address these issues and require that individual septic systems be examined for functionality. Additionally, newly constructed systems cannot be placed within the 100-year floodplain and systems installed at existing homes must be placed above the 100-year flood elevation. However, many residences grandfathered into this code throughout the state have not upgraded or installed fully functioning systems (Krenz and Lee, 2005). In these cases, septic effluent discharges into field tiles or open ditches and waterways and will likely continue to do so due to the high cost of repairing or modernizing systems ($4,000 to $15,000; ISDH, 2001). Lee et al. (2005) estimates that 76,650 gallons of untreated wastewater per system is expelled in the state of Indiana annually. The true impact of these systems on the water quality in the watershed cannot be determined without a complete survey of systems.

The NRCS ranks each soil series in terms of its limitations for use as a septic tank absorption field. Each soil series is placed in one of three categories: severely limited, moderately limited, and slightly limited. Some soils are also unranked. Severe or very limited limitations delineate areas whose soil properties present serious restrictions to the successful operation of a septic tank tile disposal field. Using soils with a severe limitation increases the probability of the system's failure and increases the costs of installation and maintenance. Areas designated as having moderate or somewhat limited limitations have soil qualities which present some drawbacks to the successful operation of a septic system; correcting these restrictions will increase the system's installation and maintenance costs. Slight limitations delineate locations whose soil properties present no known complications to the successful operation of a septic tank tile disposal field. Use of soils that are rated moderately or severely limited generally require special design, planning, and/or maintenance to overcome limitations and ensure proper function.

Watershed stakeholders are concerned about the lack of maintenance associated with septic tanks, the use of soils that are not suited for septic treatment and the presence of straight pipe systems within the watershed. These concerns are exacerbated by the fact that severely limited soils cover essentially the entire watershed (Figure 13). Nearly 179,485 acres or 94% of the watershed is covered by soils that are considered very limited for use in septic tank absorption fields. Approximately 11 acres (<1%) are somewhat limited meaning that these soils are generally suitable for septic systems. The remaining 9,885 acres (5%) not rated for septic usage as it is not generally industry standard to install a septic system in these geographic locations.

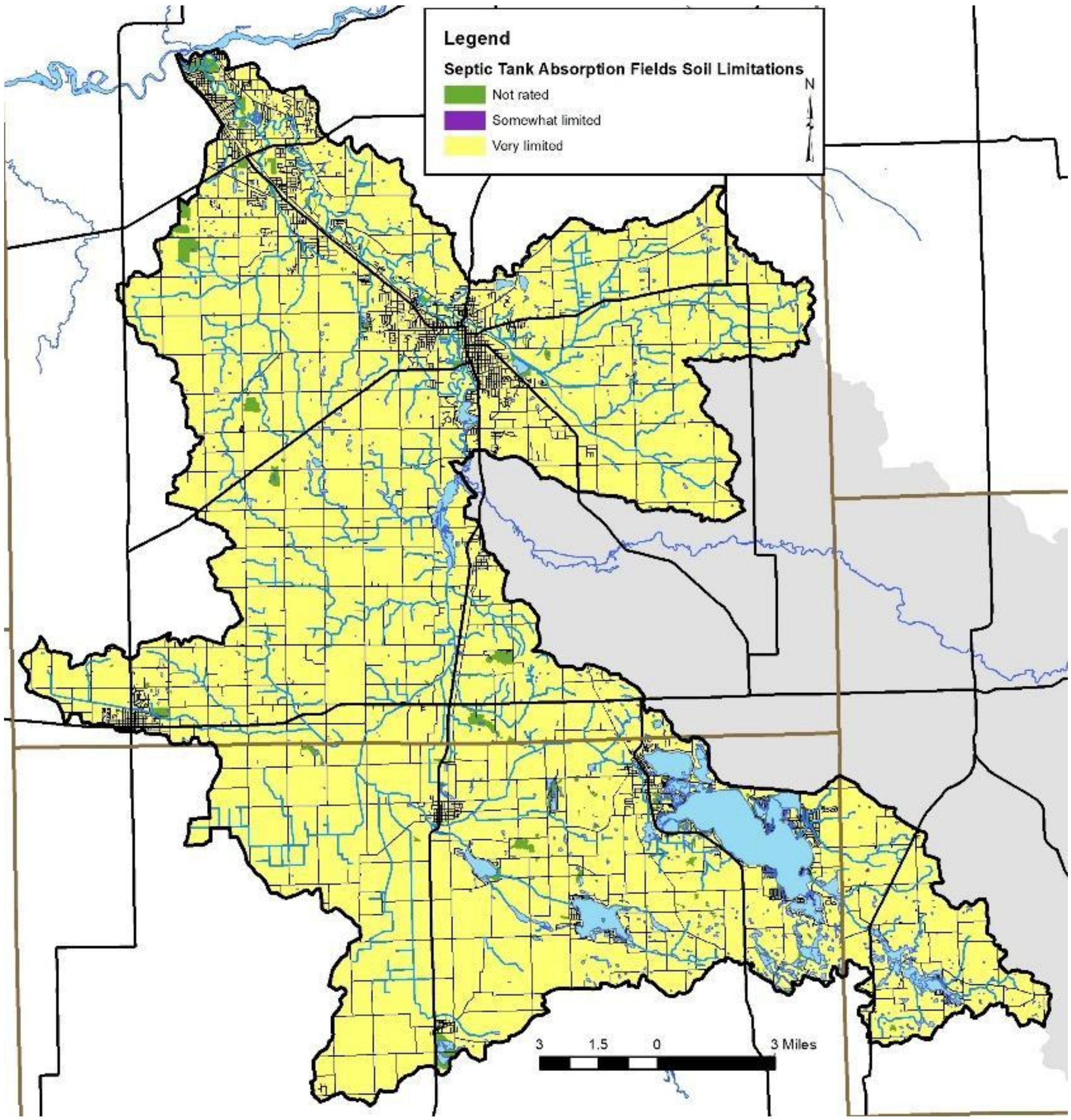

Figure 13. Suitability of soils for septic tank usage in the Lower Elkhart River Watershed.

Septic systems that are properly designed and maintained should not serve as a source of contamination to surface waters. However, septic systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure are seasonal high water tables, compact glacial till, bedrock, coarse sand and gravel outwash and fragipan. When these septic systems fail via surface breakouts or due to inadequate soil filtration there can be adverse effects to surface waters due to E. coli, nitrate, 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.

A comprehensive database of septic systems within the Lower Elkhart River Watershed is not available. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural household density. Based on estimates, more than 53,000 individuals live in rural residences within the

Lower Elkhart River Watershed. Those located on Group C and D soils have slow infiltration rates with finer textures and slow water movement and are of higher concern for septic system maintenance issues.

2.6.2 Wastewater Treatment

Several facilities which treat wastewater are permitted to discharge the treated effluent are located within the watershed. These facilities are regulated by National Pollution Discharge Elimination System (NPDES) permits. These include several wastewater treatment plants. NPDES-regulated facilities located within the watershed are shown in Figure 14 and Table 5. Wastewater treatment plant septage sludge is either applied to the land or hauled to a landfill in the Lower Elkhart River Watershed. Table 5 details the NPDES facility name, activity, and permit number for those facilities which discharge into a Lower Elkhart River waterbody. More detailed information for each wastewater facility is discussed below.

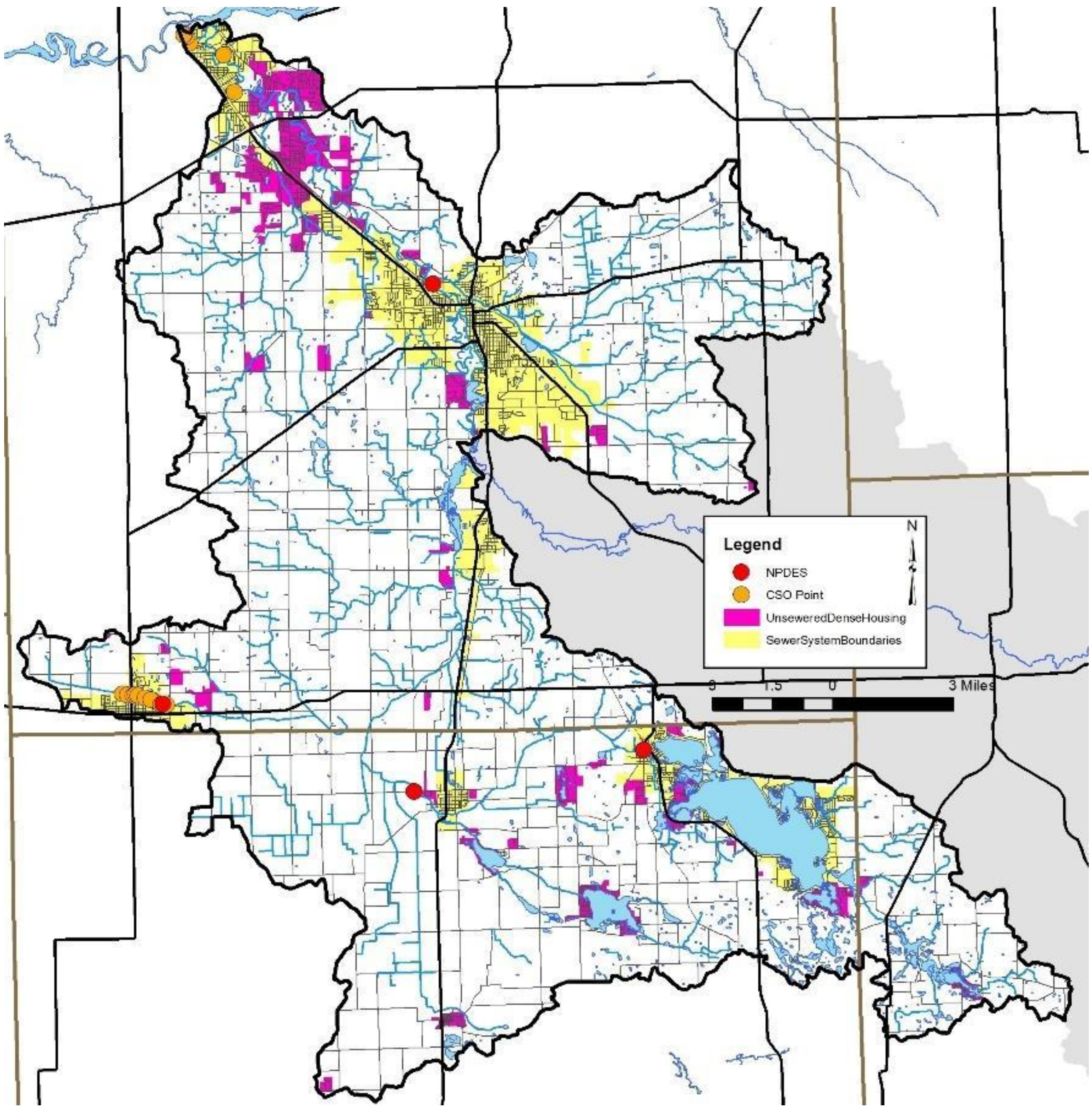

Figure 14. NPDES-regulated facilities, wastewater treatment plant treatment areas, CSO locations and locations of unsewered, dense housing in the Lower Elkhart River Watershed.

Table 5. NPDES-regulated facility information.

NPDES ID	Facility Name	Volume (MGD)
IN0025755	GOSHEN WWTP	5.0
IN0038318	MILFORD WWTP	0.25
IN0021466	NAPPANEE WWTP	1.9
IN0021172	SYRACUSE WWTP	1.05

2.6.3 Municipal Wastewater Treatment

There are 4 wastewater treatment facilities located within and discharging to waterbodies in the Lower Elkhart River Watershed including Goshen Wastewater Treatment Plant (WWTP), Milford WWTP, Nappanee WWTP and Syracuse WWTP.

The City of Goshen currently operates a Class III, 5.0 MGD (Millions of Gallons per Day) activated sludge facility. The facility consists of a two-bar screen, an influent flow meter, grit removal, six primary clarifiers, four activated sludge tanks, two secondary clarifiers, phosphorus removal chlorination/dechlorination facilities, two final clarifiers and an effluent flow meter. A 5th aeration basin was added in 2022. Sludge is treated with two anaerobic digesters. The final sludge is land-applied. The collection system is comprised of 136 miles of sewers (17 miles separate storm sewers, 57 miles separate sanitary sewers, 62 miles of combined sewers). To store stormwater, the city has a wet-weather detention facility with a storage capacity of 12 MGD. Three combined sewer overflow (CSO) outfalls are prohibited per their NPDES permit and have been diverted to the wet-weather detention facility. This facility has not had a discharge since 2018. There are currently no maintenance or compliance issues with the Goshen WWTP.

The Town of Milford currently operates a Class II, 0.25 MGD extended aeration treatment facility consisting of a lift station, bar screens, two oxidation ditches, phosphorus removal, two secondary clarifiers, chlorination/dechlorination, post aeration, and an effluent flow meter. Sludge handling includes aerobic digestion before it is hauled off-site to a landfill. The collection system is comprised of combined storm and sanitary sewers with no overflow or bypass points. There are currently no maintenance issues or concerns at the Town of Milford's WWTP.

The City of Nappanee currently operates a Class III, 1.9 MGD activated sludge plant consisting of an influent pumping station, mechanical bar screen, aerated grit chamber, two primary clarifiers, six aeration tanks, two final clarifiers, six aerobic digester tanks, two anaerobic digester tanks, a sludge pumping station, belt filter press, sludge drying beds, phosphorus removal, UV disinfection and influent and effluent flow meters. The final sludge is dried and landfilled. The collection system is comprised of combined sanitary and storm sewers. The city also operates a 5.0 MGD wet-weather treatment facility, which has one outfall. This includes a CSO storage basin, screening and pumping, UV disinfection, and a high-rate clarification facility. In 2018, the City of Nappanee implemented a CSO Long Term Control Plan. The NPDES permit lists eleven CSO locations, which are now prohibited per their NPDES permit; however, IDEM shows these points as active CSO locations and they are therefore included in Figure 14. There are currently no maintenance or compliance concerns at the City of Nappanee's WWTP.

The Town of Syracuse operates a Class II 1.05 MGD oxidation ditch facility. The facility includes a mechanically cleaned bar screen, forced vortex-type grit removal chamber, influent flow meter, two oxidation ditches, two secondary clarifiers, post aeration, phosphorus removal, UV disinfection and an effluent flow meter. Sludge handling includes aerobic digestion and dewatering via a belt filter press. The final sludge is land-applied on permitted agricultural land. The collection system is 100% separate sanitary sewers with no overflow or bypass points. In 2020, the facility was sent a non-compliance letter by IDEM regarding copper and chlorine effluent limit violations. An inspection by IDEM in September 2021 rated the collection system, the facility/site, records/reports, pre-treatment and effluent limits compliance as all unsatisfactory. In 2021, monthly average concentrations were exceeded for total recoverable copper, total residual chlorine, total suspended solids, and total phosphorus. It was noted that chemicals were not stored properly, and the UV disinfection system was out of service. As of September 2022, IDEM sent an agreed order listing fines and a timeline for compliance.

Additionally, while they discharge outside of the Lower Elkhart River watershed, the Turkey Creek, Regional Sewer District, New Paris wastewater treatment plant and City of Elkhart wastewater treatment plant treatment areas are all displayed on Figure 14. It should be noted that the City of Elkhart has six active CSOs which are governed by their long-term control plan. The long-term control plan (2011) will be implemented over several decades. Based on modeling, the plan is expected to:

- Reduce the frequency of overflows to no more than 9 overflow events in a year with typical rainfall.
- Improve system-wide capture of wet-weather sewer flows from a baseline of 82% to 96% in a typical year.
- Reduce average annual overflow volume by 75% compared to baseline conditions.
- Reduce Elkhart's CSO share of the total E. coli load to the St. Joseph River from 9.1% to 2.4%.
- Reduce E. coli exceedances by more than 50% at locations between Elkhart and Mishawaka.

2.6.4 Unsewered Areas

Approximately 8,043 acres of unsewered dense housing areas were identified within the watershed (Figure 14). Areas that have at least 25 houses within a square mile outside of the sanitary district boundaries were classified as dense, unsewered areas.

2.7 Hydrology

Watershed streams, reservoirs, legal drains, floodplains, wetlands, storm drains, groundwater, subsurface conveyances, and manmade drainage channels all contribute to the watershed's hydrology. Each component moves water into, out of, or through the system. Their contributions will be covered in further detail in subsequent sections.

2.7.1 Watershed Streams

The Lower Elkhart River Watershed contains approximately 488 miles of streams/rivers, canals/ditches, pipelines, and connectors. (Figure 16). Of these, approximately 294.5 miles are canals/ditches, while 144.6 miles are streams and rivers. It should be noted that regulated drains are maintained by the County surveyor's office and all of the regulated drains within the watershed have both a regular maintenance fund and a regular maintenance schedule. Maintenance practices can include dredging with large construction equipment to maintain flow, debris removal, and vegetation management both within the regulated drain and the riparian zone. As these waterbodies are subject to periodic cleaning, it is important to work with the county surveyor to establish priorities for these waterbodies in terms of water quality improvement and erosion control. Each time a ditch is cleaned out or maintained, this action increases the amount of sediment going downstream towards the mainstem of the Elkhart River.

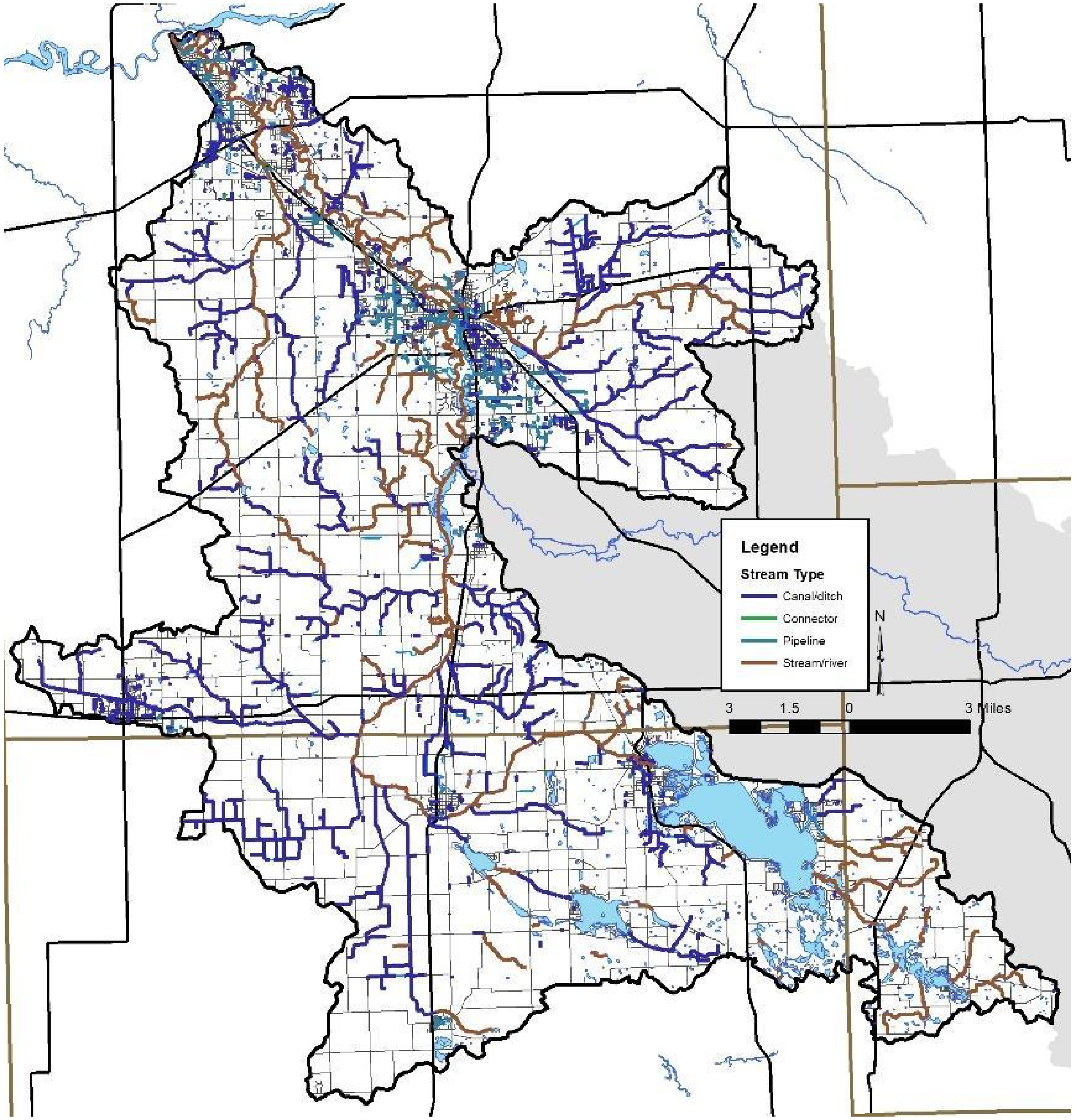

Figure 15. Waterbodies by type in the Lower Elkhart River Watershed.

The section of the river considered to be the Lower Elkhart River begins south of Goshen, near its confluence with Turkey Creek. The Elkhart River flows 35.6 miles from this point to the end of this watershed, where it outlets into the St. Joseph River. The major tributaries to Lower Elkhart River include Turkey Creek, Berlin Court Grand Ditch, Yellow Creek, Rock Run Creek, and Dausmann Ditch (Table 6). The Elkhart River is used for recreational kayaking and canoeing as well as fishing, swimming and aesthetic enjoyment. Several tributaries to Lower Elkhart River Creek are also used for canoeing, kayaking, fishing and aesthetic enjoyment.

Table 6. Streams in the Lower Elkhart River Watershed.

Steam Name	Length (mi)	Stream Name	Length (mi)
Berlin Court Grand Ditch	9.0	Kehr Ditch	1.0
Boyer Ditch	5.2	Kieffer Ditch	5.2
Cable Run	2.7	Kohler Ditch	3.2
Coppes Ditch	4.9	Leedy Ditch	5.0
Darkwood Ditch	3.7	Little Yellow Creek	3.8
Dausman Ditch	7.1	New Miller Ditch	1.5
Davisson Ditch	5.4	Omar Neff Ditch	3.5
Dillon Creek	3.1	Owl Creek	1.6
Elkhart River	22.1	Piper Branch	2.1
Fetters Martin Ditch	1.7	Preston Miles Ditch	3.3
Fuller Arm	1.5	Rock Run Creek	12.0
Fulmer Ditch	1.9	Shaffer Ditch	2.0
Hammond Ditch	2.3	Skinner Ditch	3.1
Hoke Ditch	3.1	Turkey Creek	22.0
Hoopingarner Ditch	4.1	Wagner Ditch	2.7
Hoover Ditch	2.8	Weaver Ditch	2.4
Horn Ditch	5.4	Yellow Creek	12.4
Kauffman Ditch	1.0		

In a review of the hydrogeology of the St. Joseph River basin in Indiana (of which the Elkhart River is part), Crompton and others (1986) stated that the St. Joseph River basin has some of the most productive aquifers in the state. The entire basin has unconsolidated glacial deposits underlying it. Much of the basin is underlain by thick (100-300 ft) deposits of sand and gravel. These sands and gravels form an extensive unconfined buried aquifer with very high transmissivity rates that recharge the river (Crompton and others, 1986; Fowler,1992). Crompton and others estimated that 80 percent of the flow in the river is supplied by these aquifers.

Compared to streams in central and southern Indiana, streams in the St. Joseph River basin have higher base flow and lower flood flows. This is a result of: 1) good hydraulic connection between highly permeable outwash aquifers and stream channels and 2) large amount of surface storage from lakes and wetlands. Streams can maintain steady flow even in times of drought because stored water is released (Crompton and others, 1986).

2.7.2 Lakes, Ponds, and Impoundments

Numerous lakes and ponds dot the Lower Elkhart River Watershed landscape. The largest of these include Lake Wawasee, Syracuse Lake, Dewart Lake, Waubee Lake and Goshen Dam Pond, all of which measure 100 or more acres. In total, five dam structures create Flatbelly Lake , Price Lake, Shock Lake, Lake Papakeechie and the Goshen Dam Pond (Figure 16). Many other lakes in the Lower Elkhart River Watershed possess water control structures; however, these are not mapped by the IDNR as part of their dams GIS layer. Lakes throughout the watershed provide local swimming holes, recreational boating options and localized fishing as well as providing water storage and retention to assist with flooding. Table 7 details lakes with public access sites, which are more readily used for fishing, swimming, boating and other recreation. In total, there are 1053 lakes and ponds in the watershed.

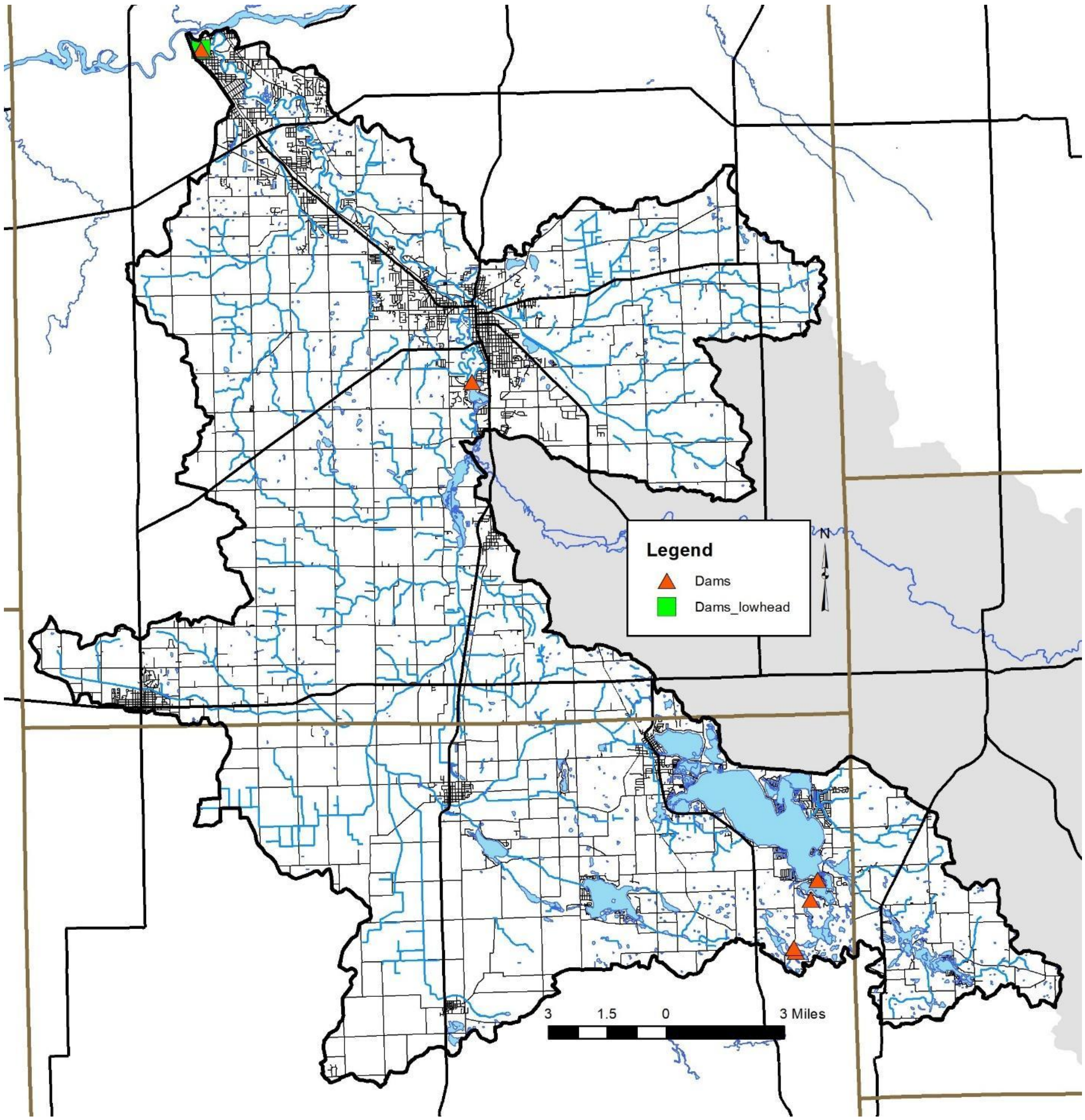

Figure 16. Dams including lowhead dams located in the Lower Elkhart River Watershed.

Table 7. Publicly accessible lakes in the Lower Elkhart River Watershed.

Lake Name	Area (acres)	Lake Name	Area (acres)
Allen	5.3	Moss	7.3
Barrel and a Half	12.3	Norton	50.9
Butts	39.5	Price	8.0
Dewart	557.9	Rider	2.7
Gordy	26.6	Rothenberger	5.3
Goshen Dam Pond	80	Shock	34.4
Hammond	8.0	Spear	40.5
Harper	13.3	Syracuse	413.0
Hindman	9.4	Village	11.5
Knapp	79.1	Wabee (Waubee)	186.7
Wawasee	3464.2	Yellow Creek	15.7
Long	9.4		

2.7.3 Floodplains

Flooding is a common hazard that can affect a local area or an entire river basin. Flooding is a concern to Lower Elkhart River Watershed stakeholders. Increased imperviousness, encroachment on the floodplain, deforestation, stream obstruction, tiling or failure of a flood control structure all are mechanisms by which flooding occurs. Impacts of flooding include property and inventory damage, utility damage and service disruption, bridge or road impasses, streambank erosion and riparian vegetation loss, water quality degradation, and channel or riparian area modification.

Floodplains are lands adjacent to streams, rivers and other waterbodies that provide temporary storage for water. These systems act as nurseries for wildlife, offer green space for humans and wildlife, improve water quality, and buffer the waterbody from adjacent land uses. Local stakeholders are concerned about impacts to floodplains from development, lack of landowner maintenance, and soil erosion and deposition within the floodplain.

Figure 17 details the locations of floodplains within the Lower Elkhart River Watershed. Narrow floodplains lie adjacent to Yellow Creek, Turkey Creek, Berlin Court Ditch, Horn Ditch and the Elkhart River. The widest floodplain lies adjacent to Rock Run Creek before its confluence with Horn Ditch. Approximately 8% (14,851 acres) of the Lower Elkhart River Watershed lies within the 100-year floodplain (Figure 17). This 100-year floodplain is composed of three regions:

- Zone A is the area inundated during a 100-year flood event for which no base flood elevations (BFE) have been established. Nearly 5,031 acres (2.6%) of the Lower Elkhart River Watershed is in Zone A.
- Zone AE is the area inundated during a 100-year flood event for which BFEs have been determined. The chance of flooding in Zone AE is the same as the chance of flooding in Zone A; however, floodplain boundaries in Zone A are approximated, while those in Zone AE are based on detailed hydraulic models which allows Zone AE floodplains to be more accurate. Nearly 9414 acres (5%) of the Lower Elkhart River Watershed is in Zone AE.
- Zone X includes areas outside the 100-year and 500-year floodplains which have a 1% chance of flooding to a depth of one foot of water. No BFEs are available for these areas and no flood insurance is required. Zone X contains 406 acres (less than 1% of the Lower Elkhart Watershed.

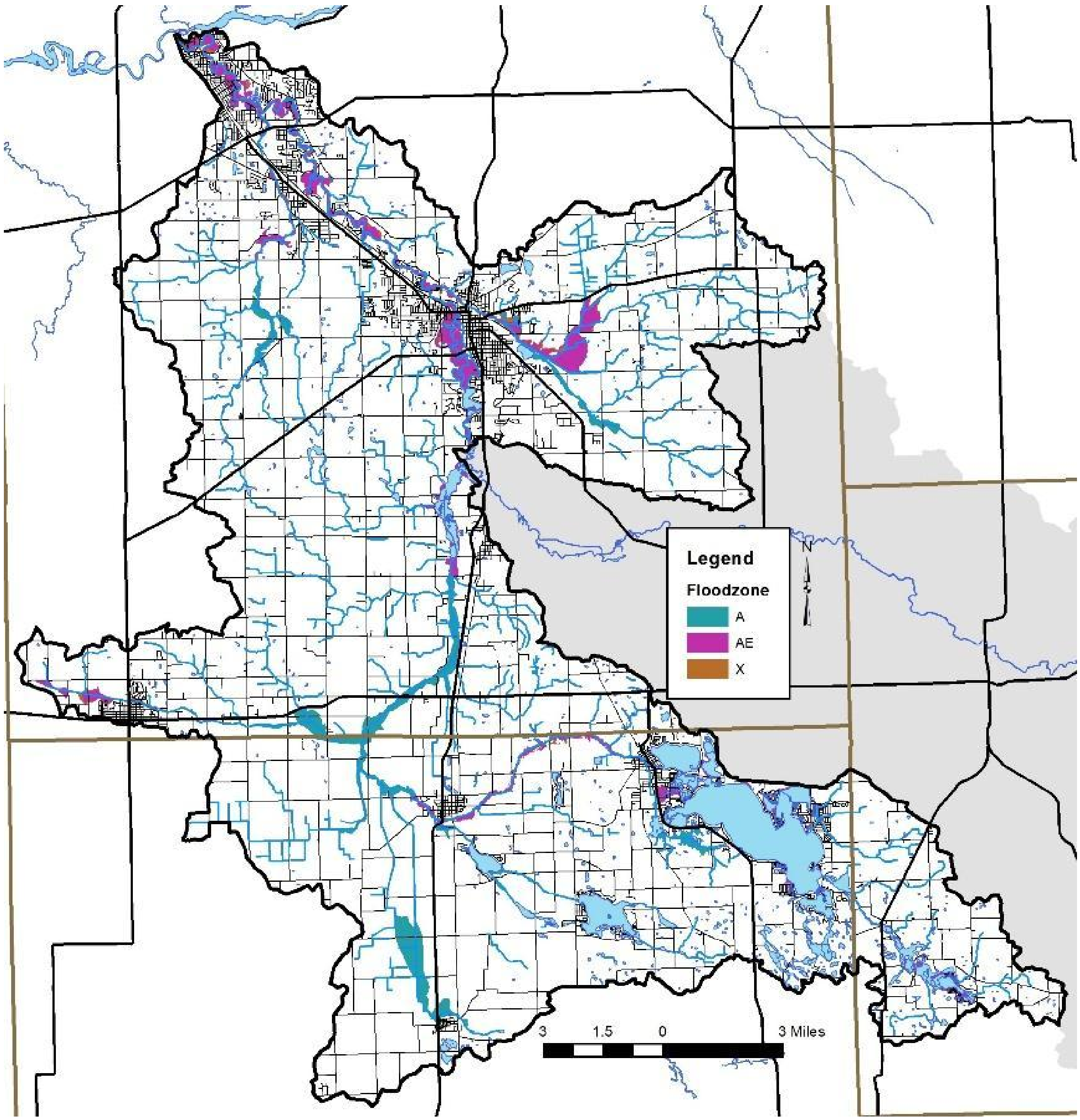

Figure 17. Floodplain locations within the Lower Elkhart River Watershed.

2.7.4 Wetlands

Approximately 25% of Indiana was covered by wetlands prior to European settlement (IDEM, 2007). Overall, 85% of wetlands have been lost resulting in Indiana ranking fourth in the nation in terms of percentage of wetland loss. Wetlands provide numerous valuable functions that are necessary for the health of a watershed and waterbodies. Wetlands play critical roles in protecting water quality, moderating water quantity, and providing habitat. Wetland vegetation adjacent to waterways stabilizes shorelines and streambanks, prevents erosion, and limits sediment transport to waterbodies. Additionally, wetlands have the capacity to increase stormwater detention capacity, increase stormwater attenuation, and moderate low water levels or flow volumes by allowing groundwater to slowly seep back into waterbodies. These benefits help to reduce flooding and erosion. Wetlands also serve as high quality natural areas providing breeding grounds for a variety of wildlife. They are typically diverse ecosystems which can provide recreational opportunities such as fishing, hiking, boating, and bird watching. It should be noted that natural wetlands are regulated through the IDEM and the U.S. Army Corps of Engineers while USDA has jurisdiction over wetlands on agricultural fields. Any modification to wetlands requires permits from these agencies.

Wetlands cover only14,048 acres, or approximately 7% of the watershed. When hydric soil coverage is used as an estimate of historic wetland coverage, it becomes apparent that more than 9% of wetlands have been modified or lost over time. This represents more than 16,400 acres of wetland loss within the Lower Elkhart River Watershed. As commodity prices continue to go up and down, area land values remain high and as a result, individuals are spending a great deal of money to drain small natural wetlands in their fields in order to be able to farm that additional couple acres of land as it is cheaper to tile it than to buy ground already in production.

Figure 18 shows the current extent of wetlands within the Lower Elkhart River Watershed. Wetlands displayed in Figure 18 results from compilation efforts by the U.S. Fish and Wildlife Service as part of the National Wetland Inventory (NWI). The NWI was not intended to map specific wetland boundaries that would compare exactly with boundaries derived from ground surveys. As such, NWI boundaries are not exact and should be considered to be estimates of wetland coverage. Using this map will help us to identify which portions of the watershed would make ideal candidates for wetland restoration efforts, which would reduce the amount of sediment and nutrients reaching the creek, as well as helping to restore the natural hydrology of the area which could help to reduce flooding impacts locally.

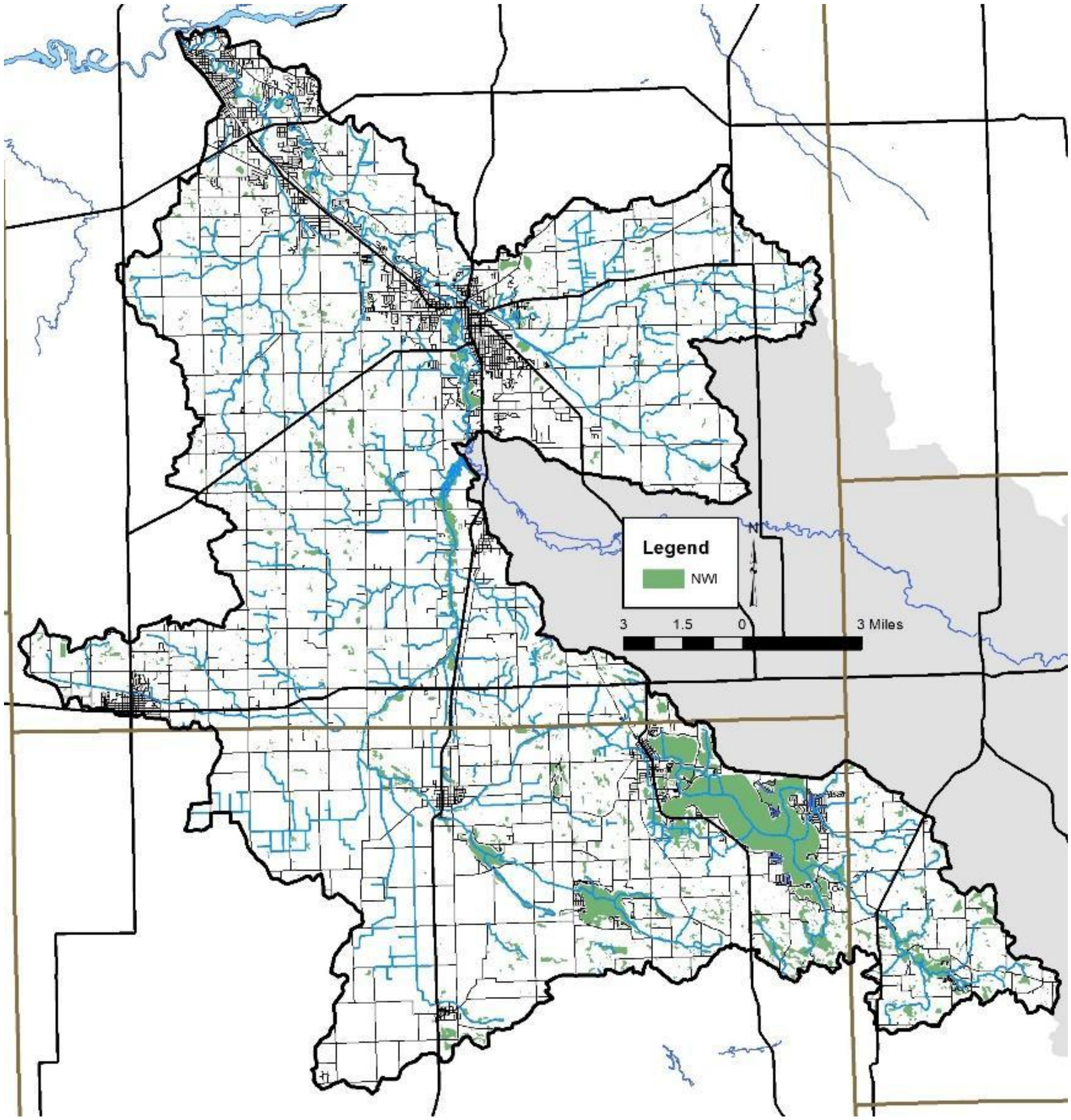

Figure 18. Wetland locations within the Lower Elkhart River Watershed. Source: USFWS, 2017.

2.7.5 Stormwater and Storm Drains

Under natural conditions, the majority of precipitation is allowed to infiltrate the soil and recharge groundwater resources. The volume of infiltration and groundwater recharge diminishes as development increases. To handle the large volume of precipitation falling in urban areas, stormwater systems have been constructed. Storm drain systems are present in most urban areas throughout the watershed. There are two municipal separate storm sewer systems (MS4) in the Lower Elkhart River Watershed: Elkhart County Stormwater Partnership, which includes Elkhart County, the City of Elkhart and the City of Goshen, and the City of Nappanee. 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 CSOs and publicly owned treatment works. Figure 19 details the MS4 boundaries for the watershed's MS4s.

On December 18, 2021, IDEM issued the MS4 General Permit. This replaced 327 IAC 15-13 (rule 13) that previously established permitting requirements for all designated MS4s in Indiana. In April 2022, the City of Nappanee received a letter from IDEM that the city met the requirements to be regulated under the new general permit. On November 29, 2022, the Board of Public Works and Safety approved an agreement for stormwater consulting to respond to the letter from IDEM.

The Elkhart County MS4 is managed by the Elkhart County Stormwater Partnership which is a cooperative effort covering the town of Bristol, the City of Elkhart, the City of Goshen and Greater Elkhart County. The Elkhart County Stormwater Partnership has plans which include six minimum control measures and outlines programs to improve the quality of stormwater that runs off of the land and into rivers, lakes, and streams within their boundaries. More than 28,619 acres of the Lower Elkhart River Watershed are located in one of the two designated MS4s (Table 8).

Table 8. MS4 communities in the Lower Elkhart River Watershed.

