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Pigeon River Watershed Management Plan

A project for the LaGrange County Soil and Water Conservation District

January 15, 2013

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1.0 Introduction

The LaGrange County Soil and Water Conservation District (SWCD) has been working with landowners and producers in LaGrange County to provide education on water quality issues and sustainable farming for the past 17 years. The relationship that has been formed between the SWCD and the farmers in the community has afforded the SWCD the ability to write comprehensive watershed management plans (WMP) for the Little Elkhart River and the Little Elkhart Addendum and begin implementation of those WMPs with full support and help from the community. Monthly water testing has shown improvements in water quality indicating that the SWCD's and local farmer's efforts to implement best management practices and improve water quality have made a difference in the watershed.

The success seen in the Little Elkhart watershed led the SWCD to look at surrounding watersheds to see if they could expand their efforts. Steuben County SWCD wrote a WMP for the portion of the Pigeon Creek watershed located within Steuben County (Figure 1). That WMP was approved by the Indiana Department of Environmental Management (IDEM) in 2006 and the Steuben SWCD is currently implementing that WMP. The Pigeon Creek flows southwesterly through Steuben County and enters the east side of LaGrange County. Pigeon Creek turns into the Pigeon River once the creek meets the Mongo Millpond. From there the river flows west by northwest up to St. Joseph County Michigan, then it curves southwesterly back to Elkhart County where it eventually meets the St. Joseph River. Since the Pigeon River Watershed is located not only in Steuben County but also in LaGrange and the northeast corner of Elkhart County, Indiana and St. Joseph County, Michigan, the SWCD began to investigate the Pigeon River to see if it was a good candidate for expanding their efforts.

The Pigeon River watershed project, including part of HUC 0405000110 and HUC 0405000111, has several waterbody segments listed as impaired on the 303(d) List of Impaired Waters in the Indiana Integrated Water Monitoring and Assessment Report (IR). The impairments include impaired biotic communities, phosphorus, dissolved oxygen, and *E. coli*. The watershed is approximately 155,000 acres comprised of mostly agricultural land. The majority of the rural area of the watershed is farmed by Amish (approximately 55%) who own small segments of land to raise livestock for transportation, production of income, and food. As was learned during the development of the Little Elkhart WMP, the unique lifestyle of the Amish community often leads to excess sediment and nutrients entering surface waters due to livestock with direct access to surface water and improper barnyard drainage.

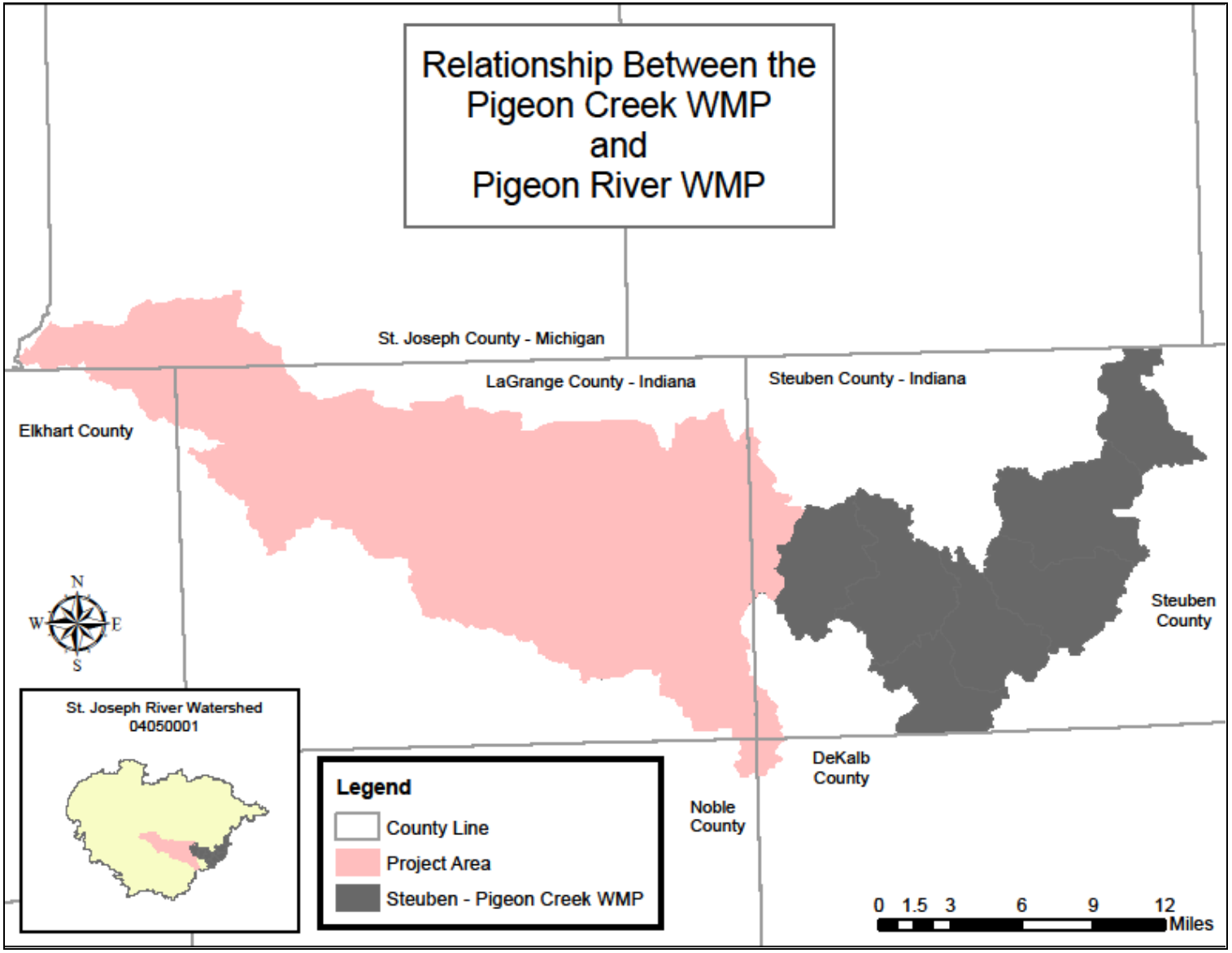

Figure 1: Relationship between Pigeon River and Pigeon Creek WMPs

There are five urban areas located within the watershed; LaGrange, IN (P=2927), Shipshewana, IN (P=529), Howe, IN (P=550), Mongo, IN (P=300) and White Pigeon, MI (P=1544). Historically in this area, urban lawns are over fertilized and there is a significant amount of horse manure on the streets from the Amish means of transportation, all of which will be transported into surface water by way of stormwater runoff.

Northeastern Indiana is often referred to as "Lake Country" as there are many lakes which were formed during the last glaciation. The lakes located within the Pigeon River Watershed are a great eco-service as they provide recreational opportunities such as boating and fishing. The lake system in the watershed is also a great revenue producer for the community as the lakes bring in thousands of tourists every year. The lakes within the watershed that are listed on the 303(d) list of impaired waters are primarily listed for impaired biotic communities. Most of the impairments to these lakes can be linked to over fertilization of lawns adjacent to the lakes and lakes that do not have a central sewer system as septic systems are a major contributor of nonpoint source pollution.

Another revenue source for the community and a great resource that must be protected is the Pigeon River Fish and Wildlife Area near Mongo, IN. This area encompasses over 11,000 acres of land and is a major recreation area as locals and tourists visit the area for canoeing, fishing, hunting, bird watching, and hiking.

After taking the above findings into consideration the SWCD met with several local organizations and agencies to present the above information and to collaborate on a project to write a WMP for the portion of the watershed that does not currently have one and begin implementation to delist the impaired waterways from the IDEM 303(d) list outlined in the IDEM Integrated Report which is submitted to the US Environmental Protection Agency (EPA) every two years. A collaborative effort between the Steuben County SWCD, The Nature Conservancy, Pheasants Forever, Shipshewana Lake Association, Indiana Department of Natural Resources (IN DNR), Friends of the St. Joe, and the St. Joseph River Basin Commission led to an application for funding to be submitted to IDEM through the CWA§319 grant program in September, 2009. The application was approved and the project began in September, 2010.

The SWCD sent invitations to local landowners, producers, and city and county planners, and sent press releases to local publications to encourage the public to attend the project kick-off meeting which was held in December, 2010. The purpose of the meeting was to inform the stakeholders in the watershed about the project and to gather support for the project. It was also intended to be a platform for stakeholders to voice any questions or concerns regarding the project itself, or water quality and for the SWCD to recruit steering committee members for the project. Table 1 below is a list of those individuals who have committed to be on the steering committee for this project.

Table 1: Steering Committee Members

Name	Affiliation
Monroe Raber	Landowner
Neil Ledet	IN Dept. of Natural Resources
Joe Draper	The Nature Conservancy
Beth Warner	The Nature Conservancy
Elizabeth Mizell	The Nature Conservancy
Kayleen Hart	Steuben County SWCD
Brian Musser	Steuben County SWCD
Steve Weideman	Shipshewana Lake Association
Rex Pranger	LaGrange County Surveyor
Karen Mackowiak	St. Joseph River Basin Commission
Steve Roth	Pigeon River Fish and Wildlife Area
Tom Atwater	Landowner
Lynn Bowen	LaGrange County Lakes Council
Boyd Jones	Shipshewana Sewage Treatment Manager
Sheryl Kelly	Town of Shipshewana
Derek Thompson	Natural Resource Conservation Service
Martin Franke	LaGrange County SWCD
Dona Hunter	LaGrange County SWCD

Stakeholder concerns regarding water quality and land use are listed in Table 2 as well as the relevance of the concerns to this project.

Table 2: Stakeholder Concerns

Concerns	Relevance	Potential Problem
Livestock access to open water	It has been noted that livestock often have regular access to open water for drinking water or to move between adjacent pastures	*E. coli* contamination, excess nutrients, streambank erosion and sediment
Stormwater runoff from barnyards	Stormwater will pick up pollutants from barnyards and carry them to open water if it is not properly contained or diverted from ditches, streams, rivers, and ponds	*E. coli* contamination, excess nutrients, and sediment
Increase in impervious surfaces	As the urban areas in the watershed expand, especially in Shipshewana, so does the impervious surfaces that increase stormwater runoff which will potentially carry pollutants to open water	Oil and grease, sediment, nutrients, increase in combined sewer overflows
Fertilizer used on urban lawns	As the urban centers in watershed expand so do the number of homes. Many homeowners are unaware of how to follow guidelines for lawn fertilizers and may over-apply fertilizer which has the potential to run over the land and into waterways	Excess nutrients and impaired biotic communities
Lakes in the area becoming more developed	Over fertilization of lawns around lakes in the area has been noted in the past. As more homes are built around the lakes more fertilizer has the potential to runoff the land and directly into the lakes	Excess sediment, nutrients and impaired biotic communities, *E. coli*
Septic system discharge	Septic systems, if not properly maintained, can leak effluent into ground water or leach into surface waters. There have been many advances in the area to improve sewage treatment however, this problem is out of the jurisdiction of the SWCD and will be handled by the local Health Departments.	Excess nutrients, *E. coli*
Horse manure on public roads	Due to a large Amish population in the watershed there is a concern about manure from horses on the public roads which has the potential to runoff the road during rain events and enter open water. This is a concern that will be discussed in the WMP but it is beyond the scope of this project to implement any measures to address the concern	*E. coli* contamination, excess nutrients

2.0 Physical Description of the Watershed Project Area

2.1 Watershed Location

The Pigeon River watershed project area is located within LaGrange and Steuben counties, as well as small portions of Elkhart, Noble, and DeKalb counties in Indiana, and St. Joseph County in Michigan. The Pigeon River and Pigeon Creek watersheds are subwatersheds of the greater St. Joseph River watershed (HUC 04050001).