MS4 Community	Permit ID	Area (Acres)
Elkhart County Stormwater Partnership	INR040137	27,061
City of Nappanee	N/A	1,558

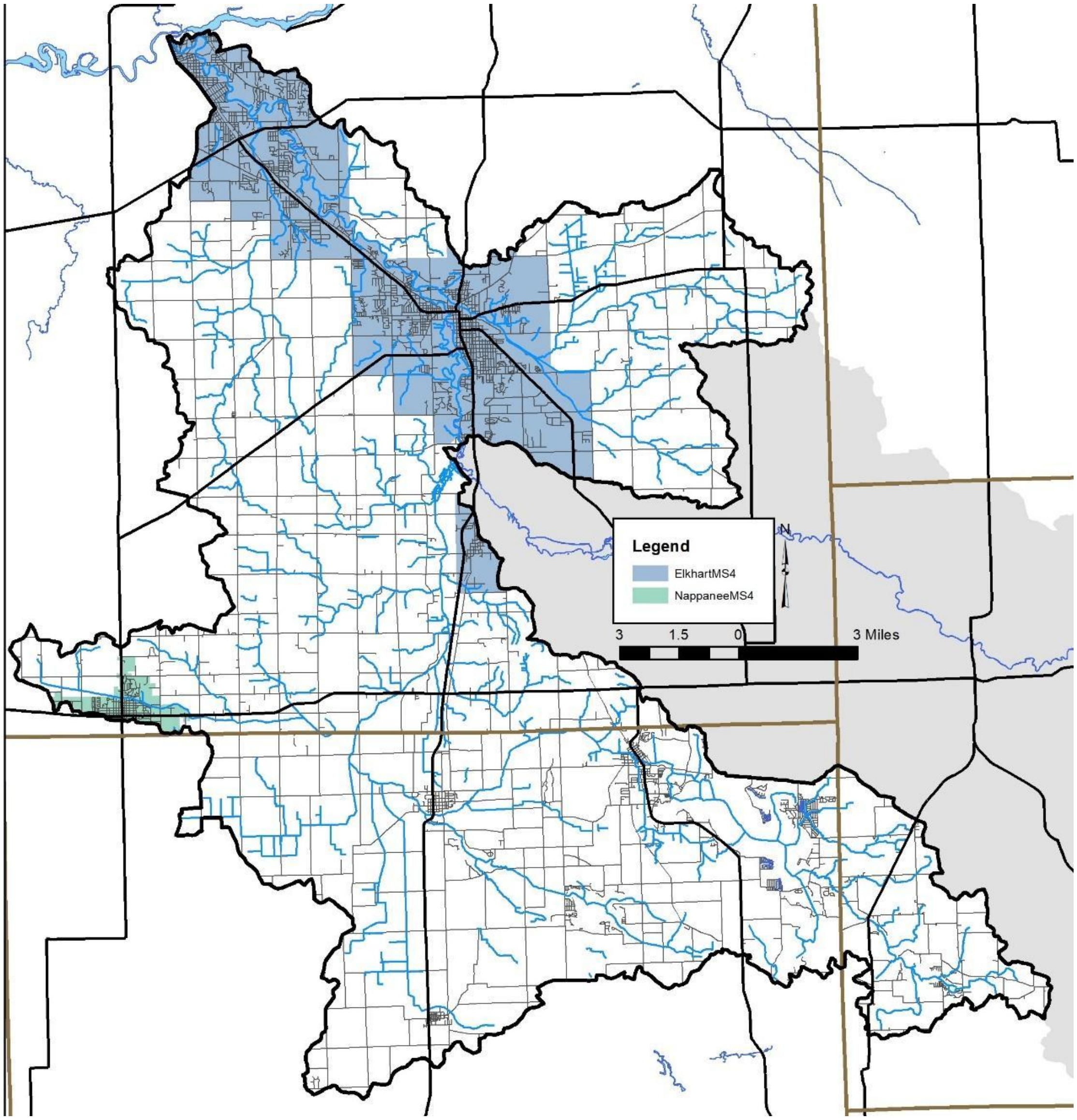

Figure 19. MS4 boundaries for the City of Nappanee and the Elkhart County Stormwater Partnership located within the Lower Elkhart River Watershed.

2.7.6 Wellfields/Groundwater Sensitivity

Recharge to the bedrock aquifer occurs at bedrock outcrops where precipitation enters the aquifer directly or indirectly via unconsolidated deposits. Table 9 lists wellhead protection areas within and adjacent to the Lower Elkhart River Watershed. Potential pollution from construction, sewage outfalls or overflows, illegal dumping, agriculture and stormwater runoff must be avoided or controlled due to the recharge of these aquifers from runoff and river water.

Table 9. Wellhead protection areas in and adjacent to the Lower Elkhart River Watershed.

County	PWSID	System Name	Population
Elkhart	522007	Elkhart Mobile Home Park	96
Elkhart	522008	Elkhart Public Works and Utilities	40880
Elkhart	522009	Goshen Water Utility	32267
Elkhart	522012	Broadmore Estates	972
Elkhart	522016	Nappanee Water Utility	6800
Elkhart	522021	Skyview Mobile Home Park	84
Elkhart	522031	Country Meadows Mobile Home Park	55
Kosciusko	5243019	Pinecrest Mobile Home Park	44
Kosciusko	5243025	Syracuse Water Company	2810
Kosciusko	5243031	Wabee Lake Mobile Home Park	30
Kosciusko	5243032	Turkey Creek Regional Sewer District	593
Kosciusko	524050	Wawasee Mobile Village	25

2.8 Natural History

Geology, climate, geographic location and soils all factor into shaping the native flora and fauna which occurs in a particular area. Categorization of these floral and faunal communities has been completed by a number of ecologists since the earliest efforts by Coulter in 1886. Since this time, Petty and Jackson (1966) identified regional communities; Homoya et al. (1985) classified Indiana into natural regions, while Omernik and Gallant (1988) categorized Indiana into ecoregions.

2.8.1 Natural and Ecoregion Descriptions

According to Homoya et al.'s (1985) classification of natural regions in Indiana, the Lower Elkhart River Watershed lies within the Northern Lakes Section of the Northern Lakes Natural Region. The Northern Lakes section natural region is best identified by the numerous freshwater lakes of glacial origin which were formed by the Wisconsinan age ice sheet. As a result, the area is also covered with a thick and complex deposit of glacial material which, in places, is over 450 feet thick. Glacial topography can be characterized by knobs, kettles, kames, valley trains and outwash plains.

The Lower Elkhart River Watershed also lies in the Southern Michigan/Northern Indiana Drift Plains Ecoregion as defined by Omernik and Gallant (1988). The SMNID plains ecoregion is defined as broad till plains with thick and complex deposits of drift, paleo beach ridges, relict dunes, morainal hills, kames, drumlins, meltwater channel and kettles. This region could be further classified into two sub-regions. The first sub-region is Ecoregion 56a, Lake Country. The Lake Country ecoregion is a hummocky and pitted morainal area characterized by many pothole lakes, ponds, marshes, bogs and clear streams. The well-drained end moraines and kames once supported oak-hickory forests with wetter areas including beech forests or northern swamp forests. The very poorly drained kettles had tamarack swamp, cattail-bulrush marshes or sphagnum bogs. Today, marshes and woodland remain but corn, soybean and livestock farming are dominant. Additionally, recreational and residential developments commonly surround the lakes of Ecoregion 56a. Lake Country covers the southern portion of the watershed. Ecoregion 56b, Elkhart Till Plains, cover the remainder of the watershed. This ecoregion is punctuated by end moraines, kames and lacustrine flats. Kettle hole lakes occur in the Elkhart Till Plains ecoregion, but are much rarer than in the Lake Country ecoregion. Oak-hickory forests and beech maple forests once dominated the Elkhart Till Plains ecoregion; however, corn, soybean and wheat farming is more extensive than woodland in present day. The Elkhart Till Plains ecoregion is fairly diverse as it is also covered with bog, fen, marsh, prairie, sedge meadow, swamp, seep spring, lake and various deciduous forest types. Streams of this sub-region are typically clear, medium to low-gradient, and have sandy gravel beds.

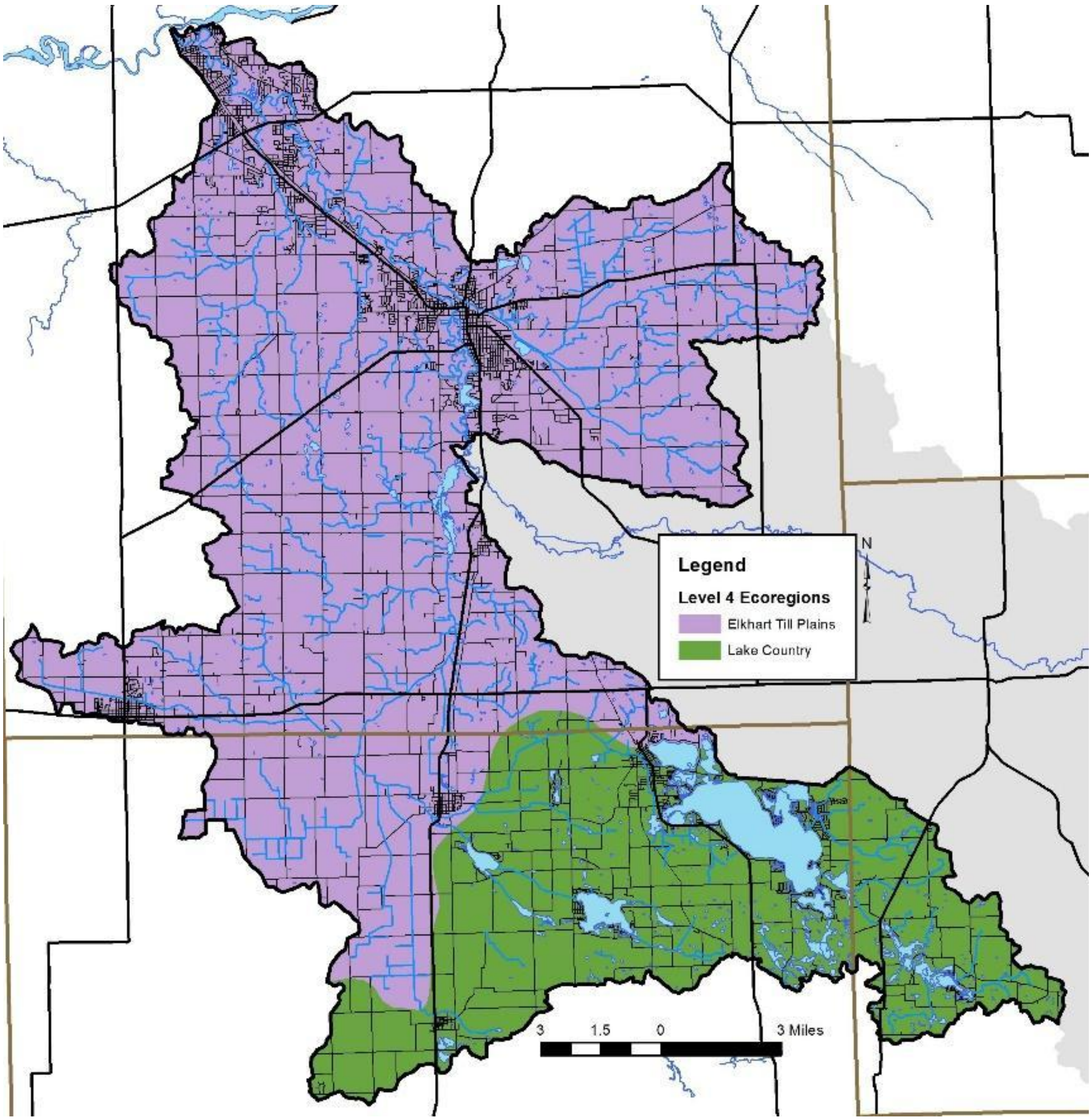

Figure 20. Level 4 eco-regions in the Lower Elkhart River Watershed.

2.8.2 Wildlife Populations and Pets

Individuals are concerned about local wildlife and pet populations, the impact that these have on pathogen levels and the impact that changing land uses could have on these populations. These will be quantified in subsequent sections. With these concerns in mind, wildlife density can be estimated from a variety of sources. The Indiana Department of Natural Resources (IDNR) is tasked with managing wildlife populations throughout the state. In order to complete this task, the IDNR must have an idea of the population density within specific areas, counties, or regions. The most recent survey of wildlife populations for which data are publicly available occurred in 2005. Those densities are shown in Table

10 with deer, squirrels and turkey being the most common wildlife present within the region. It should be noted that these numbers could both underestimate and overestimate populations within the watershed. Densities are recorded based on animal observations per 1000 hours of overall observation. If observation areas are not equally spread throughout the region, over or underestimates of the populations could occur. Likewise, animals are not likely equally distributed throughout the region; therefore, the regional density may again over or underestimate the true density of the animal in question. Nonetheless, these estimates provide the best guess at wildlife densities. Wildlife waste will be an issue in the more natural, forested or wetland portions of the watershed.

Table 10. Surrogate estimates of wildlife density in the IDNR northeast region, which includes the Lower Elkhart River Watershed.

Animal	2005 Population Observation (per 1,000 hours of observation)
Badger	0.4
Bobcat	0.2
Bobwhite	31.1
Coyote	14.4
Deer	1,038.2
Fox squirrel	564.5
Gray fox	0.2
Gray squirrel	61.8
Grouse	0.7
Domestic cat	24.8
Muskrat	3.7
Opossum	8.3
Rabbit	29.9
Raccoon	53.5
Red fox	8.5
Skunk	10.2
Turkey	205.7

Source: Plowman, 2006.

Pet populations can affect pathogen levels similar to the impacts provided by wildlife. While a count of pets located in the Lower Elkhart River Watershed was not completed, dog and cat populations were estimated for the watershed. Statistics reported in the 2022 U.S. Pet Ownership & Demographics Sourcebook were used to find these figures. Specifically, the Sourcebook reports that on average 37.4 percent of households own dogs and 32.9 percent of households own cats. Typically, the average number of pets per household is 1.7 dogs and 2.2 cats. However, pets are likely only a significant source of E. coli in population centers including Elkhart, Goshen, Nappanee, Syracuse, and Milford. The estimated number of domestic pets in the Lower Elkhart River Watershed is based on the average number of pets per household multiplied by the population of the watershed resulting in a suggested population of 39,571 cats and 34,760 dogs. Pet waste issues are more predominant in the urban areas noted above but are also present at any residential parcel.

2.8.3 Endangered Species

The Indiana Natural Heritage Data Center, part of the Indiana Department of Natural Resources, Division of Nature Preserves, maintains a database documenting the presence of endangered, threatened, or rare species; high quality natural communities; and natural areas in Indiana. The database originated as a tool to document the presence of special species and significant natural areas and to assist with management of said species and areas where high quality ecosystems are present. The database is populated using individual observations which serve as historical documentation or as sightings occur; no systematic surveys occur to maintain the database.

The state of Indiana uses the following definitions to list species:

- Endangered: Any species whose prospects for survival or recruitment with the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government which occur in Indiana. Plants currently known to occur on five or fewer sites in the state are considered endangered.
- Threatened: Any species likely to become endangered within the foreseeable future. This includes all species classified as threatened by the federal government which occur in Indiana. Plants currently known to occur on six to ten sites in the state are considered threatened.
- Rare: Plants and insects currently known to occur on eleven to twenty sites.

In total, 103 observations of listed species and/or high-quality natural communities occurred within the Lower Elkhart River Watershed (Figure 21; Davis, personal communication). These observations include five invertebrate species, 23 vascular plant species, 26 vertebrate animal species, including two bat species, 11 birds, two turtle and one snake species, as well as seven terrestrial high quality natural communities including Northern Lakes Dry-mesic Upland Forest, Lake, Circumneutral Bog, Marsh, Sedge Meadow and Shrub Swamp. State endangered species include the Upland Sandpiper, American Bittern, Black Tern, Sedge Wren, Least Bittern, Loggerhead shrike, King Rail, Virginia Rail, Cerulean Warbler, Lake Sturgeon, cisco (fish), greater redhorse (fish), boreal stonefly, American salmonfly, Indiana Bat, evening bat, spotted turtle, Blanding's turtle, eastern massasauga, Beck's water-marigold, wild calla, pink lady's slipper, Bicknell's northern cranesbill, Fries' pondweed, Oakes' pondweed and horned bladderwort. While state threatened species include Hickey's clubmoss, green-keeled cotton-grass, herb-Robert, butternut, ground juniper, ostrich fern, whorled water-milfoil, straight-leaf pondweed, American wintergreen, water bulrush, false asphodel and marsh arrow-grass. State species of special concern include: Blanchard's cricket frog, four-toed salamander, common mudpuppy, osprey, longnose dace (fish) and American badger. These species are found in high quality natural areas identified in the Lower Elkhart River Watershed as well as in forests, wetlands and other natural areas throughout the watershed. Appendix B includes the database results for the Lower Elkhart River Watershed, as well as County-wide listings for Elkhart, Noble, and Kosciusko counties.

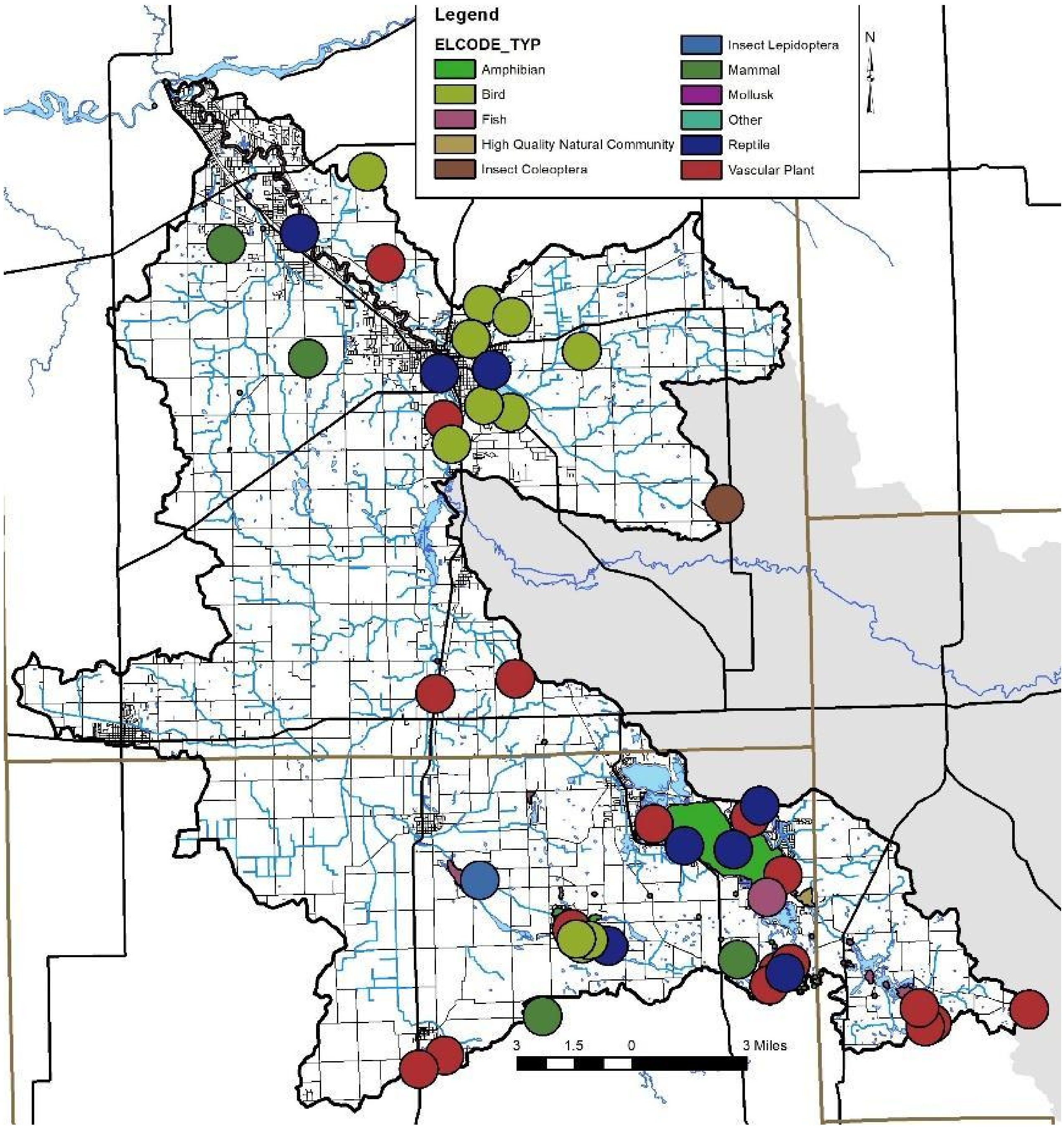

Figure 21. Locations of special species and high quality natural areas observed in the Lower Elkhart River Watershed. Source: Davis, 2023.

2.8.4 Recreational Resources and Significant Natural Areas

A variety of recreational opportunities and natural areas exist within the Lower Elkhart River Watershed. Recreational opportunities include local parks, fish and wildlife areas, nature preserves, fairgrounds, golf courses and school grounds (Table 11, Figure 22). There are several significant natural areas located within the Lower Elkhart River Watershed. The Indiana DNR; Elkhart, Nappanee, and Goshen Park Boards and Goshen College maintain, preserve, and protect these properties. There are many lake public access sites maintained by the Indiana DNR. Additional recreational opportunities exist at Goshen College, various schools, and recreational facilities.

Table 11. Natural areas in the Lower Elkhart River Watershed.

Natural Area	County	Organization	Access
Allen Lake, Rothberger Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
American Park	Elkhart	Elkhart County Park & Rec Dept.	Open
Baker Park	Elkhart	Elkhart County Park & Rec Dept.	Open
Barrell & A Half Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Bass Pond Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Burdick St. Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Crosson Mill Park	Kosciusko	Syracuse Parks & Recreation Dept.	Open
Dam Access Site	Elkhart	Goshen Parks and Recreation Dept.	Open
Derksen Farm and Wetland Area	Elkhart	Nappanee Park Board	Open
Dewart Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Dorothy McFarland Park	Elkhart	Goshen Parks and Recreation Dept.	Open
East Goshen Park, Dykstra Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Elkhart Environmental Center	Elkhart	Elkhart County Park & Rec Dept.	Open
Elkhart River Public Access Site	Elkhart	Indiana DNR Div. of Fish & Wildlife	Open
Gans Park	Elkhart	Elkhart County Park & Rec Dept.	Open
Greider's Woods Nature Preserve	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Goshen Millrace Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Hammond Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Henry Ward Park	Kosciusko	Syracuse Parks and Recreation Dept	Open
Hoy's Beach	Kosciusko	Syracuse Parks and Recreation Dept.	
Indian Village Lake Public Access Site	Noble	Indiana DNR Div. of Fish & Wildlife	Open
Island Park	Elkhart	Elkhart County Park & Rec Dept.	Open
John Derksen (Stauffer) Park	Elkhart	Nappanee Park Board	Open
John O. Abshire Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Knapp Lake Public Access Site	Noble	Indiana DNR Div. of Fish & Wildlife	Open
Linway Lake Park	Elkhart	Goshen Parks and Recreation Dept.	Open
McCormick Creek Golf Course	Elkhart	Nappanee Park Board	Open
Mullett Park	Elkhart	Goshen Parks and Recreation Dept.	
Nappanee (Westside) Community Park	Elkhart	Nappanee Park & Recreation Dept.	Open
North Goshen Park (N.8th St. Park)	Elkhart	Goshen Parks and Recreation Dept.	Open
Oakridge Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Oxbow County Park	Elkhart	Elkhart County Park & Rec Dept.	Open
Price & Long Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Pringle Park	Elkhart	Goshen Parks and Recreation Dept.	Open
Rieth Park	Elkhart	Goshen Parks and Recreation	Open
Rogers Park	Elkhart	Goshen Parks and Recreation	Open
Shanklin Park & Public Access Site	Elkhart	Goshen Parks and Recreation Dept.	Open
Shock Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Shoup-Parson Woods Park	Elkhart	Goshen Parks and Recreation	Open

Natural Area	County	Organization	Access
Spear Lake Public Access & Nature Trail	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Studebaker Park	Elkhart	Goshen Parks and Recreation	Open
Sunnyside Park	Elkhart	Town of New Paris	Open
Syracuse Lake Public Access Site	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Syracuse Lakeside Park	Kosciusko	Syracuse Parks & Recreation Dept.	Open
Tri-County Fish and Wildlife Area	Kosciusko, Noble	Indiana DNR Div. of Fish & Wildlife	Open
Turkey Creek Site	Elkhart	Elkhart County Park & Rec Dept.	Open
Walnut Park (N. 5th St. Park)	Elkhart	Goshen Parks and Recreation Dept.	Open
Wawasee Public Fishing Area	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Open
Wawasee Wetlands Conservation Area	Kosciusko	Indiana DNR Div. of Fish & Wildlife	Restrictions
Waubee Lake Park	Kosciusko	Milford Park Board	Open
West Goshen Park (Baker Park)	Elkhart	Goshen Parks and Recreation Dept.	Open
Yellow Creek Lake Public Access Site	Elkhart	Indiana DNR Div. of Fish & Wildlife	Open

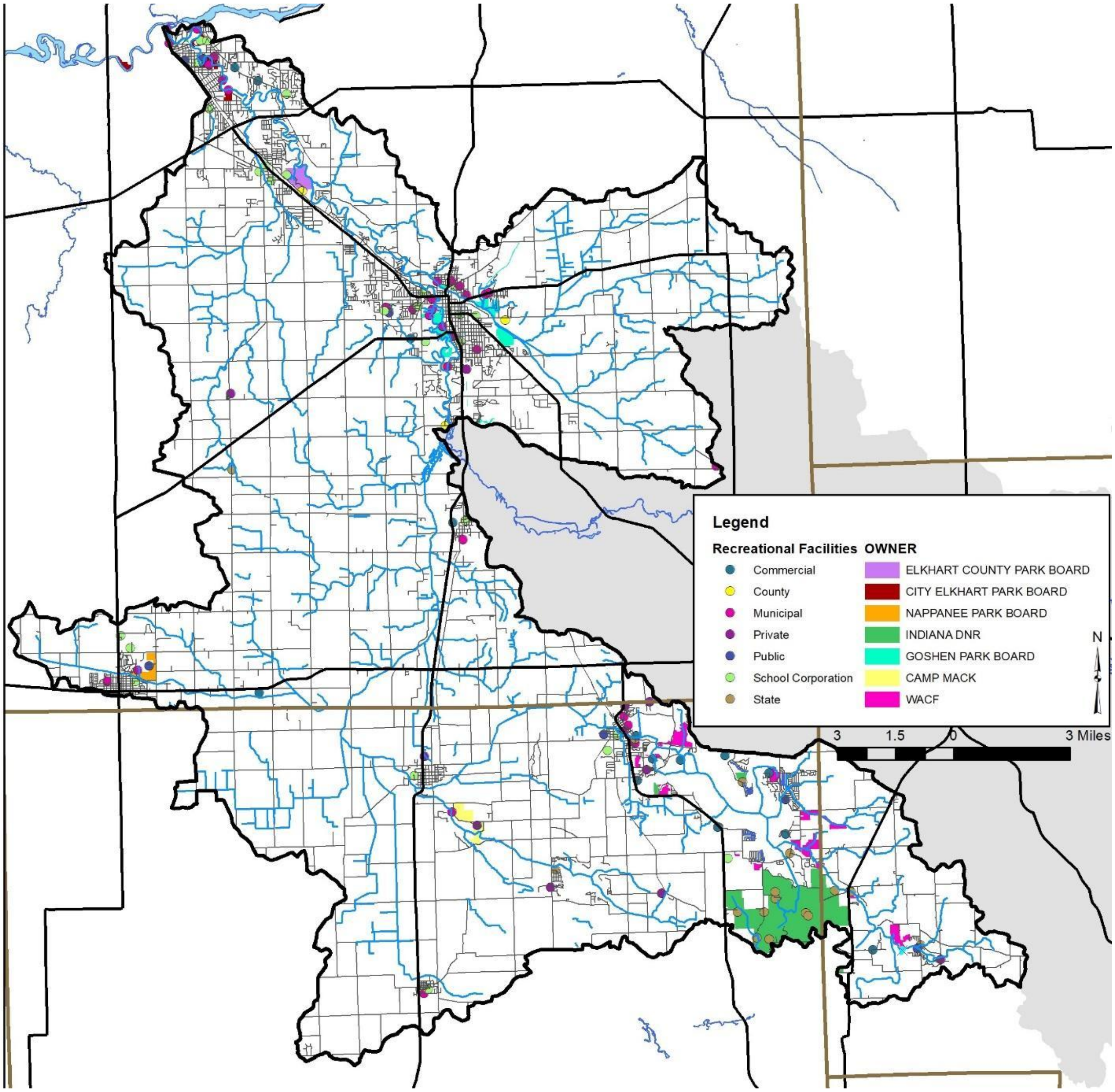

Figure 22. Recreational opportunities and natural areas in the Lower Elkhart River Watershed.

2.9 Land Use

Water quality is greatly influenced by land use both past and present. Different land uses contribute different contaminants to surface waters. As water flows across agricultural lands, it can pick up pesticides, fertilizers, nutrients, sediment, pathogens and manure, to name a few. However, when water flows across parking lots or from roof tops it not only picks up motor oil, grease, transmission fluid, sediment and nutrients, but it reaches a waterbody faster than water flowing over natural or agricultural land. Hard or impervious surfaces present in parking lots or on rooftops create a barrier between surface and groundwater. This barrier limits the infiltration of surface water into the groundwater system resulting in increased rates of transport from the point of impact on the land to the nearest waterbody.

2.9.1 Current Land Use

Today, the majority of the Lower Elkhart River Watershed is covered by agricultural land uses (127,078 acres or 67%; (Table 12, Figure 23) which consists of pastureland/hay (16,699 acres or 9%) and row crop agriculture (110,379 acres or 58%). Nearly 12% of the watershed is mapped in natural land uses including forest, grassland and wetlands. Developed open space and low, medium and high density developed land covers 18% of the watershed, while open water covers the remaining 3% of the watershed.

Table 12. Detailed land use in the Lower Elkhart River Watershed.

Classification	Area (acres)	Percent of Watershed
Cultivated crop	110,379	58%
Pasture/hay	16,699	9%
Developed open space	14,245	8%
Low intensity development	11,488	6%
Deciduous forest	11,212	6%
Woody wetland	9261	5%
Open water	5515	3%
Medium intensity development	4493	2%
High intensity development	2854	2%
Emergent wetland	1708	1%
Barren land	442	0%
Mixed forest	435	0%
Grassland	343	0%
Evergreen forest	238	0%
Shrub/scrub	175	0%
Entire Watershed	**189,488**	**100%**

Source: USGS, 2016

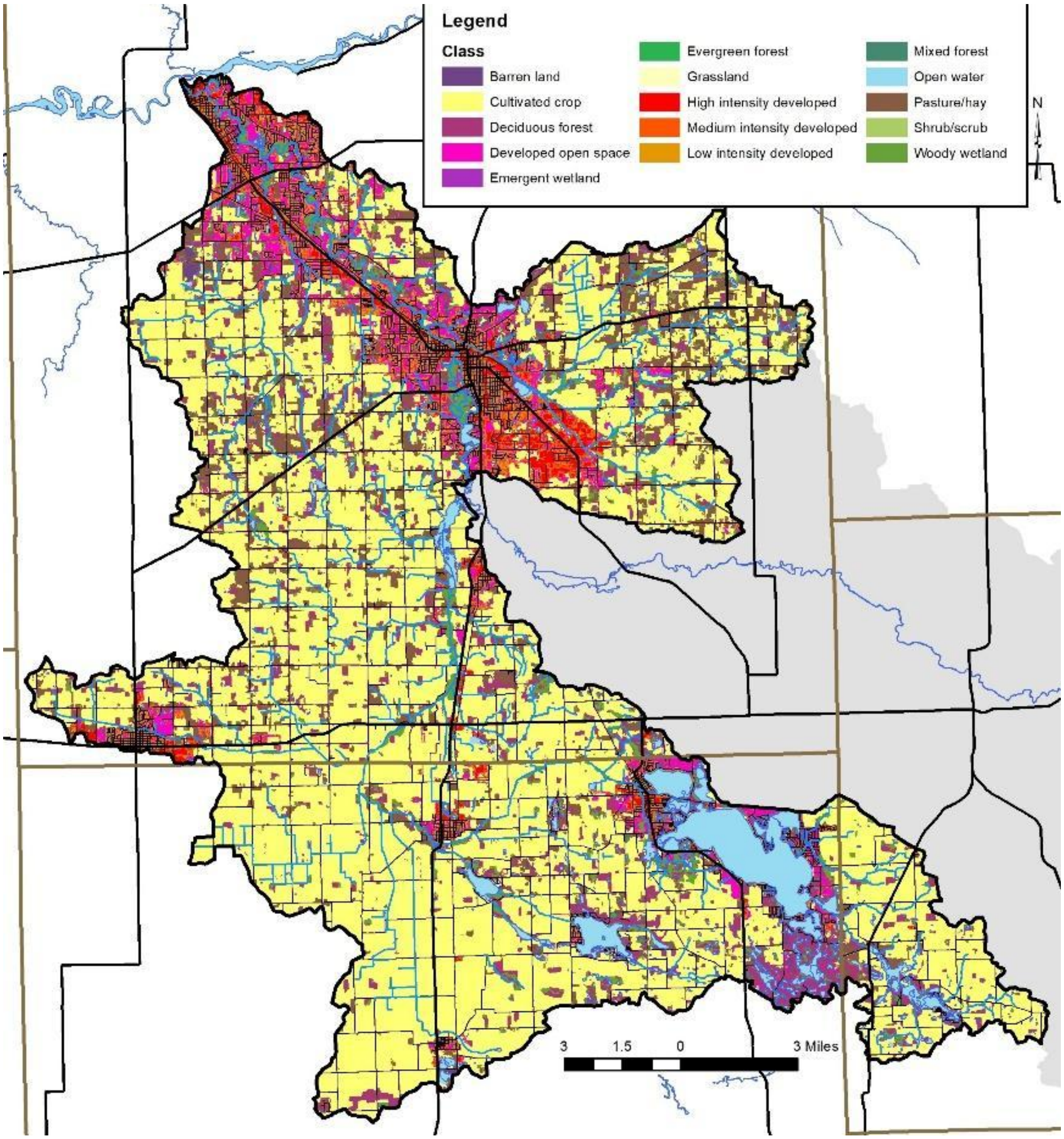

Figure 23. Land use in the Lower Elkhart River Watershed. Source: NLCD, 2016.

2.9.2 Agricultural Land Use

Individuals are concerned about the impact of agricultural practices on water quality. Specifically, the volume of exposed soil entering adjacent waterbodies, the prevalence of tiled fields and thus the transport of chemicals into waterbodies, the use of agricultural chemicals, and the volume of manure applied via small animal farms and through confined animal feeding operations are concerning to local residents. Each of these issues will be discussed in further detail below.

Tillage Transect

Tillage transect information data for Elkhart, Kosciusko, and Noble counties was compiled for 2022 (Table 13; ISDA, 2022 A-D). As reported by ISDA, members of Indiana's Conservation Partnership (ICP) conduct a field survey of tillage methods. A tillage transect is an on-the-ground survey that identifies the types of tillage systems farmers are using and long-term trends of conservation tillage adoption using GPS technology, plus a statistically reliable model for estimating farm management and related annual trends. Table 13 provides the number of acres and percent of acres on which conservation tillage was utilized for each county by corn and soybeans. These numbers may be an underestimate due to the timing of tillage transects in each county.

Table 13. Conservation tillage data as identified by County tillage transect data for corn and soybeans (ISDA, 2022).

County	Corn (acres)	Corn (%)	Soybeans (acres)	Soybeans (%)
Elkhart	28,143	59%	34,503	93%
Kosciusko	67,670	67%	67,680	80%
Noble	52,983	87%	57,660	93%

Agricultural Chemical Usage

Agricultural pesticides and fertilizers are commonly applied to row crops in Indiana. These chemicals can be carried into adjacent waterbodies through surface runoff and via tile drainage. This is especially an issue if a storm occurs prior to the chemicals being broken down and used by the crops.

Data for chemical usage on an individual County or watershed level are not currently collected. Rather, data is collected for the state as a whole in two forms. First, the National Agricultural Statistics Survey (NASS) collects information on chemical usage, number of applications per year, type of chemical applied, and the application rate. These data were last collected in 2006 (NASS, 2006). Additionally, NASS collects farmland data for the number of acres in agricultural production by type (i.e. corn, soybeans, grains) by County (NASS, 2022). These data indicate that corn (209,600 acres planted in Elkhart, Kosciusko and Noble counties) and soybeans (183,700) acres planted in Elkhart, Kosciusko and Noble counties) are the two primary crops grown in the watershed.

Nitrogen is more typically applied to corn than to soybeans. Soybeans have symbiotic bacteria on their roots that act as nitrogen fixers, which means that they pull the nitrogen that they need from the atmosphere then convert it into a form which they can use. Corn does not fix nitrogen; therefore, nitrogen needs to be applied. Nitrogen is typically applied twice in Indiana – once at or before planting and a second time when corn reaches approximately one foot in height (NASS, 2007). Fall application of nitrogen also occurs and is particularly problematic. Agricultural data indicate that corn receives 98% of the nitrogen applied in the state and 87% of the phosphorus. For these reasons, nutrient calculations were only completed for corn as applications to soybeans are likely negligible. Based on these data, it is estimated that 22,227 tons of nitrogen and 10,995 tons of phosphorus are applied annually within the counties in which the Lower Elkhart River Watershed is located (Table 14).

Table 14. Agricultural nutrient usage for corn in the Lower Elkhart River Watershed counties.

Nutrient	Acres of Corn	% of Area Applied	Applications (#/year)	Rate/Application (lb/acre)	Total Applied/Year (tons)
Nitrogen	209,600	100	2.2	67	22,227
Phosphorus	209,600	93	1.4	56	10,995

Source: NASS, 2007; NASS, 2022

Pesticides are also used on crops grown in Indiana. The Office of the Indiana State Chemist indicates that the two predominant herbicide active ingredients applied are atrazine and glyphosate. Atrazine is most commonly applied as a corn herbicide, while glyphosate is used on both corn and soybean fields as an herbicide. NASS indicates that in 2005, an average of 1.24 pounds of atrazine and 0.6 pounds of glyphosate were applied per acre of corn and 0.73 pounds of glyphosate were applied per acre of soybeans (NASS, 2006). Using these rates, we estimated that approximately 187 tons of atrazine and approximately 173 tons of glyphosate are applied to cropland in the Lower Elkhart River Watershed counties annually (Table 15).

Table 15. Agricultural herbicide usage in the Lower Elkhart River Watershed counties.

Crop	Acres	Application Rate (lb/acre)	Total Applied (lbs)	Total Applied/ Year (tons)
Corn (Atrazine)	209,600	1.24	373,976	187
Corn (Glyphosate)	209,600	0.60	180,956	90
Soybeans (Glyphosate)	183,700	0.73	165,115	83

Source: NASS, 2006; NASS, 2022

Confined Feeding Operations and Hobby Farms

A mixture of small, unregulated and larger, regulated livestock operations (concentrated animal and confined feeding operations) is found within the Lower Elkhart River Watershed. Small farms are those which house less than 300 animals, while larger farms that house large numbers of animals for longer than 45 days per year are regulated by IDEM. These regulations are based on the number and type of animals present. IDEM requires permit applications which document animal housing, manure storage, and disposal and nutrient management plans for farms which maintain 300 or more cows, 600 or more hogs or 30,000 or more fowl. These facilities are considered confined feeding operations (CFO). In Indiana, all regulated animal feeding operations are considered CFOs. The difference between a CFO and a concentrated animal feeding operation (CAFO) relates to the size of the operation. A CFO that meets the size classification as a CAFO is a farm that meets or exceeds an animal threshold number in the U.S. Environmental Protection Agency's definition of a large CAFO, which is 700 mature dairy cows, 1,000 veal calves, 1,000 cattle other than mature dairy cows, 2,500 swine above 55 pounds, 10,000 swine less than 55 pounds, 500 horses, 10,000 sheep or lambs, 55,000 turkeys, 30,000 laying hens or broilers with a liquid manure handling system, 125,000 broilers with a solid manure handling system, 82,000 laying hens with a solid manure handling system, 30,000 ducks with a solid manure handling system or 5,000 ducks with a liquid manure handling system.

There are 10 CAFOs and 28 CFOs located in the watershed (Figure 24). In total, these facilities are permitted to house up to 59,950 pigs, 236 beef cattle, 3,272 dairy cattle, 649,800 chickens, 83,900 ducks and 83 horses. In total, 346 small, unregulated animal farms containing more than 6,570 animals were identified during the windshield survey, which is most likely an underestimate of the actual number. These small "mini farms" contain small numbers of cattle, horses, bison, sheep or goats, which could be sources of nutrients and E. coli as these animals exist on small acreage lots with limited ground cover. In total, approximately 803,885 animals per year are housed in CAFOs, CFOs and on unregulated farms in the watershed, generating approximately 560,288 tons of manure per year spread over the watershed. This volume of manure contains approximately 20,287,514 pounds of nitrogen, 16,418,073 pounds of phosphorus and 1.36E+20 col of E. coli.

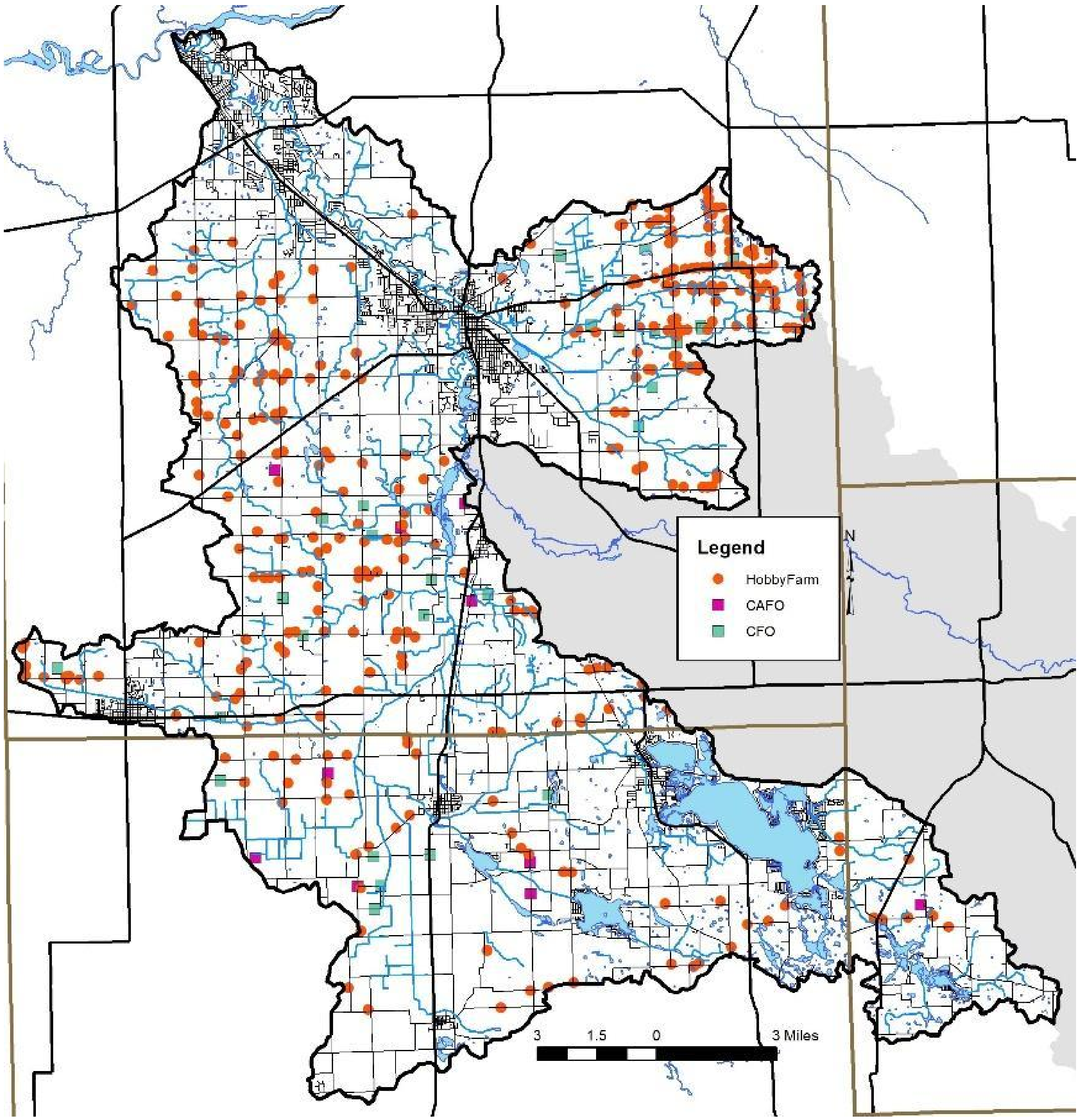

Figure 24. Confined feeding operation and unregulated animal farm locations within the Lower Elkhart River Watershed.

2.9.3 Natural Land Use

Natural land uses including forest, wetlands, and open water cover approximately 15% of the watershed. Approximately 20,844 acres or 11% of the watershed is covered by trees. Forest cover occurs adjacent to waterbodies throughout the watershed.

2.9.4 Urban Land Use

Urban land uses cover approximately 32,213 acres or 18% of the watershed (

Table 16). Most developed areas are associated with the Cities of Goshen and Elkhart, as well as the various lake communities in the southeastern portion of the watershed. Although this is only a small portion of the watershed, there are some significant issues related to the developed areas. Especially troublesome are issues related to failing septic systems, impervious surfaces, flooding and stormwater runoff that allow untreated sewage and stormwater to flow into the watershed during heavy rain events.

Impervious Surfaces

Impervious surfaces are hard surfaces which limit surface water from infiltrating into the land surface to become groundwater thereby creating high overland flow rates. Hard surfaces include concrete, asphalt, compacted soils, rooftops, and buildings or structures. In developed areas, land which was once permeable has been covered by hard, impervious surfaces. This results in rain which once absorbed into the soil running off of rooftops and over pavement to enter the stream with not only higher velocity but also higher quantities of pollutants. There are also two MS4 Communities in the watershed, covering more than acres of the Lower Elkhart River Watershed.

Legacy Pollutant Remediation Sites

Remediation sites including industrial waste, leaking underground storage tanks (LUST), open dumps and brownfields are present throughout the Lower Elkhart River Watershed (Figure 25). Most of these sites are located within the developed areas of the watershed. In total, 55 industrial waste sites, 103 leaking underground storage tanks (LUST facilities), 10 voluntary remediation project (VRP) locations, two solid waste sites and 48 brownfields are present within the watershed.

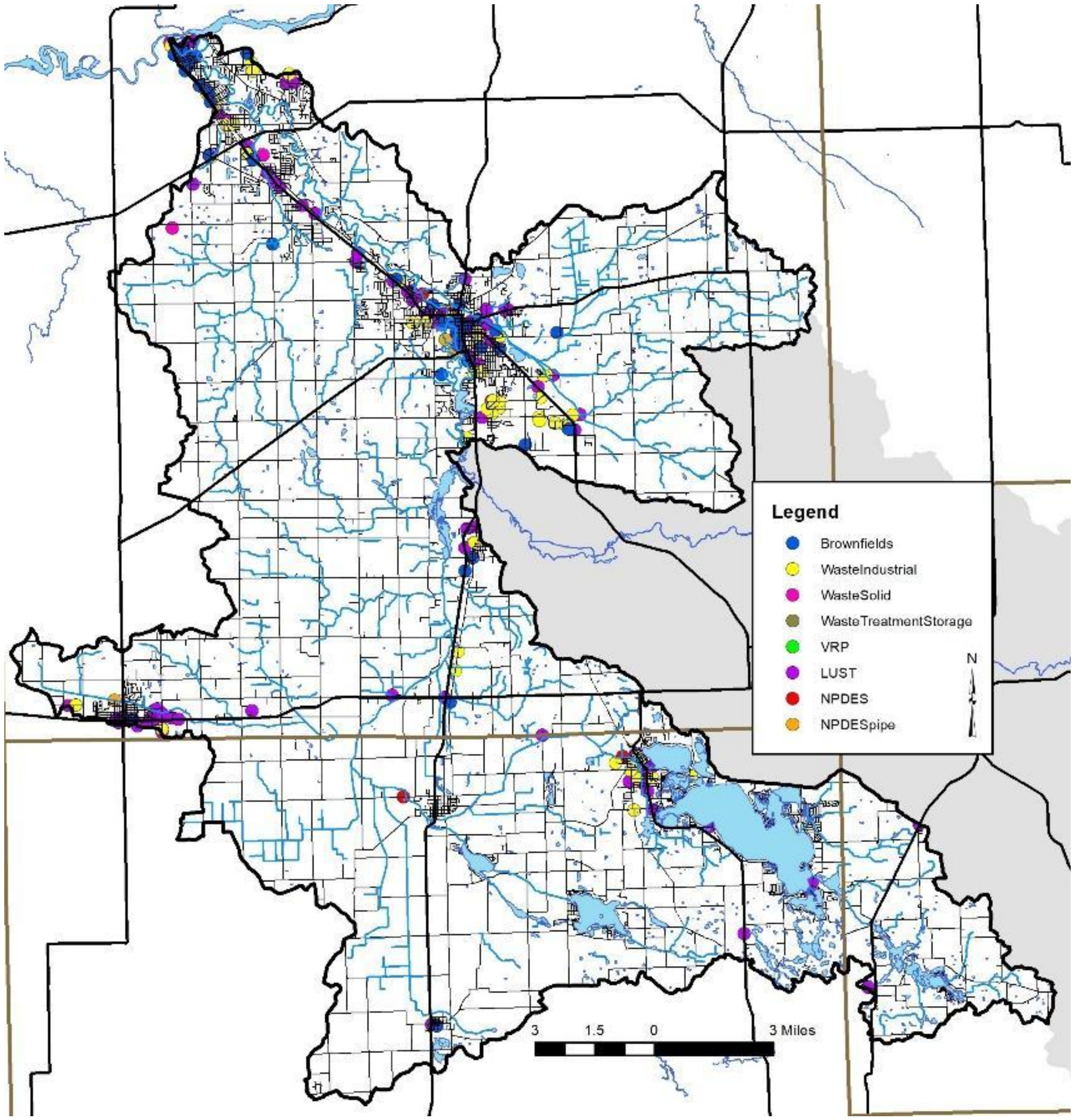

Figure 25. Industrial remediation and waste sites within the Lower Elkhart River Watershed.

2.10 Population Trends

The Lower Elkhart River Watershed is a mix of relatively sparsely populated areas and urban centers in general. The City of Goshen, City of Elkhart, City of Nappanee, Town of Syracuse and Town of Milford house the highest density populations. Table 16 details the population of each county in the Lower Elkhart River Watershed. These data indicate that two of the counties, Elkhart and Kosciusko, are growing; however, Noble County saw a slight decrease in population from 2010 to 2020. The steering committee identified that development can be sources of pollutants including sediment, nutrients and pathogens.

Table 16. Population data for counties in the Lower Elkhart River Watershed.

County	2000	2010	2020	Population Change 2010 to 2020
Elkhart	182,791	197,559	205,184	+7,625
Kosciusko	74,057	77,358	80,240	*2,882
Noble	46,275	47,536	47,640	-104

Tracking population changes within a watershed is challenging as data is published by counties and townships rather than watershed boundaries. Changes in watershed population and the associated land use changes and infrastructure impacts were noted by watershed stakeholders. Estimated populations in the Lower Elkhart River Watershed indicate that 35% of the population is rural residents while 65% of the population reside in urban locations. Table 17 displays estimated populations for the portion of each County located within the watershed (US Census data, 2020).

Table 17. Estimated watershed demographics for the Lower Elkhart River Watershed.

County	2020 Population	Total Estimated Watershed Population	Total Estimated Watershed Urban Population	Total Estimated Watershed Rural Population	Percent of Total Watershed Population
Elkhart	205,184	124,636	95,389	29,247	80.9%
Kosciusko	80,240	26,399	4799	21,600	17.1%
Noble	47,457	3005	0	3005	2.0%
Total	**332,882**	**154,040**	**100,188**	**53,853**	**100%**

2.11 Planning Efforts in the Watershed

Multiple plans have encompassed portions of the Lower Elkhart River Watershed or areas which it drains or outlets into. Planning efforts cover three main areas: 1) Project-focused planning efforts where a specific area or portion of the Lower Elkhart River Basin was assessed and specific water quality improvement projects identified, 2) Flow-based assessments and planning efforts, and 3) Comprehensive plans. Plans are listed in chronological order.

2.11.1 Project-Focused Planning Efforts

Waubee Lake Diagnostic Study (2002)

In July 2002, the INDR Division of Soil Conservation released the Waubee Lake Report. In 2001, the Waubee Lake Association became concerned about nutrient and sediment loading in the lake. The IDNR Division of Soil Conservation assisted in an investigation to determine the sources of nutrients and sediment. From December 2001 to May 2002, sampling was conducted three times on the lake's two main tributaries: Hammond Ditch and Felkner Ditch. Felkner Ditch originates in an animal waste pond, although no water quality problems were found to be associated with the animal waste. It was concluded that that an overabundance of vegetation in the wetlands could release nutrients from decomposing plant materials.

Waubee Lake Sediment Removal Plan (2005)

In September 2005, JFNew released the Waubee Lake Sediment Removal Plan, completed with guidance from the Waubee Lake Association and funded by the IDNR Lake and River Enhancement (LARE) program. The plan was designed to improve the aesthetics and usability of Waubee Lake. Dredging began in the middle of July 2005 and was completed by the end of August 2005.

Approximately 3.8 acres of sediment was removed with an average depth of 4.4 feet from near the outlet of Felkner Ditch. It was estimated that the sediment originated from bare ground areas, such as agricultural fields, or from decomposing plant material. Dredge spoils were disposed of in a nearby abandoned gravel pit.

Dewart Lake Diagnostic Study (2005)
In May 2005, JFNew released a diagnostic study for Dewart Lake, funded by the IDNR LARE program. Although Dewart Lake had better water clarity and nutrient values than most Indiana lakes, lake residents had noticed changes in the lake for several years preceding the study. Specifically, changes were noted in the types and distribution of aquatic vegetation and decreased water clarity during weekend heavy boat use. It was determined that Dewart Lake's phosphorus concentration had the potential to increase the lake's productivity. Continued attainment of water quality goals will require both in-lake and watershed management.

- Recommendations (watershed): Ravine stabilization, homeowner best management practices, filter strip implementation, livestock fencing, wetland restoration, use Conservation Reserve Program and conservation tillage, streambank stabilization.
- Recommendation (in-lake): Comprehensive recreational use plan, creation of a rooted plant management section that considers use of ecozones.

Wawasee Area Watershed WMP (2007)
In April 2007, JFNew released the Wawasee Area Watershed Management Plan (WMP). The watershed is located in southwestern Noble and northeastern Kosciusko Counties and contains 25 lakes and 14 miles of streams. The Wawasee Area Conservancy Foundation (WACF) obtained funding from the IDNR LARE program in an effort to improve water quality. Input from stakeholders expressed numerous concerns. Stressors associated with the top concerns were: 1) high nutrient and sediment loads in the watershed; 2) Lack of knowledge by property owners in the watershed; 3) pathogenic contamination by high E. coli levels; 4) Overuse through recreation. Goals developed in the WMP were:

- Reduce nutrient loading reaching Lake Wawasee by 25% over the next 10 years.
- Reduce sediment loading to the waterbodies within the Wawasee Area Watershed by 50% over the next 5 years.
- Reduce the concentration of E. coli within Wawasee Area Watershed so that water within the streams and lakes meet the state's standard for E. coli within 10 years.
- Within 5 years, 50% of landowners within the Wawasee Area Watershed will attend one educational event, and 25% of landowners implement one water quality improvement project.
- Maintain and improve the recreational setting of the Wawasee Area Watershed by developing and implementing a recreational management plan for Lake Syracuse and Lake Wawasee within five years.

Bayshore Watershed Sediment Control Project Design Report (2007)
The Bayshore watershed project was named after an embayment on the south end of Lake Wawasee. In April 2007, JFNew, in partnership with the WACF and with funding from the IDNR LARE program, released the Bayshore Watershed Sediment Control Project Design Report. The Bayshore Watershed consists of 105 acres of agricultural land which drains into Lake Wawasee through an approximately 3700-foot channel. The purpose of the project was to develop a plan to reduce heavy sediment loads entering Lake Wawasee from the channel. A four-step sediment removal system was proposed:

1) A sediment trap that can be accessed and cleaned of heavier particles.
2) A second settling pond for finer materials.
3) A wetland filter.

4) A finishing pond for the finest sediments.

It was noted that sediment is derived from the upper watershed surface erosion, and ultimately the upper watershed should be converted to grassland or forest.

Turkey Creek Sediment Trap Project Design-Build (2008)

In April 2008, JFNew released the Turkey Creek Sediment Trap Project report. This design-build project was funded by IDNR LARE program and presented to the WACF. The project objective was the reconstruction of a previously existing sediment trap that had filled with sediment from the Turkey Creek watershed. The project location was Turkey Creek as it flows into Gordy Lake in Noble County. The average sediment load from Turkey Creek to Gordy Lake was estimated to be 3-4 tons per year. The trap was designed to be large enough to capture any bed load, sand particles in suspension, and a majority of the silt and organic matter coming down Turkey Creek. Construction was completed in 2008.

Elkhart River WMP (2008)

The Elkhart River Alliance (ERA) was formed as a committee of the Elkhart River Restoration Association, Inc. (ERRA) to address concerns regarding sediment in the Goshen Dam Pond and pollution in the Elkhart River Watershed. With assistance from the Elkhart County SWCD, the ERRA obtained funding from a Section 319 grant for the development and implementation of a watershed management plan for the Elkhart River Watershed. A steering committee was organized to work with the watershed coordinator to develop and implement the WMP and contracted with V3 Companies to guide WMP development.

The Elkhart River WMP is intended as a guide for the protection and enhancement of the environment and quality of the Elkhart River Watershed while balancing the different uses and demands of the community on this natural resource. Watershed plan goals include:

- Sustain the financial and institutional capacity of a stakeholder group. Increase the collaboration of both urban and agricultural stakeholders to eliminate program duplication, reduce costs and identify effective solutions.
- Reduce soil erosion and sedimentation so that surface water functions and aesthetics are improved and protected. By the year 2027, surface waters within the Elkhart River Watershed will comply with the recommended water quality threshold of 80 mg/L total suspended solids.
- Reduce the concentration levels of E. coli so the primary and secondary contact waters within the Watershed do not pose an adverse human health impact. By the year 2027, surface waters within the Elkhart River Watershed will comply with the Indiana state E. coli water quality standard of 235 cfu/100 ml.
- Reduce the amount of nutrient loading (phosphorus and nitrogen) so that surface water functions and aesthetics are improved and protected. By the year 2027, surface waters within the Elkhart River Watershed will comply with the recommended water quality threshold of 10 mg/L of nitrate/nitrite and 0.3 mg/L of phosphorus.
- Increase preservation, restoration, and appreciation of open space and maintain a proper balance between the many diverse land uses in the Elkhart River Watershed.
- Develop an outreach and education program that keeps stakeholders involved in issues in the Watershed, and coordinate volunteer activities that benefit the health of the Elkhart River Watershed.

ERRA initiated one round of cost share project implementation including implementing 13 rain gardens, 50 rain barrels, completed three stream buffers, seven bioretention projects, eight pervious pavement projects, one green roof, two grassed waterways, one WASCOB and two rotational grazing systems.

Engineering Feasibility Study for Dewart Lake (2012)
In May 2012, Cardno JFNew released an Engineering Feasibility Study for Dewart Lake. The study was funded by IDNR LARE program and identified four feasibility projects involving nine individual sites. When constructed, the projects should save approximately 72 tons of eroded soil from entering Dewart Lake each year. The project focused on the Cable Run subwatershed, with one additional site in a ravine, and another additional site at an eroding hillside.

- Project 1: A ravine containing a minor tributary to the lake was the source of sedimentation and nutrient loading through bank erosion. Recommendation was installation of grade control structures.
- Project 2: Direct drainage to the lake was the source of sedimentation from an eroding slope. Recommendation was installation of a vegetated swale.
- Project 3: Three sites along Cable Run were the source of sedimentation and nutrient loading from bank erosion. Recommendations were installation of rock toes to stabilize eroding slopes, bank regrading, banks to be seeded with a native slope stabilization mix and covered with an erosion control blanket.
- Project 4: Four sites along Cable Run and a small tributary were the source of sedimentation and nutrient loading from bank erosion. Recommendations were installation grade control structures, installation of rock toes to stabilize eroding slopes, bank regrading, banks to be seeded with a native slope stabilization mix and covered with an erosion control blanket.

Goshen Dam Pond Sediment Removal Plan (2014)
In March 2014, Cardno JFNew released the Goshen Dam Pond Sediment Removal Plan. The Elkhart River Restoration Association received a grant from the IDNR LARE program to develop a sediment removal plan. Goshen Dam Pond is an impoundment of the Elkhart River located within the city of Goshen. Accumulated sediment made the water too shallow for residents to access the lake with boats, and also provided habitat for nuisance vegetation such as purple loosestrife. The majority of the sediment is deposited just as the Elkhart River enters the impoundment. The sediment has formed an island at this location, which grows as more sediment settles. Accumulated sediment was measured as deep as 8 feet in some spots. It was proposed that 36.3 acres of the 140 acre lake be dredged.

Turkey Creek Branch Stream Bank Restoration Engineering Design Report (2017)
In June 2017, S&L Environmental Group released the Turkey Creek Branch Stream Bank Restoration Engineering Design Report, funded by the IDNR LARE program. Turkey Creek Branch is in Noble County and is a tributary of Turkey Creek, which flows into Lake Wawasee. Large amounts of sediment were being deposited upstream from Turkey Creek Branch's confluence with Turkey Creek near the Noble-Kosciusko County Line. Areas where sediment was being deposited, such as a small lake, were nearly at capacity, thus allowing sediment and associated nutrients to move farther downstream toward Lake Wawasee. Preliminary field investigations indicated that the most critical bank erosion was occurring from near the county line upstream to State Road 5. The streambanks and channel are eroding from water velocities exceeding permissible soil velocities. Streambanks were being undercut, resulting in in fallen trees and logjams. The design focused on using bio-engineered best management practices to reduce stream velocities by 20-50%, thereby reducing bank and channel erosion. In addition, 32% (approximately 5100 lineal feet) of the design reach will also have bank reconstruction and stabilization.

Lake Wawasee Sediment Removal Plan (2019)
In January 2019, Aquatic Weed Control, in partnership with the Wawasee Property Owner's Association, released the Lake Wawasee Sediment Removal Plan. The report was funded by the IDNR LARE program. Fourteen sites where sediment deposits hindered lake activities were selected. These sites were scattered around the lake and were investigated for water and sediment depths. Sediment depths ranged from 1.9 feet to 6.4 feet. Sediments included decomposing organic matter, sand and gravel. Tributary streams Turkey Creek, Laurer Ditch and a small un-named ditch, in addition to a small spillway from Papakeechie Lake were associated with some of the sediment deposits. Four sites were not recommended for dredging because the water depth was greater than 6 feet, and an additional site was not recommended for dredging because aquatic vegetation control needed to be the focus of efforts. A five-foot wide shelf along the shoreline was proposed at all dredging sites as a zone for emergent vegetation growth.

Lake Wawasee National Water Quality Initiative Watershed Management Plan (in development)
In December 2021, WACF in partnership with NRCS launched an updated watershed management plan. As of this draft, the plan has not yet been completed; however, the following goals have been identified:

- Measure an increase in acres enrolled in BMPs as percentage of total agricultural acres in watershed.
- 40% increase in BMP practices across the watershed. Practices identified for implementation include cover crops, filter strips, grassed waterways, nutrient management, two-stage ditch, drainage water management, conservation tillage, riparian buffers, bioreactors, waste storage and wetland restoration.
- 10% reduction in sediment, nitrogen and phosphorous loading rates.

The plan represents the first phase of the project. The second phase was awarded in December 2022 and includes $1.25 million in conservation funding to implement agricultural BMPs over three years (2023, 2024, 2025).

2.11.2 Flow-based Assessments and Plans
A series of maps was developed by USGS (Strauch, 2013) to illustrate the potential for flooding of the Elkhart River in an 8.3-mile reach from Goshen Dam downstream to County Road 17. This river reach includes the City of Goshen. One major tributary, Rock Run Creek, flows into the Elkhart River in the City of Goshen. Based on the USGS gauge at Goshen (station number 04100500), estimates were made of the areal extent and depth of flooding corresponding to nine selected water levels at 1-foot intervals. This USGS gauge has data for peak streamflow since 1925 and has data for continuous stage monitoring since 1931. An assumption was made that runoff in the Elkhart River basin would be uniformly distributed in time and space. A hydraulic model was used to compute surface water profiles from bankfull (5 ft.) to greater than the highest recorded water level (13 ft.). Flood stage is 7 feet. Surface water profiles were then combined with Geographic Information Systems (GIS) and Digital Elevation Models (DEM) to delineate flooded areas at each water level. These maps provide residents and emergency management personnel with critical information for flood response and post-flood recovery.

2.11.3 Comprehensive Plans
St. Joseph River TMDL Study (2004)

In February of 2004, IDEM released a Total Maximum Daily Load (TMDL) report for E. coli for the St. Joseph River in Elkhart and St. Joseph counties. This TMDL evaluated the data collected on the St. Joseph River and several tributaries, including the Elkhart River, and made recommendations for load reductions to bring the St. Joseph River into compliance with both Indiana and Michigan's WQS.

It was noted in the study that when E. coli limits were being surpassed in the St. Joseph River, many of the tributaries, including the Elkhart River were also exceeding the water quality standard for E. coli. Therefore, E. coli sources were not restricted to the St. Joseph River itself but were being exacerbated by inputs from tributaries. Data indicated several violations in the Elkhart River. The St. Joseph River TMDL indicated that both point and nonpoint sources of pollution were responsible for the E. coli contamination in the St. Joseph River. It was also determined that to meet the state standard, the target load had to be set at a concentration value of 125 cfu per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over thirty days. Some specific sources indicated in the TMDL include combined sewer overflows. The communities named in the TMDL that are part of the Elkhart River Watershed are the cities of Elkhart and Goshen. All of these communities are required to reduce the impact of CSOs by developing Long Term Control Plans (LTCPs) for their CSOs. These plans are approved by IDEM through the National Pollutant Discharge Elimination System (NPDES).

St. Joseph River Watershed Management Plan (2005)
In June 2005, the Friends of the St. Joe River (FOTSJR) released a watershed management plan for the St. Joseph River Watershed. In the fall of 2002, the Friends of the St. Joe River was awarded a grant from the Michigan Department of Environmental Quality to develop a Watershed Management Plan for the entire St. Joseph River Watershed. This plan was intended to unite stakeholders in a concerted effort to address water quality issues and natural resource protection across jurisdictional boundaries. Although several Lake Michigan Lakewide Management Plan, LARE and federally funded Clean Water Act projects had been conducted in subwatersheds in both Michigan and Indiana, and the St. Joseph River was identified by U.S. EPA as the biggest contributor of atrazine to Lake Michigan and a significant contributor of sediments and toxic substances such as mercury and PCBs, comprehensive planning efforts for the entire watershed had not been conducted at the time in which this WMP was written.

The FOTSJR coordinated with other key organizations for watershed plan preparation. The watershed management plan was developed from November 2002 through June 2005 and objectives include:

- Reduce soil erosion and sedimentation so that surface water functions and aesthetics are improved and protected.
- Reduce the amount of nutrient loading that so that surface water functions and aesthetics are improved and protected.
- Increase preservation, restoration, protection, and appreciation of open space (a system of natural areas, natural systems, corridors, farmland, open land, and parklands).
- Educate local planning officials/commissions about water quality issues, smart growth, and the protection of natural resources through coordinated planning, zoning, and ordinances.
- Provide riparian landowners, both private and public, with information regarding shoreline protection.
- Establish Michigan Heritage Water Trails on all navigable rivers in the watershed.
- Eliminate/correct sources of disease-causing organisms that are harmful to public health and that limit the use of rivers, creeks, and lakes.
- Increase the development of certified manure management plans.

- Reduce the levels of pesticides, and other toxins that are harmful to public health and that degrade aquatic habitat.
- Develop and implement residential/commercial stormwater education programs in urban areas to reduce volume and velocity of runoff.
- Increase the number of small and medium size producers who complete chemical storage and handling assessments, particularly in areas with high water tables, porous soils, and those near C
- Provide and/or enhance hazardous waste collection programs.

Town of Syracuse Comprehensive Plan (2017)
The Town of Syracuse completed a comprehensive plan in 2006. Recommendation identified in the 2006 plan were used as the basis for an update in 2017. Goals were grouped into nine categories. Objectives pertaining to natural resources were included in categories for 1) Land Use and Development and 2) Environment and Sustainability. Specifically:

1. Land Use and Development

- Require land uses that are sensitive to adjacent environmental features where necessary.
- Encourage infill development and rehabilitation of existing structures.
- Use the future land use map as a guideline for new development and policy decisions.

2. Environment and Sustainability

- Identify and protect environmentally sensitive areas within the Syracuse-Wawasee watershed.
- Identify and address existing and future threats to the community's natural resources.
- Protect and expand the vast tree canopy within Syracuse.
- Encourage the continued participation of the Syracuse Lake Association, Wawasee Property Owners Association, and the Wawasee Area Conservation Foundation in local planning efforts.
- Acquire and protect additional land for environmental protection as needed.
- Continue educating and encouraging local residents and organizations to preserve the overall quality of Syracuse's natural resources.
- Protect and celebrate viewsheds that are special to the community.
- Encourage alternative storm water management techniques for new developments within the town.
- Explore and promote individual and municipal use of alternative energy sources.

City of Goshen Comprehensive Plan (2018)
The City of Goshen Comprehensive Plan was adopted in 2014. It outlines ten-year visions and goals for Goshen. The Comprehensive Plan was updated in 2018 to include the Elkhart and Goshen Bicycle and Pedestrian Master Plan. Goals in the City of Goshen Comprehensive Plan that pertain to natural resources include:

- Protect, preserve, and enhance natural habitats and resources.
- Maintain and increase open spaces and parks.
- Promote environmental education.
- Maintain, promote, and grow Goshen's urban forest system.
- Reduce toxins in the community.
- Improve water and air quality.
- Use best practices to reduce and dispose of solid waste.
- Encourage sustainable living and business practices.
- Encourage development that is sensitive to the natural environment.
- Protect and enhance the quality of ground and surface water.

- Minimize impacts on habitats and public safety through enhanced stormwater management.
- Strengthen regional land-use planning.

Noble County Comprehensive Plan (2019)
In 2019, Noble County and its major cities wrote comprehensive plans to govern their future. The Countywide plans are detailed below.

The first County comprehensive plan was adopted in 1968 and updated in 1986. The next plan was adopted in 2007 and the 2019 comprehensive plan was written with the intent to replace it. The planning process for the 2019 Noble County Comprehensive Plan, Noble Tomorrow, was started in Spring of 2017. A steering committee comprised of Noble County citizens and stakeholders convened to write this plan based on the input of the public through surveys, workshops, and interest group meetings. While this plan also has goals that cover economic values and other areas of Noble County resources, the goals that pertain to natural resources include:

- Protecting lakes and natural resources.
- Preserving agricultural heritage while continuing to use innovative farming practices.
- Implement land use planning and strategic investments to encourage growth.
- Prioritize incremental development in towns rather than large scale development further away from towns.
- Require sanitary sewers in all new large-scale developments.
- Protect prime farmland from development.
- Restrict development in environmentally sensitive areas beyond minimum requirements from the state and federal government to ensure higher quality building.
- Development should be symbiotic with the natural environment.
- Establish a county regional sewer district to decrease pollution potential from septic systems on ill-suited lands.
- Sensitive land like wetlands, floodplain, and older growth forests should be conserved through education of existing programs that provide financial incentives.
- Require all development in hazardous areas to meet strong flood protection standards.
- Require all development to have no adverse impact on neighboring landowners.
- Promote the establishment of conservancy districts to effectively manage flood risks and maintain waterways.
- Prohibit new septic systems in the floodplain without higher regulatory standards for the protection from infiltration.
- Encourage use of innovative stormwater management practices like bio-swales, on-site bio-retention, and filter strips on developments both big and small.
- Strictly limit impervious surfaces that do not mitigate their own ill effects.
- Become a participating community in FEMA's Community Rating System to reduce flood risks and decrease flood insurance costs.
- Keep all parts of the Elkhart River clean and free from excessive obstruction.
- Build a multi-modal trail between Ligonier and West Noble Schools along the creek, between Cromwell and West Noble Schools, between Albion and Chain O' Lakes State Park, and between Albion and West Noble Schools.

Noble County Parks Plan (2019)
The Noble County 2019-2024 Parks Plan was created to provide direction for the parks board to accomplish their goal of providing recreational facilities that meet the needs of Noble County residents. Goals of the park plan include:

- Increase the miles of trails available to residents.
- Develop a trail head for the Fishing Line Trail.
- Install emergency trail markers along trails.
- Improve Americans with Disabilities Act (ADA) accessibility along trails.
- Develop water based recreational opportunities on the Elkhart River.
- Publicize recreation assets.
- Develop a master plan for the next five years.

Elkhart County Parks & Recreation Master Plan (2019)
The 2019-2023 Elkhart County Parks & Recreation Master Plan was prepared by Lehman & Lehman, Inc in April of 2019. Their purpose of writing this master plan was to enable Elkhart County Parks to continue balanced planning for the overall park system; meet local recreation needs within available resources and to help the Parks and Recreation Board, community members and leaders to establish their current state of operations, their future desired state and provide structure to help achieve their goals and to monitor their successes. The Elkhart County Park Department staff and the Park Board have agreed on the following goals for the 5-Year Parks and Recreation Plan:

- Use national recreation standards, combined with a careful needs analysis to create new priorities for parks and recreation in the county.
- Receive approval from IDNR for eligibility for application for Land and Water Conservation Fund grant programs.
- Make park sites more ADA accessible.
- Protect natural resources through land acquisition and invasive species removal.
- Survey property boundaries.

Nappanee Parks and Recreation Five-Year Master Plan 2019-2023 (2019)
Nappanee Parks and Recreation updated their five-year master plan in 2019. Prepared by the Troyer Group, this plan replaced the 2013-2017 Parks Master Plan. The city updated its Parks Master plan to ensure its parks support the goals and objectives of the city, meet the needs of its residents, and contribute to a high quality of life in the community. The objectives of the update Master Plan are:

- Inventory and evaluate the physical condition of existing parks, amenities, and programming.
- Acquire input from a diverse group of stakeholders, residents and park users and report the findings in an accurate manner.
- Gather public support and increase parks awareness in the community.
- Discover strengths, weaknesses, opportunities, and threats.
- Set achievable goals and objectives that reflect current issues, challenges, and opportunities as they relate to the current park system.
- Analyze information and public input to determine strategies, priorities, and an action plan for the next five years.
- Provide a guide for the development of park and recreation amenities that reflect the interests and needs of the community.
- Develop master plans for each of the individual parks, showing potential improvements and new amenities.
- Expand opportunities to obtain funding for the park system amenities and programming.
- Serve as a supporting document to secure funding for proposed projects.
- Provide the foundation to make accurate budget decisions.

Kosciusko County Comprehensive Plan (2022)

Kosciusko County adopted a Comprehensive Plan in 1996. In March 2022, Kosciusko County updated their county plan. The project team recruited five primary groups acting as advisors: project steering committee, project leadership group, community committees, outreach committee, and residents of Kosciusko County. The completed plan, titled FORWARD Kosciusko County, outlined goals for physical, social cultural, and economic outcomes. Goals which pertain to natural resources include:

- Encourage the development and expansion of outdoor facilities and amenities.
- Encourage building practices and infrastructure improvements which preserve natural areas and amenities.
- Encourage the preservation and conservation of productive agricultural land.
- Encourage the development, expansion, and maintenance of wastewater systems along lakefronts to protect water quality.
- Support the protection and restoration of local lakes, watersheds, natural drains, rivers and riverbank areas, forested lands, and natural habitats.
- Support the preservation and use of public easements and rights-of-way to access local lakes and waterbodies.
- Support the safe activation of the Tippecanoe River.
- Support an increase in parkland to ensure equitable access to parks and open spaces based on the needs of county residents.
- Promote the educational opportunities offered by Grace College-Lilly Center for Lakes and Streams, The Watershed Foundation, and the Wawasee Area Conservancy Foundation for residents and visitors interested in exploring the county's natural features.

Town of Milford Comprehensive Plan (2022)

In 2022, Kosciusko County drafted a new county-wide comprehensive plan as well as new plans for its cities and towns. While the county-wide plan is an all-encompassing document, the individual city plans were written with each town's unique needs in mind. In addition to the county-wide goals listed above, goals and policies that are specific to Milford include:

- Encourage development to utilize site design standards that are complementary to adjacent agricultural uses.
- Expand park and playground facilities within the Town, as well as gathering spaces for community and private events.
- Encourage neighborhood reinvestment by providing resources for building repair, maintenance, and sidewalk improvements.

2.12 Watershed Summary: Parameter Relationships

Several relationships among watershed parameters become apparent when watershed-wide data are examined. These relationships are discussed here in general, while relationships within specific subwatersheds are discussed in more detail in subsequent sections.

2.12.1 Topography, Soils and Nutrient and Sediment Loss

Much of the topography and terrain characteristics within the Lower Elkhart River Watershed have a direct correlation to water quality. Approximately 31% of the Lower Elkhart River Watershed is mapped in highly erodible lands. Highly erodible lands are very susceptible to erosion. Nutrients, such as phosphorus, and sediment erode easily when these soils are not covered. Sediments and nutrients that reach Lower Elkhart River waterbodies are likely to degrade water quality. Highly erodible lands that are used for animal production or are located on cropland are more susceptible to soil erosion.

2.12.2 Wetland Loss, Hydromodification and Flooding

Wetlands cover 14,049 acres, or 7% of the watershed. When hydric soil coverage (30,473 acres) is used as an estimate of historic wetland coverage, it becomes apparent that more than 53% of wetlands have been modified or lost over time. Additionally, it is estimated that more than 150 miles of surface drains have been constructed in the watershed to move water more rapidly from land to adjacent waterbodies. In total, nearly 36% of the watershed is estimated to be covered by tile-drained soils. As commodity prices continue to go up and down, area land values remain high and as a result, individuals are spending a great deal of money to drain small natural wetlands in their fields in order to be able to farm that additional couple acres of land as it is cheaper to tile it than to buy ground already in production. The modification of the Lower Elkhart River Watershed directly impacts its ability to retain and store water. Additionally, these efforts push water from one area to another resulting in flooding in portions of the watershed. It should be noted that the outstanding rivers identified in the Lower Elkhart River Watershed are listed for the contiguous wetland complexes which exist within the river's floodplain.

2.12.3 Topography, Population Centers and Septic Soil Suitability/Manure Volume

While much of the watershed's population is located within incorporated areas, there are large swaths of unsewered, dense housing as well as individuals housing in unincorporated areas outside cities and towns in the Lower Elkhart River Watershed. Unsewered, dense housing areas are located throughout the watershed with small subdivisions and lake and roadside housing developments occurring throughout the watershed covering nearly 8,050 acres. This is a concern because adequate filtration may not occur, and this water may easily reach water sources and groundwater. With a lack of natural filtration of septic fields to groundwater, degradation of water quality is likely if septic systems are not maintained. Septic maintenance is a concern of Lower Elkhart River Watershed stakeholders. Additionally, the large volume of manure produced on small, unregulated animal farms, confined feeding operations and concentrated animal feeding operations lead to E. coli impairments throughout the watershed.

2.12.4 High-quality Habitat and ETR Species

Many high-quality communities occur throughout the Lower Elkhart River Watershed. Several of these are preserved for future generations. The high-quality natural areas including, heavily forested riparian areas associated with the mainstem of Elkhart River provide unique habitats which house several endangered, threatened, or rare communities and species. The topography, bedrock and soils in this area support ravines and mature forest habitats that provide rare habitat that is home to many species of wildlife, fish, and plants. The topography here made this area less suitable for farming and so more of the natural community and habitat has been preserved here. Many of the endangered, threatened, and rare species and high-quality natural communities in the watershed are found along this stretch of the stream corridor, making this an important area to focus habitat preservation and restoration efforts.

3.0 WATERSHED INVENTORY II-A: WATER QUALITY AND WATERSHED ASSESSMENT

In order to better understand the watershed, an inventory and assessment of the watershed and existing water quality studies conducted within the watershed is necessary. Examining previous efforts allowed the project participants to determine if sufficient data was available or if additional data needed to be collected in order to characterize water quality problems. Once the water quality data assessment occurred, the watershed was then characterized to determine potential sources of any water quality issues identified by the data review. Subsequently, pollutant sources could then be tied to stakeholder concerns and collected data could be used to estimate pollutant loads from each identified source location. The following sections detail the water quality and watershed assessment efforts on both the broad, watershed-wide scale and in a focused manner looking at each subwatershed within the Lower Elkhart River Watershed.

3.1 Water Quality Targets

Many of the historic water quality assessments occurred using different techniques or goals. Several sites were sampled only one time and for a limited number of parameters. Monitoring committee members were reluctant to draw too many conclusions based on a single sampling event. Nonetheless, the available data are detailed below and compared in general with water quality targets. In order to compare the results of these assessments, the steering committee identified a standard suite of parameters and parameter benchmarks. Table 18 details the selected parameters and the benchmark utilized to evaluate collected water quality data.

Table 18. Water quality benchmarks used to assess water quality from historic and current water quality assessments.

Parameter	Water Quality Benchmark	Source
Dissolved oxygen	>4 mg/L	Indiana Administrative Code
pH	>6 or <9	Indiana Administrative Code
Temperature	Monthly standard	Indiana Administrative Code
Conductivity	<1050 mmhos/cm	Indiana Administrative Code
E. coli	<235 colonies/100 mL	Indiana Administrative Code
Nitrate-nitrogen	<1.5 mg/L	Dodds et al. (1998)
Ammonia-nitrogen	0.0 – 0.21 mg/L	Indiana Administrative Code
Total Kjeldahl nitrogen	0.57 mg/L	USEPA (2000)
Total phosphorus	<0.08 mg/L	Dodds et al. (1998)
Orthophosphorus	<0.05 mg/L	Dunne and Leopold (1978)
Total suspended solids	<15 mg/L	Waters (1995)
Turbidity	<5.7 NTU	USEPA (2000)
Qualitative Habitat Evaluation Index	>51 points	IDEM (2008)
Index of Biotic Integrity	>36 points	IDEM (2008)
Macroinvertebrate Index of Biotic Integrity	>2.2 points (old) >36 points (new)	IDEM (2008)

3.2 Historic Water Quality Sampling Efforts

A variety of water quality assessment projects have been completed within the Lower Elkhart River Watershed (Figure 26). Statewide assessments and listing including the impaired waterbodies assessments and fish consumption advisories. Additionally, the Wawasee Area Conservancy Foundation (WACF), Greater Elkhart Stormwater Partnership, ERRA, the Indiana Department of Environmental Management (IDEM), Indiana DNR Lake and River Enhancement Program (LARE), U.S. Geological Survey (USGS), U.S. EPA National Aquatic Resource Survey (NARS) and Lake Papakeechie have completed assessments within the watershed. Volunteer based sampling of water quality through the Hoosier Riverwatch program also provides water quality data that can characterize the watershed. A summary of each assessment methodology in general results are discussed below.

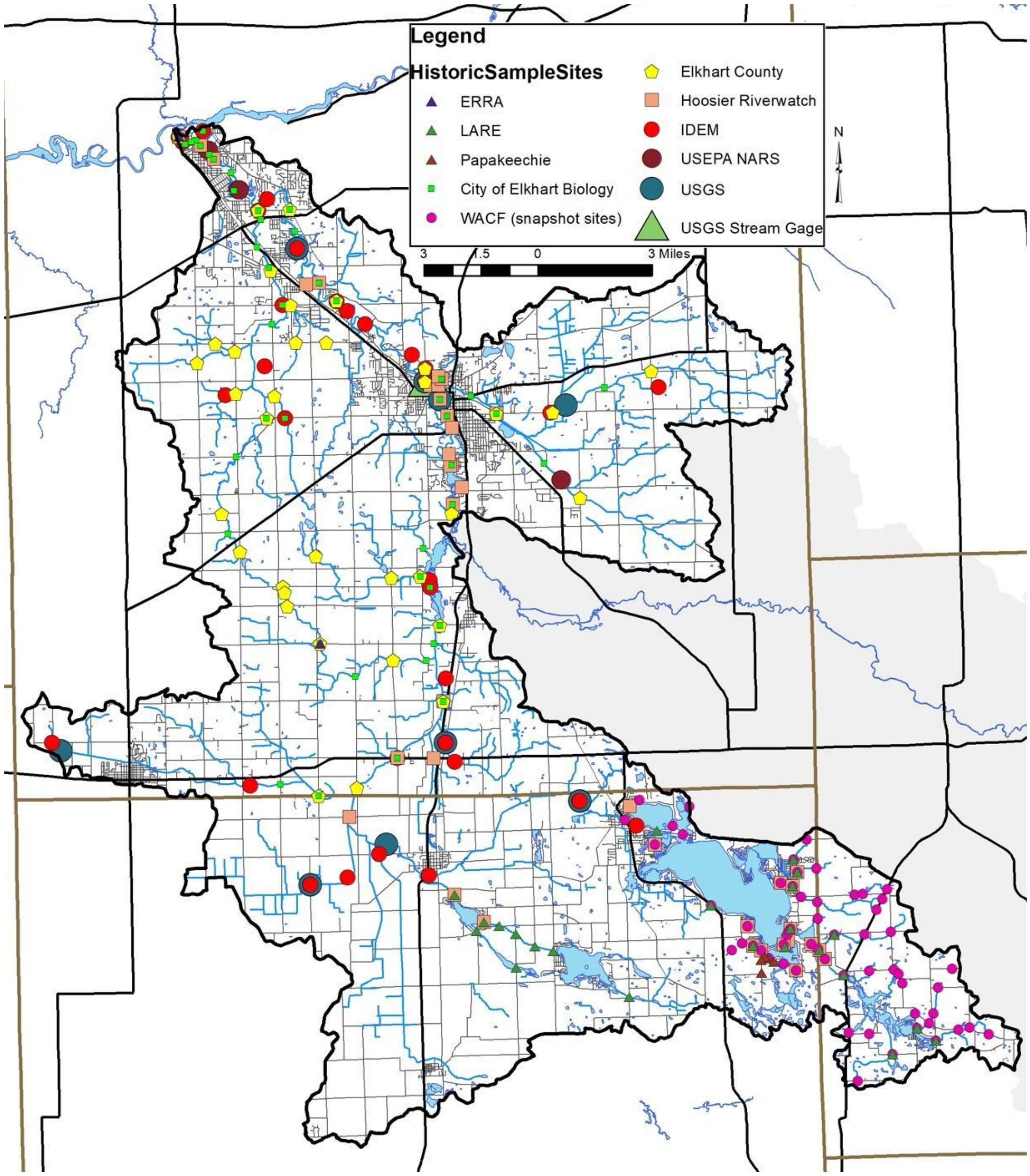

Figure 26. Historic water quality assessment locations.

3.2.1 Impaired Waterbodies (303(d) List)

The impaired waterbodies, or 303(d) list, is prepared biannually by the Indiana Department of Environmental Management. Waterbodies are included on the list if water quality assessments indicate that they do not meet their designated use. A total of 39 stream segments as well as several lakes in the Lower Elkhart River Watershed are included on the list of impaired waterbodies (Figure 27,Table 19). Waterbodies are listed as impaired for E. coli (138.0 miles), E. coli and fish consumption (9.0 miles), and nutrients, DO, and E. coli (7.8 miles). Impaired lakes include Hammond Lake, Lake Wawasee, Rothenberger Lake, and Barrel and a Half Lake for PCBs in fish tissue and Gordy Lake, Hindman Lake, Knapp Lake, and Village Lake for impaired biotic communities.

Table 19. Impaired waterbodies on the Lower Elkhart River Watershed impaired waterbodies list.