As can be seen in Figure 2, the project area extends from the northwest and northeast corners of DeKalb and Noble counties, respectively, northwesterly through LaGrange County, the most northeast corner of Elkhart County to the southwestern portion of St. Joseph County. Land uses within the watershed consist of forest land, grassland, agriculture (row crops and animal operations), and small areas of residential, commercial and industrial land uses. The major residential areas within the project area include LaGrange, the LaGrange county seat, Mongo, Shipshewana, and Howe, Indiana and White Pigeon, Michigan. With 155,543 acres (243 square miles) the Pigeon River watershed comprises nearly 60% of LaGrange County and almost 92% of the Pigeon River watershed is located within LaGrange County.

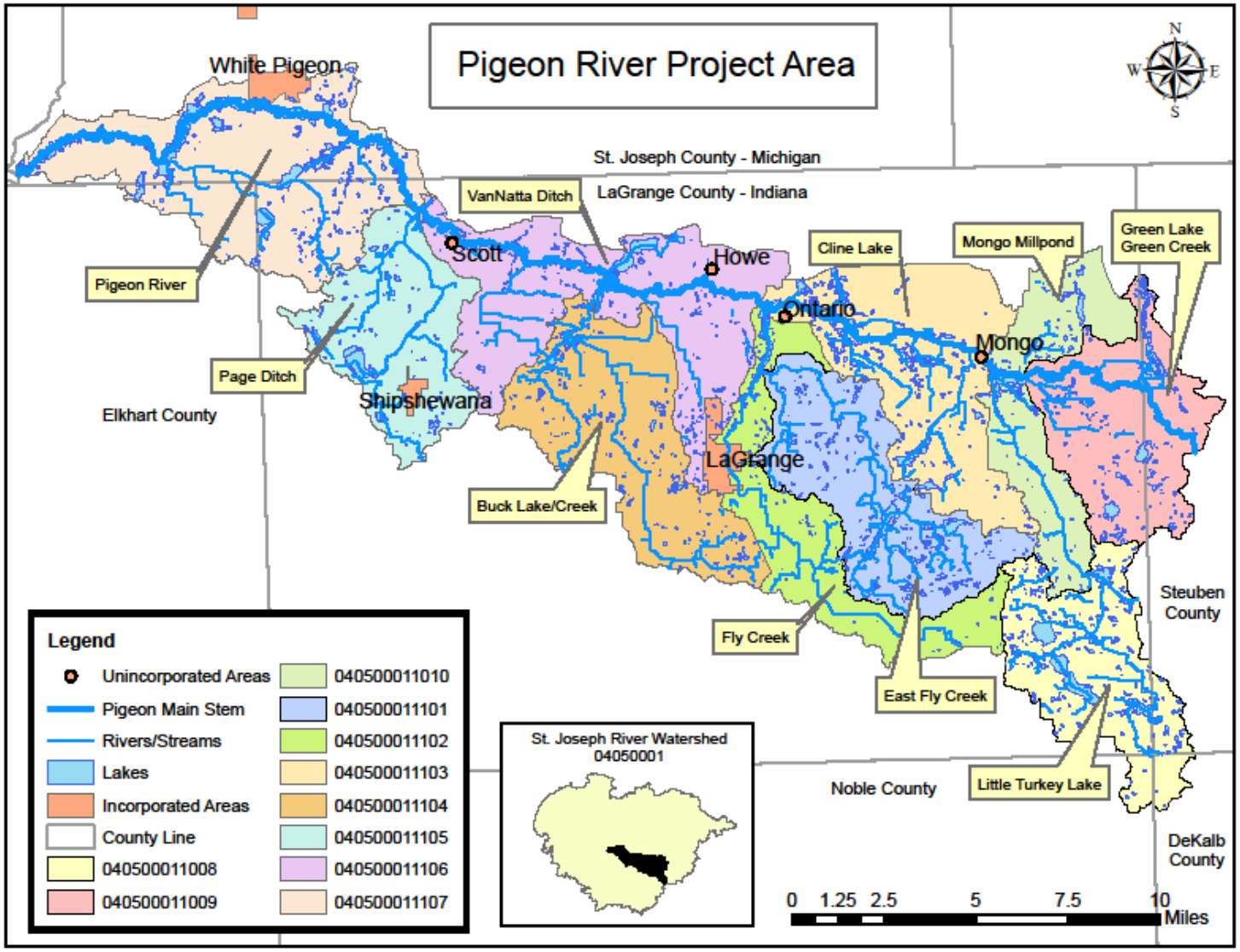

Figure 2: Pigeon River WMP Project Area

2.2 Subwatersheds

The Pigeon River and Pigeon Creek watersheds are subwatersheds of the greater St. Joseph River watershed (HUC 04050001). The project area, as can be seen in Figure 1, consists of ten, 12 digit HUCs; Green Lake-Green Creek (HUC 040500011009), Little Turkey Lake (HUC 040500011008), Buck Lake-Buck Creek (HUC 040500011104), Page Ditch (HUC 040500011105), Fly Creek (HUC 040500011102), VanNatta Ditch (HUC 040500011106), East Fly Creek (HUC 040500011101), Cline Lake (HUC 040500011103), Mongo Millpond (HUC 040500011010), and Pigeon River (HUC 040500011107). Each subwatershed will be discussed in further detail in Section 3 of this WMP.

2.3 Geology, Topography, and Soils

The landscape of northern Indiana and southern Michigan is directly influenced by the last great glaciation which occurred over 10,000 years ago; the Lake Michigan Lobe of the Wisconsinan glaciation. Prior to the glaciers sweeping over the land, the project area's landscape was comprised of rolling hills separated by broad valleys (Wilson, 2008). All of Indiana looked much like what southern Indiana currently looks like as the limits of the Wisconsinan glaciation follows the line connecting Terre Haute, Edinburgh, and Richmond, Indiana (Figure 3). As the glaciers advanced and retreated, the massive structures flattened the land surface and wiped out whole forests. As the glaciers melted they formed the many kettle lakes that give northern Indiana the nickname of "Lake Country". The melting glaciers also deposited rock, dirt and sand that they had picked up while traveling across the landscape. In the project area of northern Indiana and southern Michigan, where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left. However, the landscape is still much more level than pre-Wisconsinan times but presents a low rolling landscape.

The bedrock of the project area was deposited during the Mississippian Age, some 300 million years ago. The rocks deposited during the Mississippian Age are called the Borden Group and consist of siltstone, shale, sandstone, and a limited amount of limestone (Indiana Geological Survey, 1998). The type of bedrock present within the project area accounts for the ground water wells that supply drinking water to the Village of White Pigeon, MI, the towns of LaGrange and Shipshewana, IN and the many wells that supply drinking water to the rural communities throughout the project area. The surficial geology overlaying the bedrock ranges in thickness from 350 to 500 feet thick in the southeast portion of the project area, to 150 – 250 feet thick in the northwest portion of the project area. The unconsolidated deposits, above the bedrock, are between 351 and 500 feet thick in the southeast portion of the project area and between 151 and 250 feet thick in the north and northwest portion of the project area. The project area is covered in glaciofluvial material over the deeper clay deposits. The glaciofluvial material consists of mostly sand and gravel or loamy till.

The project area is located within several physiographic regions of Indiana and Michigan; the St Joseph Drainageway in the north, the Plymouth Morainal Complex and Warsaw Moraine in the central portion of the project area, and the Auburn Morainal Complex in the most southern edge of the project area (Figure 3). The topography of the project area is not drastically

different from one end of the watershed to the other. However, in Steuben County, where the project area begins, the land elevation is between 820 and 900 feet above sea level and in Elkhart County, where the watershed ends the land elevation varies between 760 and 810 feet above sea level. It is important to note however, that there are several small knobs with higher elevations from deposits left by the glaciers scattered throughout the watershed which gives the landscape of the project area small, beautiful rolling hills.

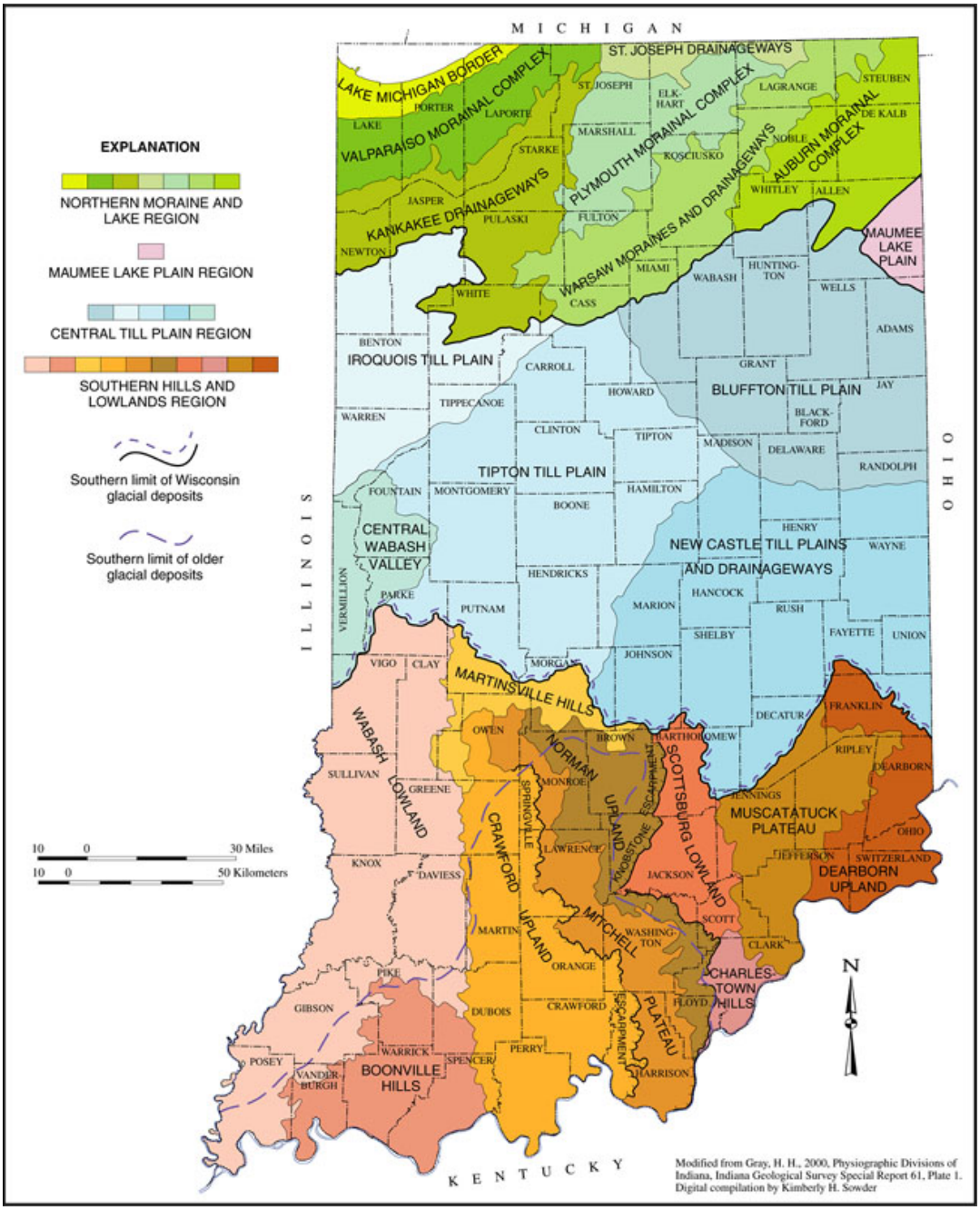

Figure 3: Indiana Physiographic Regions and Glaciation

The project area is comprised of four main soil associations, and six additional associations that make up less than 2% of the entire watershed. Table 3 is a list of the soil associations present in the project area and a description of each association. Soil association descriptions were acquired from the St. Joseph, Elkhart, DeKalb, Steuben and LaGrange county USDA soil surveys.

Table 3: Soil Associations

Soil Association	Association Description
Boyer - Oshtemo	Nearly level to moderately steep, well drained, coarse textured soils on outwash plains, valley terrains, moraines, and kames
Sebewa - Gilford - Homer	Nearly level, very poorly drained and somewhat poorly drained, medium textured and moderately coarse textured soils on outwash plains or valley terrains
Plainfield - Gilford	Nearly level to moderately sloping, excessively drained and very poorly drained, coarse textured and moderately coarse textured soils on outwash plains, knolls, and eolian dunes
Wawasee - Hillsdale - Conover	Nearly level to strongly sloping, well drained and somewhat poorly drained, moderately coarse textured and medium textured soils on till plains and moraines
Soil Associations totaling <2%	**Association Description**
Rawson - Morely	Gently sloping to strongly sloping, well drained and moderately well drained, medium textured and moderately coarse textured soils on till plains and moraines
Plainfield - Chelsea - Granby Variant	Deep, nearly level to moderately sloping, excessively drained and very poorly drained, sandy soils on outwash plains and bottom land
Kosciusko - Ormas - Boyer	Nearly level to strongly sloping, well drained, loamy and sandy soils that are moderately deep or deep over sand and gravel; on outwash plains and moraines
Riddles - Miami - Brookston	Deep, nearly level to moderately steep, well drained and very poorly drained, loamy soils on till plains
Glynwood - Pewamo - Morley	Deep, moderately well drained, very poorly drained, and well drained, nearly level to steep, loamy, clayey, and silty soils; on till plains and moraines
Blount - Pewamo - Glynwood	Deep, moderately well drained to very poorly drained, nearly level and gently sloping, silty, clayey, and loamy soils; on till plains and moraines

The NRCS maintains a database of highly erodible land (HEL), potentially highly erodible land (PHEL), and hydric soils for each county. The soils that have been determined to be highly erodible are so designated by dividing their average rate of erosion by the soil loss tolerance, which is the maximum amount of soil loss that can occur before a long term reduction in productivity will be seen. Soils are determined potentially highly erodible based on the percent slope and length of the slope. Hydric soils are designated as such due to their capacity to hold water. The list of HEL and PHEL provided by the LaGrange County, NRCS has several soils in

LaGrange County listed as either highly or potentially highly erodible. The LaGrange County soil survey posted on the NRCS Field Office Technical Guide, online, also listed those soils that are designated as hydric in LaGrange County. It is important to note that each county classifies the soils present within their jurisdiction differently, while the NRCS is in the process of standardizing classifications throughout the country, each county within the project area currently classify their soils differently which accounts for the abrupt change in soil classification that can be seen in the following HEL and PHEL, and hydric soil maps of the project area.

Constituting approximately 50% of the surface area, there are several soils that are classified as either HEL or PHEL located within the project area as can be seen below in Figure 4. Producers that are farming on HEL and PHEL can implement best management practices to limit the amount of soil runoff and the formation of rills or gullies so as to not lower the productivity of their farmland and to reduce the impact of sediment runoff into surface waters. It is suggested that any producer working HEL or PHEL follow a conservation plan to protect their vulnerable cropland.

Approximately 15% of soils present within the project area are classified as being hydric (Figure 5) which can pose threats to surface water when farmed due to excessive runoff of fertilizers, pesticides, and manure. Farmland located on hydric soils often requires the installation of field tiles to keep the fields from flooding or ponding. Field tiles can provide a direct conduit for water polluted with fertilizer, land applied manure, and sediment to reach surface waters. Hydric soils are also not suitable soils for septic usage as they do not allow for proper filtration of the septic leachate and may result in surface and/or groundwater contamination. Soils that are considered hydric are so classified for several reasons. The following explanation of hydric soils was taken from the NRCS, Field Office Technical Guide.

1. All Histels except for Folistels, and Histosols except for Folists.
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that:
    A. are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
    B. are poorly drained or very poorly drained and have either:
        1.) water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
        2.) water table at a depth of 0.5 foot or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
        3.) water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
3. Soils that are frequently ponded for long/very long duration at the growing season.
4. Soils that are frequently flooded for long/very long duration at the growing season.

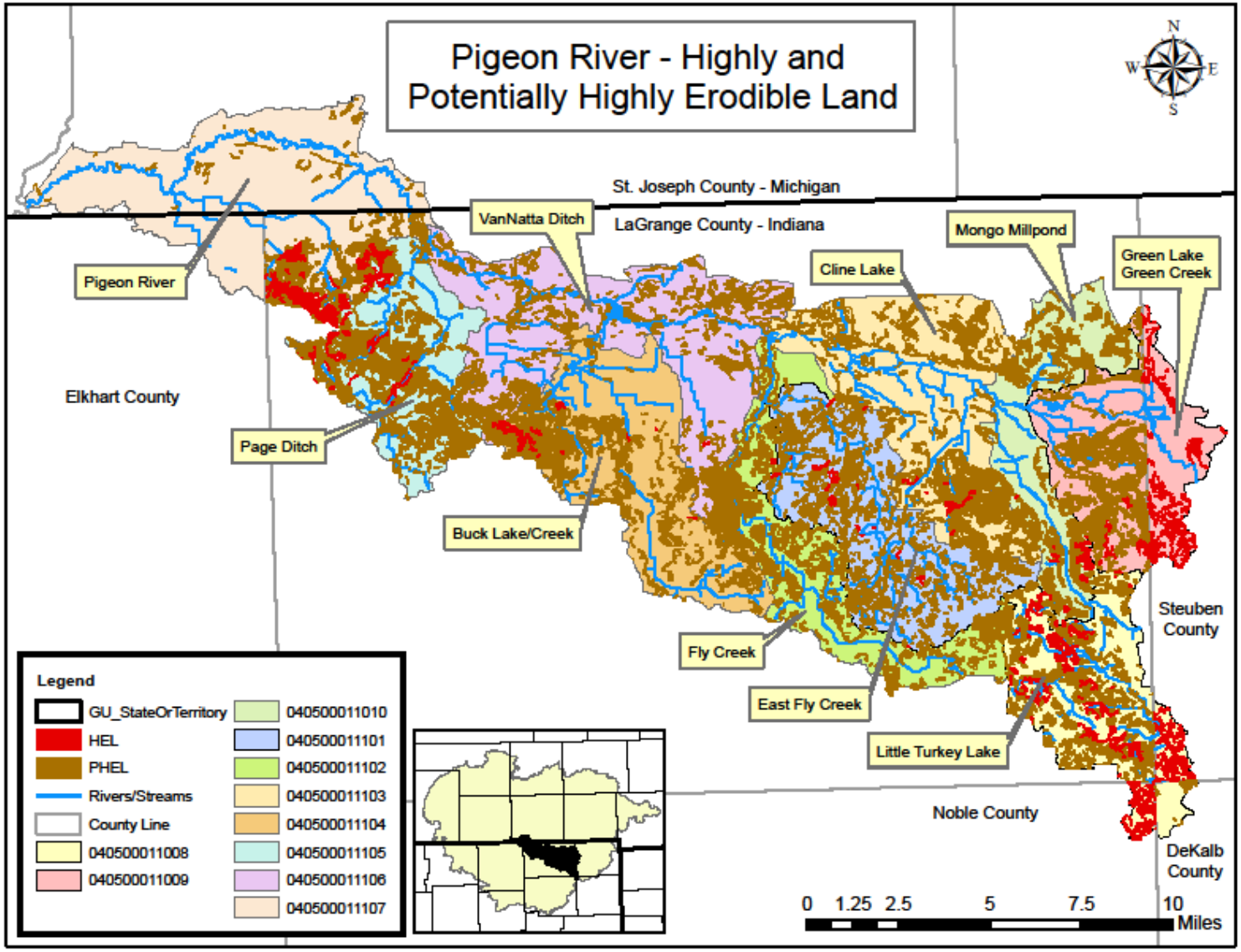

Figure 4: Highly and Potentially Highly Erodible Land

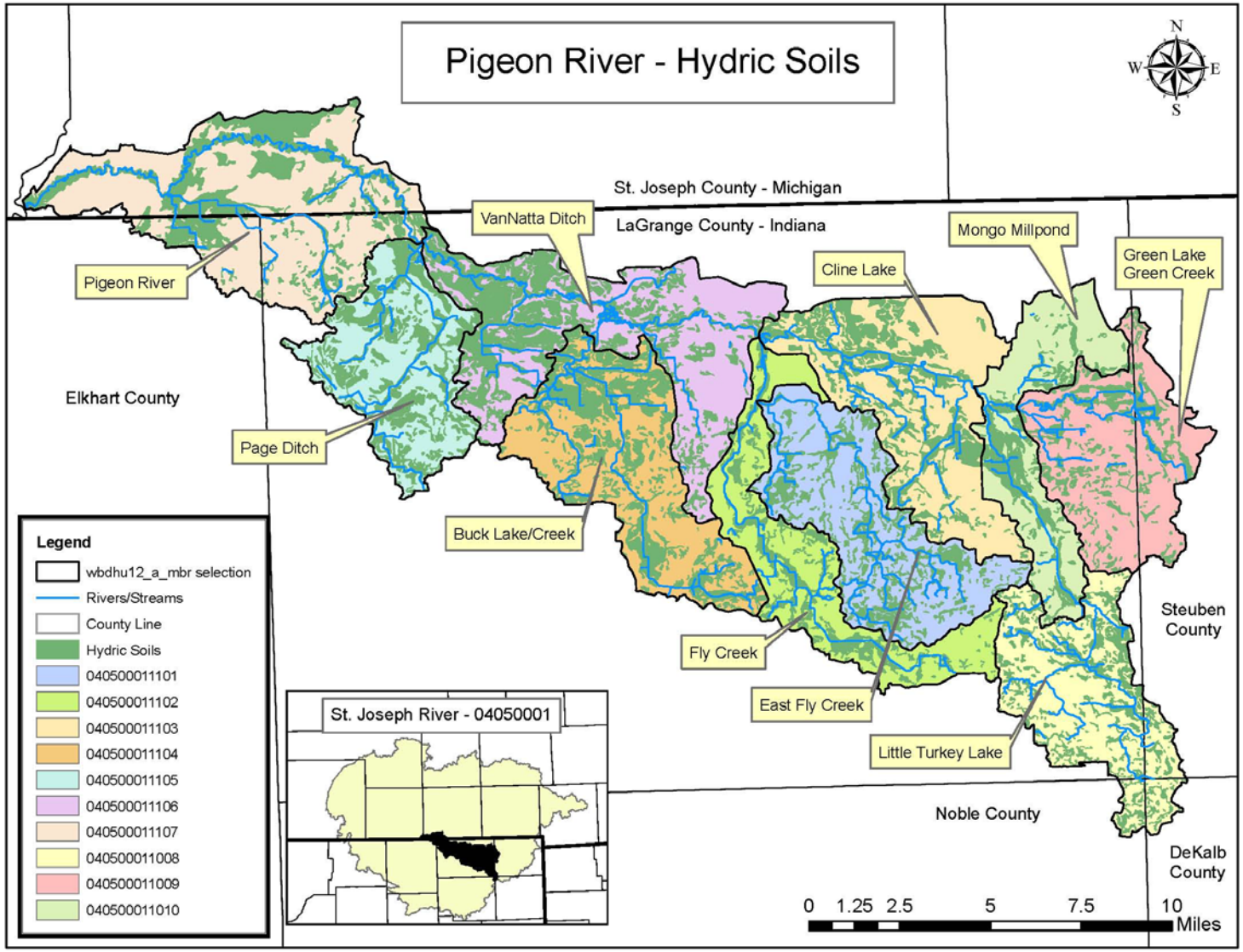

Figure 5: Hydric Soils in Pigeon River Watershed

Soil type is important to consider when installing a septic tank as traditional septic tanks utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic tank absorption fields are subsurface systems of french drains that distribute septic liquid waste evenly throughout the designated area and into the natural soil. Soil properties and landscape features that affect the ability of the soil to properly absorb and filter the effluent should be considered when designing a septic system. Most of the rural population within the Pigeon River project area uses septic systems to handle their wastewater. However, nearly all soils (85% of surface area) located within the project area are rated as "very limited" for septic usage according to the NRCS, except for four soil types, which are rated as "somewhat limited". Somewhat limited means that modifications can be made to either the site of septic installation or to the system itself to overcome any potential problems. A designation of "Very limited" means that modifications to the septic system site, or septic system itself, are either impractical or impossible. This will be discussed further in Section 2.6.2.