Stream Name	Assessment ID	Impairment(s)
BERLIN COURT DITCH	INJ01H6_03	Nutrients, DO, E. coli
BERLIN COURT DITCH (LTD)	INJ01H6_04	Nutrients, DO, E. coli
DAUSMAN DITCH	INJ01H8_T1003	E. coli
ELKHART RIVER	INJ01J4_04	E. coli
ELKHART RIVER	INJ01J4_05	E. coli
ELKHART RIVER	INJ01J4_08	E. coli
ELKHART RIVER	INJ01J4_03	E. coli, fish consumption
ELKHART RIVER	INJ01J4_09	E. coli, fish consumption
ELKHART RIVER	INJ01J4_10	E. coli, fish consumption
ELKHART RIVER - UNNAMED TRIBUTARY	INJ01J4_T1005	E. coli
ELKHART RIVER HYDRAULIC CANAL	INJ01J4_T1006	E. coli
HOOPINGARNER DITCH	INJ01H4_T1003	E. coli
KIEFFER DITCH	INJ01H8_T1005	E. coli
OMAR-NEFF DITCH	INJ01H7_T1005	E. coli
OWL CREEK	INJ01J3_T1004	E. coli
ROCK RUN CREEK	INJ01J1_04	E. coli
ROCK RUN CREEK	INJ01J1_05	E. coli
ROCK RUN CREEK	INJ01J2_06	E. coli
ROCK RUN CREEK	INJ01J2_07	E. coli
ROCK RUN CREEK	INJ01J2_08	E. coli
ROCK RUN CREEK - UNNAMED TRIBUTARY	INJ01J1_T1005	E. coli
ROCK RUN CREEK - UNNAMED TRIBUTARY	INJ01J1_T1006	E. coli
ROCK RUN CREEK - UNNAMED TRIBUTARY	INJ01J2_T1013	E. coli
ROCK RUN CREEK - UNNAMED TRIBUTARY	INJ01J2_T1014	E. coli
SKINNER DITCH	INJ01H4_T1004	E. coli
SKINNER DITCH	INJ01H4_T1005	E. coli
TURKEY CREEK	INJ01H4_02	E. coli
TURKEY CREEK	INJ01H4_03	E. coli
TURKEY CREEK	INJ01H4_04	E. coli
TURKEY CREEK	INJ01H5_02	E. coli
TURKEY CREEK	INJ01H5_03	E. coli
TURKEY CREEK	INJ01H7_05	E. coli
TURKEY CREEK	INJ01H7_06	E. coli
TURKEY CREEK	INJ01H7_07	E. coli
TURKEY CREEK	INJ01H8_02	E. coli

TURKEY CREEK	INJ01H8_03	E. coli
TURKEY CREEK	INJ01H9_02	E. coli
TURKEY CREEK	INJ01H9_03	E. coli
TURKEY CREEK- UNNAMED TRIBUTARY	INJ01H4_T1006	E. coli

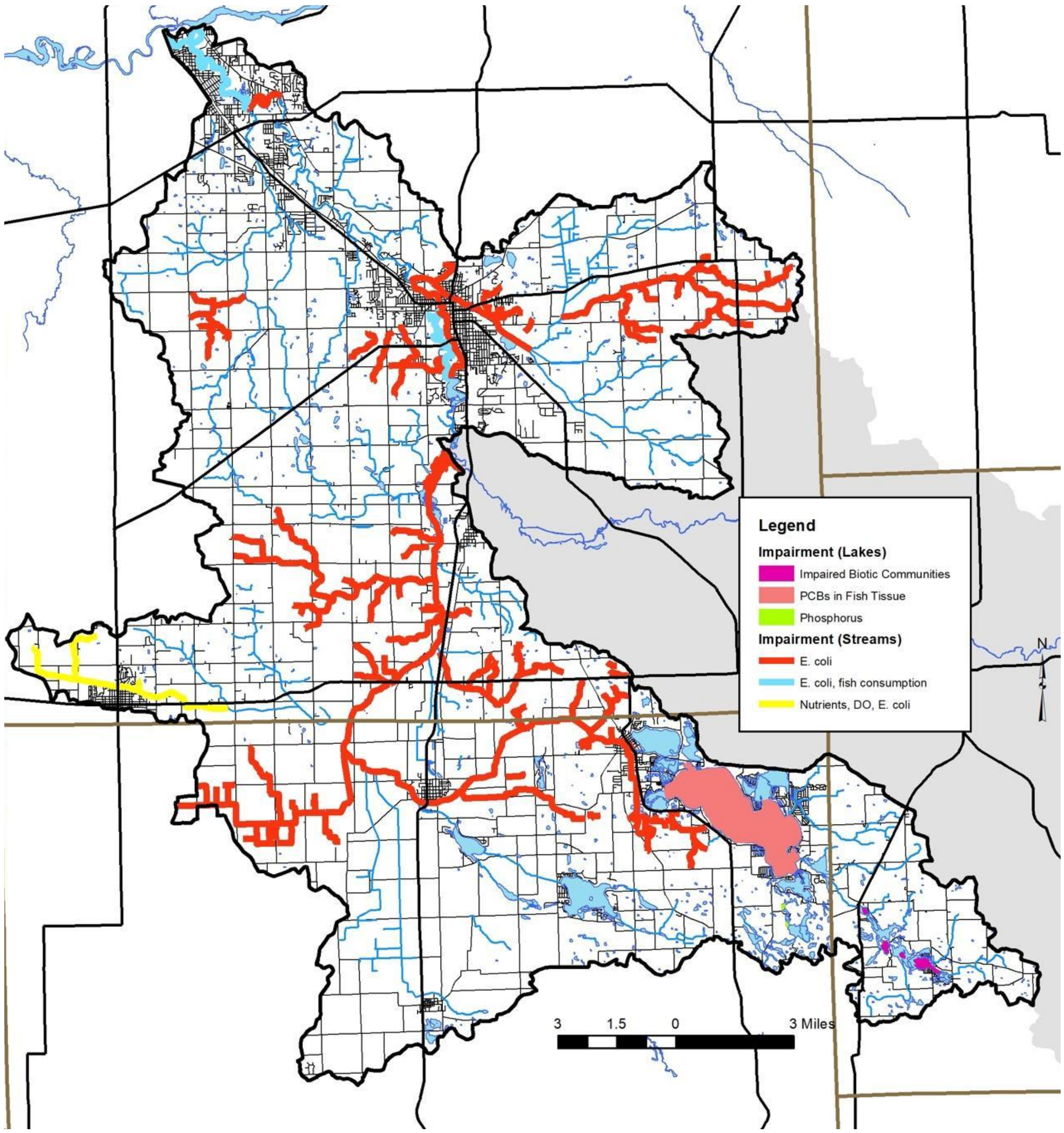

Figure 27. Impaired waterbody locations in the Lower Elkhart River Watershed.

3.2.2 Fish Consumption Advisory (FCA)

Three state agencies collaborate annually to compile the Indiana Fish Consumption Advisory (FCA). The Indiana Department of Natural Resources, Indiana Department of Environmental Management and Indiana State Department of Health have worked together since 1972 on this effort. Samples are collected through IDEM's rotating basin assessment for bottom feeding, mid-water column feeding and top feeding fish. Fish tissue samples are then analyzed for heavy metals, PCBs, and pesticides. Advisories listings are as follows:

- Level 3 – limit consumption to one meal per month for adults with pregnant or breastfeeding women, women who plan to have children, and children under 15 consuming zero volume of these fish.
- Level 4 – limit consumption to one meal every 2 months for adults with women and children detailed above having zero consumption.
- Level 5 – zero consumption or do not eat.

There are no specific advisories for the Elkhart River. However, based on the Elkhart County listing, the following conclusions can be drawn:

Sensitive populations should follow the eating guideline which includes not consuming:

- Channel catfish up to 20 inches in size more than once a month and more than six times a year for 20+ inches.
- Northern hogsucker of all sizes more than once a week.
- Redhorse species of all sizes more than once a month.
- Rock bass of all sizes more than once a week.
- Smallmouth bass of all sizes more than once a week.
- Walleye of all sizes more than once a week.
- White sucker up to 16 inches in size more than once a week and more than once a month for 16+ inches.

General populations should not consume:

- Channel catfish up to 20 inches in size more than once a month and more than six times a year for 20+ inches.
- Redhorse species of all sizes more than once a week.
- Smallmouth bass of all sizes more than once a week.
- Walleye of all sizes more than once a week.
- White sucker of all sizes more than once a week.

General population may have unrestricted consumption of the Northern hogsucker species and Rock bass species.

3.2.3 IDEM Rotational Basin Assessments (1990-2023)

Between the years of 1990 and 2023, IDEM sampled water chemistry at many locations in the Lower Elkhart River Watershed. Based on the water chemistry assessments, the following conclusions can be drawn:

- Ammonia concentrations exceeded state standards in 36% (138 of 380) of samples collected.
- *E. coli* concentrations exceeded the state standard in 52% (98 of 285) samples collected.
- Dissolved oxygen (DO) concentrations exceeded state standards (<5 mg/L or >12 mg/L) in 34% (251 of 743) samples collected.
- pH levels exceeded state standards in 20% (197 of 996) of samples collected.
- Total Kjeldahl nitrogen (TKN) exceeded water quality targets in 86% (520 of 606) samples collected.

- Orthophosphorus (OP) concentrations exceeded target concentrations (0.03 mg/L) in 100% (3 of 3) samples collected.
- Total suspended solids (TSS) concentrations exceeded water quality targets (15 mg/L) in 21% (119 of 567) samples collected.
- Turbidity exceeded water quality in 71% (460 of 645) of samples collected.

3.2.4 USGS (2005, 2007-2010)

The USGS assessed stream water chemistry within the Lower Elkhart River Watershed at seven locations. Based on the assessments, the following conclusions can be drawn:

- pH levels did not exceed water quality standards in any sample (26) collected.
- Turbidity exceeded water quality targets in 91% (10 of 11) of samples collected.

3.2.5 U.S. EPA NARS (2008, 2014, 2018, 2019)

The U.S. EPA NARS sampled water chemistry at one location in the Lower Elkhart River Watershed. Based on the water chemistry assessments, the following conclusions can be drawn:

- Ammonia concentrations did not exceed state standards in any collected samples (4).
- Conductivity did not exceed water quality targets in any samples (3) collected.
- *E. coli* concentrations exceeded the state standard in 52% (98 of 285) samples collected.
- DO concentrations did not exceed state standards (<5 mg/L or >12 mg/L) in any collected samples (3).
- pH levels did not exceed state standards in any collected samples (7).
- TSS concentrations did not exceed water quality targets (15 mg/L) in any collected samples (4).
- Turbidity exceeded water quality targets in 25% (1 of 4) of samples collected.

3.2.6 Indiana DNR, Lake and River Enhancement Program (2001, 2004, 2006)

The Indiana DNR completed a diagnostic study for Waubee Lake in 2001 and JFNew completed a diagnostic study for the Dewart Lake Watershed in 2004 and a watershed management plan for Lake Wawasee in 2007 utilizing Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program funding. The IDNR and JFNew assessed many sites for varying parameters within the watersheds. Based on data collected, the following conclusions can be drawn:

- Ammonia concentrations exceeded water quality targets in 11% (3 of 28) of samples collected.
- Conductivity did not exceed water quality targets in any samples (28) collected.
- *E. coli* concentrations exceeded the state standard in 83% (25 of 30) samples collected.
- DO concentrations exceeded state standards (12 mg/L) in 13% (4 of 30) samples collected.
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 86% (24 of 28) of samples collected.
- pH levels did not exceed state standards in any samples (35) collected.
- TKN exceeded water quality targets in 60% (18 of 30) samples collected.
- Total phosphorus (TP) concentrations exceeded target concentrations (0.08 mg/L) in 23% (7 of 30) samples collected.
- TSS concentrations exceeded water quality targets (15 mg/L) in 3% (1 of 29) samples collected.
- Turbidity exceeded water quality in 3% (1 of 29) of samples collected.

3.2.7 Hoosier Riverwatch Sampling (1999-2013, 2015-2018, 2021, 2022)

Between 1999 and 2022, volunteers trained through the Hoosier Riverwatch program assessed several sites in the Lower Elkhart River Watershed. Based on data collected, the water chemistry assessments suggest:

- *E. coli* concentrations exceeded the state standard in 58% (75 of 129) samples collected.

- DO concentrations exceeded state standards (<5 mg/L or >12 mg/L) in 8% (13 of 165) samples collected.
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 58% (100 of 172) of samples collected.
- pH levels exceeded state standards in 1% (2 of 171) of samples collected.
- TP concentrations exceeded target concentrations (0.08 mg/L) in 75% (3 of 4) samples collected.
- Turbidity exceeded water quality in 44% (70 of 160) of samples collected.

3.2.8 WACF, Snapshot Sites (2021-2023)

The WACF Snapshot Day is a citizen science water quality monitoring event to research stream data in the Lower Elkhart River Watershed. Data are collected from up to 33 sites throughout the Lake Wawasee drainage in one afternoon annually to create a snapshot of water quality. Based on data collected, the water chemistry assessments suggest:

- *E. coli* concentrations exceeded the state standard in 40% (18 of 45) samples collected.
- DO concentrations exceeded state standards (<5 mg/L or >12 mg/L) in 15% (10 of 65) samples collected.
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 50% (23 of 46) of samples collected.
- pH levels exceeded state standards in 19% (16 of 84) of samples collected.
- Orthophosphorus (OP) concentrations exceeded target concentrations (0.03 mg/L) in 42% (27 of 65) samples collected.

3.2.9 Lake Papakeechie (2013, 2015-2023)

Lake Papakeechie samples three stream sites across their watershed. Based on data collected, the water chemistry assessments suggest:

- DO concentrations exceeded state standards (12 mg/L) in 89% (17 of 19) samples collected.
- Ammonia concentrations did not exceed state standards in any collected samples (6).
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 18% (14 of 77) of samples collected.
- pH levels did not exceed state standards in any samples (1) collected.
- TP concentrations exceeded target concentrations (0.08 mg/L) in 46% (70 of 152) samples collected.

3.2.10 Greater Elkhart Stormwater Partnership (2009-2022)

The Greater Elkhart Stormwater Partnership including the Elkhart County, City of Elkhart, City of Goshen and others collect water quality at multiple locations throughout the county from April to October. In total, up to 24 samples are collected from each site annually. The St. Joseph River Basin Commission (Barrett, 2022) cleaned and compiled data and drew the following conclusions for the data collected across the county:

- All the water quality variables exhibited significant annual, seasonal, and regional changes. The high variability in water quality over regions, years, and months reinforce the value of this program in establishing baseline conditions for monitoring sites. However, DO and temperature exhibit a typical seasonal pattern that is characteristic of waterbodies in the region.
- Several variables are correlated with each other and the strength of many of these relationships appears to increase under wet weather conditions. The negative associations between dissolved oxygen and conductivity, dissolved oxygen and total phosphorus and dissolved oxygen and total suspended solids are consistent with known patterns of eutrophication and

subsequent reductions in oxygen availability in aquatic systems. The correlation analysis also revealed a strong positive association between total suspended solids and E. coli, suggesting that both components increase in similar ways in the watershed.

- Correlations must be interpreted with caution because not all variables were reported completely in each year and across all sites. Thus, the correlations give an overall snapshot of potential relationships among variables, but they do not prove cause-and-effect.
- The proportion of sites exceeding the water quality targets for E. coli and phosphorus is trending upwards over time, while the exceedances of the water quality standards for DO, nitrates, and TSS are much lower in comparison. Collectively, Turkey Creek, Yellow Creek, Rock Run Creek and Pine Creek exceed water quality standards much more frequently compared to the other major surface waters.
- Analysis of long-term water quality trends across major water regions revealed striking spatial trends in TSS, nitrates, phosphorus, and E. coli. Presenting aggregated water quality trends for major waterways aided in identifying areas of concern and should serve as a basis for detailed analysis of specific sites.
- SJRBC noted that the above trends may be influenced by the site selection process. Since different combinations of sites are sampled each year, differences in water quality over time may be due, in part, to the differences in sites sampled over years.

Based on data collected within the Lower Elkhart River only, the water chemistry assessments suggest:

- Conductivity exceeded water quality targets in 5% (132 of 2,694) of samples collected.
- *E. coli* concentrations exceeded the state standard in 72% (1,993 of 2,779) samples collected.
- DO concentrations exceeded state standards (<5 mg/L or >12 mg/L) in 17% (465 of 2,771) samples collected.
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 82% (2,320 of 2,834) of samples collected.
- pH levels exceeded state standards in 1% (31 of 2,708) of samples collected.
- TP concentrations exceeded target concentrations (0.08 mg/L) in 98% (2,916 of 2,962) samples collected.
- TSS concentrations exceeded water quality targets (15 mg/L) in 31% (650 of 2,064) samples collected.

3.2.11 Elkhart Watershed Management Plan (2007)

The Elkhart River Alliance (ERA) formed as a committee through the Elkhart River Restoration Association, Inc. (ERRA) for the development and implementation of a watershed management plan for the Elkhart River Watershed. Two sites are located in the Lower Elkhart River Watershed. Based on data collected from these efforts, water chemistry assessments suggest:

- Conductivity did not exceed water quality targets in any collected samples (4).
- *E. coli* concentrations did not exceed the state standard in any collected samples (4).
- DO concentrations did not exceed state standards (<5 m/L or >12 mg/L) in any collected samples (4).
- Nitrate-nitrogen exceeded target concentrations (1 mg/L) in 100% (4 of 4) of collected samples.
- pH levels did not exceed state standards in any collected samples (4).
- TP concentrations did not exceed target concentrations (0.08 mg/L) in any collected samples (4).
- TSS concentrations did not exceed water quality targets (15 mg/L) in any collected samples (4).
- Turbidity exceeded water quality targets in 25% (1 of 4) of samples collected.

3.3 Current Water Quality Assessment

3.3.1 Water Quality Sampling Methodologies

The 2008 Elkhart River Watershed Plan identified improperly functioning/failing septic systems, erosion and sedimentation, pasture runoff, heavily grazed areas, livestock manure, manure fertilizer, livestock access to streams, wastewater treatment plants and wildlife as sources *of E. coli*. The update of the Elkhart River Watershed Management Plan will address the same concerns to assess and improve water quality and quantity in the Lower Elkhart River Watershed.

As part of the current project, the Lower Elkhart River Watershed Project implemented a one-year water quality monitoring program. The program included monthly water chemistry sample collection and one macroinvertebrate community and habitat assessment. The program is detailed below and in the Quality Assurance Project Plan for the Lower Elkhart Watershed Management Plan approved on January 25, 2023. Sites sampled through this program are displayed in Figure 28. Sample sites were selected based on watershed drainage and correspond with sites sampled by IDEM in the past. The monthly sampling regimen was enacted to create a baseline of water quality data. The collection of this data will allow for the identification of problem areas, determination of critical areas, characterization of the watershed, and lay a foundation for future assessment of implementation and education and outreach successes for Lower Elkhart River.

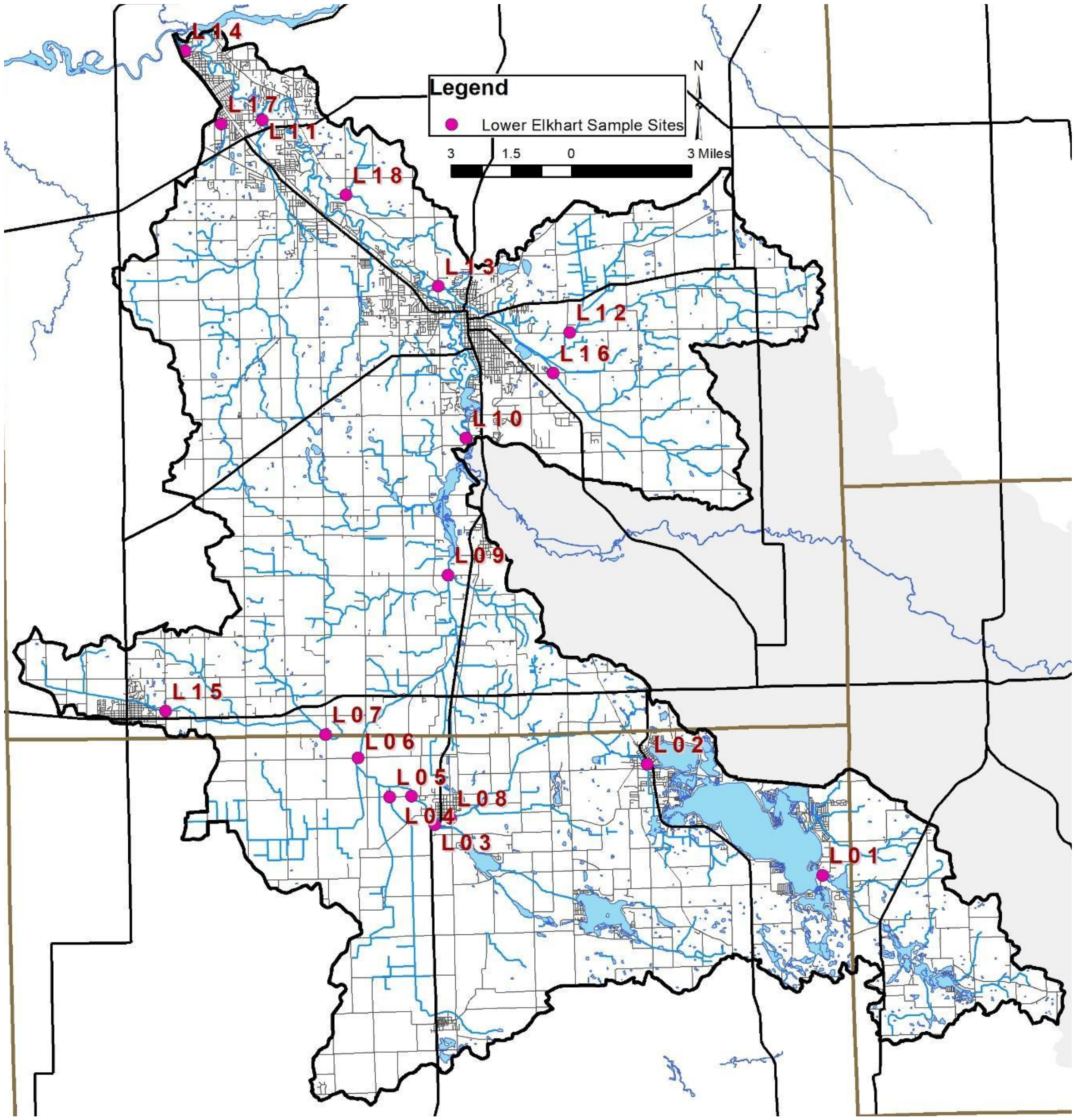

Figure 28. Sites sampled as part of the Upper Elkhart River Watershed Management Plan.

Stream Flow

Stream flow was calculated by scaling stream flow measured at the U.S. Geological Survey (USGS) stream gages to subwatershed drainage area. The Elkhart River at Goshen (USGS 04100500) was used to scale flow Lower Elkhart River sites.

Field and Laboratory Chemistry Parameters

Field and laboratory water chemistry data collection at each site will include monitoring for nutrients (nitrate-nitrogen, total phosphorus), *E. coli*, total suspended solids, dissolved oxygen, conductivity, turbidity, temperature, and pH at all sites monitored. Total phosphorus, total suspended solids and *E. coli* solids will be determined in the laboratory using approved methods. Dissolved oxygen, temperature, conductivity, turbidity, pH (Hydrolab MS5), and nitrate-nitrogen (YSI Pro DSS) will be determined on site using handheld probes.

Biological Community and Habitat
Benthic macroinvertebrates (primarily aquatic insect larvae and nymphs) will be sampled at each site using the IDEM macroinvertebrate Index of Biotic Integrity methods at the same stations once between July and October. Macroinvertebrate samples will be preserved in the field using 90% ethanol. Preserved samples will be processed, and individuals are identified to the genus level. The macroinvertebrate IBI (mIBI) will be calculated using protocols developed for use by the Indiana Department of Environmental Management. Stream habitat at each site will be evaluated using the Qualitative Habitat Evaluation Index (QHEI, Ohio Environmental Protection Agency, 2006). Habitat assessment will occur concurrent with biological sampling.

3.4 Watershed Inventory Assessment

3.4.1 Watershed Inventory Methodologies

Windshield surveys were completed throughout the Lower Elkhart River Watershed in the spring of 2023. Surveys were conducted by driving all accessible roads throughout the watershed. Large maps with aerial photographs, road and stream names, and public property labels were provided to assess in surveying. Observations were recorded on the provided maps and data sheets, field conditions were documented using photographs, and additional notes were provided to the Project Coordinator for review. The windshield surveys were also used to confirm GIS map layer data throughout the watershed. Items targeted during the surveys included, but were not limited to the following:

- Aerial land use category
- Field or gully erosion
- Pasture locations and condition
- Livestock access and impact to streams
- Buffer condition and width
- Bank erosion or head-cutting
- Logjams located within the stream
- Dumping areas or areas where trash or debris accumulate
- Abandoned mines or mine shafts
- Small, unregulated farms
- Environmental site confirmation (NPDES, CFO, open dump, Superfund, etc.)

3.4.2 Watershed Inventory Results

All accessible road-stream crossings were inventoried. Issues identified within the watershed fall under 3 categories: erosion, narrow buffer, and livestock access. Figure 29 details locations throughout the Lower Elkhart River Watershed where problems are identified. A total of 7.5 miles of streams were eroded among 33 different locations, 2.9 miles possessed narrow buffers at eight different locations, and livestock had access to 3.3 miles of streams at three different locations.

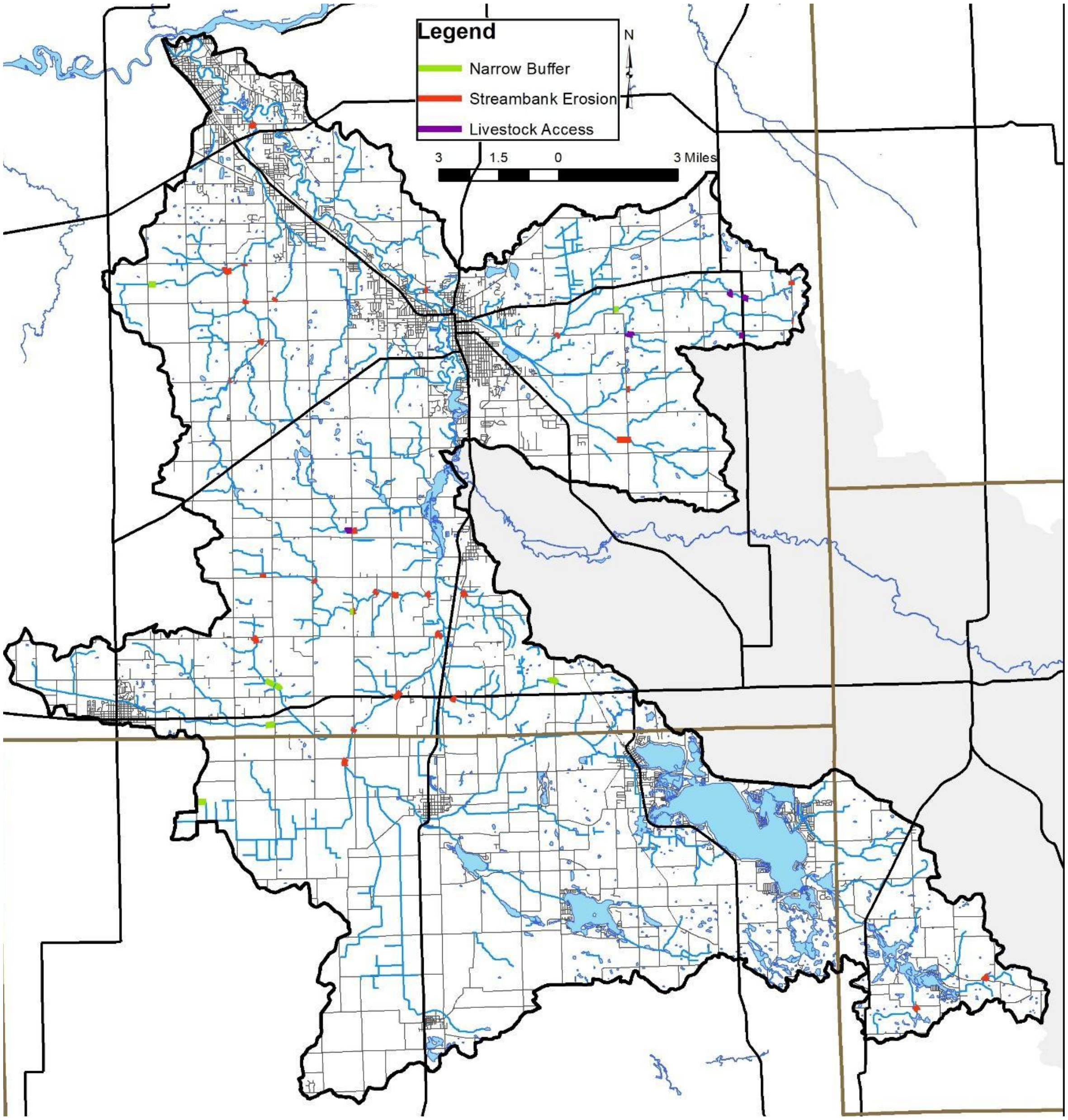

Figure 29. Stream-related watershed concerns identified during watershed inventory efforts.

4.0 WATERSHED INVENTORY II-B: subwatershed DISCUSSIONS

To gather more specific, localized data, the Lower Elkhart River Watershed was divided into thirteen (13) subwatersheds with each subwatershed reflecting one 12-digit Hydrologic Unit Code (HUC; Figure 30). These subwatersheds reflect specific tributary drainages and similar land uses and hydrology. Land uses, point and non-point watershed concern areas, and historic water quality sampling locations and results are discussed in detail below for each subwatershed.

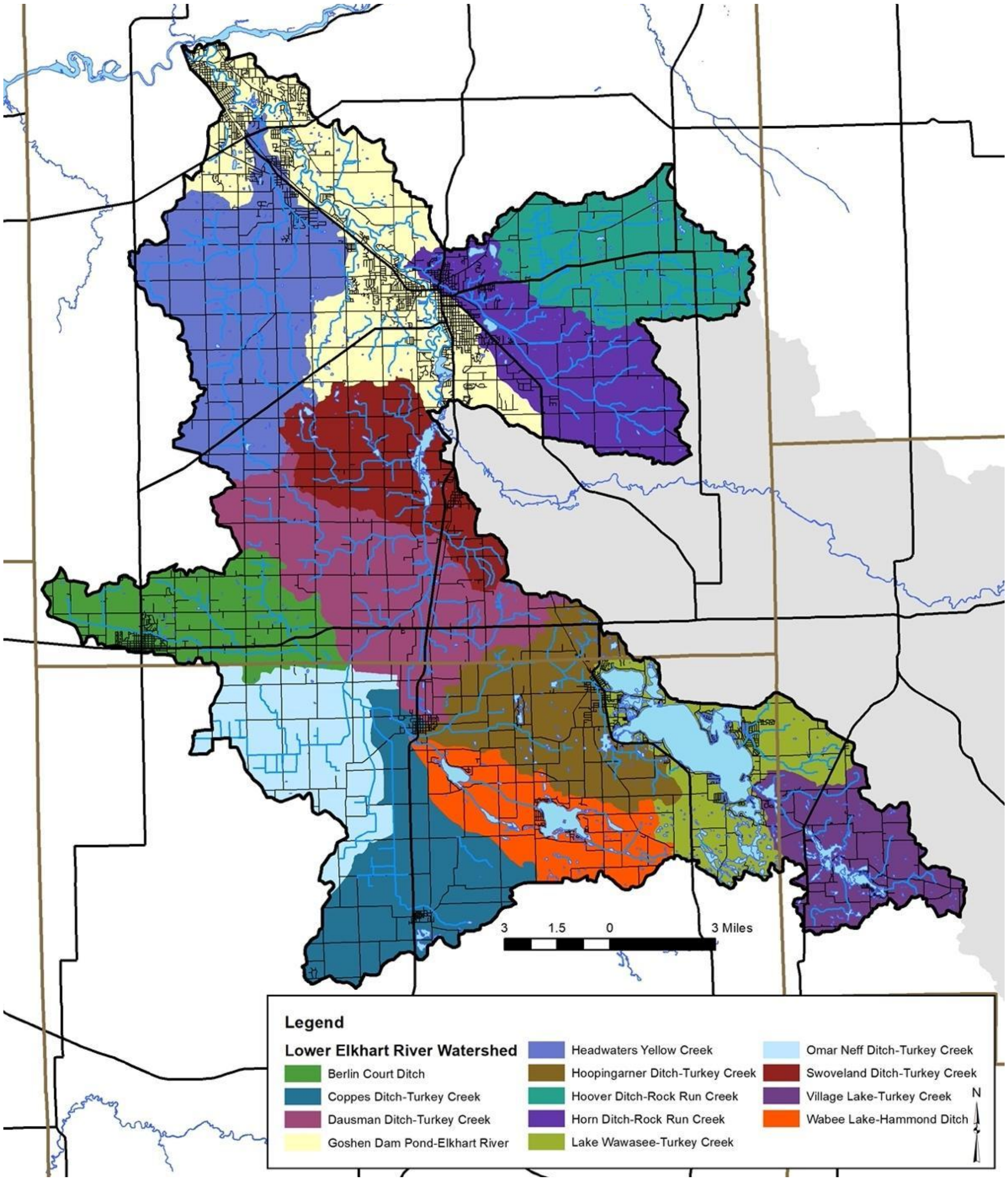

Figure 30. 12-digit Hydrologic Unit Codes subwatersheds in the Lower Elkhart River Watershed.

4.1 Village Lake-Turkey Creek subwatershed

The Village Lake-Turkey Creek subwatershed forms the southeastern tip of the Lower Elkhart River Watershed and lies within Kosciusko and Noble counties (Figure 30). It encompasses one 12-digit HUC watershed: 040500011701. This subwatershed drains 10,172 acres and accounts for 5% of the total watershed area. There are 17.6 miles of stream in the Village Lake-Turkey Creek subwatershed. IDEM has classified four lakes as impaired in the Village Lake-Turkey Creek including Gordy Lake, Hindman Lake, Knapp Lake and Village Lake, all of which are impaired for biotic communities (Figure 31).

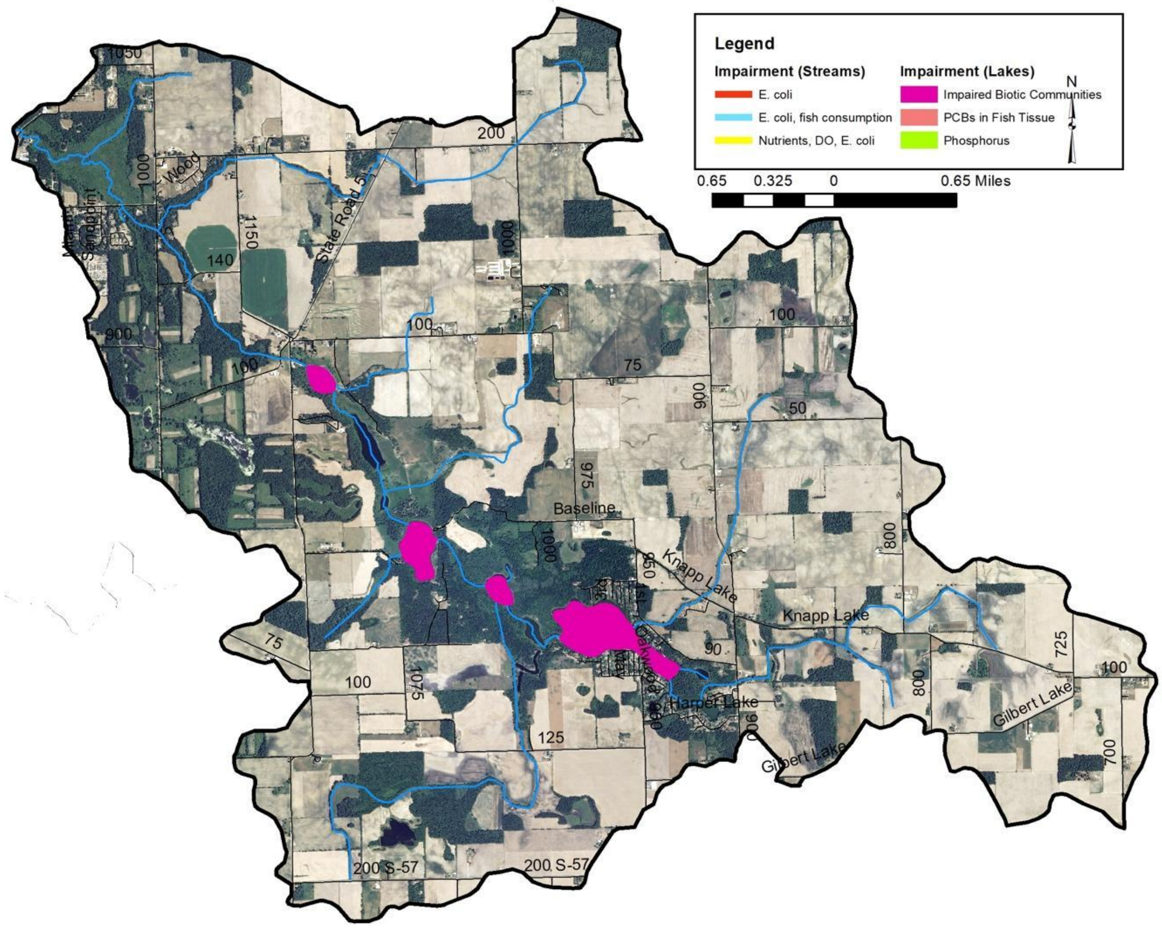

Figure 31. Impairments in the Village Lake-Turkey Creek subwatershed.

4.1.1 Soils

Hydric Soils cover 25.5%, or 2,598.1 acres, of the subwatershed. Highly erodible soils cover more than half (52.4%, or 5,334.5) of the subwatershed. In total, 9,843.3 acres (96.8%) of the subwatershed are identified as very limited for septic use. Maintenance and inspection of septic systems in this area are important to ensure proper function and capacity.

4.1.2 Land Use

Agricultural land is the majority land use in the Village Lake-Turkey Creek subwatershed, with 71.3% (7,252.6 acres) of land used for agriculture. Forested land use accounts for 10.7% (1,089.9 acres) of the subwatershed. Urban land use accounts for 11.2% (1,136.6 acres) of the subwatershed. Wetlands, open water and grassland represents 10.7%, or 1,089.9 acres, of the subwatershed.

4.1.3 Point Source Water Quality Issues

There are very few potential point sources of water pollution in the subwatershed (Figure 32). One leaking underground storage tank is in the Village Lake-Turkey Creek subwatershed.

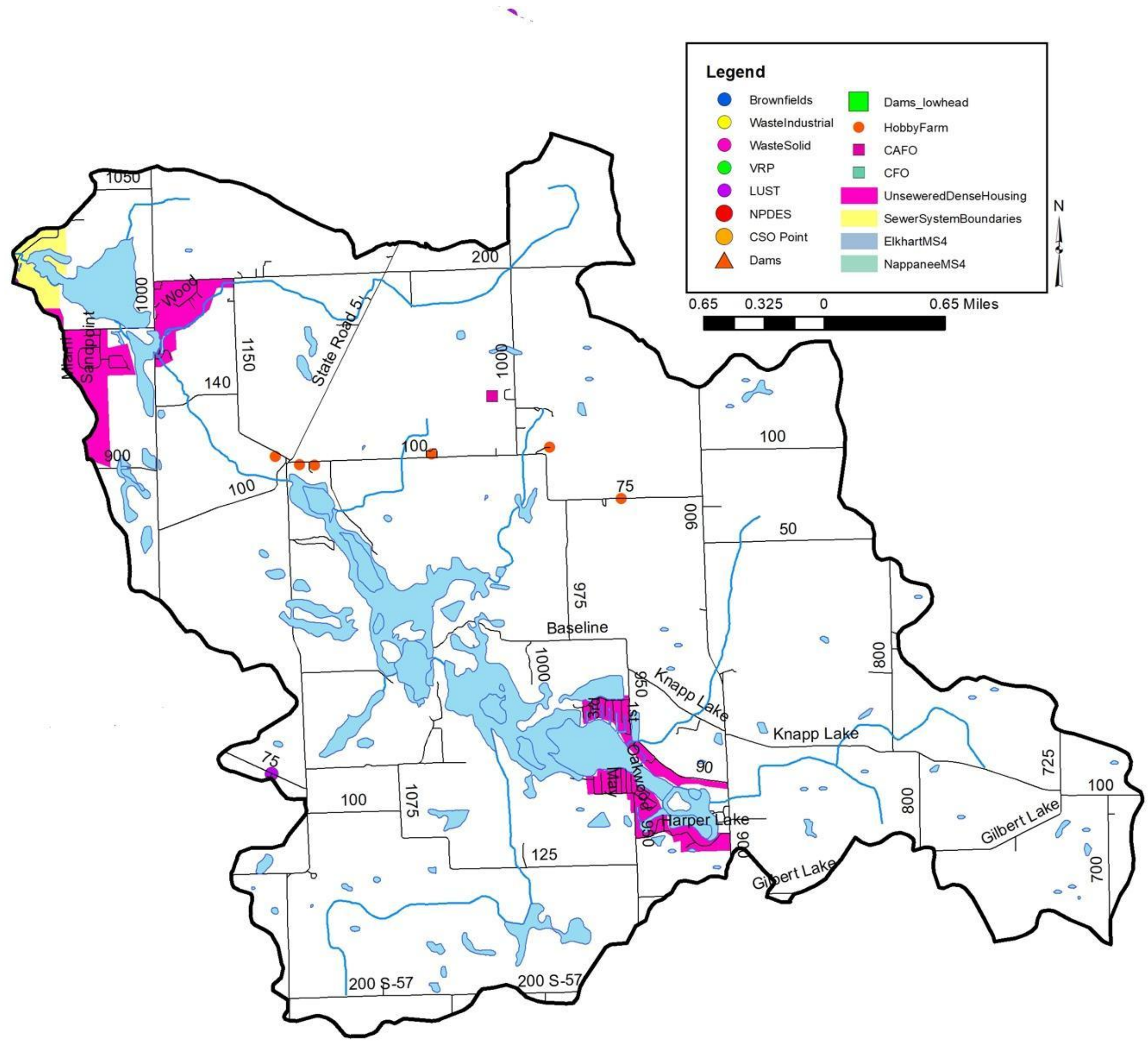

Figure 32. Potential point and non-point sources of pollution in Village Lake-Turkey Creek subwatershed.

4.1.4 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Village Lake-Turkey Creek subwatershed. Additionally, a number of small animal operations and one confined feeding operation are also present (Figure 32). In total, 8 unregulated animal operations housing more than 67 cows, horses, and sheep were identified during the windshield survey. There is one active CFO housing approximately 83,900 ducks in the subwatershed. Based on windshield survey observations, livestock do not appear to have access to the subwatershed streams. In total, manure from animal operations total over 4,987 tons per year, which contains almost 2,350,229 pounds of nitrogen, 1,963,745 pounds of phosphorus and 2.90E+14 colonies of *E. coli*. Streambank erosion is a concern in the subwatershed. Approximately 0.5 miles (2.8%) of streambank erosion were identified within the subwatershed.

4.1.5 Water Quality Assessment

Waterbodies within the Village Lake-Turkey Creek subwatershed have been sampled historically at 17 locations. Historic assessments include collection of water chemistry by WACF (12 snapshot sites), Hoosier Riverwatch (1 site), and LARE (7 sites). No stream gages are in the Village Lake-Turkey Creek subwatershed.

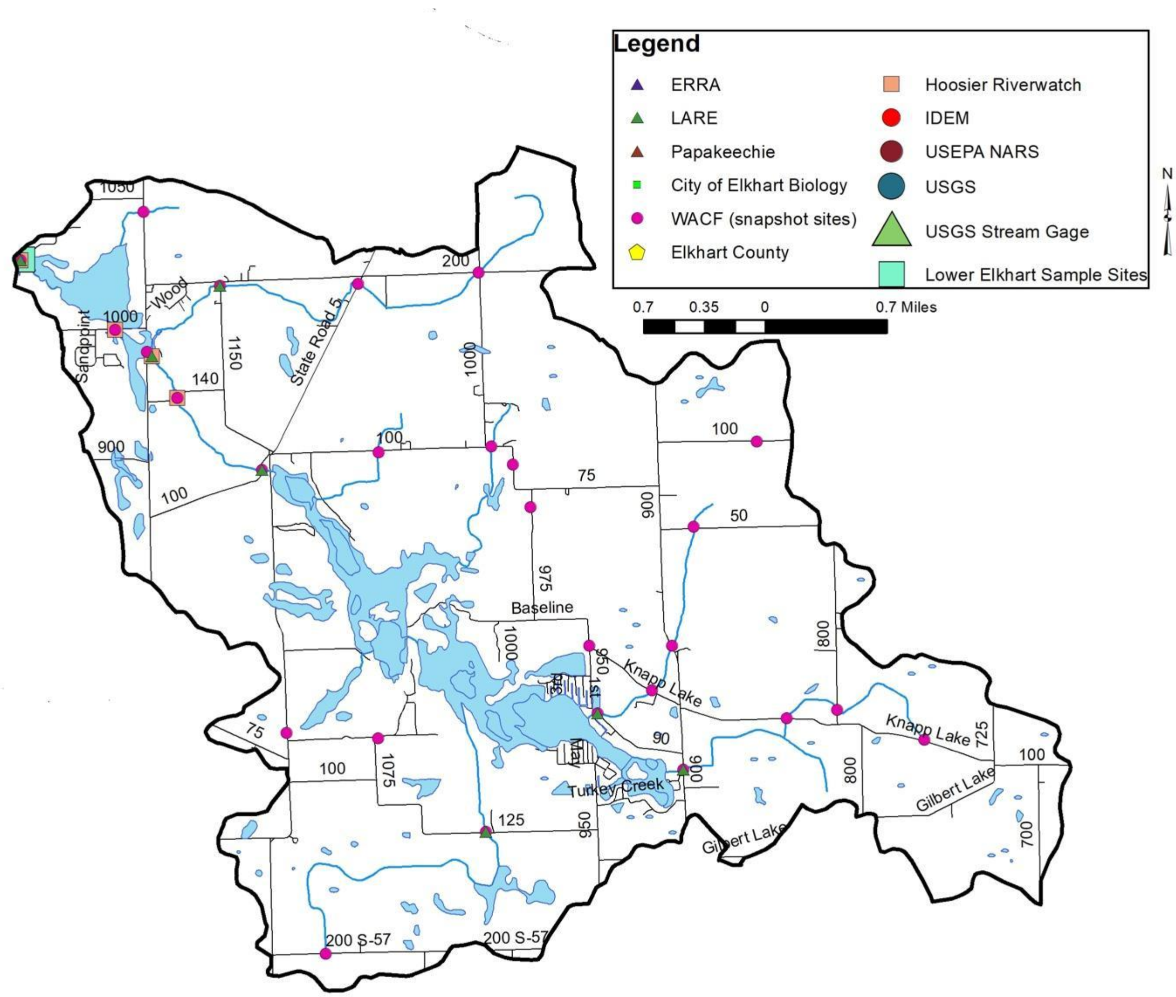

Figure 33. Locations of historic and current water quality data collection in the Village Lake-Turkey Creek subwatershed.