2.4 Climate

The project area has a temperate climate with warm summers and cool winters. According to the LaGrange County Economic and Development Corporation the average temperature in July is 72°F and 21°F in January. Due to the project area being located close to Lake Michigan, it experiences "lake effect snow" and receives higher amounts of snow fall than the rest of Indiana. Average snowfall in the project area is approximately 47 inches annually. Average rainfall in the project area is approximately 66 inches annually (LCEDC, 2010). Figure 6 graphically illustrates the temperature average per month and the annual precipitation in project area.

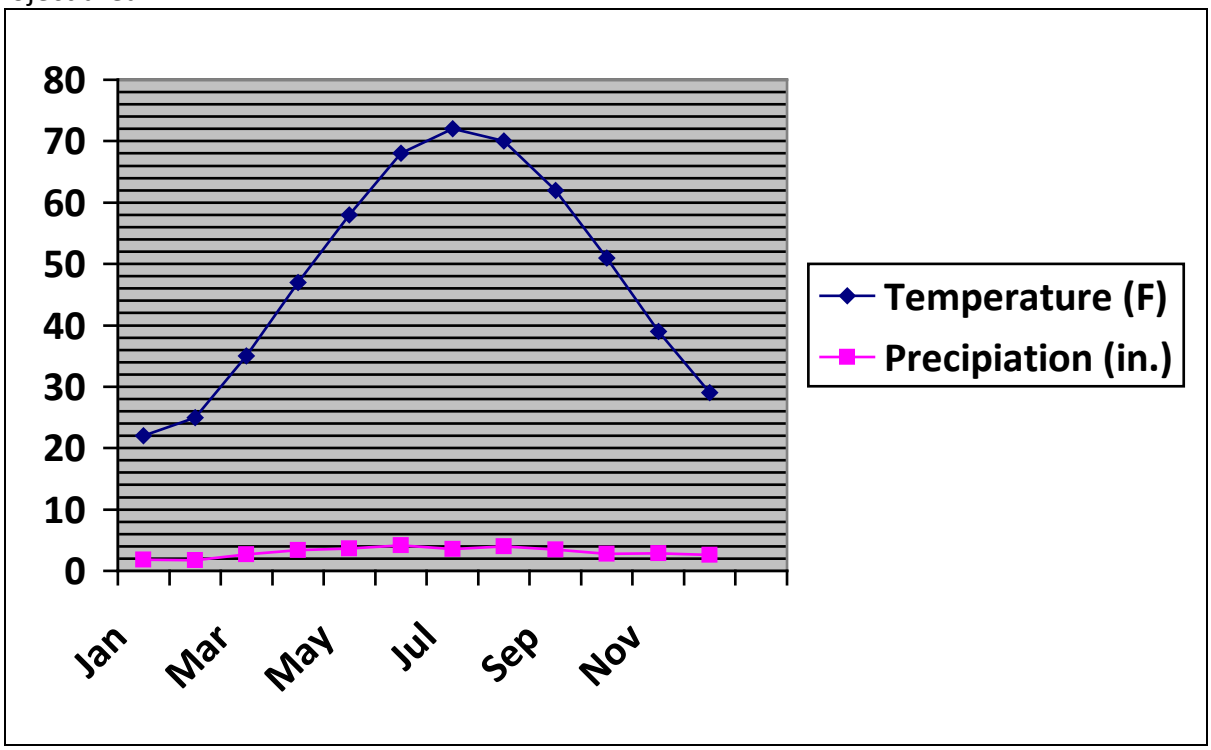

Figure 6: Pigeon River Watershed Climate

2.5 Hydrology

The Pigeon River watershed is comprised of many water resources including over 300 miles of streams, ditches, and canals, 2458 acres of lakes, 611 acres of ponds, and 19,894 acres of designated wetlands. There are 870 lakes, ponds, and reservoirs ranging in size from .25 acres up to 370 acres located within the project area. There are also over 479 miles of legal drain within LaGrange County and the portion of the watershed in the adjacent counties. Legal drains are waterways that are maintained by the local government for a designated use such as agricultural drainage ditches. Tables 4 through 6 show the number of stream miles and legal drains, and acres of wetlands, lakes, and ponds that are located within the Pigeon River project area.

Table 4: Stream Miles within the Project Area

Artificial Path (mi)	Canal/Ditch (mi)	Connector Ditch (mi)	Stream/River (mi)
90.74	55.76	0.13	160.85
Total		307.48	Miles

Table 5: Legal Drain Miles within the Project Area

County	DeKalb	Elkhart	LaGrange (Entire County)	Noble	St. Joseph	Steuben
	22.9	2.31	442.51	6.4	1.44	3.965
				Total	479.525	Miles

Table 6: Wetlands, Lakes, and Ponds within the Project Area

Freshwater Emergent Wetland (acres)	Freshwater Forested/Shrub Wetland (acres)	Freshwater Pond (acres)	Lake (acres)	Riverine (acres)	Other (acres)
6691.35	12823.55	611.91	2458.033	379.3791	0.01
			Total	22964.32	Acres

The most notable waterway located within the Pigeon River watershed is the Pigeon River itself. The Pigeon River is listed by Indiana as an "outstanding river" from S.R. 137 to the Indiana-Michigan border. An outstanding river is one that is of particular aesthetic or environmental value. The Pigeon River has over 40 miles of floatable length and flows through the Pigeon River Fish and Wildlife Area. For this reason, the Pigeon River is used frequently by outdoor recreation enthusiasts.

There are three dams located along the Pigeon River; at Mongo, forming the Mongo Millpond, at Ontario and at Nasby. The Mongo dam is regulated by the IN DNR to keep the millpond depth at a certain level to be used for hydroelectric power and it is approximately 77 acres in size. The Ontario pond is approximately 100 acres in size and the Nasby pond is nearly 40 acres in size. Both the Ontario and Nasby millponds are no longer used for hydroelectric power but are still both regulated by the IN DNR.

The IN DNR maintains a canoeing path along the Pigeon River from just east of Mongo up to the Michigan-Indiana border. There are three launching sites on the path; one at Mongo millpond, one just west of Howe, IN, and another west of Scott, IN near interstate 80/90. There are ten additional public access sites to the Pigeon River, which are not maintained by the state. The Pigeon River, as well as several surrounding lakes within the project area, is well regarded by anglers as there are several different types of fish that can be found within the watershed including largemouth bass, catfish, crappie, bluegill, and perch. As designated cold water streams, Pigeon River and Turkey Creek are both listed in the IN DNR 2011 trout stocking plan which has made this area of particular interest to anglers.

Northern Indiana is well known for three different attributes; 1) the many lakes in the area, 2) the abundance of hydric soils resulting in many wetlands, and 3) the prime agricultural land. These three resources located in northern Indiana can affect water quality and be affected by how the resources are used. For instance, the beautiful lake system in the project area has attracted not only the recreation enthusiasts mentioned above, but also many people who wish to live by or on the lakes' shores. There are thirteen residentially developed lakes located in the watershed in Indiana and two in Michigan. The following built-up lakes are located in the IN portion of the watershed starting east and moving west through the project area: Lake of the Woods, Big Long, Pretty, Big Turkey, Little Turkey, Royer, Fish, Pigeon, North Twin, South Twin, Shipshewana, Hunter, and Stone lakes. Marl and Fish lakes are located in MI. Total populations of each of these lakes cannot be accurately determined. The fact that these lakes are becoming more built-up is a concern of local stakeholders as this activity poses many threats to water resources such as sediment and excessive nutrients entering the lakes from overly manicured lawns and *E. coli* contamination from faulty or inadequately placed septic systems.

Nearly 90% of the project area use to be comprised of wooded areas and wetlands before the area was colonized. While many of these areas have been lost to agriculture or urbanized, there are still many wetlands that exist in the area; the most notable being located in the Pigeon River Fish and Wildlife Area (PRFWA) which is maintained by the IN DNR. The PRFWA has 356 acres of open water wetlands located on the property. Wetlands are vital to the sustainability of the ecosystem as they are essential for flood control and are natural pollution sinks as well as provide habitat for many flora and fauna including the endangered Massassauga Rattlesnake, Indiana Bat, and the Mitchell's Satyr Butterfly. Because of the many wetlands, which attract an abundance of fish and wildlife, located within the PRFWA, it is a popular destination for anglers, hunters and trappers as well as hikers and bird and wildlife watchers. Figure 7 shows where the wetlands within the project area have been delineated as determined by the USFWS National Wetland Inventory (NWI). The wetlands delineated in Figure 7 were not verified by a ground survey so should not be considered definite wetland boundaries but rather estimations only.

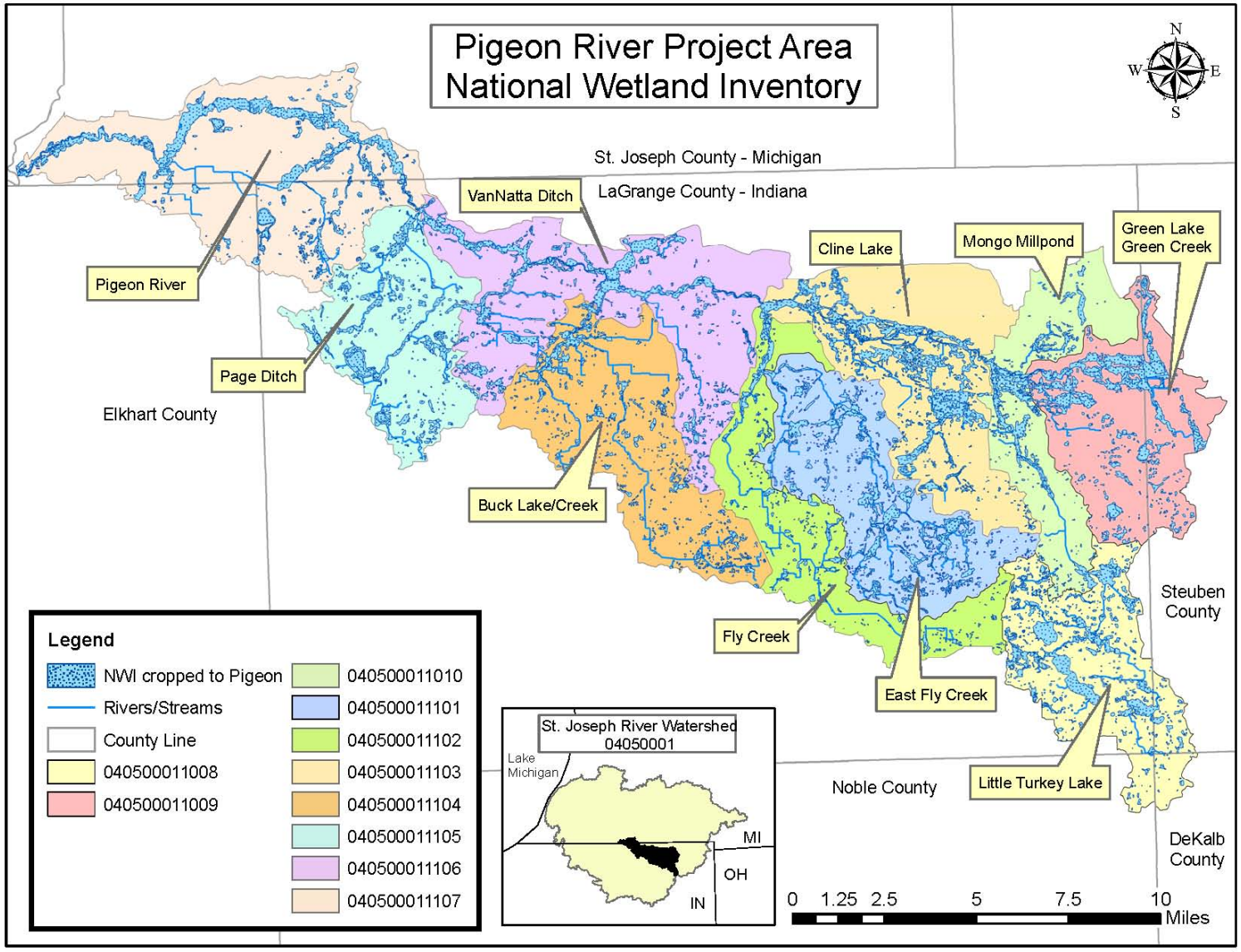

Figure 7: Wetlands Located within the Project Area

2.6 Land use

Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over-worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients have the potential to reach open water sources and effect aquatic plants and animals and cause the water to become non-potable. Livestock rearing often can lead to high levels of bacteria in open water from manure storage areas that are not properly maintained or from livestock having direct access to open water sources. These two activities can also lead to high levels of sedimentation and nutrients in the water column. Industrial areas and urban centers can pose a threat to water quality due to the increased imperviousness of the landscape and industrial waste outfalls. For the reasons listed above, it is very important to investigate land use activities in the project area so as to determine the best method of remediating the pollution coming from the various land uses in the project area.

The Pigeon River project area land use is primarily agriculture, as can be seen in Figure 8 and Table 7. The land in the watershed that is utilized for the purpose of agriculture is either in row crops or it is utilized as pasture fields; typically for horses and/or cattle. There are few urban areas located in the project area including LaGrange, IN (P=2927), Shipshewana, IN (P=529), Howe, IN (P=550), Mongo, IN (P=300) and White Pigeon, MI (P=1544). There are also several small, unincorporated areas located within the project area including Ontario and Scott, IN. Table 7 below shows the number of acres of land in each type of land use per sub-watershed. Values were determined through the use of the Long Term Hydrologic Impact Analysis (L-THIA) program maintained by Purdue University's Engineering Department. It is important to note that Figure 8 depicts more land uses than was analyzed using the L-THIA program, however the analysis performed by L-THIA is a more accurate tool to determine percentages of land use with in the watershed project area.

Table 7: Distribution of Land Use in the Project Area

Land use	Unit	Green Lake/ Creek	Mongo Millpond	Little Turkey Lake	Cline Lake	East Fly Creek	Fly Creek	VanNatta Ditch	Buck Lake	Page Ditch	Pigeon River	Total	% of Project Area
Water	Acres	3766.3	2390.9	3248.8	4705.8	3378.6	1138.9	3234.9	1761.9	1948.8	671.7	**26246.6**	**16.8**
Developed (High Density)	Acres	240.9	185.4	313.4	303.5	353	774.3	1064.7	471.5	677.5	678.2	**5062.4**	**3.3**
Developed (Low Density)	Acres	494	288.6	517.9	722.7	909.8	845.7	1005.6	569.6	471.8	1372.13	**7197.83**	**4.6**
Industrial	Acres	28.7	N/A	4.4	0.9	17.9	53.8	94.4	5.5	108.8	N/A	**314.4**	**0.2**
Cultivated Crops	Acres	6382	6146.7	5874.5	8992.8	7805.7	5852	10485.8	7341.3	4116.8	11471	**74468.6**	**47.9**
Grass/ Pasture	Acres	1688.5	859.9	2343.5	1158.7	3137.9	1796.2	3527	5618.1	4659.8	2639.7	**27429.3**	**17.6**
Forest	Acres	960.1	620.6	970.3	1412.4	1169.1	443	903.6	709.4	676.2	5600.7	**13465.4**	**8.7**
Other	Acres	1.5	0	10.2	6.2	0	2.1	0	4.7	3.3	1330.57	**1358.57**	**0.9**
Total	**Acres**	**13562**	**10492**	**13283**	**17303**	**16772**	**10906**	**20316**	**16482**	**12663**	**23764**	**155543**	**100**

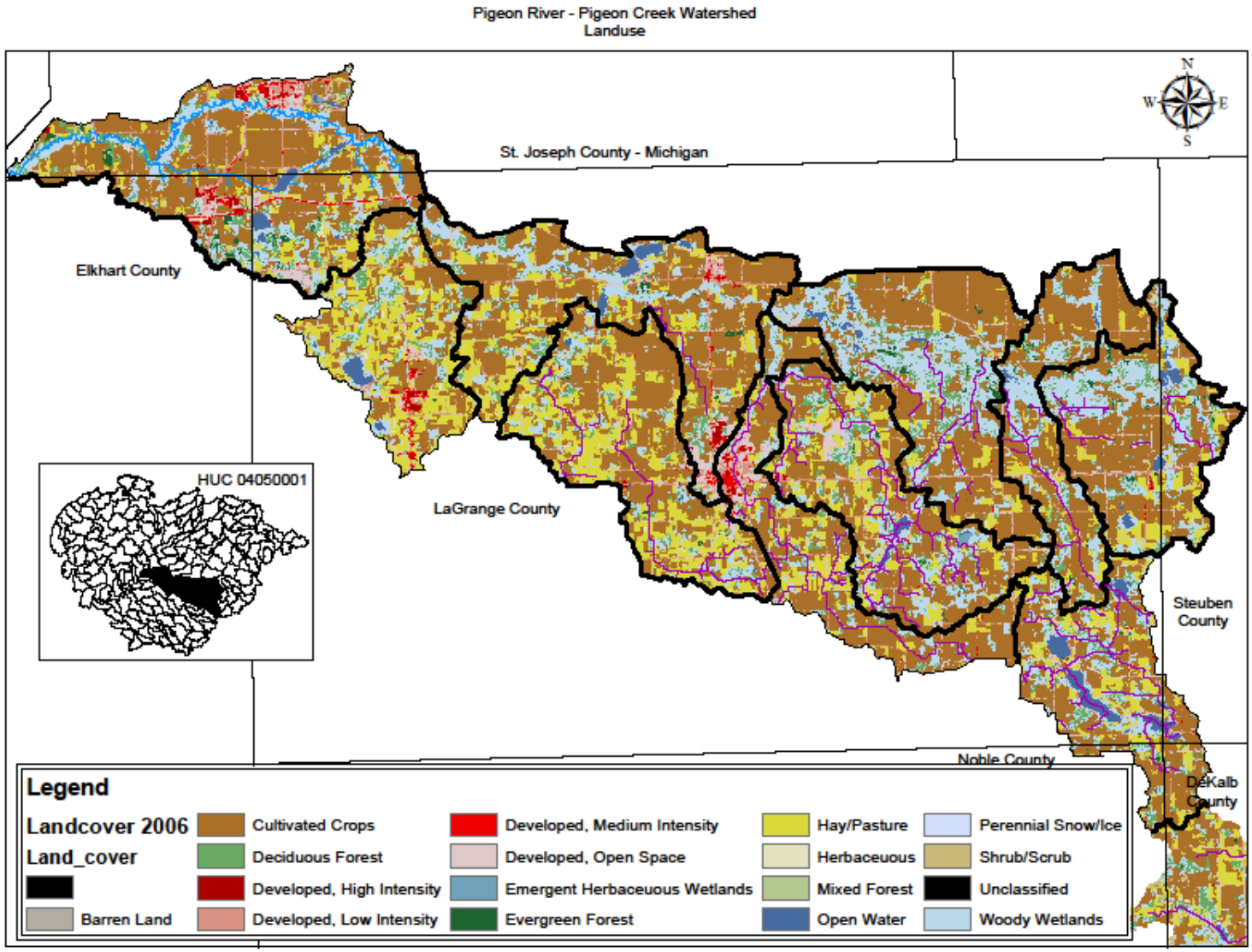

Figure 8: Pigeon River Watershed Project Area Land use

2.6.1 Tillage Transect

Tillage transect data was only requested for St. Joseph County, MI and Steuben and LaGrange County, IN as the portion of the watershed located in DeKalb, Elkhart, and Noble County is negligible. Transect data has not been collected in MI since 1993 and Jerry Grigar, the MI NRCS State Agronomist, believes there are a lot more beans and small grains in no-till now than when the data was last collected. Steuben County has been very successful in encouraging and implementing conservation tillage practices with over 90% of all fields being in some type of conservation tillage practice. LaGrange County has a significant number of fields in conservation tillage, but it has proven difficult to convince Amish producers in the county to switch from traditional conventional tillage practices. Table 8 shows the percent, or number, of fields in conservation tillage by county.

Table 8: Tillage Transect Data

County	Year Data Collected	No-Till	Mulch Till	Reduced Till	No-Till	Mulch Till	Reduced Till	Unit
		Corn			Beans			
St. Joseph	1993	20,000	N/A	N/A	14,000	N/A	N/A	Acres
Steuben	2010	37.9	32.2	23.2	93.9	3	2.4	Percent
LaGrange	2009	26	12	14	68	16	8	Percent

2.6.2 Septic Systems

There are several communities located within the project area utilizing on-site waste water treatment systems. However, it is important to note that the more populated towns and lakes are now on a centralized sewer system, or have plans to convert to a centralized sewer system in the near future. The communities on a central sewer system are the towns of LaGrange and Shipshewana, as well as Fish and Royer Lake which are serviced by the LaGrange County Regional Utility District F and Little and Big Turkey Lakes, Lake of the Woods, Pretty Lake and Big Long Lake which are serviced by the LaGrange County Regional Utility District B.

In 2005 the LaGrange County Health Department conducted a study to determine the number of faulty septic systems present within LaGrange County. Through that study, it was determined that nearly 75% of all septic systems within LaGrange County are failing. This is likely due to the fact that there are very few soils located within the project area that are considered by the United States Department of Agriculture to be suitable for septic system usage. As discussed in Section 2.3, USDA soil surveys rank soils as being suitable, somewhat limited, or very limited for septic system placement. Most soils located within the project area are ranked as either very limited or somewhat limited for septic system usage. This is due to the porous soils and a high water table. Faulty septic systems are a concern as septic system leachate may increase nutrient levels, as well as, fecal coliform, including the harmful *E. coli* bacteria, in both surface water and ground water, which is the predominant source of drinking water within the project area. Figure 9 graphically shows the location of soils in the watershed that are ranked somewhat or very limited for septic system placement.