Table 20 details historic water chemistry data collected in the Village Lake-Turkey Creek subwatershed. As shown in the table, ammonia, conductivity, and TSS levels did not exceed in any samples collected. DO concentrations exceed water quality targets in 3% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 74% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 90% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 71% of samples. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 21% of samples, while orthophosphorus concentrations exceed water quality targets (0.03 mg/L) in 25% of samples collected. pH levels exceed water quality targets in 11% of samples collected. TSS levels did not exceed water quality targets (15 mg/L) in any samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 7% of samples.

Table 20. Village Lake-Turkey Creek historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.0	0.12	0	14	0%
Conductivity	493.0	809.0	0	14	0%
DO	3.0	12.0	1	34	3%
E. coli	0.0	51,000.0	154	208	74%
Nitrate	0.5	10.0	27	30	90%
OP	0.0	2.0	5	20	25%
pH	0.0	9.0	4	38	11%
TKN	0.279	1.128	10	14	71%
TP	0.02	0.14	3	14	21%
TSS	0.3	7.3	0	13	0%
Turbidity	0.5	23.0	1	15	7%

4.2 Lake Wawasee-Turkey Creek subwatershed

The Lake Wawasee-Turkey Creek subwatershed forms some of the eastern boundary of the Lower Elkhart River Watershed and encompassing Lake Wawasee, Syracuse Lake and other lakes as well as part of the Tri County Fish and Wildlife Area. The subwatershed stretches over Kosciusko and Noble counties (Figure 30). It encompasses one 12-digit HUC watershed: 040500011702. This subwatershed drains 14,276 acres and accounts for 8% of the total watershed area. There are 11.3 miles of stream. IDEM has identified four lakes in the subwatershed as impaired, including Hammond Lake, Lake Wawasee, Rothenberger Lake and Barrel and a Half Lake for PCBs in fish tissue (Figure 34).

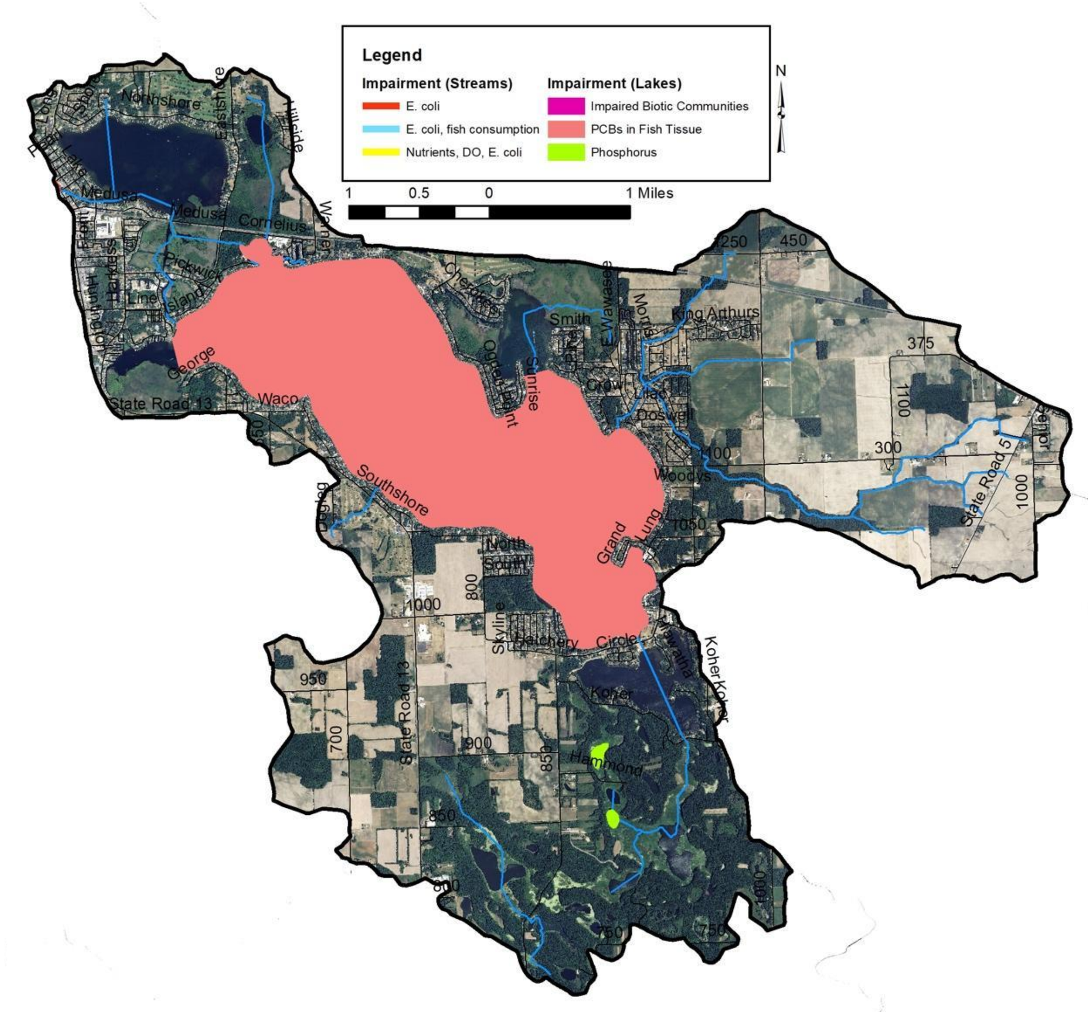

Figure 34. Impairments in the Lake Wawasee-Turkey Creek subwatershed.

4.2.1 Soils

Hydric soils cover 2,692.4 acres (18.9%) of the subwatershed. Highly erodible soils cover 3,211.3 (22.5%) of the subwatershed. In total, 8,893.7 acres (62.3%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.2.2 Land Use

Wetland, open water, and grassland cover is the largest land cover use in this subwatershed, covering almost 39% (5,548.0 acres) of land. Agricultural land use is lowest of any Lower Elkhart River subwatershed, with 30.2% (4,309.1 acres) of the Lake Wawasee-Turkey Creek subwatershed used for agriculture. Urban land use accounts for 17.4% (2,484.8 acres) of the subwatershed including areas around Lake Wawasee. Forested land use covers 13.5% (1,934.3 acres).

4.2.3 Point Source Water Quality Issues

There are multiple potential point sources of water pollution in the Lake Wawasee-Turkey Creek subwatershed (Figure 35). There are 11 leaking underground storage tank sites and two industrial waste sites located in the subwatershed. Additionally, 22 underground storage tank sites not identified as leaking are in the subwatershed. One NPDES-permitted facility is in the subwatershed in Syracuse.

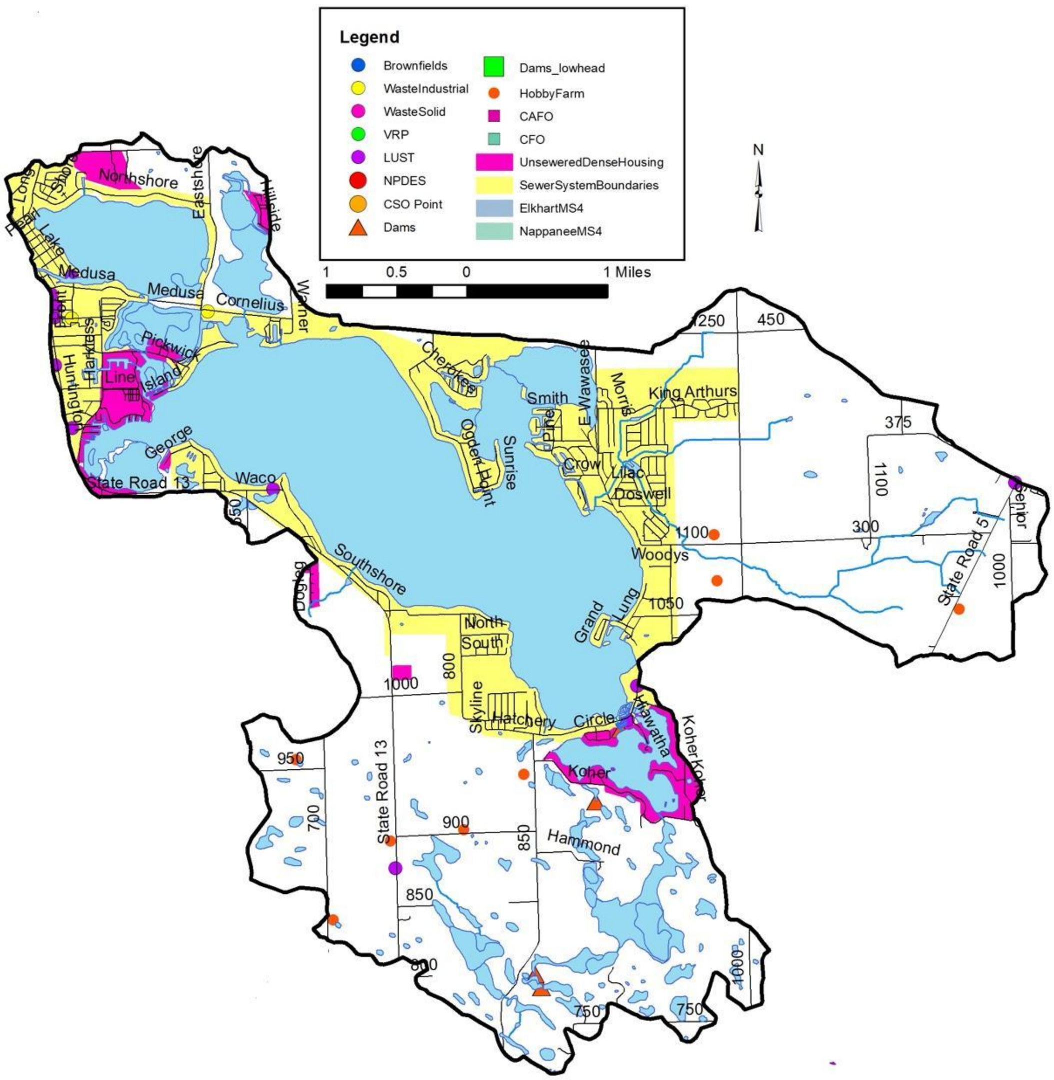

Figure 35. Potential point and non-point sources of pollution in the Lake Wawasee-Turkey Creek subwatershed.

4.2.4 Non-Point Source Water Quality Issues

While agricultural land use is not the predominant land use in the Lake Wawasee-Turkey Creek subwatershed, a number of small animal operations are still present. In total, eight unregulated animal operations housing more than 53 cows and horses were identified during the windshield survey. No active CFOs are located within the Lake Wawasee-Turkey Creek subwatershed. In total, manure from small animal operations total over 1,136 tons per year, which contains almost 568 pounds of nitrogen, 282 pounds of phosphorus and 2.96E+13 colonies of *E. coli*. Livestock do not appear to have access to the subwatershed streams based on windshield survey observations. Streambank erosion is not a concern in the subwatershed.

4.2.5 Water Quality Assessment

Waterbodies within the Lake Wawasee-Turkey Creek subwatershed have been sampled historically at 70 locations. One site in the subwatershed is being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (2 sites), WACF (17 snapshot sites), Hoosier Riverwatch (17 sites), LARE (7 sites), and Lake Papakeechie (27 sites).

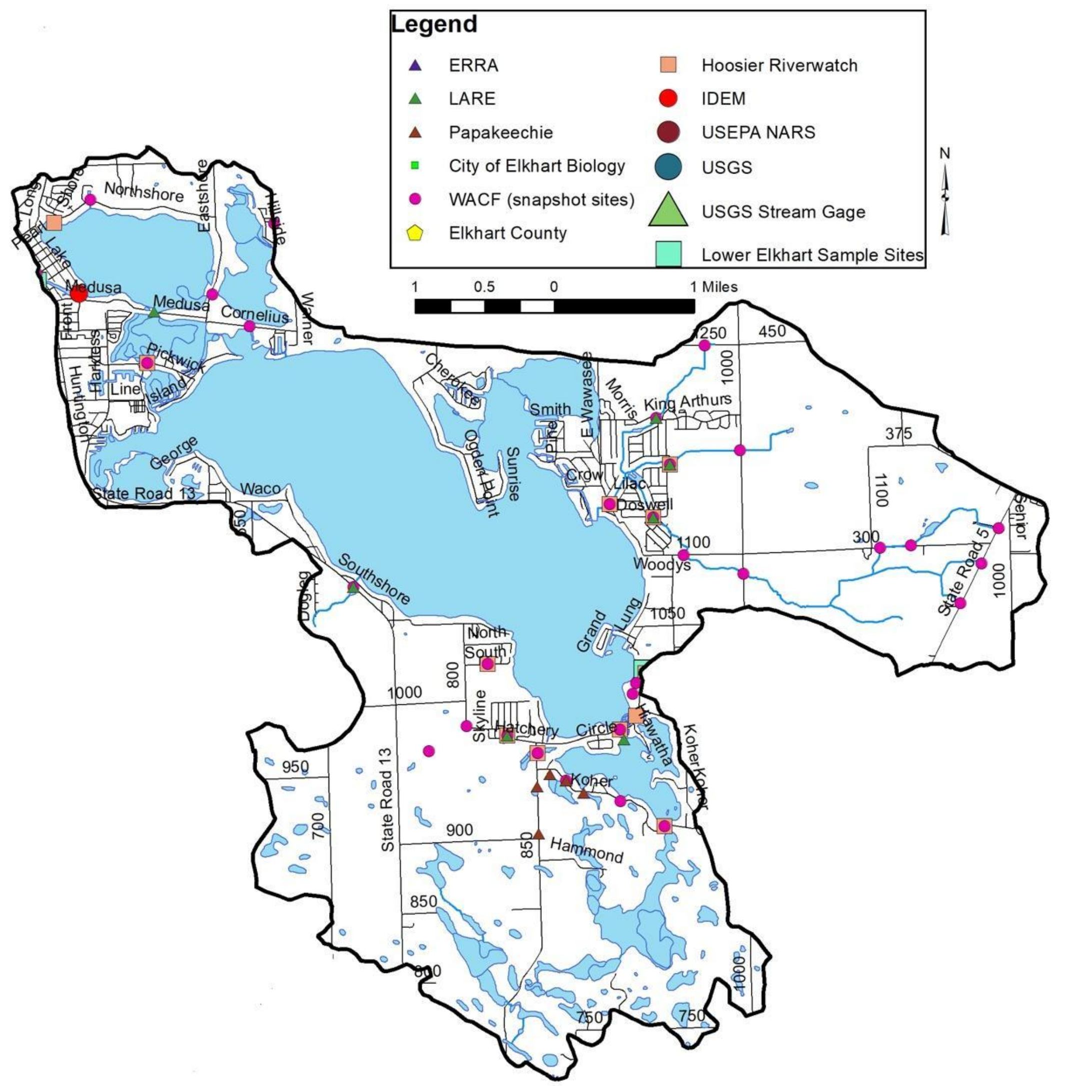

Figure 36. Locations of historic and current water quality data collection in the Lake Wawasee-Turkey Creek subwatershed.

Table 21 details historic water chemistry data collected in the Lake Wawasee-Turkey Creek subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 25% of samples collected. Conductivity concentrations did not exceed water quality targets (1050 mg/L) in any samples collected. DO concentrations exceed water quality targets in 12% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 27% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 29% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 7% of samples. pH levels exceed water quality targets in 10% of samples collected. Orthophosphorus concentrations exceed water quality targets (0.03 mg/L) in 62% of samples. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 1% of samples. TSS levels exceed water quality targets (15 mg/L) in 7% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 4% of samples.

Table 21. Lake Wawasee-Turkey Creek historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.2	5.17	5	20	25%
Conductivity	255	675.0	0	14	0%
DO	0.0	305.0	32	118	27%
E. coli	0.0	124,000.0	0	76	0%
Nitrate	0.0	20.0	45	157	29%
OP	0.0	4.5	49	79	62%
pH	0.0	9.5	12	116	10%
TKN	0.23	0.843	7	14	7%
TP	0.0	5.0	2	169	1%
TSS	0.5	46.7	1	14	7%
Turbidity	0.0	8.9	1	24	4%

Biological monitoring was conducted by LARE at 14 sites, three times for macroinvertebrate community assessments and 14 times for habitat assessment (Table 22). Habitat scores ranged from 37 to 71.5, with 71% of sites scoring below the state target (51). Macroinvertebrate assessments consistently rated above target level of 2.2.

Table 22. Lake Wawasee-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	37	71.5	10	14	71%
Fish (IBI)	--	--	--	--	--
Macroinvertebrates (mIBI, Kick)	2.7	5.1	0	3	0%
Macroinvertebrates (mIBI, Multi Habitat)	--	--	--	--	--

4.3 Wabee Lake-Hammond Ditch subwatershed

The Wabee Lake-Hammond Ditch subwatershed sits at the center of the southern border of the Lower Elkhart River Watershed and lies entirely in Kosciusko County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011703. This subwatershed drains 10,120 acres and accounts for 5% of the total watershed area. There are 13.0 miles of stream, none of which IDEM has classified as impaired (Figure 37).

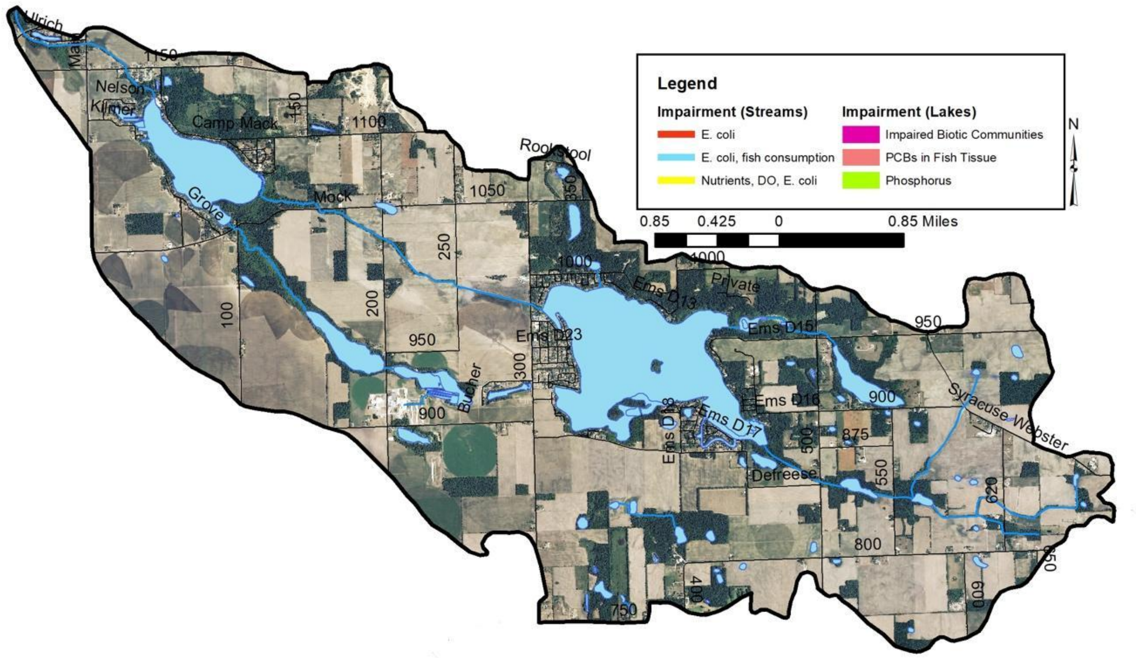

Figure 37. Wabee Lake-Hammond Ditch subwatershed.

4.3.1 Soils

Hydric soils cover 1,100.8 acres (10.9%) of the subwatershed. Highly erodible soils cover 47% of the subwatershed (4,752.1 acres). In total, 8,984.8 acres (88.8%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.3.2 Land Use

Agricultural land use is the majority land use in the Wabee Lake-Hammond Ditch subwatershed with 66.7% (6,755.0 acres) in agricultural land usage. Forested land use covers 10.7% of land in the subwatershed, or 1,086.3 acres. Urban land is smallest in this subwatershed, covering 7.6% (773.0 acres) of the land. Wetlands, open water, and grassland cover 1,506.3 acres, or 14.9%, of the subwatershed.

4.3.3 Point Source Water Quality Issues

There are few potential point sources of water pollution in the subwatershed (Figure 38). There are two underground storage tank sites not identified as leaking in the Wabee Lake-Hammond Ditch subwatershed.

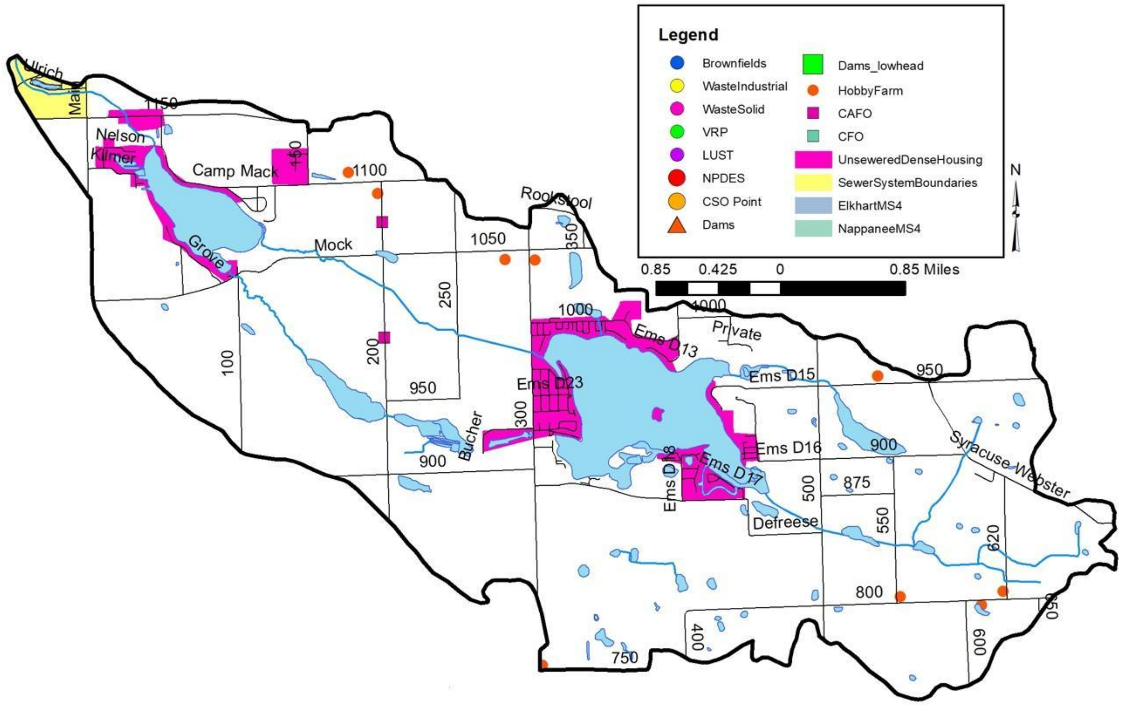

Figure 38. Potential point and non-point sources of pollution in Wabee Lake-Hammond Ditch subwatershed.

4.3.4 Non-Point Source Water Quality Issues

Agricultural land use is the predominant land use in the Wabee Lake-Hammond Ditch subwatershed. Additionally, a number of small animal operations and pastures are also present (Figure 38). In total, eight unregulated animal operations housing more than 52 cows, horses, goats, sheep and donkeys were identified during the windshield survey. One active confined feeding operation housing 7,670 pigs is located within the Wabee Lake-Hammond Ditch subwatershed. In total, manure from animal operations total over 32,206 tons per year, which contains almost 95,077 pounds of nitrogen, almost 71,688 pounds of phosphorus and 1.76E+16 colonies of *E. coli*. Livestock do not appear to have access to the subwatershed streams based on windshield survey observations. Streambank erosion and narrow buffer was not identified during the windshield survey, therefore may not be a concern in the subwatershed.

4.3.5 Water Quality Assessment

Waterbodies within the Wabee Lake-Hammond Ditch subwatershed have been sampled historically at 11 locations (Figure 39). One site in the subwatershed is being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (1 site), LARE (8 sites), and Hoosier Riverwatch (2 sites). No stream gages are in the Wabee Lake-Hammond Ditch.

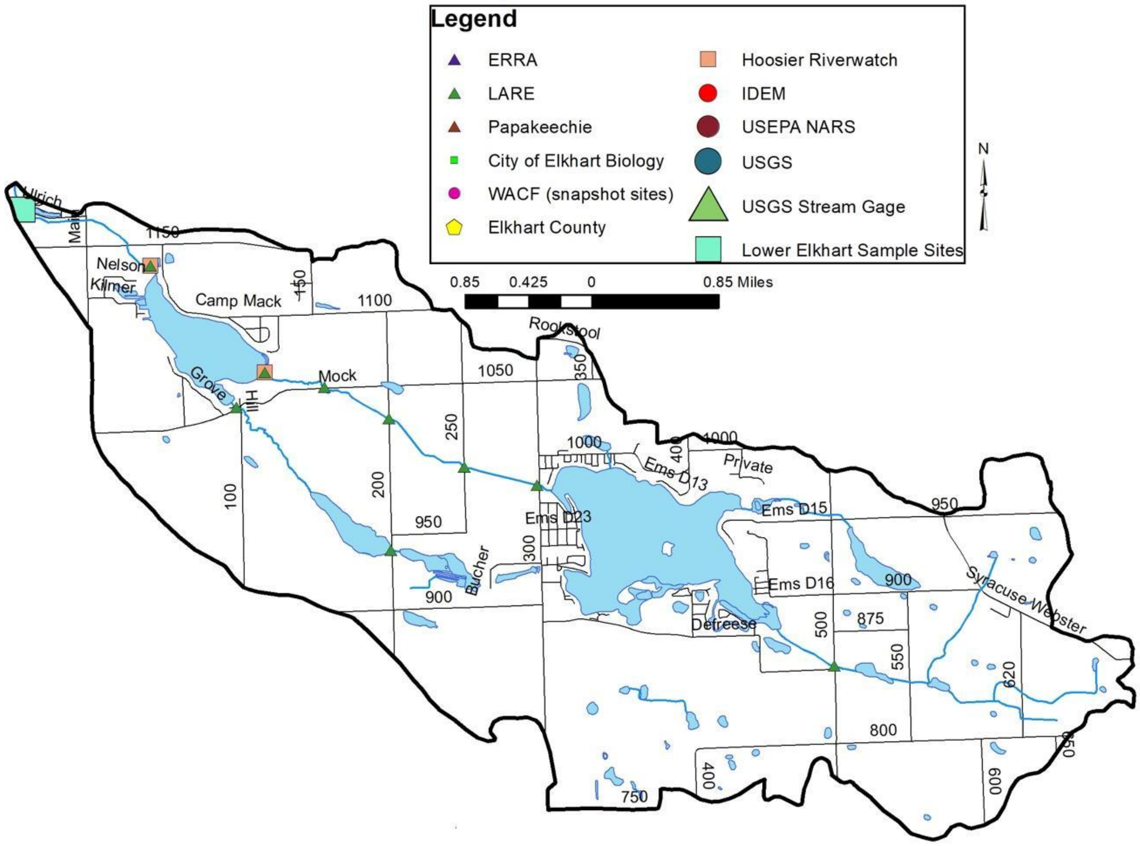

Figure 39. Locations of historic and current water quality data collection in the Wabee Lake-Hammond Ditch subwatershed.

Table 23 details historic water chemistry data collected in the Wabee Lake-Hammond Ditch subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 50% of samples collected. DO concentrations exceed water quality targets in 8% of samples collected. *E. coli* concentrations do not exceed state grab sample standards (235 col/100 ml) in any samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 100% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 50% of samples. pH levels exceed water quality targets in 6% of samples collected. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 50% of samples. TSS levels exceed water quality targets (15 mg/L) in 50% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 50% of samples. Conductivity was not sampled in Wabee Lake-Hammond Ditch subwatershed.

Table 23. Wabee Lake-Hammond Ditch historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.2	0.75	1	2	50%
DO	6.0	88.0	1	13	8%
E. coli	0.0	60.0	0	8	0%
Nitrate	2.2	29.33	9	9	100%
pH	5.7	9.0	1	18	6%
TKN	0.227	1.943	1	2	50%
TP	0.057	0.347	1	2	50%
TSS	2.25	16.9	1	2	50%
Turbidity	0.2	60.0	6	12	50%

Biological monitoring was conducted by LARE at one site with one site assessed for macroinvertebrates (Table 24). Habitat assessment occurred once and resulted in a score of 40, not reaching the state target of 51. Fish community assessments rated good and meets the state's aquatic life use designation. Macroinvertebrate assessments using the kick sampling method measured above state target of 2.2.

Table 24. Wabee Lake-Hammond Lake subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
QHEI	40	40	1	1	100%
IBI	--	--	--	--	--
mIBI kick	5.3	5.3	0	1	0%
mIBI mulit	--	--	--	--	--

4.4 Hoopingarner Ditch-Turkey Creek subwatershed

The Hoopingarner Ditch-Turkey subwatershed is in the middle to eastern edge of the Lower Elkhart Watershed and lies within Elkhart and Kosciusko Counties (Figure 30). It encompasses one 12-digit HUC watershed: 040500011704. This subwatershed drains 13,613 acres and accounts for 7% of the total watershed area. There are 28 miles of stream. IDEM has classified almost all (27.6 miles) length of stream in the Hoopingarner Ditch-Turkey Creek subwatershed as impaired for *E. coli* (Figure 40).

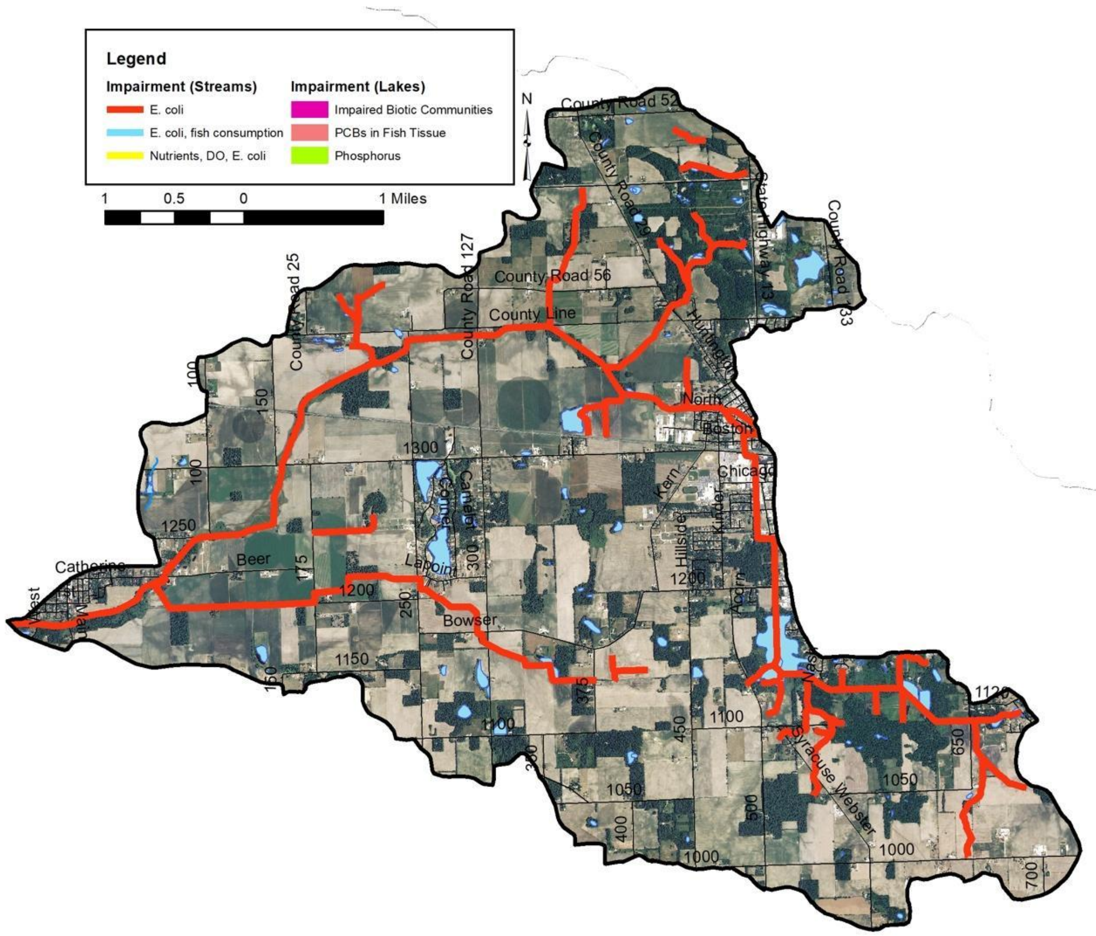

Figure 40. Impairments in the Hoopingarner Ditch-Turkey Creek subwatershed.

4.4.1 Soils

Hydric soils cover 3,029.3 acres (22%) of the subwatershed. Highly erodible soils cover 5,698.2 acres (42%) of the subwatershed. In total, 13,269.9 acres (97%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.4.2 Land Use

Agricultural land uses are the major land use of the Hoopingarner Ditch-Turkey Creek subwatershed, with 71% of land (9,670 acres) used for agriculture. Nearly 12% (1,615.5 acres) of the subwatershed is in urban land use including the Town of Syracuse. Forest land use accounts for 8% (1,086.4 acres) of the subwatershed. Wetlands, open water and grassland cover the remaining the approximately 9% (1,241.4 acres) of the subwatershed.

4.4.3 Point Source Water Quality Issues

There are few potential point sources of water pollution in the Hoopingarner Ditch-Turkey Creek subwatershed (Figure 41). Six leaking underground storage tanks and six industrial waste sites are located in the subwatershed. Twelve underground storage tanks that are not identified as leaking are also located in this subwatershed.

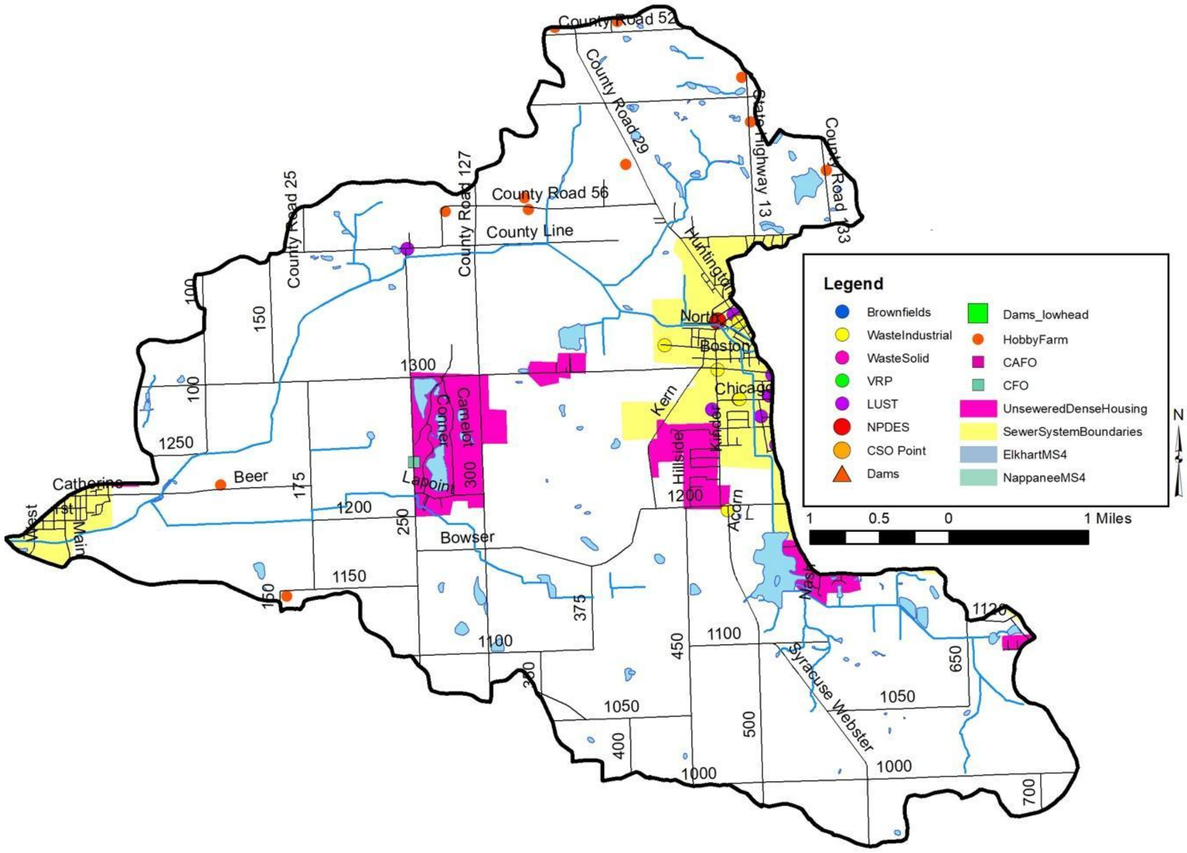

Figure 41. Potential point and non-point sources of pollution and suggested solutions in the Hoopingarner Ditch-Turkey Creek subwatershed.

4.4.4 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land uses in the Hoopingarner Ditch-Turkey Creek subwatershed. Eleven unregulated animal operations housing more than 149 cows, horses and sheep were identified during the windshield survey. Livestock do not appear to have access to streams in the subwatershed. There is one active CFO housing 1,700 pigs located in the Hoopingarner Ditch-Turkey Creek subwatershed. In total, manure from all small animal operations total over 9,521 tons per year, which contains almost 22,818 pounds of nitrogen, 16,731 pounds of phosphorus and 4.20E+15 colonies of *E. coli*. Streambank erosion and lack of buffers are not a concern in the subwatershed.

4.4.5 Water Quality Assessment

Waterbodies within the Hoopingarner Ditch-Turkey Creek subwatershed have been sampled historically at four locations. Three sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (3 sites) and USGS (1 site). No stream gages are in the Hoopingarner Ditch-Turkey Creek subwatershed.

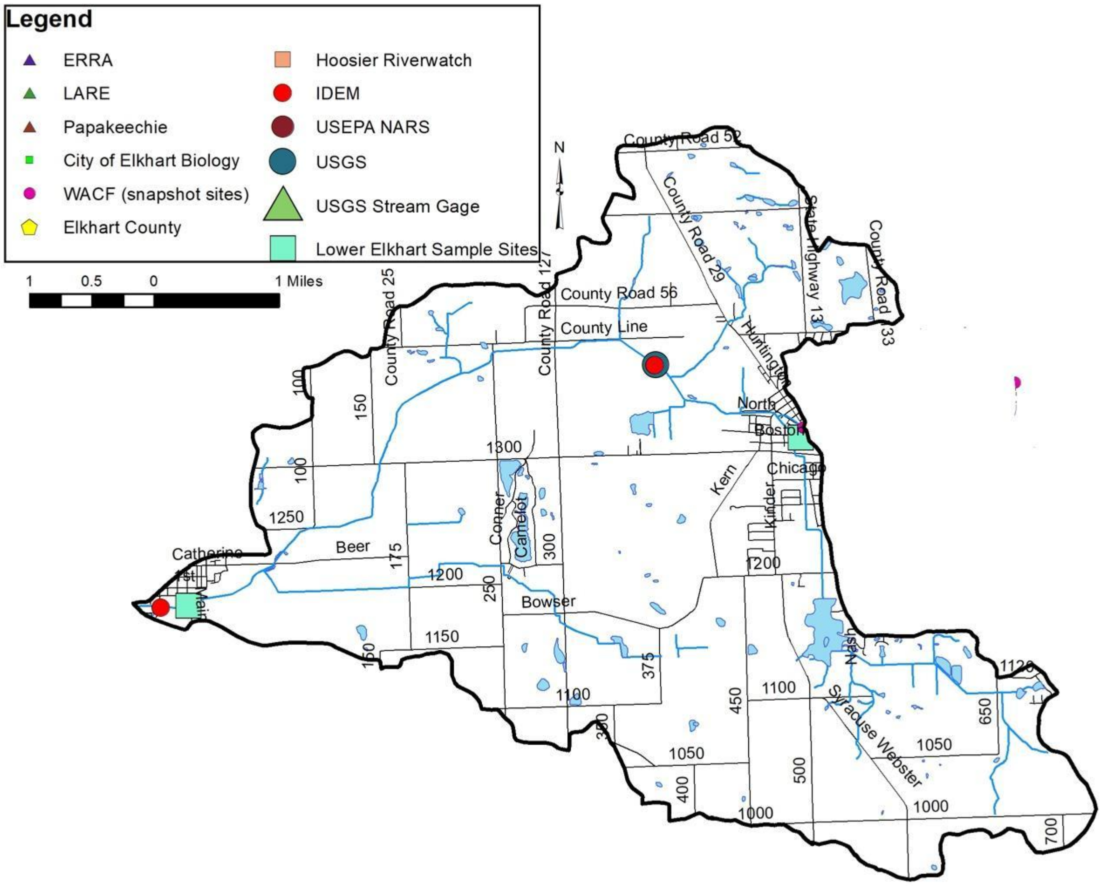

Figure 42. Locations of historic and current water quality data collection in the Hoopingarner Ditch-Turkey Creek subwatershed.

Table 25 details historic water chemistry data collected in the Hoopingarner Ditch-Turkey Creek subwatershed. As shown in the table, ammonia, DO, pH, and turbidity results do not exceed water quality targets in any samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in more than half (60%) of samples collected. Conductivity, nitrate-nitrogen, OP, TKN, TP, and TSS were not sampled in Hoopingarner Ditch-Turkey Creek subwatershed.

Table 25. Hoopingarner Ditch-Turkey Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.1	0	1	0%
DO	7.3	10.0	0	13	0%
E. coli	88.0	816.0	6	10	60%
pH	7.8	8.2	0	16	0%
Turbidity	0.0	3.89	0	13	0%

IDEM assessed the biological data at two sites, with one site assessing fish community and one site assessing macroinvertebrate community (Table 26). Habitat was assessed at both sites, with scores ranging from 58 to 60, measuring above state target of 51. Macroinvertebrate assessments using the multihabitat assessment measured above target, indicating it meets the state's aquatic life use designation. The fish community assessment scored above the target level.

Table 26. Hoopingarner Ditch-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	58	60	0	2	0%
Fish (IBI)	42	42	0	1	0%
Macroinvertebrates (mIBI, Kick)	--	--	--	--	--
Macroinvertebrates (mIBI, Multi Habitat)	40	40	0	1	0%

4.5 Coppes Ditch-Turkey Creek subwatershed

The Coppes Ditch-Turkey Creek subwatershed forms the southwestern boundary of the Lower Elkhart River Watershed and sits entirely in Kosciusko County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011705. This subwatershed drains 14,412 acres and accounts for 8% of the total watershed. There are 15.2 miles of stream. IDEM has classified 1.6 miles of stream length in this subwatershed as impaired for *E. coli*.