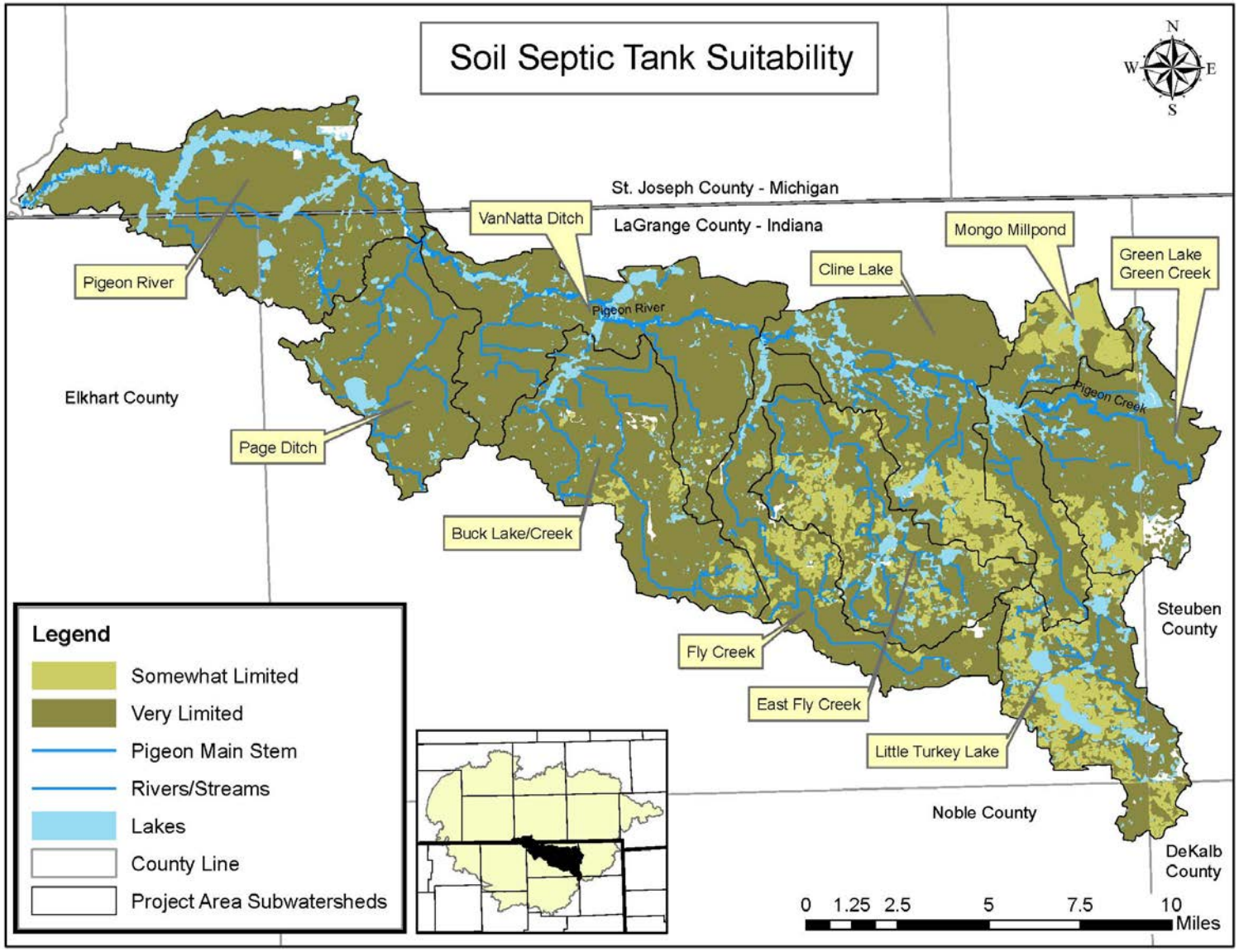

Figure 9: Project Area Soil Suitability for Septic System Placement

2.6.3 Animal Feeding Operations

With a large portion of the population in the project area being Amish, many of the rural homes have several horses on the property, including standard horses to be used as a means of transportation, and draft horses which are used as work horses, typically for plowing. The large number of horses in the watershed can pose a threat to water resources as they leave a significant amount of manure on public roads, and often have direct access to surface water for drinking water. This will be discussed in further detail in subsequent sections.

Also scattered throughout the project area are animal operations with animal counts below the threshold which would require the producer to acquire a permit. It has been noted that several poultry houses are going up throughout LaGrange County. There are also several livestock operations, mostly dairy, scattered throughout the project area. The unregulated animal feeding operations can pose a threat to surface water if the manure is not properly stored or utilized, the barnyard does not have runoff control, and if the livestock have direct access to an open ditch.

There are 15 registered Confined Feeding Operations (CFOs) located in the project area, with two of those CFOs being Concentrated Animal Feeding Operations (CAFOs). A confined feeding operation is so designated if there are 300 cattle, 500 horses, 600 swine or sheep, or 30,000 fowl present on the property and confined for at least 45 days during the year where there is no ground cover or vegetation present over at least half of the animals' confinement area. If the size of the operation is very large, or there have been compliance issues with an operation in the past, the CFO may be designated as a Concentrated Animal Feeding Operation (CAFO), and will be required to obtain a National Pollution Discharge Elimination System (NPDES) permit. A map of CFOs/CAFOs located in the project area can be seen in Figure 10.

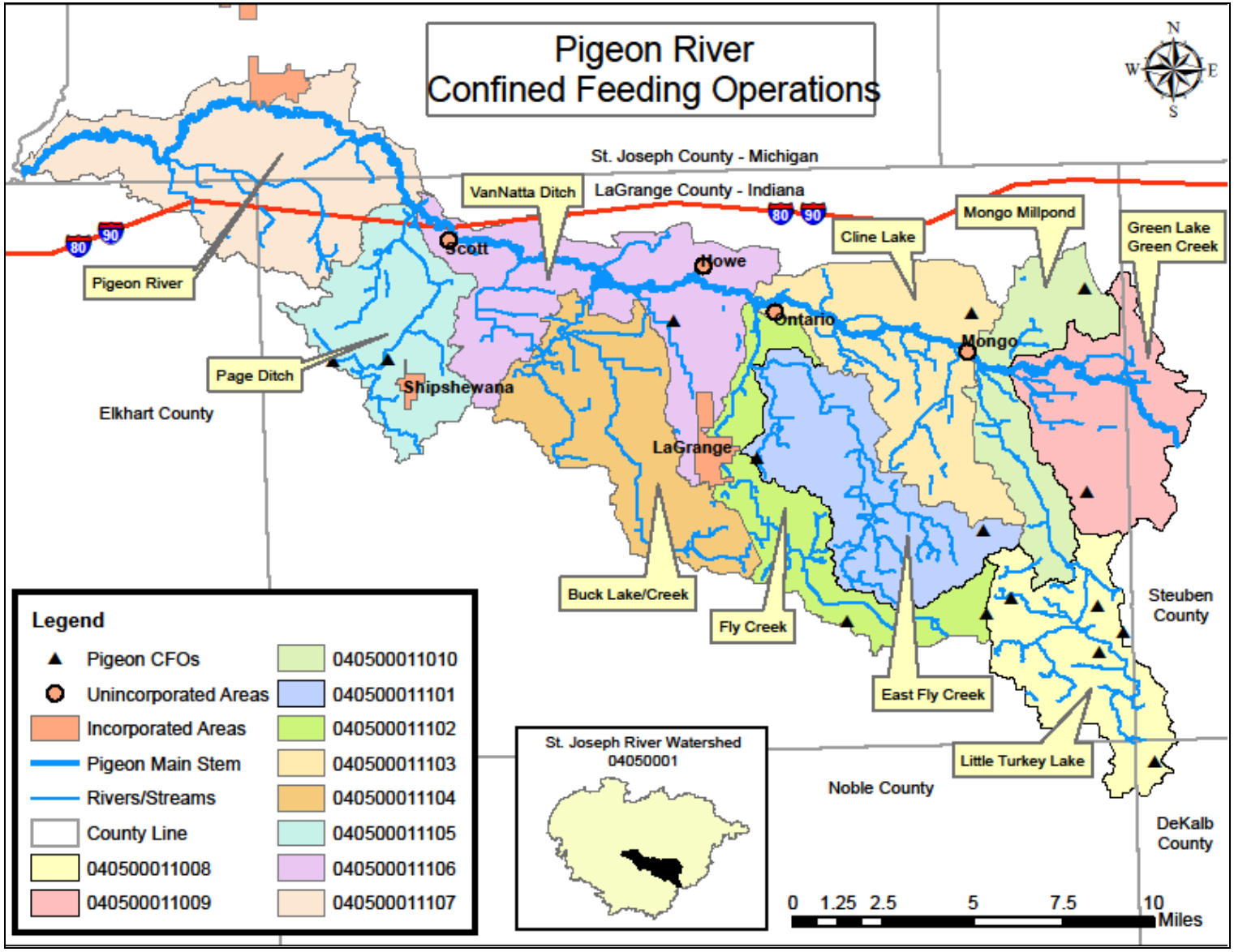

Figure 10: Pigeon River Project Area CFOs

2.6.4 Population Centers

Few medium and low density urban areas are located within the project area including the incorporated city of LaGrange (P = 2927) and Town of Shipshewana (P = 529), as well as the unincorporated Village of Howe (P = 550), Village of Mongo (P = 300), Scott and Ontario, Indiana (population not documented) and over half of the incorporated area of the Village of White Pigeon, MI (P = 1544) (Figure 11). While most urban areas have a stagnant growth rate, the Town of Shipshewana has been growing rapidly due to it being a prime tourist attraction in the region. Of the 870 lakes, ponds, and reservoirs located in the project area; fifteen of the lakes are built-up. When people make their home around a lake much of the natural land around the lake is removed to make room for houses, boat launches, septic systems, and turf grass. This often leads to increased imperviousness and nutrient content of the lake, and decreased prime wildlife habitat.

2.6.5 Community Parks

Several parks, encompassing approximately 12,178 acres of land, are located within the project area. The parks are managed by the state, county, town, or a non-profit entity. The parks are used by local stakeholders for recreational purposes. A list of the parks located within the project area is provided in Table 9.

Table 9: Parks Located Within Pigeon River Watershed

Name	County	Acreage	Managed by:
Cline Lake Fen	LaGrange	124	The Nature Conservancy
Maple Wood Nature Preserve	LaGrange	29.6	Acres Land Trust
Maple Wood Park	LaGrange	131	LaGrange Parks Dept
Pigeon River Fish and Wildlife Area	LaGrange	11,605	IN DNR
Pine Knob Park	LaGrange	59	LaGrange Parks Dept
Scott Mill Park	LaGrange	120	LaGrange Parks Dept
Shipshewana Lake Beach	LaGrange	2	LaGrange Parks Dept
Shipshewana Town Park	LaGrange	23	Shipshewana Park Dept
Stark Nature Preserve	LaGrange	41.2	Acres Land Trust
Turkey Creek Wetland Conservation Area	LaGrange	8	IN DNR
Wahbememe Historical Monument	St. Joseph	N/A	St. Joseph Parks Dept
Yost Pond Nature Preserve	LaGrange	35	IN DNR

2.6.6 Potential Contamination Sites

There are several remediation sites and potential contamination sites located in the project area including underground storage tanks (USTs), leaking underground storage tanks (LUSTs), facilities required to hold a National Pollution Discharge Elimination System (NPDES) permit, and industrial waste sites (Figure 11). These sites must be monitored carefully to be sure that no contamination of surface or ground water occurs. There are no brownfield or superfund sites located within the project area.

USTs are managed by the IDEM Office of Land Quality's Underground Storage Tank program and the MI DEQ Underground Storage Tank program. The states are charged with assuring all underground storage tanks meet both state and federal regulations to mitigate the risk of contamination to surrounding land and/or water resources. The states are also responsible for making sure those tanks that do not meet requirements are properly closed or up graded. There are 54 USTs located in the project area, of those, 31 are considered to be LUSTs. LUSTs will be discussed in Section 3 under each respective subwatershed.

Facilities that discharge directly into a waterbody are required to obtain an NPDES permit from the overseeing state agency (IDEM and MI DEQ). The permit regulates the amount of contaminants a facility can discharge into surface water and requires the facility to conduct regular water quality monitoring. While these facilities are regulated by the State, there is the potential that they may have accidental leaks, or in some cases, the facilities may release a substance that they are not required to report to the State which may pose a threat to water quality; phosphorus is a common parameter not required to be reported. There are several NPDES permitted facilities located in the project area. NPDES facilities and their discharge points will mapped in their respective subwatershed in Section 3 of this WMP.

There are several facilities located on the EPA's toxic release inventory (TRI) as industrial waste sites located throughout the project area. However, most facilities are located near population centers or near interstate 80/90. The TRI is a database containing the names of facilities that dispose of or release toxic chemicals into the environment. There are over 600 toxic chemicals that are included in the TRI.

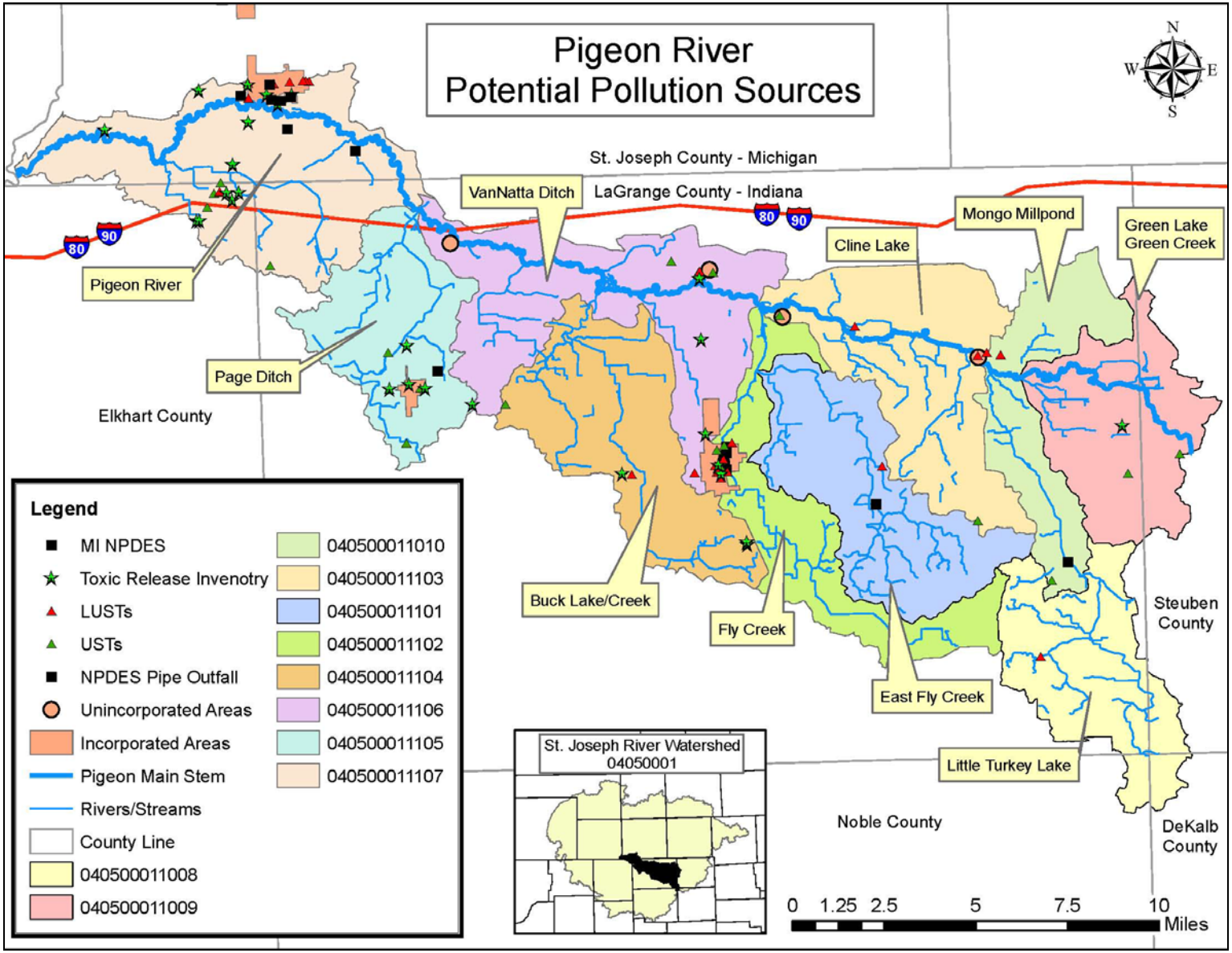

Figure 11: Potential Pollution Sites

2.7 Current and Historic Watershed Planning Efforts

The project area provides many scenic areas which many of the stakeholders in the watershed feel should be preserved as well as an abundant amount of recreational opportunities for the individuals who live within the project area and tourists from around the region. For these reasons, several studies regarding water quality, land use, and wildlife habitat have been conducted and many resource management plans have been developed within the Pigeon River watershed.

The Steuben County SWCD developed a WMP for the Pigeon Creek watershed located entirely within Steuben County. While the WMP does not cover any portion of the Pigeon Creek or Pigeon River located within this project area, it does provide information regarding problems found in the Pigeon Creek, which drains into the Pigeon River watershed, and proposes solutions to those problems.

Several concerns that were identified during the creation of the Pigeon Creek WMP mirror the concerns of the stakeholders within the Pigeon River watershed and are outlined in Table 10. The proposed solutions to stakeholder concerns and water quality problems identified in the Pigeon Creek WMP, once implemented, will have a positive impact on the project area's water quality by decreasing the amount of NPS entering the Pigeon River watershed.

Table 10: Stakeholder Concerns in the Pigeon River and Pigeon Creek Watersheds

Concerns	Pigeon River Watershed	Pigeon Creek Watershed (Steuben)	Proposed Solutions from Pigeon Creek WMP
Livestock access to open water	√	√	Fence animals out of open water
Stormwater runoff from barnyards	√	√	Manure management, filter strips
Increase in impervious surfaces	√	√	limit new construction, on-site stormwater management
Fertilizer used on urban lawns	√		
Lakes in the area becoming more built-up	√		
Septic system discharge	√	√	Inspections, dye testing, hook-up to municipal sewer systems, education/outreach
Horse manure on public roads	√		

There have been several studies completed specifically in the Pigeon River watershed as well as Master and/or Comprehensive Plans for urban areas located within the project area. Table 11 is a list of the scientific or investigative studies that are relevant to the concerns of the project

stakeholders and have been completed within the project area to date, the date in which it was completed, by whom the study was conducted, and the relevance of the study to stakeholder concerns. Table 13 is a list of the Municipal Master/Comprehensive Plans that have been completed within the project area and Table 14 is a list of all wellhead protection plans that have been completed in the project area to date.

Table 11: Previous Studies in Pigeon River Watershed

Study/Plan	Topic	Year	Writer	Stakeholder's Relevant Concern
Big Turkey and Little Turkey Lake Enhancement Feasibility Study	Water Quality	1990	Harza Engineering Co	Lakes in the area becoming more built-up, fertilizer used on urban lawns
Big Long Lake, Lake of the Woods, McClish Lake, and Pretty Lake, A Study for their Improvement, Restoration, and Protection	Water Quality/ Fisheries	1991	EarthSource Inc.	Lakes in the area becoming more built-up, livestock access to open water, fertilizer used on urban lawns
Monitoring Study for the Turkey Creek Land Treatment Project	Water Quality - Land Treatment	2001	J.F. New Assoc. Inc.	Septic system discharge
Pretty Lake Diagnostic Study	Water Quality/Fisheries	2007	J.F. New Assoc. Inc.	Septic system discharge, Lakes in the area becoming more built-up, fertilizer used on urban lawns
Pretty Lake Engineering Feasibility Study	Land Treatment	2009	J.F. New Assoc. Inc.	Septic system discharge, Lakes in the area becoming more built-up, fertilizer used on urban lawns
Saint Joseph River Watershed Management Plan	Water Quality/Watershed Management	2005	Friends of the St. Joseph River Association	Septic system discharge, stormwater runoff from barnyards, fertilizer used on urban lawns

Big Turkey and Little Turkey Lake Enhancement Feasibility

The 1990, Harza study of Big and Little Turkey Lakes was conducted at the request of the lake residents and users as they noticed increased macrophyte beds, algae blooms, and sediment plumes following storm events. The Turkey lake stakeholders were concerned about the overall water quality of the lake system as the lakes became more built-up and unsustainable agricultural farming techniques lead to increased erosion and nutrient runoff. The main recommendation proposed in the study to remediate the problems seen in the lakes was to install wetlands within the lake watersheds to act as sediment traps which would not only lower the frequency of sediment plumes but would also keep nutrients attached to the soil particles from reaching the lakes thus lowering the frequency of macrophyte and algae beds. However, it was recognized that the installation of sediment traps is not a long term solution to the problem. Therefore, the study recommended that agricultural land within the watershed be enrolled in the Conservation Reserve Program (CRP), cover crops be installed, and nutrient management plans be implemented to stop the pollution at the source.

Big Long Lake, Lake of the Woods, McClish Lake, and Pretty Lake

As mentioned previously, the lakes in Northeast Indiana provide many resources to the region such as fishing, swimming, boating, and wildlife viewing and they provide a great economic benefit to the community. For this reason, the LaGrange County Health Department performed a preliminary study of 24 lakes within LaGrange County in 1988. The 1991 study conducted by EarthSource, Inc. was an expansion of that initial study. The findings made by EarthSource indicated that many of the lakes in LaGrange County are eutrophic as a result of increased urban expansion, unsustainable agricultural practices, and excess phosphorus entering open water from sediment runoff and agricultural and urban fertilizers. Recommendations provided by EarthSource to remediate the problems seen within the lake system include preservation of forests, riparian vegetation and wetlands, avoid stream modification, stabilize drainage areas after and during construction, restrict livestock access to open water, incorporate manure immediately after land application, use low phosphorus fertilizers, and use lake water as fertilizer to provide a source of nutrients.

Monitoring Study for the Turkey Creek Land Treatment Project

The Steuben County Soil and Water Conservation District received funding in 2001 from the INDNR, Lake and River Enhancement Program (LARE) to perform a water quality analysis in the Turkey Creek Watershed as stakeholders were concerned about the degradation of the creek. The findings of the study showed *E. coli* levels that exceeded the state standard, impaired fish and insect communities, and aquatic habitat, as well as a lack of pool-riffle-run characteristics in the creek which is necessary for a healthy biotic community. Several recommendations were provided in the study which would improve water quality within the watershed. The recommendations included implementing best management practices such as riparian corridor plantings, streambank stabilization, wetland restoration, and nutrient, pesticide and tillage management plans, among others and to begin an intensive stakeholder education program focusing on water quality and best management practices. It was also suggested in the study to continue monitoring water quality as BMPs are implemented to determine the effects the projects are having on the quality of watershed. The Steuben county SWCD has continued to receive funding to implement the BMPs outlined in the study and has had great success doing so over the past decade. Table 12 shows the BMPs implemented through the Turkey Creek LARE grant.

Table 12: Turkey Creek Implementation

BMP	Amount	Unit
Filter Strip	53.4	Acre
Tree Plantings	136.2	Acre
Sediment Control Structures	9	Each
Animal Waste Facility	2	Each
Hay Plantings	716.4	Acre
Grass Waterway	8945	Feet
Critical Area Planting	1.1	Acre
Tree Spraying	79	Acre
Riparian Buffer Strip	1	Each
Exclusion Fence	3451	Feet
Water Facility	1	Each
Integrated Crop Management	1201.1	Acre
Cover Crop	69	Acre

Pretty Lake Diagnostic Study

Pretty Lake has historically been known as a lake with good water quality and great clarity which has drawn individuals to the lake for recreational activities as well as a home. The shoreline of the lake has been completely developed over the last several decades which led to an increase in NPS reaching the lake. Lake residents began to notice a decrease in water clarity, especially after heavy rain events, and together with the Pretty Lake Conservation Club, applied for funding through the LARE Program in 2006 to perform a diagnostic study of the lake's water quality and the surrounding land uses. Water quality and land use analysis in the Pretty Lake watershed suggest that while water quality appears to be good at the present, there is

potential for it to degrade due to the soil being unsuitable for septic systems, the presence of highly erodible land, and high levels of *E. coli* present in water samples.