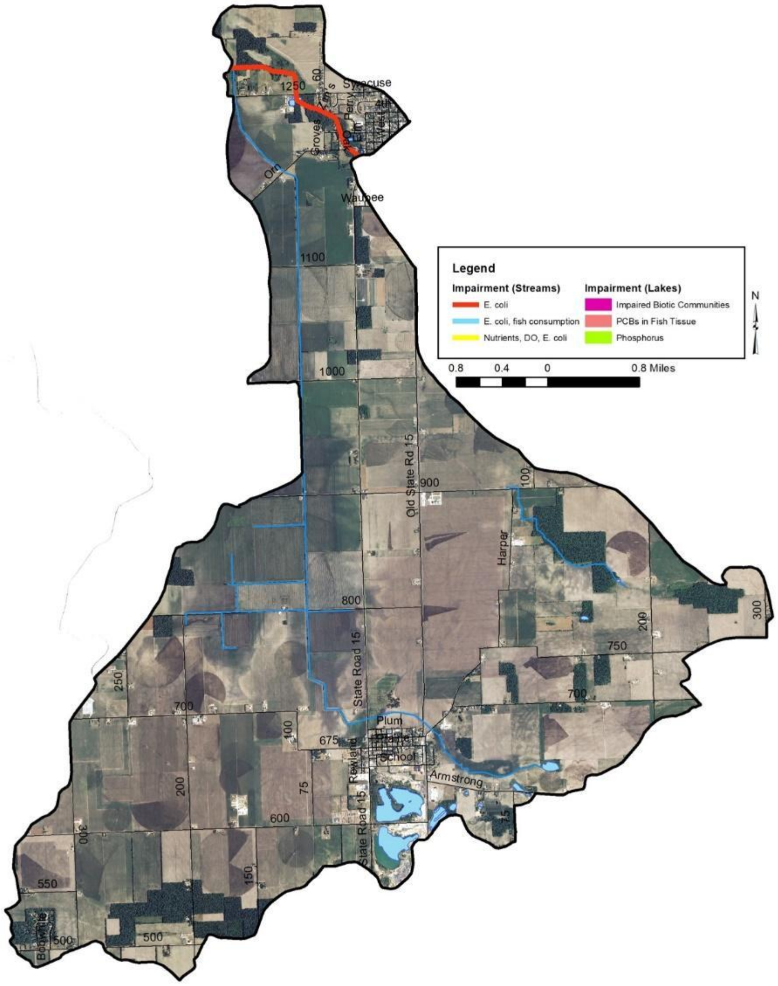

Figure 43. Impairments in the Coppes Ditch-Turkey Creek Subwatershed.

4.5.1 Soils

Hydric soils cover 3,879.0 acres, or 26.9%, of the Coppes Ditch-Turkey Creek subwatershed. Highly erodible soils cover only 967.0 acres (6.7%) of the subwatershed. In total, 14,155.9 acres or 98.2% of the subwatershed is identified as very limited for septic use.

4.5.2 Land Use

Agricultural land use dominates the Coppes Ditch-Turkey Creek subwatershed at 85.4% (12,309.3 acres). Urban land use, including the portions of the Town of Milford and of the City of Nappanee, accounts for 7.2% (1,034.2 acres) of the subwatershed land use. Forest land makes up 4.8% (688.7 acres) of the subwatershed. Wetlands, open water and grassland are the smallest land use in the Coppes Ditch-Turkey Creek subwatershed with 380.5 acres, or 2.6%, of the subwatershed.

4.5.3 Point Source Water Quality Issues

There are 12 potential sources of water pollution in the Coppes Ditch-Turkey Creek subwatershed: one leaking underground storage tanks and 11 underground storage tanks (Figure 44). One NPDES-permitted location is within the subwatershed (Milford wastewater treatment plant). One brownfield is also located within this subwatershed. No superfund sites, corrective action sites or voluntary remediation sites are located within the Coppes Ditch-Turkey Creek subwatershed.

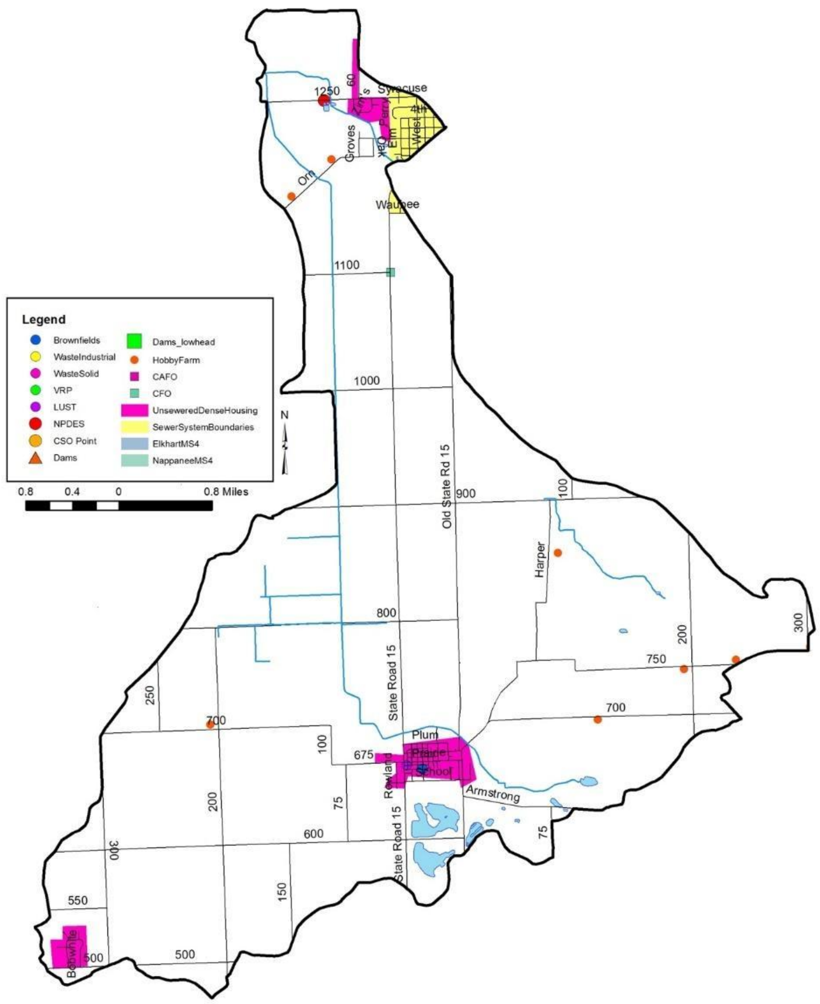

Figure 44. Potential point and non-point sources of pollution in the Coppes Ditch-Turkey Creek subwatershed.

4.5.4 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Coppes Ditch-Turkey Creek subwatershed. Additionally, a number of animal operations are present. In total, seven unregulated animal operations housing more than 55 cows, horses and goats were identified during the windshield survey. Based on windshield survey observations, livestock do not appear to have access to subwatershed streams. There is one confined feeding operation housing 513 pigs in the Coppes Ditch-Turkey Creek subwatershed. These small unregulated and confined feeding animal operations produce more than 3,262 tons of manure annually which contains more than 6,903 pounds nitrogen, 5,070 pounds of phosphorus and more than 1.20E+15 colonies of *E. coli*. Streambank erosion and lack of buffers are not a concern in the subwatershed based on observations during the windshield survey.

4.1.1 Water Quality Assessment

Waterbodies within the Coppes Ditch-Turkey Creek subwatershed have been sampled historically at four sites (Figure 45). Two sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biological data and water chemistry by IDEM (3 sites) and USGS (1 site). No stream gages are in the Coppes Ditch-Turkey Creek subwatershed.

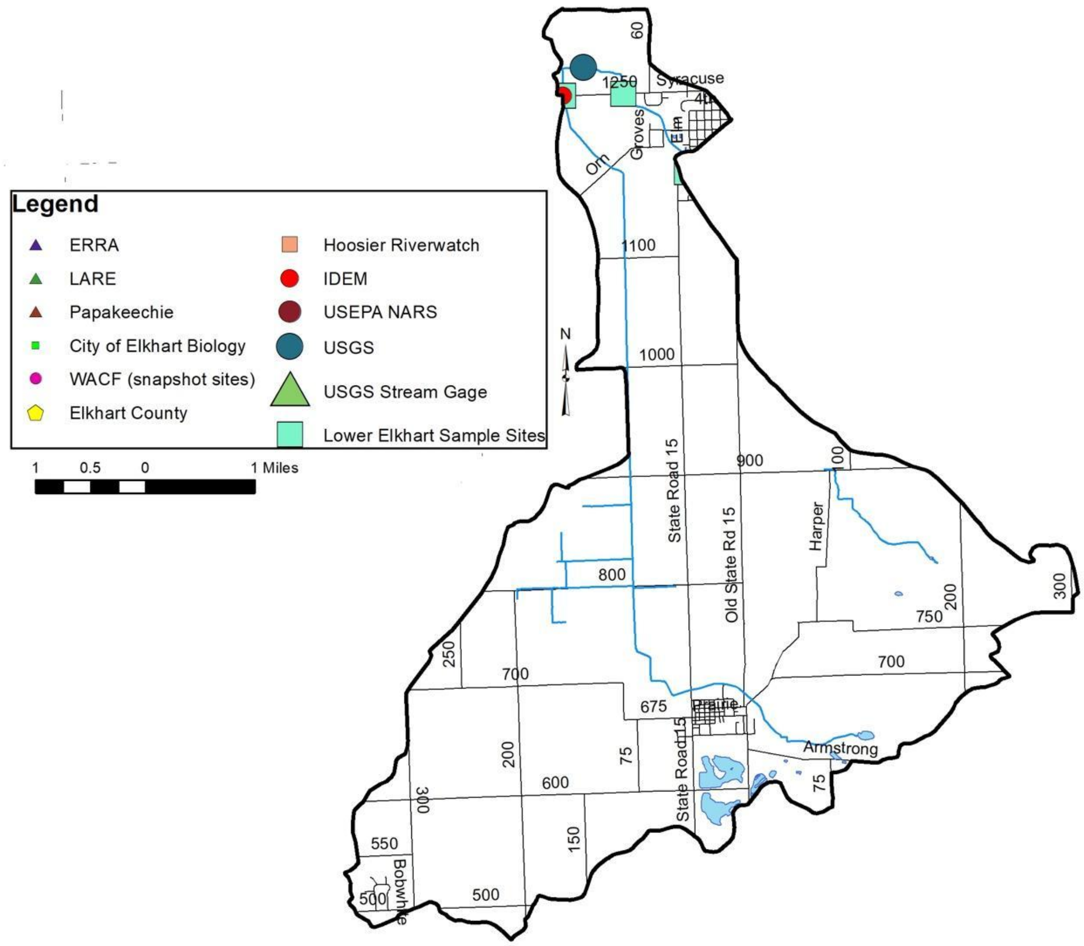

Figure 45. Locations of historic and current water quality data collection in the Coppes Ditch-Turkey Creek subwatershed.

Table 27 details historic water quality sampled collected in the Coppes Ditch-Turkey Creek subwatershed. As shown in the table, ammonia concentrations did not exceed water quality targets in any samples collected. DO concentrations exceeded water quality targets in 11% of samples collected. *E. coli* samples exceed state grab sample standards (235 col/100 ml) in 100% of samples collected. pH levels did not exceed water quality targets in any samples collected. Total Kjeldahl nitrogen (TKN) concentrations exceed water quality targets (0.50 mg/L) in 0% of samples. TSS did not exceed water quality targets in any collected sample, while turbidity levels exceed water quality targets (5.7NTU) in 33% of collected samples. Conductivity, nitrate-nitrogen, OP, and TP were not sampled in Coppes Ditch-Turkey Creek subwatershed.

Table 27. Coppes Ditch-Turkey Creek historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.1	0	3	0%
DO	5.38	13.0	1	9	11%
E. coli	325.5	2419.0	5	5	100%
pH	7.5	8.2	0	12	0%
TKN	0.5	0.5	0	3	0%
TSS	10.0	11.0	0	3	0%
Turbidity	0.0	14.4	3	9	33%

Biological monitoring was conducted by IDEM at two sites, with a fish community assessment occurring once at one site and macroinvertebrate assessments and habitat assessment occurring simultaneously at one site (Table 28). Habitat scores resulted in a score of 52, measuring above the state target (51). The fish community assessment scored above the target level. Macroinvertebrate multihabitat samples did not meet their aquatic life use designation.

Table 28. Coppes Ditch-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
QHEI	52	52	0	1	0%
IBI	40	40	0	1	0%
mIBI kick	--	--	--	--	--
mIBI mulit	26	28	2	2	100%

4.6 <u>Berlin Court Ditch subwatershed</u>

The Berlin Court Ditch subwatershed is in the western center of the Lower Elkhart River Watershed and forms the western edge of the watershed (Figure 30). The Berlin Court Ditch subwatershed lies primarily within Elkhart County, with its southern border falling in Kosciusko County (Figure 46). It encompasses one 12-digit HUC watershed: 040500011706. This subwatershed drains 11,899 acres and accounts for 6% of the total watershed area. There are 22.5 miles of stream. IDEM has classified 7.8 miles of stream as impaired for *E. coli*, nutrients and DO.

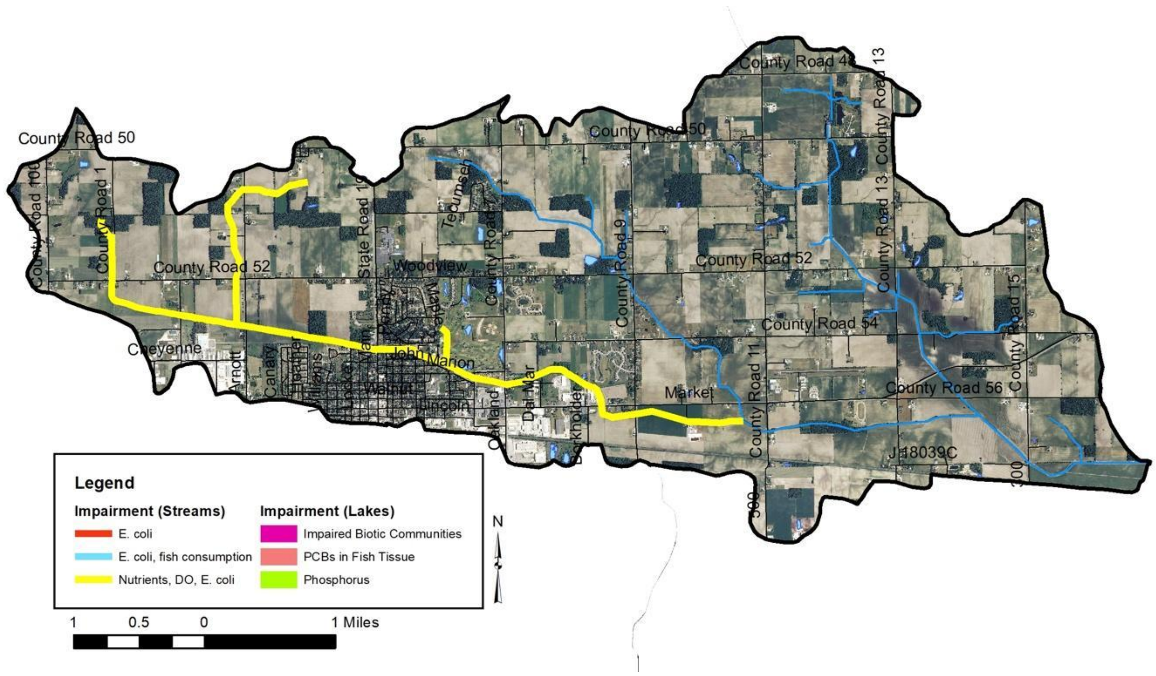

Figure 46. Impairments in the Berlin Court Ditch Subwatershed.

4.6.1 Soils

Hydric soils cover 1,191.8 acres or 10% of the subwatershed; wetlands currently cover 1.4% (168.1 acres) of the subwatershed. Highly erodible soils are prevalent throughout the subwatershed covering 4,147.4 acres or 34.9% of the subwatershed. Nearly all of the subwatershed,% (11,797.9 acres), has soils which are very limited for septic use.

4.6.2 Land Use

Agricultural land use covers nearly three quarters of the Berlin Court Ditch subwatershed at 74% (8,824.3 acres) with row crops and pastureland accounting for the majority of agricultural land uses. Urban land use including portions of Nappanee is the next largest use of the subwatershed, but only accounts for 19% (2,285 acres) of land use. Forest land covers 5.2% (621.4 acres) of the subwatershed. Wetlands, open water and grassland cover just 168.1 acres, or 1.4%, of the subwatershed.

4.6.3 Point Source Water Quality Issues

There are multiple potential point sources of water pollution in the subwatershed (Figure 47). There are 32 underground storage tank listed in this watershed. One NPDES-permitted location is located in the Berlin Court Ditch subwatershed, the City of Nappanee wastewater treatment plan, as is the designated Nappanee MS4, which covers 1,558 acres. There are no superfund sites, corrective action sites or voluntary remediation sites located within the Berlin Court Ditch subwatershed.

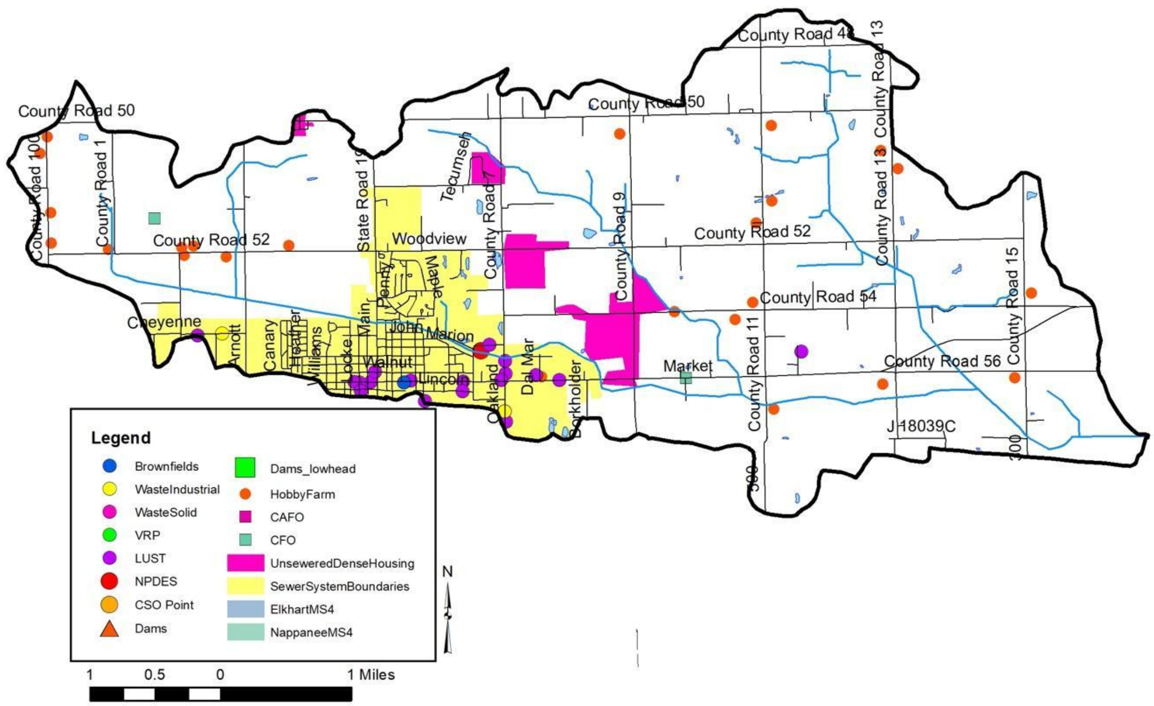

Figure 47. Potential point and non-point sources of pollution in the Berlin Court Ditch Subwatershed.

4.6.4 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Berlin Court Ditch subwatershed. As a result, various small animal operations and pastures are also present. Twenty-four unregulated animal operations housing more than 208 cows, horses, goat and donkeys were identified during the windshield survey. Livestock do not have access to Berlin Court Ditch subwatershed streams based on observations during the windshield survey. Two active CFOs are located in the subwatershed housing 83,000 chickens and 800 dairy cattle. In total, manure from these animal operations total over 35,111 tons per year, which contains almost 21,935,710 pounds of nitrogen, 1,773,193 pounds of phosphorus and 1.74E+19 col of *E. coli*. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 1.3 miles (6%) of insufficient stream buffers and 0.4 miles (1.7%) of streambank erosion were identified within the subwatershed.

4.6.5 Water Quality Assessment

Waterbodies within the Berlin Court Ditch subwatershed have been sampled historically at four locations (Figure 48). Two sites in the subwatershed are being sampled as part of the current project. Collection of water chemistry and biological data has been conducted by IDEM (3 sites), USGS (1 site), Greater Elkhart River Stormwater (2 sites), and City of Elkhart (2 sites). No stream gages are in the Berlin Court Ditch subwatershed.

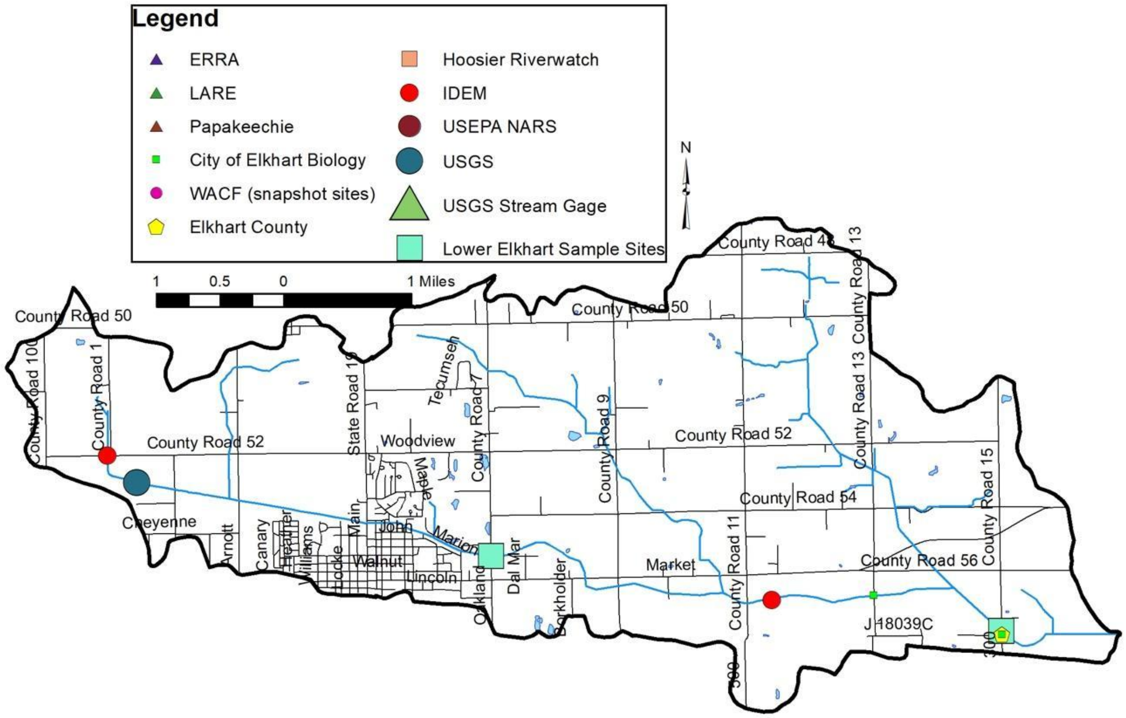

Figure 48. Locations of historic and current water quality data collection in the Berlin Court Ditch subwatershed.

Table 29 details historic water quality sampled collected in the Berlin Court Ditch subwatershed. As shown in the table, *E. coli* samples exceed state grab sample standards (235 col/100 ml) in 80% of samples collected. Total Kjeldahl nitrogen (TKN) concentrations exceed water quality targets (0.50 mg/L) in 100% of samples. Turbidity levels exceed water quality targets (5.7 NTU) in 33% of samples. Additionally, dissolved oxygen concentrations exceeded the upper state standard (12 mg/L) in 71% of samples collected. Ammonia, pH and Total Suspended Solids (TSS) did not exceed in any samples collected. Conductivity, nitrate-nitrogen, orthophosphorus (OP), and total phosphorus (TP) were not sampled in Berlin Court Ditch subwatershed.

Table 29. Berlin Court Ditch subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.1	0	1	0%
DO	0.97	10	5	7	71%
E. coli	203.5	2,602	4	5	80%
pH	6.9	8.1	0	8	0%
TKN	1.3	1.3	1	1	100%
TSS	10	10	0	1	0%
Turbidity	0.0	39.5	2	6	33%

IDEM conducted biological assessments at two sites (Table 30). Habitat assessment and macroinvertebrate assessment were conducted simultaneously at one site. Habitat scores ranged from 38 to 47 with 100% of sites scoring below the state target (51). Macroinvertebrate assessments using the kick sampling method resulted in all sites meeting their aquatic life use designation.

Table 30. Berlin Court Ditch subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
QHEI	38	47	2	2	100%
IBI	--	--	--	--	--
mIBI kick	2.4	2.4	0	1	0%
mIBI mulit	--	--	--	--	--

4.7 Omar-Neff Ditch-Turkey Creek subwatershed

The Omar-Neff Ditch-Turkey Creek subwatershed forms a southwestern edge of the Lower Elkhart River Watershed and lies within Kosciusko County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011707. This subwatershed drains 11,982 acres and accounts for 6% of the total watershed area. There are 25.1 miles of stream. IDEM has classified 18.5 miles of stream length in the Omar-Neff Ditch-Turkey Creek subwatershed as impaired for *E. coli* (Figure 49).

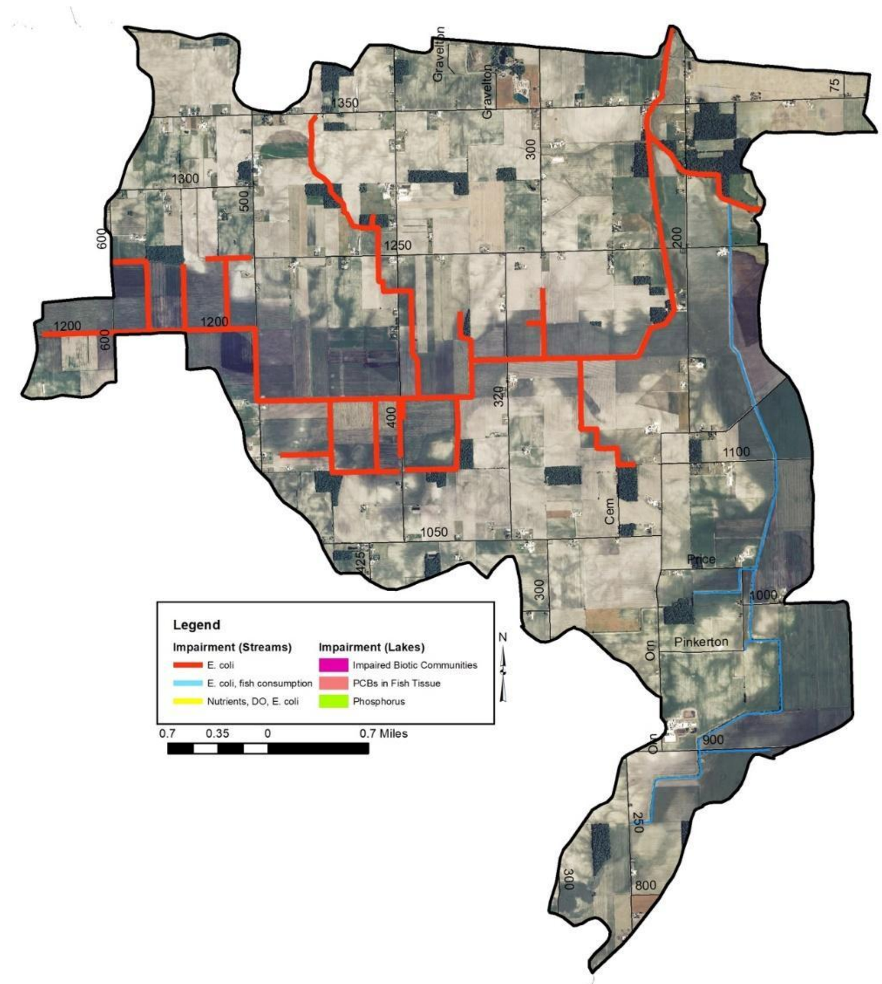

Figure 49. Impairments in the Omar-Neff Ditch-Turkey Creek subwatershed.

4.7.1 Soils

Hydric soils cover over half (52%, or 6,276.4) of the subwatershed. Highly erodible soils cover just 7.5%, or 902.7 acres, of the subwatershed. In total, 11,932.3 acres (99.6%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.7.2 Land Use

Agricultural land use is the prevalent land use in the Omar Neff Ditch-Turkey Creek subwatershed, with 91.8% (11,002.5 acres) of land used for agriculture. Forest land use covers 2.4% of land in the subwatershed, or 286.3 acres. Wetlands, open water and grass land covers only 1.6% (192.0 acres) of land in the subwatershed. Urban land covers the remaining 4.2% (501.8 acres) of land in the subwatershed.

4.7.3 Point Source Water Quality Issues

There are no potential point sources of water pollution in the Omar Neff Ditch-Turkey Creek subwatershed.

4.7.4 Non-Point Source Water Quality Issues

Agricultural land use is the predominant land use in the Omar Neff Ditch-Turkey Creek subwatershed. Sixteen unregulated animal operations housing more than 592 cows and horses were identified during the windshield survey. Livestock do not appear to have access to streams in the subwatershed based on windshield surveys. There are seven active CFOs housing 10 beef cattle, 5 horses, and 22,683 pigs in the subwatershed. In total, manure from all animal operations total over 105,865 tons per year, which contains almost 284,788 pounds of nitrogen, 213,647 pounds of phosphorus and 5.18E+16 colonies of *E. coli*. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 0.2 miles (1%) of insufficient stream buffers and 0.4 miles (1.6%) of streambank erosion were identified within the subwatershed.

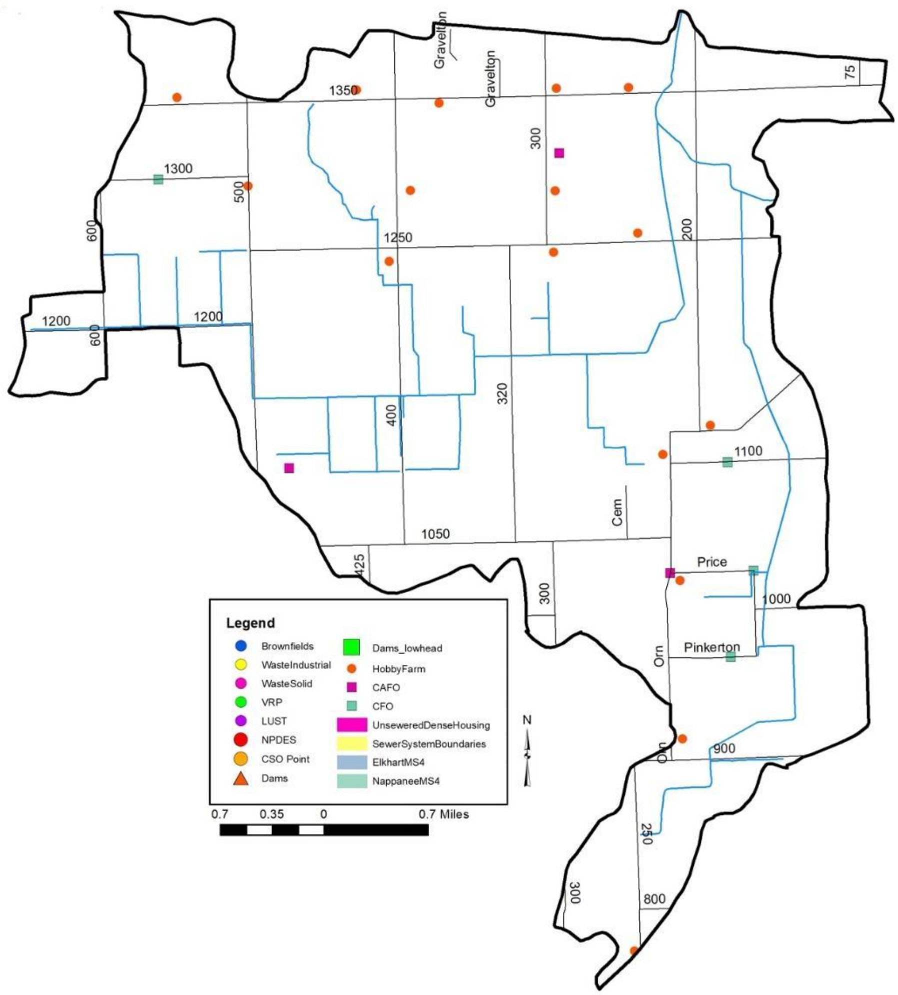

Figure 50. Potential non-point sources of pollution in the Omar Neff Ditch-Turkey Creek subwatershed.

4.7.5 Water Quality Assessment

Waterbodies within the Omar Neff Ditch-Turkey Creek subwatershed have been sampled historically at seven locations. Three sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (4 sites), USGS (1 site), HRW (1 site), Goshen (1 site), Elkhart CoWQ (1 site).

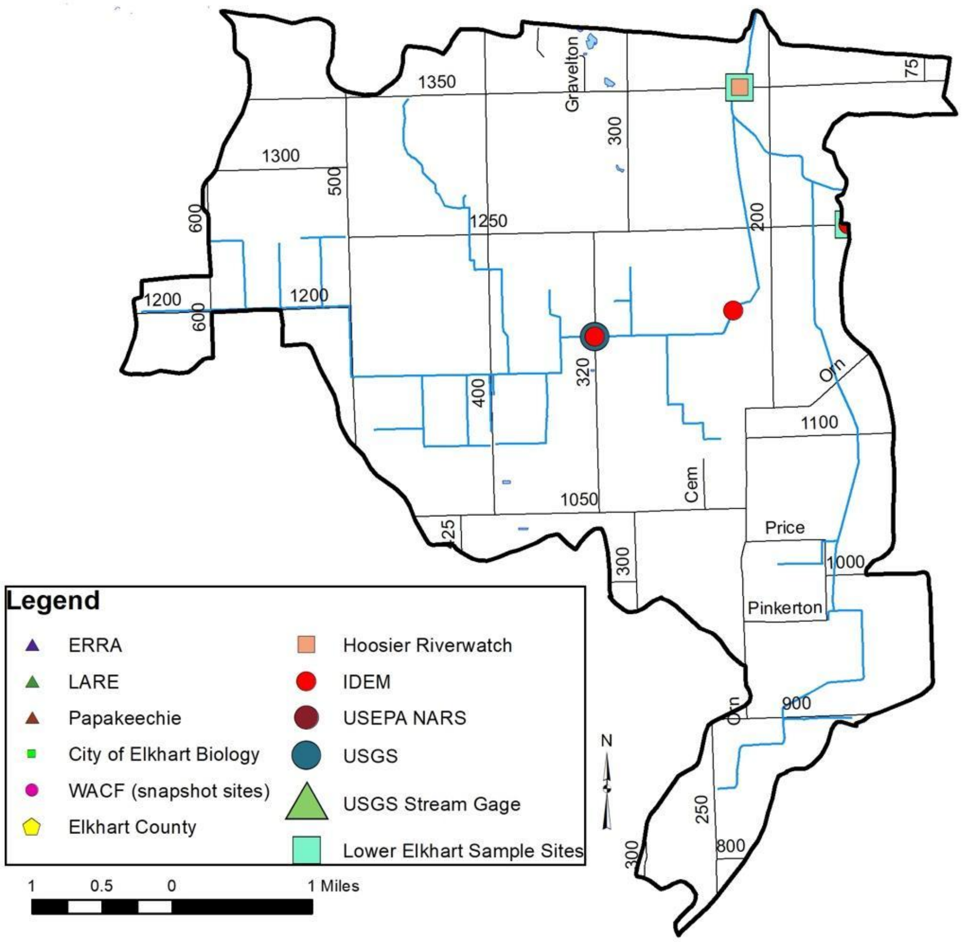

Figure 51. Locations of historic and current water quality data collection in the Omar Neff Ditch-Turkey Creek subwatershed.

Table 31 details historic water chemistry data collected in the Omar Neff Ditch-Turkey Creek subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 50% of samples collected. Conductivity concentrations exceed water quality targets (1050 mg/L) in 8% of samples collected. DO concentrations exceed water quality targets in 30% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 69% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 99% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 63% of samples. pH levels exceed water quality targets in 4% of samples collected. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 100% of samples. TSS levels exceed water quality targets (15 mg/L) in 24% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 50% of samples. OP was not sampled in the Omar Neff Ditch-Turkey Creek subwatershed.

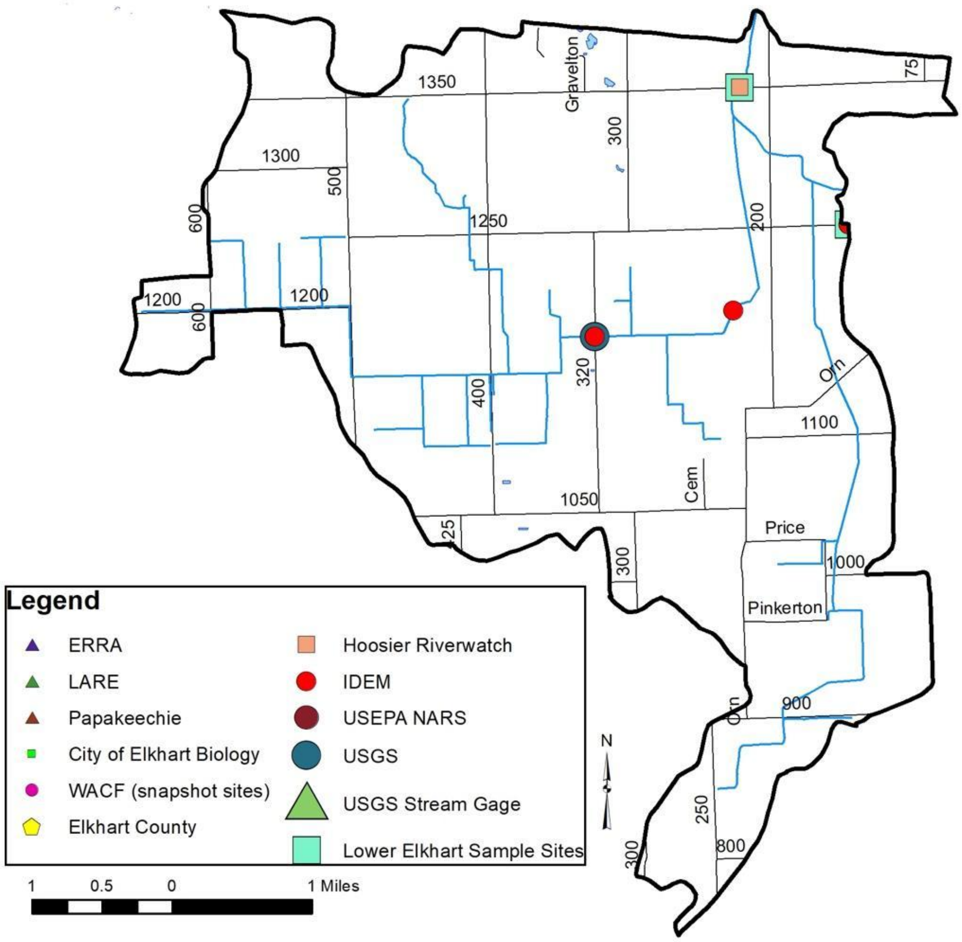

Figure 51. Locations of historic and current water quality data collection in the Omar Neff Ditch-Turkey Creek subwatershed.

Table 31. Omar Neff Ditch-Turkey Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.28	3	6	50%
Conductivity	124.0	1,344.0	6	79	8%
DO	0.33	12.0	29	97	30%
E. coli	46.0	120,980.0	56	81	69%
Nitrate	0.034	17.9	80	81	99%
pH	6.1	13.4	4	95	4%
TKN	0.5	2.5	5	8	63%
TP	0.214	5.51	76	76	100%
TSS	0.88	2,536.0	19	78	24%
Turbidity	0.0	141.0	9	18	50%

Biological monitoring was conducted by the City of Elkhart at six sites with three sites assessed for fish and one site assessed for macroinvertebrates (Table 32). Habitat assessment occurred a total of five times and resulted in scores ranging from 31 to 63. 40% of sites did not reach state target of 51 for habitat assessment. Fish community assessments scores ranged from 12 to 42, with 50% of sites not reaching the target of 36. The macroinvertebrate assessment covering multiple habitats did not measure to the state target of 2.2.

Table 32. Omar Neff Ditch-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	31	63	2	5	40%
Fish (IBI)	12	42	1	2	50%
Macroinvertebrates (mIBI, Kick)	--	--	--	--	--
Macroinvertebrates (mIBI, Multi Habitat)	28	28	1	1	100%

4.8 Dausman Ditch-Turkey Creek subwatershed

The Dausman Ditch-Turkey Creek subwatershed lies in the middle of the Turkey Creek drainage forming as small portion of the western border of the Lower Elkhart River Watershed. The Dausman Ditch-Turkey Cree ksubwatershed lies within Kosciusko and Elkhart Counties (Figure 30). This subwatershed drains 19,014 and accounts for 8% of the total watershed. It encompasses one 12-digit HUC watershed: 040500011708. There are 44.2 miles of stream. IDEM has identified 35.3 miles of stream length as impaired for *E. coli* (Figure 52).

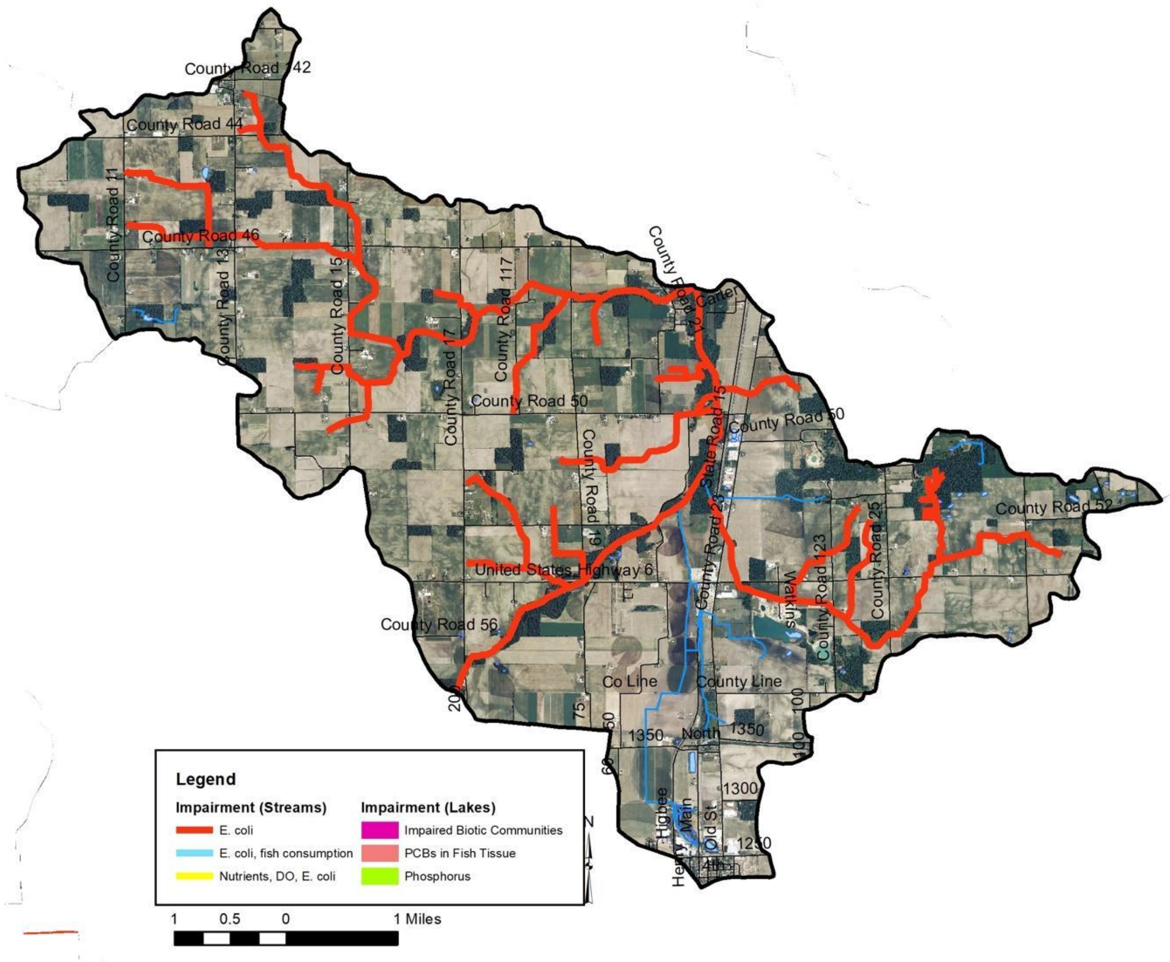

Figure 52. Impairments in Dausman Ditch-Turkey Creek subwatershed.

4.8.1 Soils

Hydric soils cover 2,074.4 acres (10.9%) of the subwatershed. Highly erodible soils cover 31.5% of the subwatershed (5,983.8 acres). A majority of the entire subwatershed, 18,783.0 acres (98.8%) are identified as very limited for septic use.

4.8.2 Land Use

Agricultural land use is the prevalent land use in the Dausman Ditch-Turkey Creek subwatershed with 82.4% (15,663.7 acres) in agricultural land uses. Approximately 8% (1,534.6 acres) of the subwatershed is in urban land use including portions of the Town of Milford and much of the State Road 15 corridor south of US. Highway 6. Forested land use cover 5%, or 952.9 acres, of the subwatershed. Wetland, open water and grass land use accounts for 4.5% (863.4 acres) of the subwatershed.

4.8.3 Point Source Water Quality Issues

There are ten potential sources of water pollution in the Dausman Ditch-Turkey Creek subwatershed (Figure 53). Three leaking underground storage tanks, one brownfield and two industrial waste sites are located within the subwatershed. Four underground storage tanks not classified as leaking are also in the subwatershed. The Elkhart MS4 covers a small portion of this subwatershed (5.6 acres).

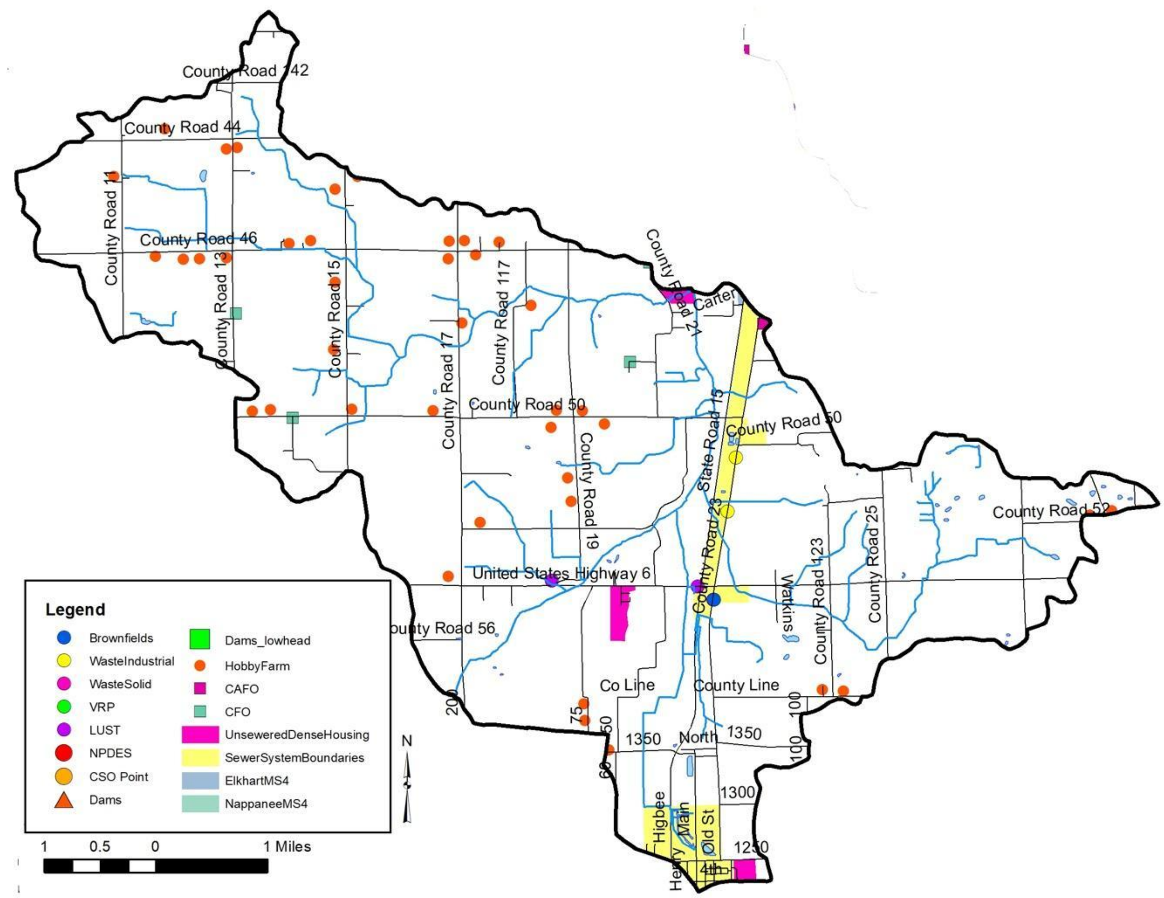

Figure 53. Potential point and non-point sources of pollution in the Dausman Ditch-Turkey Creek subwatershed.

4.8.4 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Dausman Ditch-Turkey Creek subwatershed. Additionally, nearly 40 unregulated animal operations housing more than 1,242 cows, horses and sheep were identified during the windshield survey. Based on windshield survey observations, livestock do not have access to subwatershed streams. There are four active CFOs in the Dausman Ditch-Turkey Creek subwatershed housing 8,790 pigs and 100 dairy cattle. In total, manure from these animal operations total over 64,799 tons per year, which contains almost 122,418 pounds of nitrogen, 88,773 pounds of phosphorus and 2.09E+16 colonies of *E. coli*. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 0.7 miles (1.5%) of insufficient stream buffers and 2.6 miles (6%) of streambank erosion were identified within the subwatershed.

4.8.5 Water Quality Assessment

Waterbodies within Dausman Ditch-Turkey Creek subwatershed have been sampled at 18 locations. Five sites are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (7 sites), Greater Elkhart Stormwater Partnership (6 sites), City of Elkhart (2 sites), Hoosier Riverwatch (4 sites), Goshen (6 sites), and USGS (1 site). No stream gages are in the Dausman Ditch-Turkey Creek subwatershed.

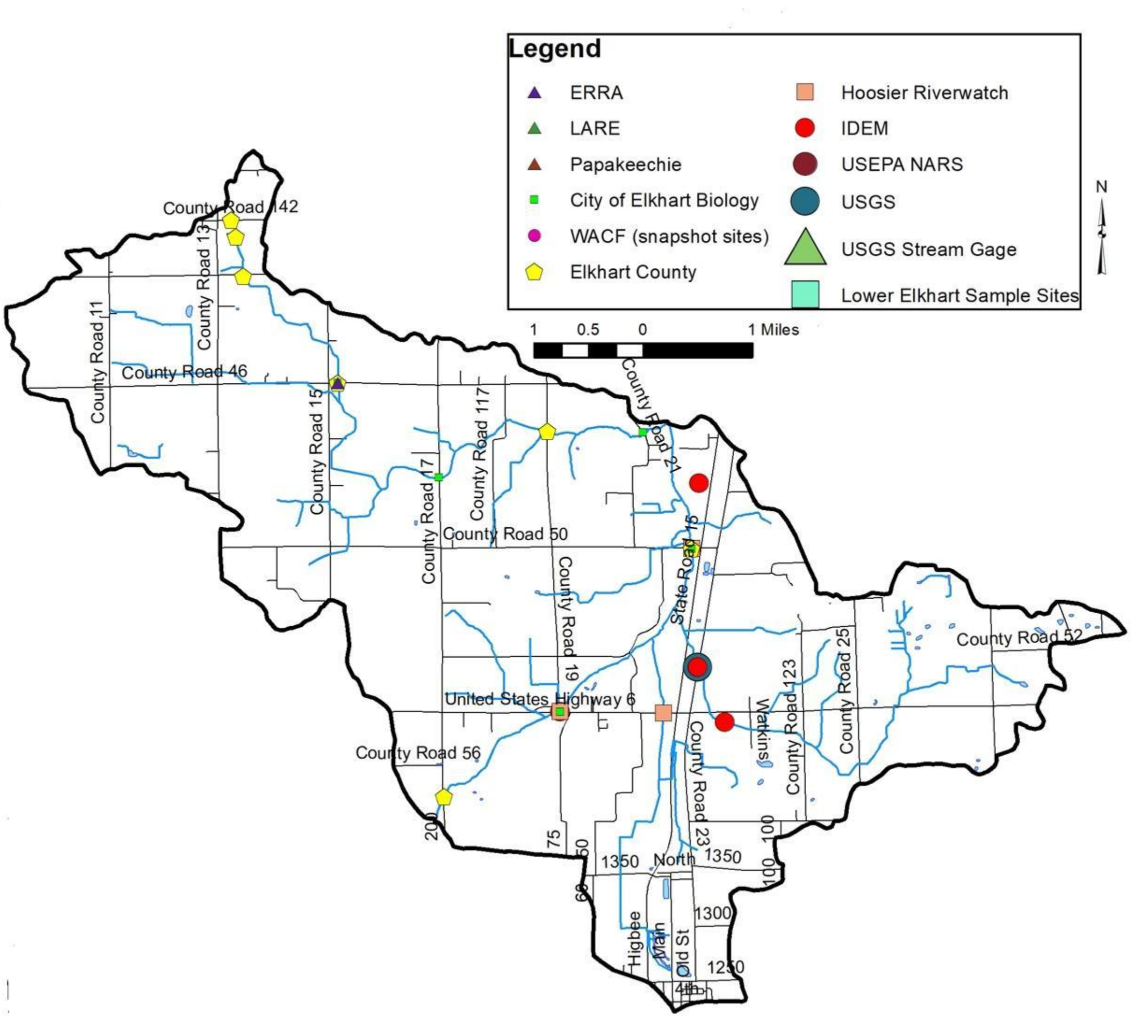

Figure 54. Locations of historic and current water quality data in Dausman Ditch-Turkey Creek subwatershed.

Table 33 details historic water chemistry data. Ammonia concentrations did not exceed water quality targets in any samples collected. Conductivity concentrations exceed water quality targets (1050 mg/L) in 16% of samples collected. DO concentrations exceed water quality targets in 24% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 83% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 83% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 67% of samples. pH exceeded target samples in 3% of samples collected. Orthophosphorus concentrations exceed water quality targets (0.03 mg/L) in 80% of samples collected. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 99% of samples. TSS levels exceed water quality targets (15 mg/L) in 39% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 100% of samples.

Table 33. Dausman Ditch-Turkey Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.10	0.10	0	3	0%
Conductivity	9	3102	83	520	16%
DO	0.01	14.0	133	544	24%
E. coli	4.0	3,465,800.0	422	510	83%
Nitrate	0.0	26.3	431	521	83%
OP	0.0	1.5	4	5	80%
pH	5.3	12.5	16	533	3%
TKN	0.5	0.86	2	3	67%
TP	0.027	14.4	527	535	99%
TSS	1.0	10,690.0	172	439	39%
Turbidity	0.0	425.0	12	21	57%

Biological monitoring was conducted by the City of Elkhart and IDEM at 12 sites in total (Table 34). Fish community assessments occurred at four sites and macroinvertebrate assessments occurred at three sites in total. Habitat scores ranged from 38 to 72, with 15% of sites scoring below the state target (51). Fish community assessments scored below the target level in 25% (1 of 4) of sites assessed. Macroinvertebrate assessments using the kick sampling method and macroinvertebrate multihabitat samples did not meet their aquatic life use designation, with both assessments not reaching target values.

Table 34. Dausman Ditch-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
QHEI	38	72	2	13	15%
IBI	14	46	1	4	25%
mIBI kick	1.6	1.6	1	1	100%
mIBI mulit	24	32	2	2	100%

4.9 Swoveland Ditch-Turkey Creek subwatershed

The Swoveland Ditch-Turkey Creek subwatershed forms a central portion of the Lower Elkhart River Watershed and lies between Elkhart and Kosciusko counties (Figure 30). It encompasses one 12-digit HUC watershed: 040500011709. This subwatershed drains 11,748 acres and accounts for 6% of the total watershed area. There are 35.2 miles of stream. IDEM has classified 10.9 miles of stream as impaired for *E. coli* (Figure 55).

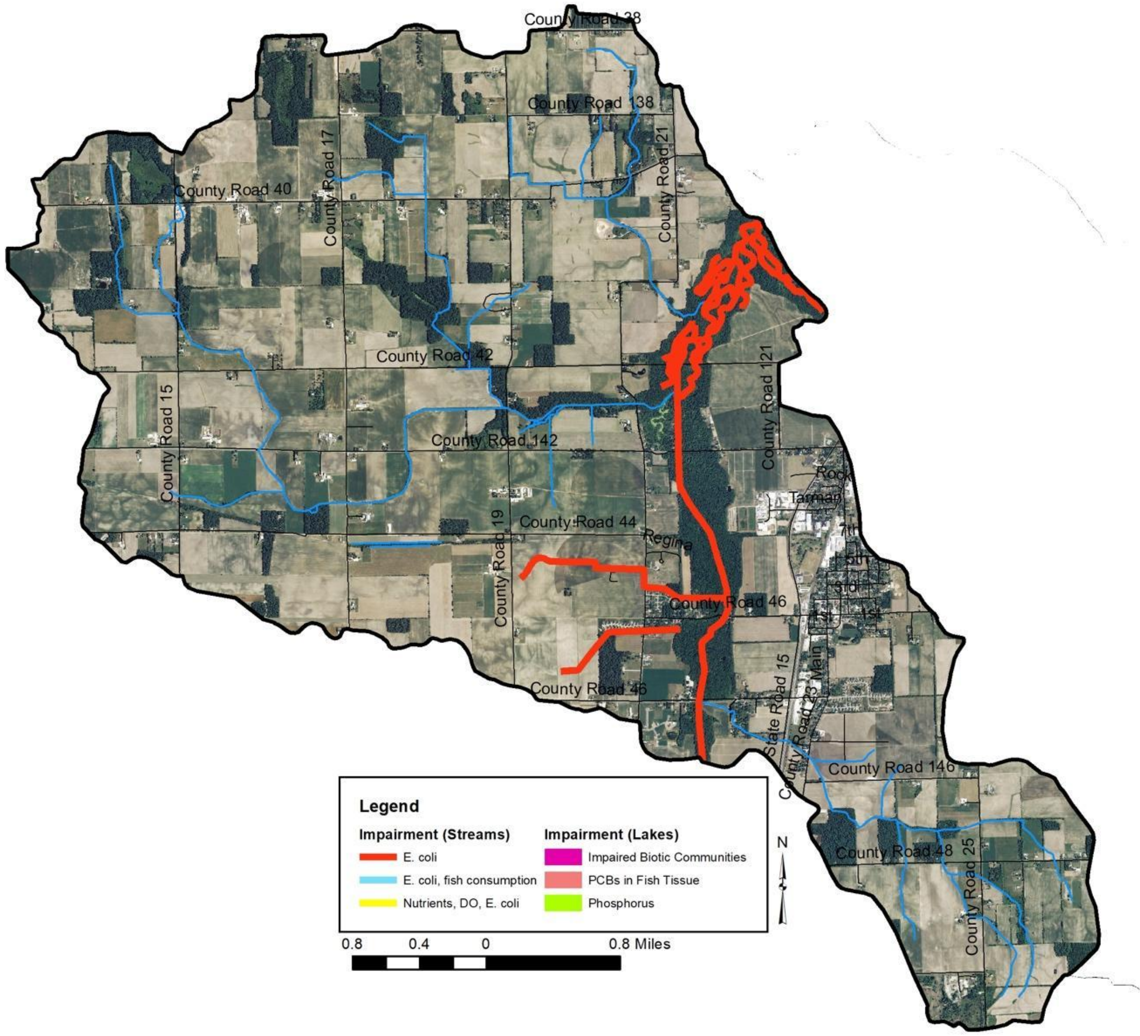

Figure 55. Impairments in the Swoveland Ditch-Turkey Creek subwatershed.

4.9.1 Soils

Hydric soils cover 1,686.9 acres (14%) of the subwatershed. Highly erodible soils cover 41% of the subwatershed, or 4,813.6 acres. In total, almost all of the subwatershed (99%, or 11,600.0 acres) is identified as very limited for septic use. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity.

4.9.2 Land Use

Agricultural land use is the majority land use in the Swoveland Ditch-Turkey Creek subwatershed covering 76.9% (9,032.5 acres) of land in the subwatershed. Urban land use covers 9.3% (1,087.8 acres) of the subwatershed. Forest land use makes up 4.9% or 576.2 acres of this subwatershed. Wetlands, open water, and grassland cover 1,052.0 acres, or 9%, of the subwatershed.

4.9.3 Point Source Water Quality Issues

There are multiple potential sources of water quality issues in the Swoveland Ditch-Turkey Creek subwatershed. There are four leaking underground storage tanks, two brownfields and one industrial waste sites in the subwatershed. Additionally, ten underground storage tanks identified as not leaking are in the subwatershed. The Elkhart MS4 is also located within this subwatershed covering 1,248 acres.

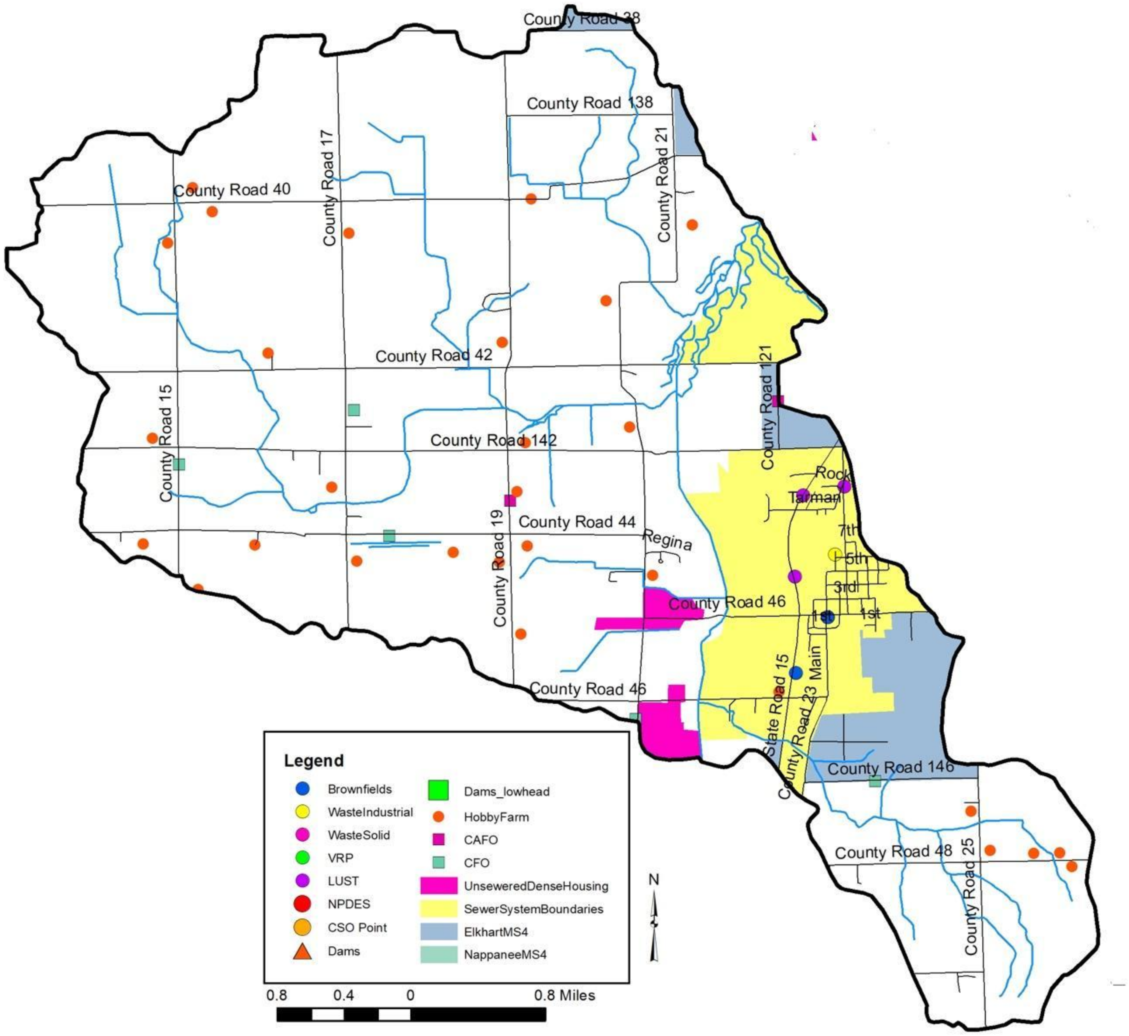

Figure 56. Potential point and non-point sources of pollution in the Swoveland Ditch-Turkey Creek subwatershed.

4.9.4 Non-Point Source Water Quality Issues

Agricultural land use is the predominant land use in the Swoveland Ditch-Turkey Creek subwatershed. Additionally, a number of small animal operations and confined feeding operations are also present. Nearly 30 unregulated animal operations housing more than 541 cows, horses, goats, and pigs were identified during the windshield survey. Four active confined feeding operations housing 6 beef cattle, 27,000 chickens, 10,632 pigs, and 400 veal calves are located within the Swoveland Ditch-Turkey Creek subwatershed. Manure from animal operations total over 98,925 tons per year, which contains almost 7,242,561 pounds of nitrogen, 5,856,572 pounds of phosphorus and 5.65E+19 colonies of *E. coli*. Livestock appear to have access to 0.4 miles (1.1%) the subwatershed streams based on windshield survey observations. Streambank erosion is a concern in the subwatershed. Approximately 0.6 miles (1.7%) of streambank erosion were identified within the subwatershed.

4.9.5 Water Quality Assessment

Waterbodies within the Swoveland Ditch-Turkey Creek subwatershed have been sampled historically at seven locations (Figure 57). Two sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (3 sites), Goshen (3 sites), Elkhart WMP (1 site), Greater Elkhart River Stormwater (4 sites), and City of Elkhart (1 site). No stream gages are in the Swoveland Ditch-Turkey Creek subwatershed.

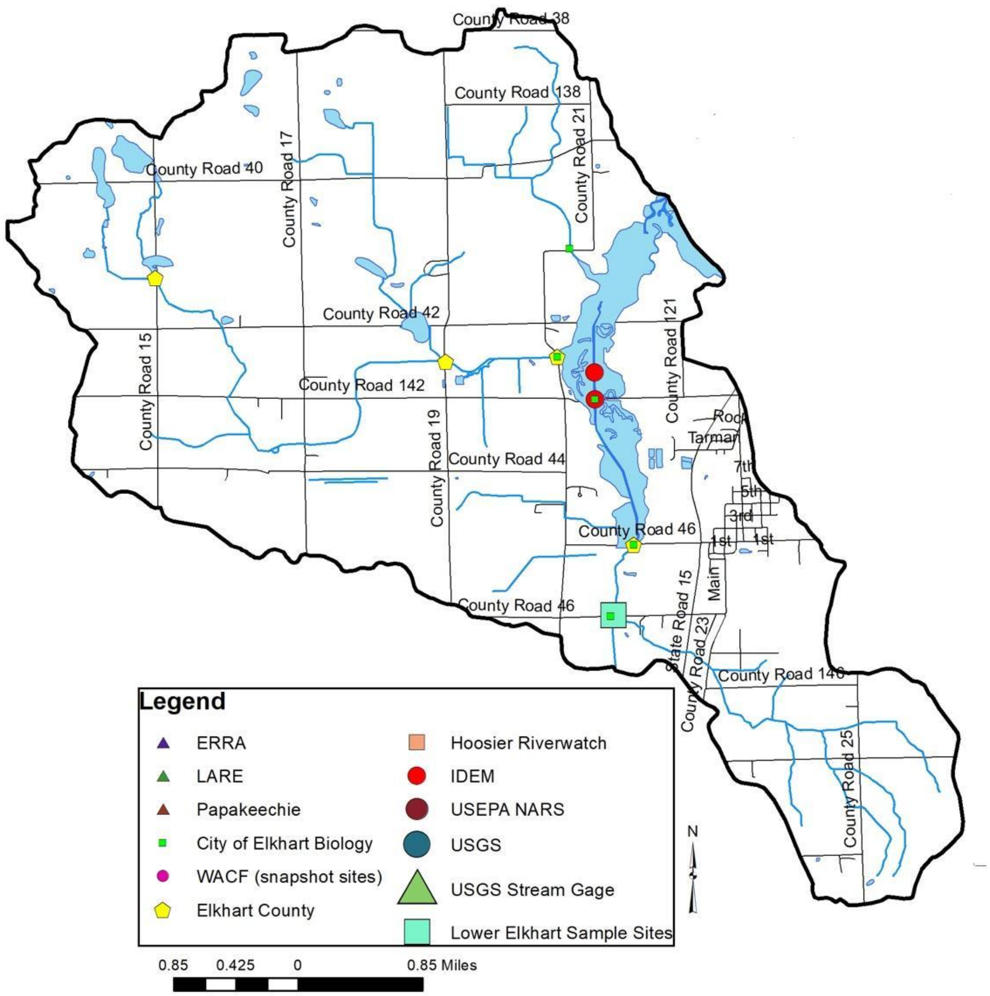

Figure 57. Locations of historic and current water quality data collection in Swoveland Ditch-Turkey Creek subwatershed.

Table 35 details historic water chemistry data collected in the Swoveland Ditch-Turkey Creek subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 100% of samples collected. Conductivity concentrations exceed water quality targets (1050 mg/L) in 5% of samples collected. DO concentrations exceed water quality targets in 36% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 74% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 83% of samples, while total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 80% of samples. pH levels exceed water quality targets in 1% of samples collected. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 34% of samples. TSS levels exceed water quality targets (15 mg/L) in 26%

of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 42% of samples. OP was not sampled in Swoveland Ditch-Turkey Creek subwatershed.

Table 35. Swoveland Ditch-Turkey Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.29	0.29	1	1	100%
Conductivity	6	2,090.0	11	212	5%
DO	0.40	17.0	80	223	36%
E. coli	8.0	120,980	154	208	74%
Nitrate	0.07	24.4	177	214	83%
pH	4.9	9.2	2	219	1%
TKN	0.39	2.9	4	5	80%
TP	0.046	9.31	76	222	34%
TSS	0.73	460.0	49	191	26%
Turbidity	0.0	135.0	5	12	42%

Biological monitoring was conducted by the City of Elkhart at one site. Habitat assessment occurred once and resulted in a score of 34, not reaching the state target of 51 (Table 36).

Table 36. Swoveland Ditch-Turkey Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	34	34	1	1	100%
Fish (IBI)	--	--	--	--	--
Macroinvertebrates (mIBI, Kick)	--	--	--	--	--
Macroinvertebrates (mIBI, Multi Habitat)	--	--	--	--	--

4.10 Hoover Ditch-Rock Run Creek subwatershed

The Hoover Ditch-Rock Run Creek subwatershed forms the northeastern corner of the Lower Elkhart River Watershed and lies entirely in Elkhart County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011901. It drains 13,673 acres and accounts for 7% of the total watershed area. There are 35.8 miles of stream. IDEM has classified 18.5 miles of stream as impaired for *E. coli* (Figure 58).

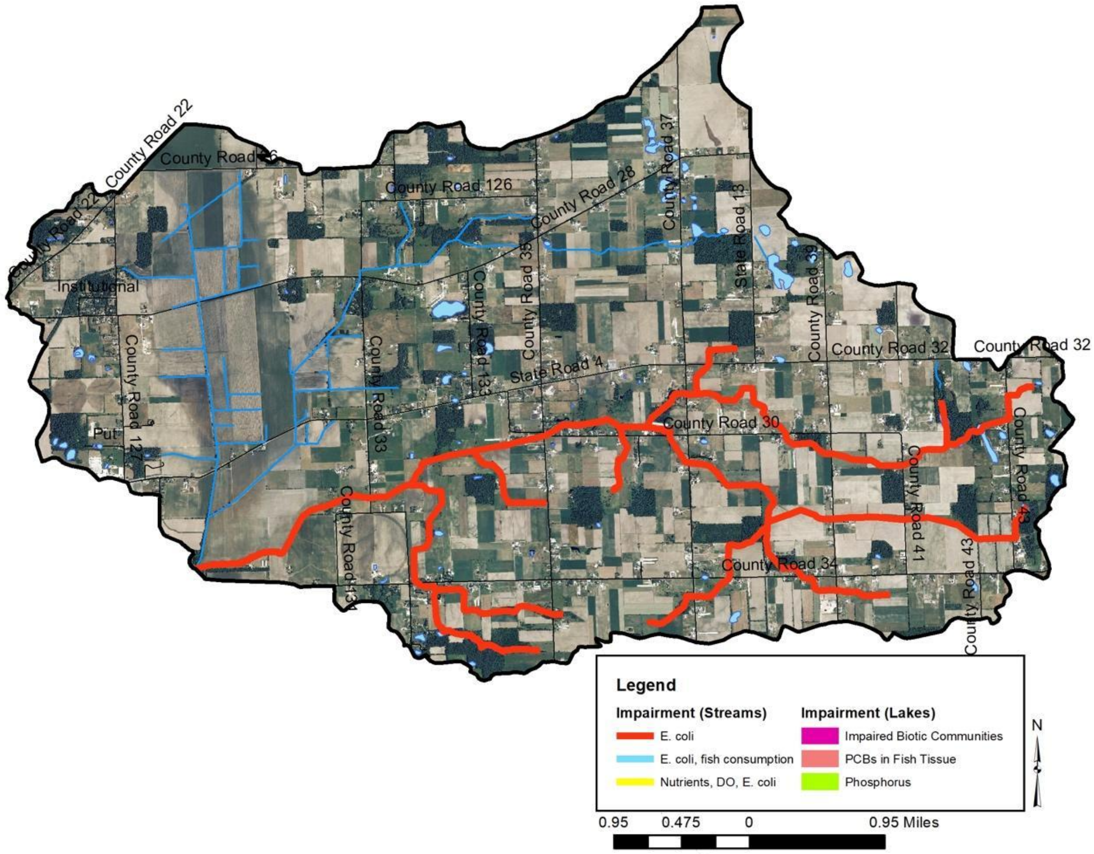

Figure 58. Impairments in the Hoover Ditch-Rock Run Creek subwatershed.

4.10.1 Soils

Hydric soils cover 1,506.8 acres (11%) of the subwatershed. Highly erodible soils cover 5,262.5 acres (38.5%) of the subwatershed. In total, almost all the subwatershed (99.9%, or 13,657.4 acres) is identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.10.2 Land Use

Agricultural land use covers a majority of the Hoover Ditch-Rock Run Creek subwatershed with 82.8% (11,327.3 acres) in agricultural land usage. Urban land use accounts for 7% (963.9 acres) of the subwatershed. Additionally, forest land use covers 5% (689.0 acres) and wetlands, open water and grassland cover 5.1% (693.5 acres) of the subwatershed.

4.10.3 Point Source Water Quality Issues

There are very few potential point sources of water pollution in the Hoover Ditch-Rock Run Creek subwatershed (Figure 59. Potential point and non-point sources of pollution in the Hoover Ditch-Rock Run Creek subwatershed.). There is one underground storage tank not identified as leaking in the subwatershed.

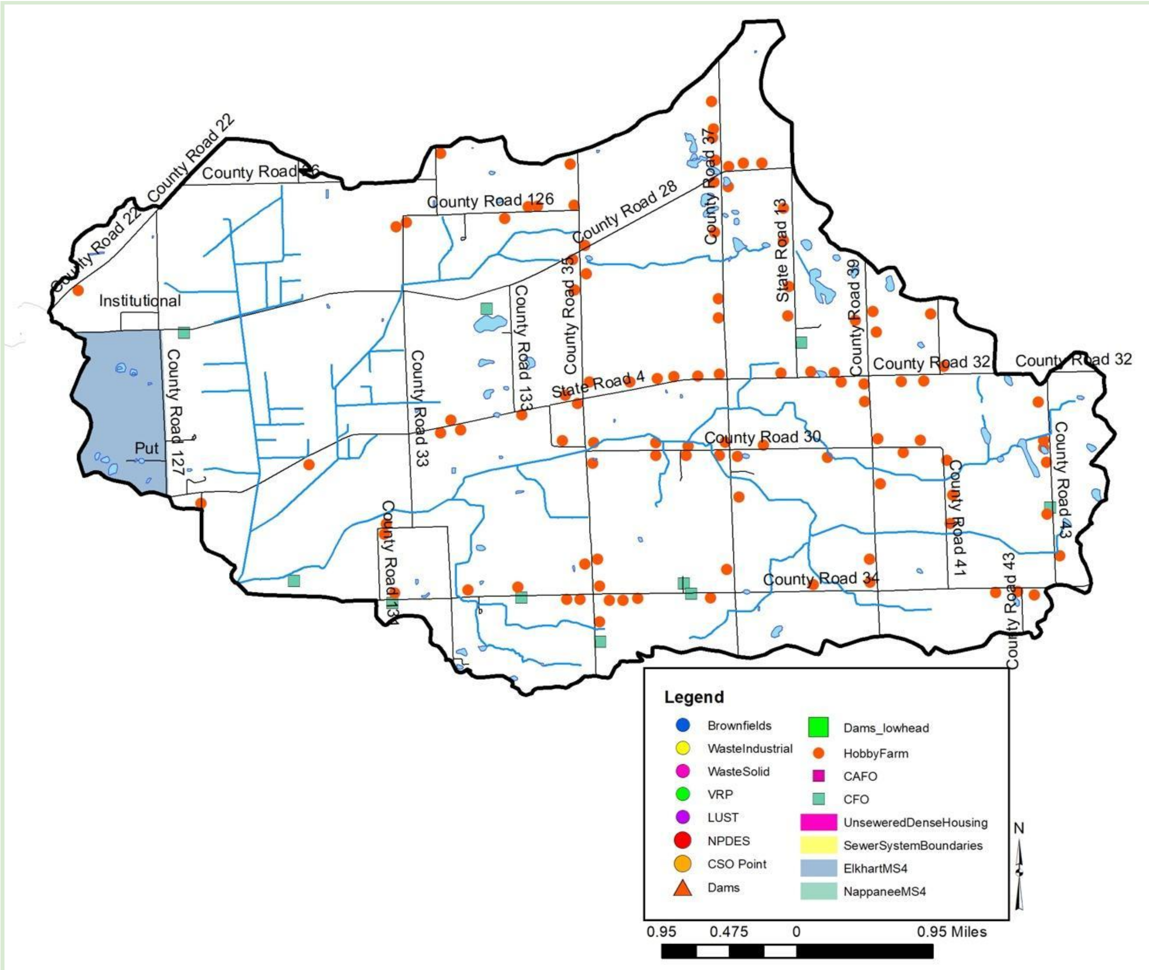

Figure 59. Potential point and non-point sources of pollution in the Hoover Ditch-Rock Run Creek subwatershed.

4.10.4 Non-Point Source Water Quality Issues

Agricultural land use is the predominant land use in the Hoover Ditch-Rock Run Creek subwatershed. During the windshield survey, more than 100 unregulated animal operations housing more than 331 cows, horses, goats and sheep were identified. Livestock have access to 1.1 miles (3.1%) of subwatershed streams. There are ten active CFOs within the Hoover Ditch Rock Run Creek subwatershed housing 220 beef cattle, 248,800 chickens, 177 dairy cattle, 73 horses, and 6,812 pigs. In total, manure from all animal operations total over 87,673 tons per year, which contains almost 6,641,034 pounds of nitrogen, 5,370,062 pounds of phosphorus and 5.21E+19 colonies of *E. coli*. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 0.2 miles (0.7%) of insufficient stream buffers and 0.3 miles (0.9%) of streambank erosion were identified within the subwatershed.

4.10.5 Water Quality Assessment

Waterbodies within the Hoover Ditch-Rock Run Creek subwatershed have been sampled historically at five locations. Historic assessments include collection of water chemistry and biology data by IDEM (4 sites), USGS (1 site), and Greater Elkhart River Stormwater (1 site). No stream gages are in the Hoover Ditch-Rock Run Creek subwatershed.

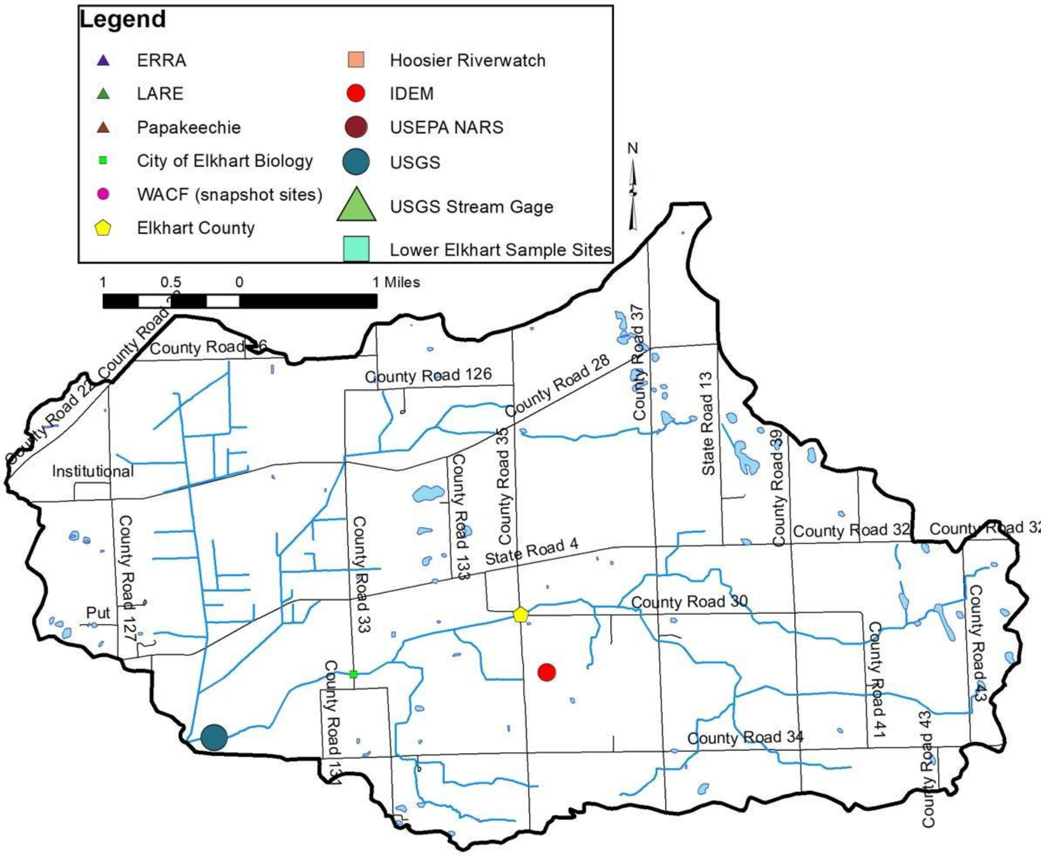

Figure 60. Locations of historic and current water quality data collection in the Hoover Ditch-Rock Run Creek subwatershed.

Table 37 details historic water chemistry data collected in the Hoover Ditch-Rock Run Creek subwatershed. As shown in the table, ammonia and pH concentrations did not exceed water quality targets in any samples collected. DO concentrations exceed water quality targets in 18% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 100% of samples collected. Total Kjeldahl nitrogen concentrations exceed water quality targets (0.5 mg/L) in 50% of samples. TSS levels exceed water quality targets (15 mg/L) in 50% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 9% of samples. Conductivity, nitrate-nitrogen, OP, and TP were not sampled in Hoover Ditch-Rock Run Creek subwatershed.

Table 37. Hoover Ditch-Rock Run Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.1	0	3	0%
DO	5.75	17.0	2	11	18%
E. coli	1,119.9	2,481.0	6	6	100%
pH	7.7	8.3	0	14	0%
TKN	0.5	1.7	2	4	50%
TSS	10.0	20.0	2	4	50%
Turbidity	0.0	9.5	1	11	9%

Biological monitoring was conducted by IDEM at three sites, with fish community assessments occurring at one site and macroinvertebrate assessments occurring at two sites in total (Table 38). Habitat scores assessed at two sites ranged from 48 to 69 with 25% of sites scoring below the state target (51). The fish community assessment scored above the target level. Macroinvertebrate assessments using the kick sampling method resulted in all sites meeting their aquatic life use designation, while 100% macroinvertebrate multihabitat samples did not meet their aquatic life use designation (Table 28).

Table 38. Hoover Ditch-Rock Run Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	48	69	1	4	25%
Fish (IBI)	42	42	0	1	0%
Macroinvertebrates (mIBI, Kick)	2.4	5	0	3	0%
Macroinvertebrates (mIBI, Multi Habitat)	28	28	1	1	100%

4.11 Horn Ditch-Rock Run Creek subwatershed

The Horn Ditch-Rock Run Creek subwatershed forms a northeastern corner of the Lower Elkhart River Watershed and sits in Elkhart County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011902. This subwatershed drains 14,153 acres and accounts for 7% of the total watershed area. There are 31.8 miles of stream. IDEM has identified 8.4 miles of stream length in the Horn Ditch-Rock Run Creek subwatershed as impaired for *E. coli* (Figure 61).

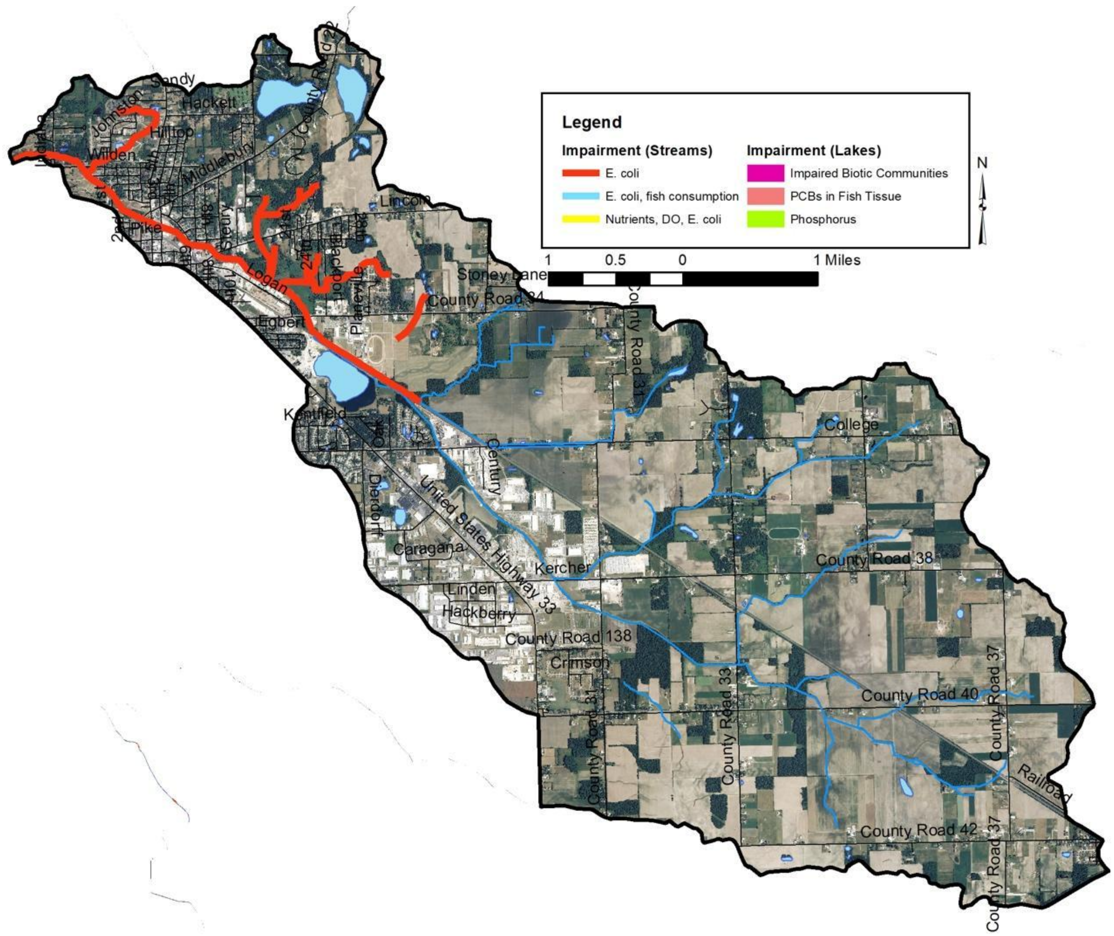

Figure 61. Impairments in the Horn Ditch-Rock Run Creek subwatershed.

4.11.1 Soils

Hydric soils cover 1,160.1 acres (8.2%) of the subwatershed. Highly erodible soils cover 37.3% (5,275.3 acres) of the subwatershed. In total, 13,879.2 acres (98.1%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.11.2 Land Use

Agricultural land use covers over half of the Horn Ditch-Rock Run Creek subwatershed with 57% (8,074.2 acres) in agricultural land use. An additional 31.8% (4,506.1 acres) of the subwatershed is in urban land use including portions of the City of Goshen. Wetlands, open water and grassland cover 950.5 acres, or 6.7%, of the subwatershed. Forested land use accounts for 4.4% of the subwatershed as well (622.8 acres).

4.11.3 Point Source Water Quality Issues

There are many potential point sources of water pollution in the Horn Ditch-Rock Run Creek subwatershed (Figure 62). There are 12 leaking underground storage tank sites, two brownfields, six industrial sites and ten solid waste sites in the subwatershed. Additionally, there are 49 underground storage tanks not identified as leaking in the subwatershed.

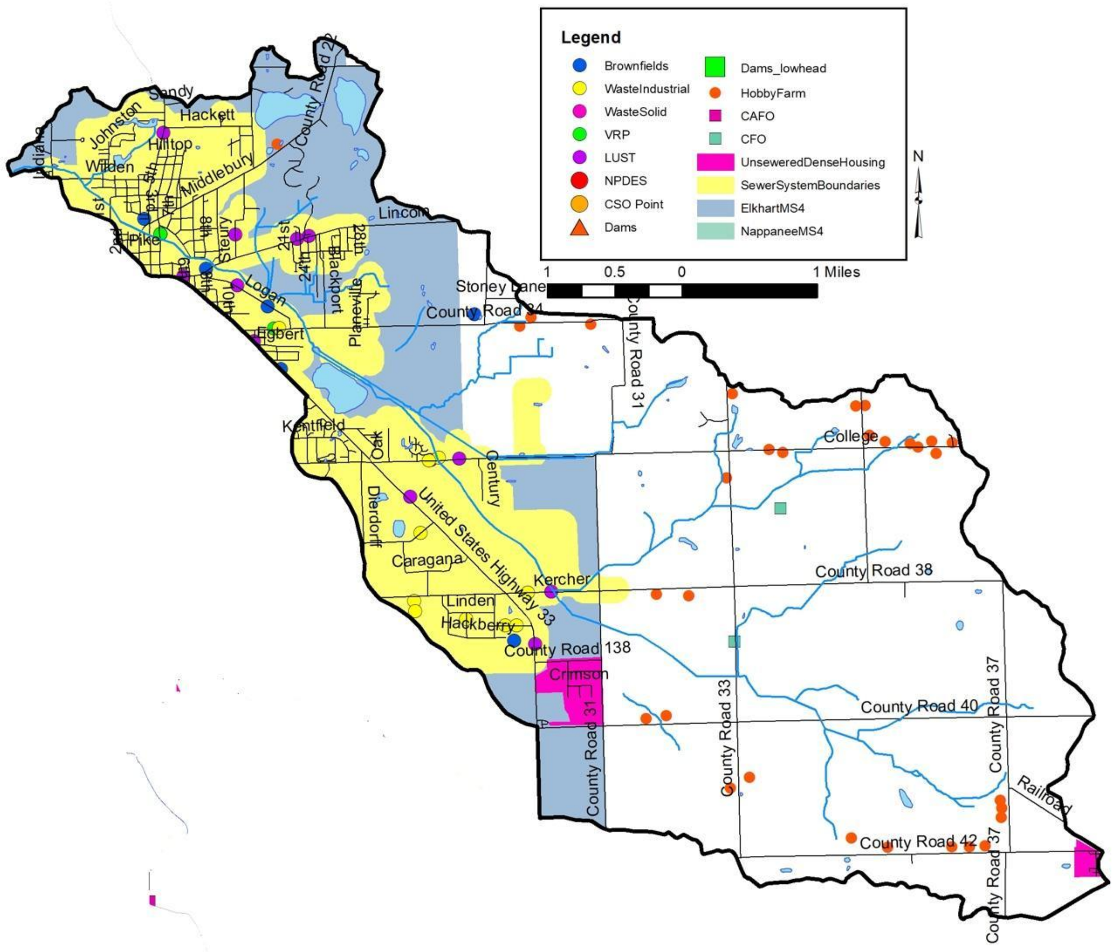

Figure 62. Potential point and non-point sources of pollution in the Horn Ditch-Rock Run Creek subwatershed.

4.11.4 Non-Point Source Water Quality Issues

Agricultural and urban land uses are the predominant land uses in the Horn Ditch-Rock Run Creek subwatershed. Additionally, a number of small animal operations and CFOs are also present. In total, 31 unregulated animal operation housing more than 331 cows, horses, goats and sheep were identified during the windshield survey. Two active CFOs housing 48,000 chickens and 1,200 pigs are located in the Horn Ditch-Run Creek subwatershed. In total, manure from all animal operations total over 19,583 tons per year, which contains almost 1,280,751 pounds of nitrogen, almost 1,035,350 pounds of phosphorus and 1.00E+19 colonies of *E. coli*. Livestock appear to have no access to the subwatershed streams based on windshield survey observations. Streambank erosion is a concern in the subwatershed. Approximately 1.2 miles (3.8%) of streambank erosion were identified within the subwatershed.

4.11.5 Water Quality Assessment

Waterbodies within the Horn Ditch-Rock Run Creek subwatershed have been sampled historically at seven locations. Three sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by Hoosier Riverwatch (4 sites), Goshen (3 sites), Greater Elkhart River Stormwater (4 sites), and City of Elkhart (5 sites). No stream gages are in the Horn Ditch-Rock Run Creek.

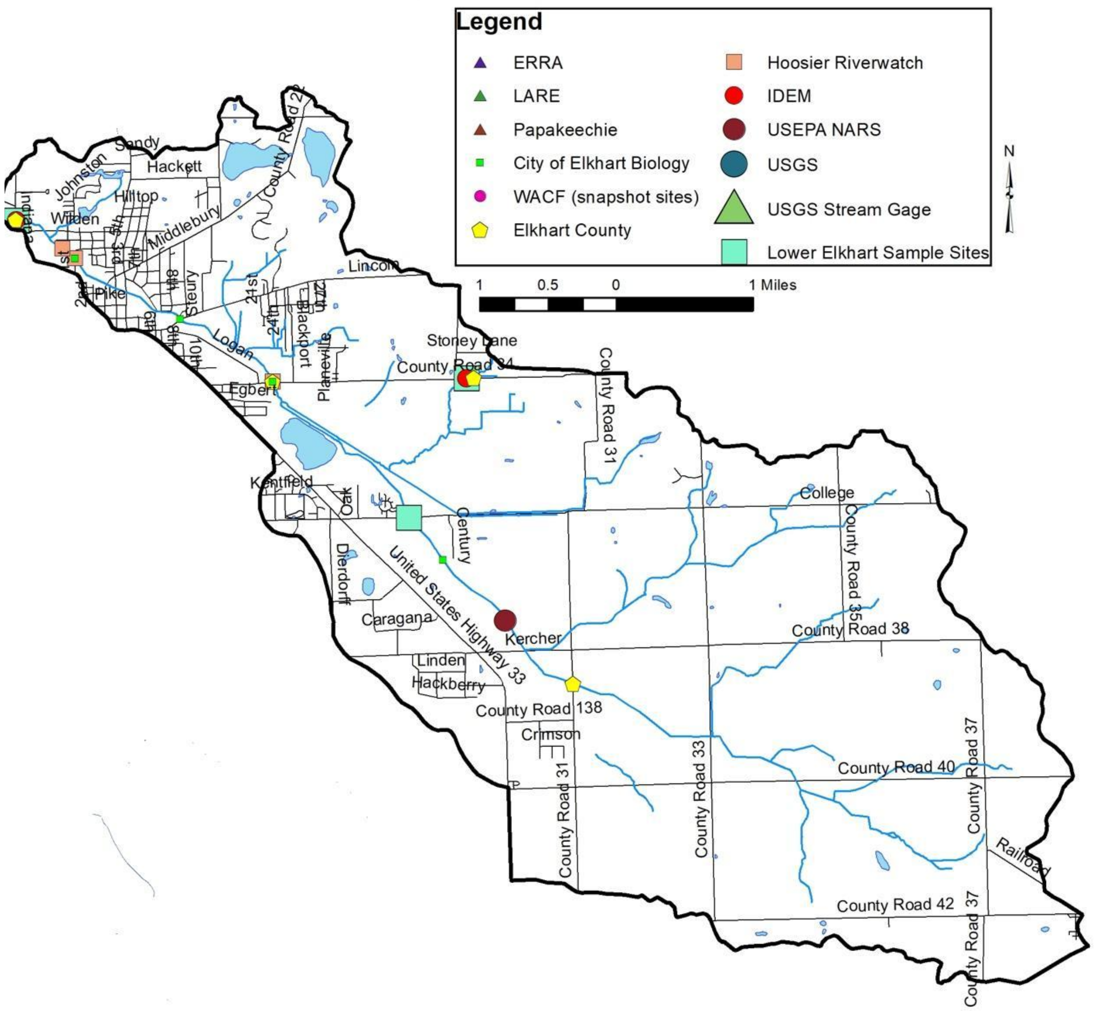

Figure 63. Locations of historic and current water quality data collection in the Horn Ditch-Rock Run Creek subwatershed.

Table 39 details historic water chemistry data collected in the Horn Ditch-Rock Run Creek subwatershed. As shown in the table, conductivity concentrations did not exceed water quality targets in any samples collected. DO concentrations exceed water quality targets in 1% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 90% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 86% of samples. Orthophosphorus concentrations exceed water quality targets (0.03 mg/L) in 78% of samples collected. pH levels did not exceed water quality targets in any samples collected. Total phosphorus concentrations exceeded water quality targets (0.08 mg/L) in 97% of samples collected. TSS levels exceed water quality targets (15 mg/L) in 16% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 30% of samples. Ammonia and TKN were not sampled in the Horn Ditch-Rock Run Creek subwatershed.

Table 39. Horn Ditch-Rock Run Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Conductivity	105	1033	0	450	0%
DO	4.01	23	3	460	1%
E. coli	0.0	241,960	427	476	90%
Nitrate	0.0	22.2	416	484	86%
OP	0.0	1.0	7	9	78%
pH	6.5	9.2	1	455	0%
TP	0.0	11.4	468	484	97%
TSS	0.0	312.0	50	312	16%
Turbidity	5.0	19.3	9	30	30%

Biological monitoring was conducted by the City of Elkhart at seven sites with four sites assessed for fish (Table 40**Error! Reference source not found.**). Habitat assessments conducted at each site resulted in scores ranging from 48 to 64, with 14% of sites not reaching state target of 51 for habitat assessment. Fish community assessments scores ranged from 35 to 42, with 25% of sites not reaching the target of 36.

Table 40. Horn Ditch-Rock Run Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	48	64	1	7	14%
Fish (IBI)	35	42	1	4	25%
Macroinvertebrates (mIBI, Kick)	--	--	--	--	--
Macroinvertebrates (mIBI, Multi Habitat)	--	--	--	--	--

4.12 Headwaters Yellow Creek subwatershed

The Headwaters Yellow Creek subwatershed forms the western edge of the northern portion of the Lower Elkhart River Watershed and lies fully within Elkhart County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011903. This subwatershed drains 23,262 acres and accounts for 12% of the total watershed area. There are 46.9 miles of stream. IDEM has classified 5.05 miles of stream length in the Headwaters Yellow Creek subwatershed as impaired for *E. coli* (Figure 64).

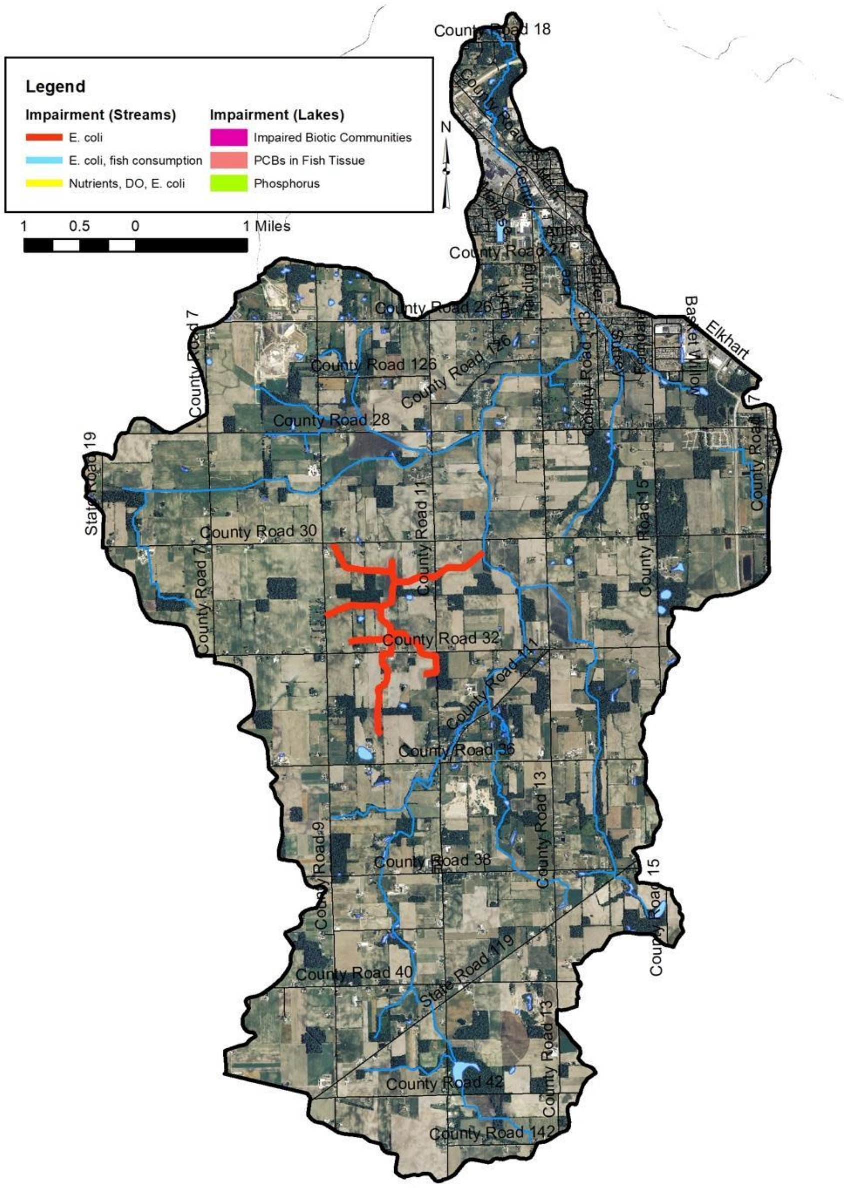

Figure 64. Impairments in the Headwaters Yellow Creek subwatershed.

4.12.1 Soils

Hydric soils cover 2,155.0 acres (10.2%) of the subwatershed. Highly erodible soils cover 42.2% (8,936.8 acres) of the subwatershed. In total, 20,649.4 miles (97.6%) of the subwatershed are identified as very limited for septic use. Based on the septic suitability of the soil, the majority of the subwatershed is very limited. Therefore, maintenance and inspections of septic systems in the area are important to ensure proper function and capacity.

4.12.2 Land Use

Agricultural land use makes up the majority of the Headwaters Yellow Creek subwatershed with 71.7% (15,173.4 acres) in agricultural land uses, including row crop and pastureland. Urban land use accounts for 16% (3,391.1 acres) including portion of the Cities of Elkhart and Goshen and the urban corridor along US Highway 33. Forested land use accounts for 7.4% (1,566.5 acres). Wetlands, open water and grassland cover nearly 5% (1,026.7 acres) of the subwatershed.

4.12.3 Point Source Water Quality Issues

There are many potential point sources of water pollution in the subwatershed (Figure 65). Five leaking underground storage tanks, two brownfields, one industrial waste site and two solid waste sites are located within the Headwaters Yellow Creek subwatershed. Sixteen underground storage tank sites that are not leaking are also in the subwatershed. The Elkhart MS4 is in the subwatershed and covers 2,630 acres.

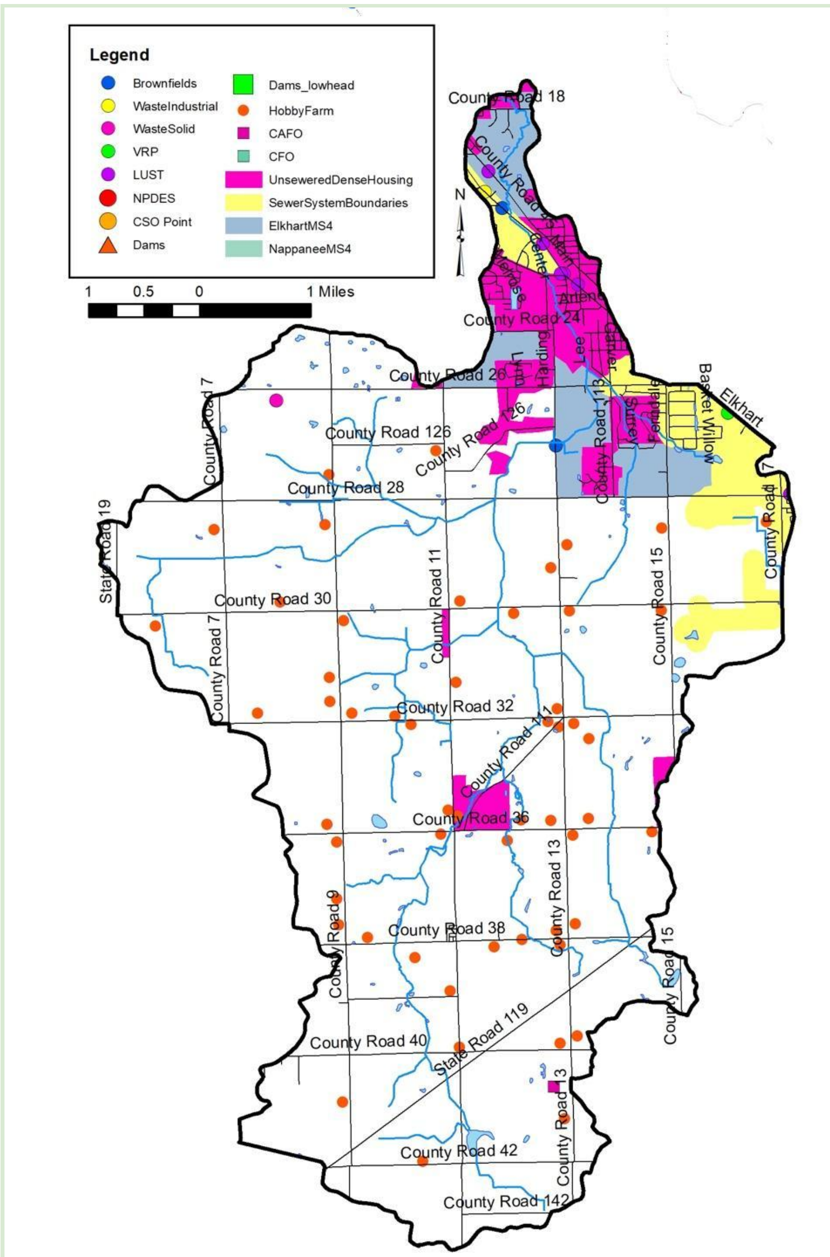

Figure 65. Potential point and non-point sources of pollution and suggested solutions in the Headwaters Yellow Creek subwatershed.

4.12.4 Non-Point Source Water Quality Issues

Agricultural land use is the predominant land use in the Headwaters Yellow Creek subwatershed. During the windshield survey, approximately 55 unregulated animal operations housing more than 2,596 cows, horses, goats, sheep and donkeys were identified. Livestock have access to 1.8 miles (4.1%) of subwatershed streams. There is one active CFO located in the Headwaters Yellow Creek subwatershed housing 1,795 dairy cattle. In total, manure from all animal operations total over 96,990 tons per year, which contains almost 46,677 pounds of nitrogen, 22,899 pounds of phosphorus and 2.95E+15 colonies of *E. coli*. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 0.4 miles (0.9%) of insufficient stream buffers and 1.5 miles (3.6%) of streambank erosion were identified within the subwatershed.

4.12.5 Water Quality Assessment

Waterbodies within the Headwaters Yellow Creek subwatershed have been sampled historically at 17 locations. Five sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (8 sites), Greater Elkhart Stormwater Partnership (13 sites), Goshen (9 sites), and City of Elkhart (10 sites). No stream gages are in the Headwaters Yellow Creek subwatershed.

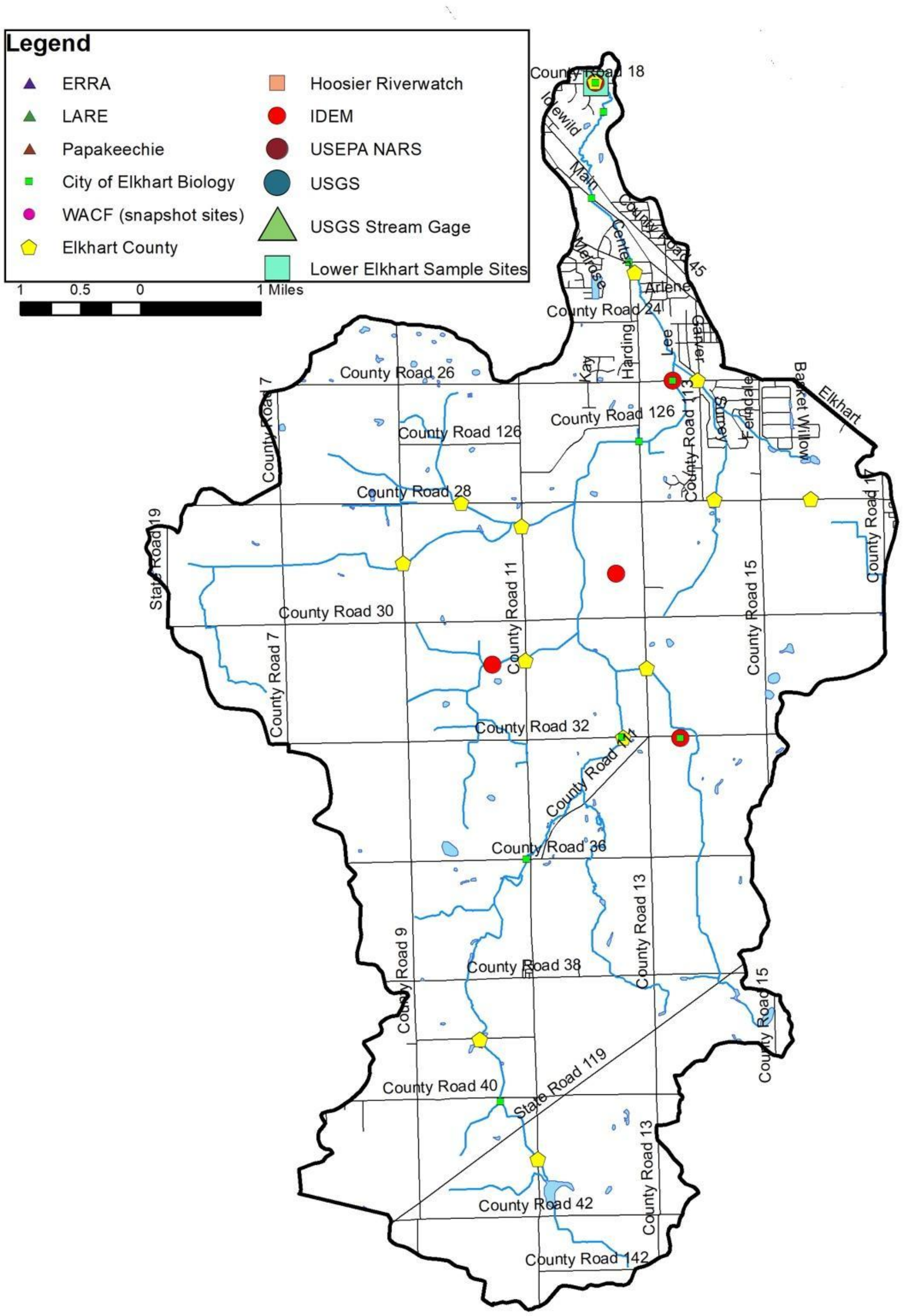

Figure 66. Locations of historic and current water quality data collection in the Headwaters Yellow Creek subwatershed.

Table 41 details historic water chemistry data collected in the Headwaters Yellow Creek subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 25% of samples collected. Conductivity concentrations exceed water quality targets (1050 mg/L) in 4% of samples collected. DO concentrations exceed water quality targets in 26% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 89% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 82% of samples, while total Kjeldahl nitrogen concentrations similarly exceed water quality targets (0.5 mg/L) in 80% of samples.

pH levels exceeded state standards in 1% of samples collected. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 99% of samples collected. TSS levels exceed water quality targets (15 mg/L) in 46% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 65% of samples. OP was not sampled in Headwaters Yellow Creek subwatershed.

Table 41. Headwaters Yellow Creek subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.1	0.4	1	4	25%
Conductivity	103	2123	31	791	4%
DO	0.05	19	215	815	26%
E. coli	0.0	241,960	755	850	89%
Nitrate	0.01	22.2	690	844	82%
pH	5.7	12.3	12	806	1%
TKN	0.48	6.1	4	5	80%
TP	0.047	14.4	879	884	99%
TSS	0.0	2,092.0	338	739	46%
Turbidity	1.6	746.0	13	20	65%

Biological monitoring was conducted by IDEM at 37 sites, with fish community assessments occurring 39 times and macroinvertebrate assessments occurring 3 times in total (Table 42). Habitat scores ranged from 24 to 80, with 21% of sites scoring below the state target (51). The fish community assessment scored below the target level of 36 in almost half (49%) of assessments. Macroinvertebrate assessments using the kick sampling method resulted in all sites meeting their aquatic life use designation, while 100% macroinvertebrate multihabitat samples did not meet their aquatic life use designation.

Table 42. Headwaters Yellow Creek subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	24	80	7	33	21%
Fish (IBI)	14	45	19	39	49%
Macroinvertebrates (mIBI, Kick)	3.4	5	0	2	0%
Macroinvertebrates (mIBI, Multi Habitat)	24	24	1	1	100%

4.13 Goshen Dam Pond-Elkhart River subwatershed

The Goshen Dam Pond-Elkhart River subwatershed forms the northern tip of the Lower Elkhart River Watershed and extends along the mainstem of the Elkhart River between two other subwatersheds. The Goshen Dam Pond-Elkhart River subwatershed lies entirely in Elkhart County (Figure 30). It encompasses one 12-digit HUC watershed: 040500011904. This subwatershed drains 23,262 acres and accounts for 12% of the total watershed area. There are 46.9 miles of stream in the Goshen Dam Pond-Elkhart River subwatershed. IDEM has classified 21.35 miles of stream as impaired for *E. coli* and fish consumption (Figure 67).

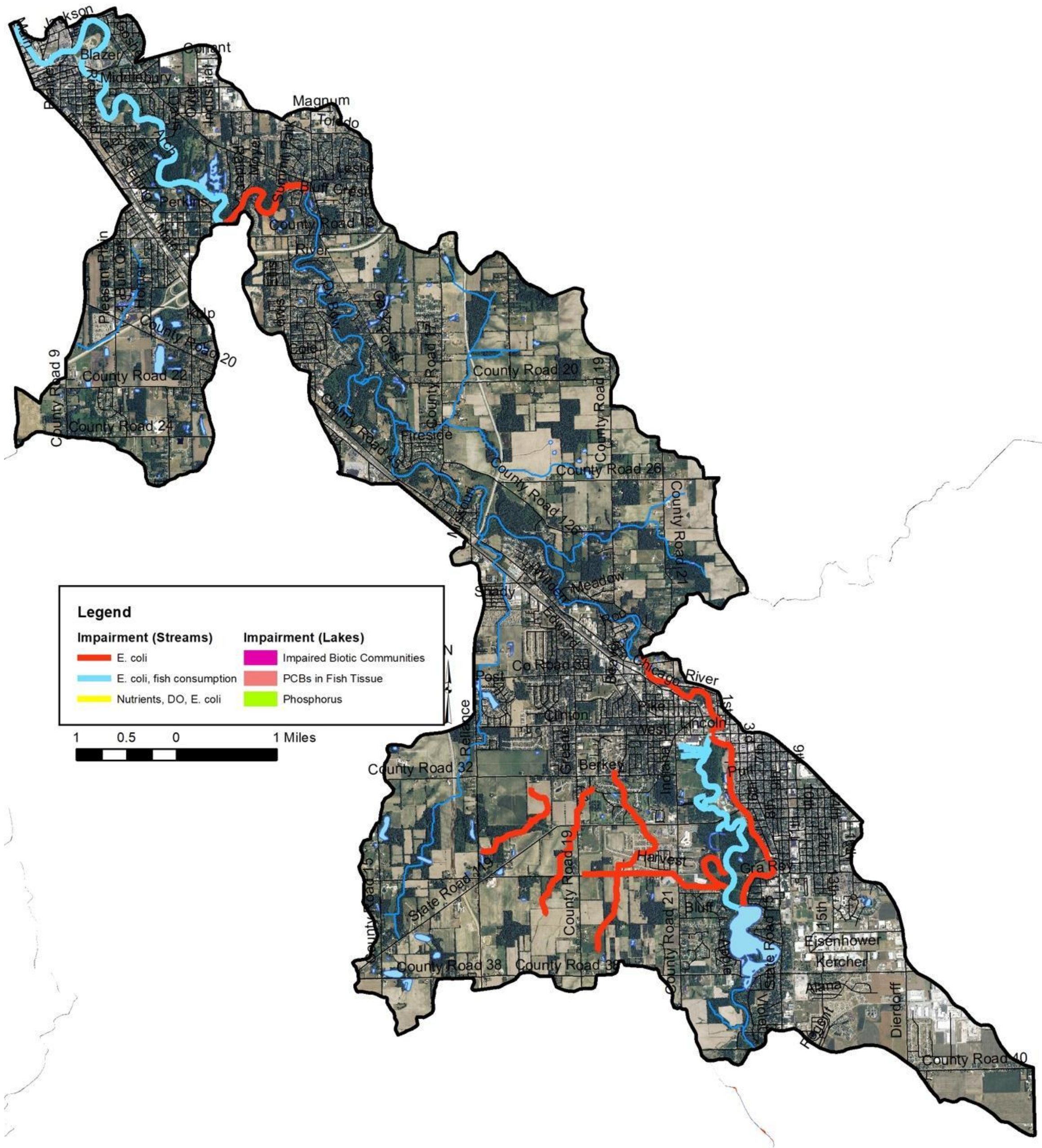

Figure 67. Impairments in the Goshen Dam Pond-Elkhart River subwatershed.

4.13.1 Soils

Hydric soils cover 1,122.3 acres, or 4.8%, of the subwatershed. Highly erodible soils cover 18.2% of the subwatershed, or 4,224.1 acres. In total, 22,038.6 acres, or 94.7%, of the subwatershed is identified as very limited for septic use. Maintenance and inspections of septic systems in the Goshen Dan Pond-Elkhart River subwatershed is important to ensure proper function and capacity.

4.13.2 Land Use

Urban land use is the predominant land cover in the subwatershed, with more than half (52.5%, or 12,208.5 acres) of the land identified as urban land. This includes portions of the Cities of Goshen and Elkhart and large areas of unincorporated Elkhart County. Agricultural land use in the Goshen Dam Pond-Elkhart River subwatershed is smaller compared to surrounding subwatersheds, with 33% (7,685.1 acres) of land in the subwatershed used for agricultural purposes. Forested land use only accounts for 4.8% (1,125.7 acres). Wetlands, open water and grassland cover 2,243.2 acres, or 9.6%, of the subwatershed.

4.13.3 Point Source Water Quality Issues

There are many potential sources of water quality issues in the Goshen Dam Pond-Elkhart River subwatershed (Figure 68). In total, 42 leaking underground storage tanks, 37 brownfields, 33 industrial waste sites and six combined sewer overflow locations (CSO) are located in the subwatershed. One NPDES permitted location in Goshen (Goshen wastewater treatment plant) is located in the subwatershed, as is the Elkhart MS4 which covers 17,088 acres. Eight voluntary remediation programs are located in the Goshen Dam-Pond Elkhart River subwatershed.

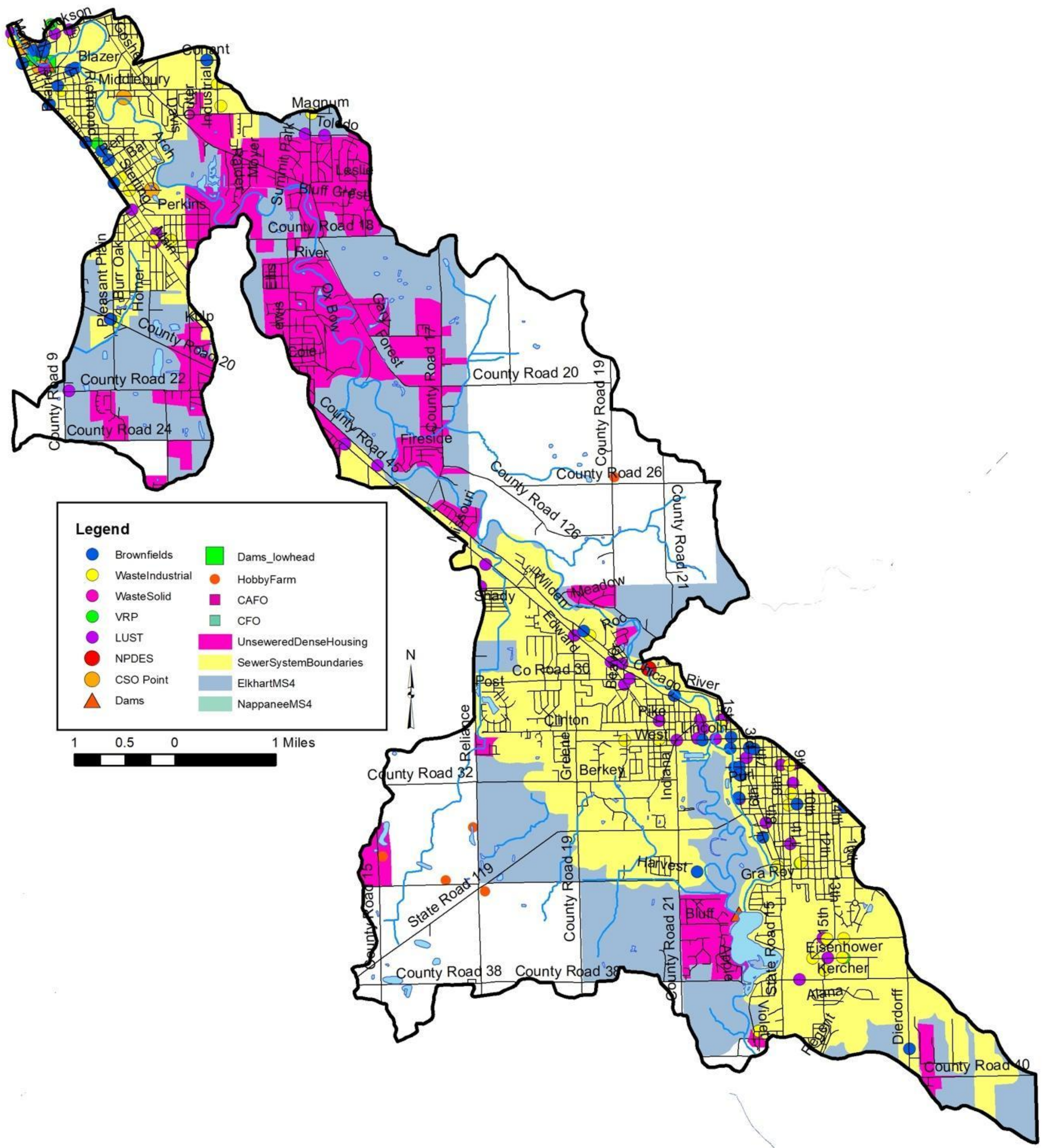

Figure 68. Potential point and non-point sources of pollution in the Goshen Dam-Elkhart River subwatershed.

4.13.4 Non-Point Source Water Quality Issues

While agricultural land uses are not the predominant land uses in the Goshen Dam-Elkhart River subwatershed, a number of small animal operations are still present. Surveyors observed five unregulated animal operations housing more than 11 cows and horses during the windshield survey. There are no active CFOs in the subwatershed. Based on windshield survey observations, livestock do not have access to subwatershed streams. Animals produce more than 231 tons of manure annually which contains more than 121 pounds nitrogen, 61 pounds of phosphorus and more than 5.51E+12 colonies of *E. coli*. Streambank erosion and lack of buffers are not a concern in the subwatershed.

4.13.5 Water Quality Assessment

Waterbodies within the Goshen Dam-Elkhart River subwatershed have been sampled historically at 44 locations (Figure 40). Five sites in the subwatershed are being sampled as part of the current project. Historic assessments include collection of water chemistry and biology data by IDEM (16 sites), City of Elkhart (16 sites), Greater Elkhart River Stormwater (5 sites), Hoosier Riverwatch (16 sites), NARS (4 sites), Goshen (5 sites), and USGS (2 sites). One stream gage is located in the Goshen Dam-Elkhart River subwatershed.

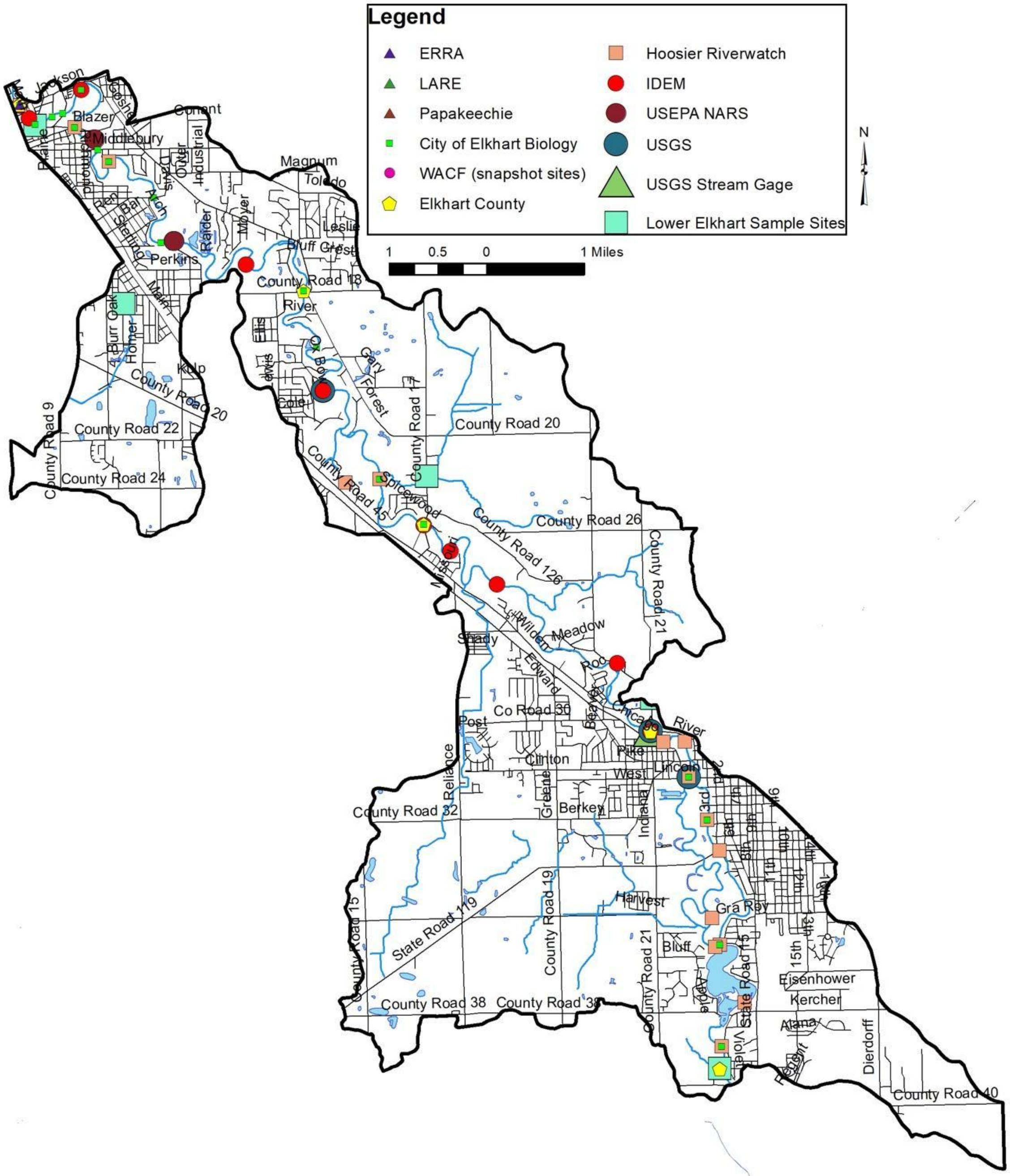

Figure 69. Locations of historic and current water quality data collection in the Goshen Dam-Elkhart River subwatershed.

Table 43 details historic water chemistry data collected in the Goshen Dam-Elkhart River subwatershed. As shown in the table, ammonia concentrations exceed water quality targets (0.2 mg/L) in 2% of samples collected. Conductivity concentrations exceed water quality targets (1050 mg/L) in 0.2% of samples collected. DO concentrations exceed water quality targets in 12% of samples collected. *E. coli* concentrations exceed state grab sample standards (235 col/100 ml) in 36% of samples collected. Nitrate-nitrogen concentrations exceed water quality targets (1 mg/L) in 74% of samples, while total Kjeldahl nitrogen concentrations similarly exceed water quality targets (0.5 mg/L) in 77% of samples.

Orthophosphorus concentrations exceed water quality targets (0.03 mg/L) in 63% of samples collected. pH levels did not exceed water quality targets. Total phosphorus concentrations exceed water quality targets (0.08 mg/L) in 98% of samples. TSS levels exceed water quality targets (15 mg/L) in 15% of samples collected. Turbidity levels exceed water quality targets (5.7 NTU) in 73% of samples.

Table 43. Goshen Dam-Elkhart River subwatershed historic water quality data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Ammonia	0.2	0.5	8	362	2%
Conductivity	2	1,331	1	649	0.2%
DO	1.42	16	168	1,457	12%
E. coli	0.0	154,800	363	1,007	36%
Nitrate	0.0	22.0	614	827	74%
OP	0.0	0.6	25	40	63%
pH	5.6	9.3	6	1,698	0%
TKN	0.2	2.6	446	577	77%
TP	0.001	18.8	748	766	98%
TSS	0.4	249.0	135	872	15%
Turbidity	0.0	171.0	462	632	73%

The City of Elkhart conducted biological data assessments 117 times at 37 sites (Table 44). Habitat was assessed 96 times while fish communities were assessed 104 times. Habitat scores ranged between 52 and 94, with all assessments measuring above the state target of 51. The fish community assessment consistently measured above target for all sites assessed.

Table 44. Goshen Dam-Pond Elkhart River subwatershed biological assessment data summary.

Parameter	Minimum	Maximum	Number Exceeding Target	Number of Samples	Percent Exceeding
Habitat (QHEI)	52	94	0	96	0%
Fish (IBI)	41	56	0	104	0%
Macroinvertebrates (mIBI, Kick)	--	--	--	--	--
Macroinvertebrates (mIBI, Multi Habitat)	--	--	--	--	--