Pretty Lake Engineering Feasibility Study

The 2009 Pretty Lake Engineering Feasibility Study, conducted as a follow-up to the 2006 diagnostic study, outlines several best management practices that should be implemented to protect Pretty Lake's water quality. These BMPs include grass swales, a rain garden, a stormwater catch basin, repairing a broken residential drainage tile, a two-stage ditch, and tree canopy reduction to promote the growth of vegetation along the streambank. All suggested practices have been given written approval by the landowner or appropriate entity in charge of the area, except for the rain garden. If these practices are implemented, the amount of sediment carrying other contaminants that reach Pretty Lake will be significantly decreased. While the main concern being addressed in the Pretty Lake studies was sedimentation, the suggested BMPs, if implemented, will also address the Pigeon River stakeholder concerns of increased fertilizer reaching open water after being over applied on urban lawns and the increase in stormwater runoff due to an increase in impervious surfaces. There have been no BMPs implemented on Pretty Lake as a result of this study to date.

St. Joseph River Watershed Management Plan

The Friends of the Saint Joe River Association, a 501(c)3 organization, completed a watershed management plan for the entire St. Joseph River watershed (HUC 04050001) in 2005. The watershed is 4,685 square miles and includes 15 counties in Michigan and Indiana. Because of the large size of the watershed, the WMP is vague in its description of the watershed and the water quality problems in the watershed. However, the plan noted the Pigeon River watershed as being critical for agricultural practices that degrade water quality. Using a SWAT model, it was determined that the most effective BMPs to limit NPS pollution from entering the Pigeon River are a combination of no-till, filter strips, and contour farming. The WMP also recognizes the LaGrange County SWCD for its efforts to reduce sediment, nutrient, and pathogen contamination of surface water by implementing a livestock management program.

Table 13: Previous Master/Comprehensive Plans in Pigeon River Watershed

Study/Plan	Topic	Year	Writer	Stakeholder's Relevant Concern
Shipshewana Master Plan	Town Planning	1993	Ball State University	Increase in impervious surfaces, lakes in the area becoming more built-up
St. Joseph County Master Plan	County Planning	1997 (updated 2007)	St. Joseph County Planning Commission	Livestock access to open water, septic system discharge
LaGrange County Comprehensive Plan	County Planning	2005	McBride Dale Clarion	Increase in impervious surfaces, lakes in the area becoming more built-up
LaGrange County Parks Department Master Plan	County Planning	2008	LaGrange County Parks Department	All concerns through education

Shipshewana Master Plan

The town of Shipshewana, IN, located in Page Ditch subwatershed, contracted Ball State University to write a Master Plan for the town in the late 1990s. Unfortunately, due to restructuring of the town government, the majority of the Plan has been lost. The portion of the Plan that is available includes plans to develop a nature trail along the old Pumpkinvine railroad corridor between the city of Elkhart and Shipshewana, improve the water quality of Shipshewana Lake, and hook the unsewered residences of Shipshewana Lake up to the Shipshewana waste water treatment plant. To date, the Pumpkinvine trail has begun development, providing more outdoor recreational opportunities for local residents and tourists, Shipshewana Lake has been dredged and water quality educational workshops and materials have been provided to the residents living on the lake, and Shipshewana began accepting bids on a waste water treatment system in November, 2010 for Shipshewana Lake residents. Work was slated to begin on the project in 2011, though no activity has taken place yet. While only a small portion of the original Master Plan is available for review, two of the major stakeholder concerns are addressed in the Plan; Lakes in the area becoming more built-up and septic system discharge. It should be noted however, that the town of Shipshewana is currently in the process of rewriting a complete Master Plan. A completion date for the new Master Plan has not been set.

St. Joseph County Master Plan

The St Joseph County Planning Commission, recognizing the fertile soil and abundance of ground water for irrigation, developed a County Master Plan in 1997 focusing on the protection of prime farmland within the county, while also taking into account the natural resources of the area. Several of the goals established during the development of the Master Plan are directly related to concerns expressed by the Pigeon River Project Steering Committee. Those goals are listed below.

- "Provide for the development of sanitary sewers, improved sanitary disposal systems…"
- "…encourage long-term commitments to environmentally sound agricultural activities…"
- "Encourage intensive livestock operations …to locate away from areas prone to flooding."
- "Do not over-plan or over-zone for commercial (or industrial) development."
- "Establish a minimum setback for vegetative buffer along lakeshore or stream (and septic tanks and drainfields)."
- "Direct animal grazing landward of the vegetative buffer strip (along lakeshores and streams)."

The St. Joseph County Planning Commission has been updating their Master Plan regularly. The last update was completed in 2007 and it had a stronger focus on environmental conservation and preservation including such goals as maintaining a 1:1 ratio of "built-up" area and open and/or green space. The 2007 update also included a map of areas where increased sewer system capacity is necessary to maintain the integrity of the surrounding natural resources. Figure 12 is a map, taken from the 2007 Master Plan update, showing where the current wastewater treatment plants are and where new or expanded systems should be constructed to meet the projected population growth. The black oval drawn on the map represents the area of St. Joseph County located within the Pigeon River project area.

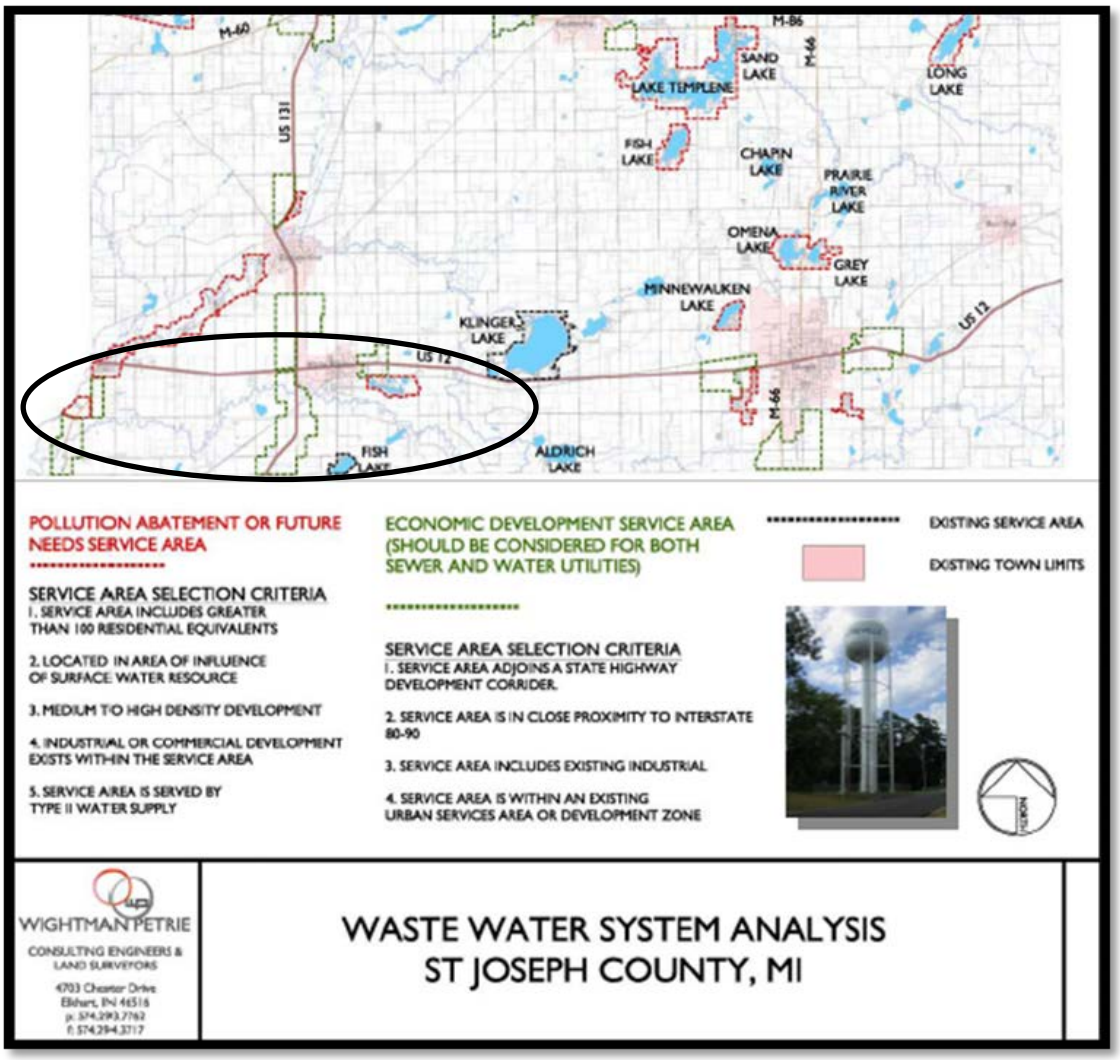

Figure 12: St. Joseph County Projected Wastewater Treatment Expansion

LaGrange County Comprehensive Plan

On December 6, 2010, the LaGrange County released their Comprehensive Plan. The Plan consists of two major subsections; the Planning Foundation and the Land Use Plan. The Planning Foundation takes natural resources into account, recognizing the uniqueness of the landscape of the county, where the Land Use Plan outlines strategies to limit the impact of urban sprawl and other construction activities on the natural environment. Goals and concerns outlined in the Plan that relate to the concerns of stakeholders in the watershed are:

- "New development will be built in a manner that maintains the integrity of the natural environment"
- "Water and water quality are valuable resources to the county both as a source of recreation and lifestyle but also as a life necessity"
- "…Urban sprawl will be minimized"
- "…poorly installed groundwater wells, placement of waste removal systems, improper manure management, or uncontrolled storm water runoff can create safety hazards…"

- "Encourage commercial uses, which are not associated with homes or farms, to locate on paved roadways"
- "Development of residential uses should be permitted at densities not to exceed two units per acre where adequate sanitary sewer services are available…housing units that have no access to sanitary sewer services should be restricted to one unit per acre…"

LaGrange County recognizes the value of the lake system and natural resources they have available in the county and have planned for their preservation to the best of their ability in the County Comprehensive Plan.

LaGrange County Parks Department Master Plan

The LaGrange County Parks Department developed a five year LaGrange Parks Master Plan in 2008. LaGrange County manages eleven parks labeled in Figure 13, which was taken directly from the Parks Master Plan. Of the eleven parks in the Plan, four are located within the Pigeon River project area; Shipshewana Lake Beach (2 acres), Scott Mill Park (120 acres), Pine Knob Park (59 acres), and the largest of the LaGrange County Parks, Maple Wood Park/LaGrange County Nature Preserve (131 acres). Parks are an important asset in any community as it provides a place for residents to get outdoors and explore nature, engage with the community, and learn about the natural environment. Parks are also an asset to water quality as parks provide "green spaces" which help to filter storm water runoff from urban areas, and limit the amount of storm water draining directly into the municipal sewer system.

There are two main goals of the LaGrange County Parks Department which are relevant to this WMP; 1) "wisely use and preserve the county's natural resources, parks, and facilities" and 2) "expand recreational opportunities in LaGrange County". These two goals correspond with the desires of LaGrange County residents according to a survey taken by the Parks Department before the release of the Master Plan. As a result of the survey, a priority exclaimed in the Master Plan is to "Maintain quality natural plant communities, wetlands, bogs, prairies, etc…" and a goal was added to include providing "…a variety of recreational, historical, and educational programming that focuses on our natural resources and parks." Both goals, if accomplished will greatly increase the public's awareness of natural resource issues.

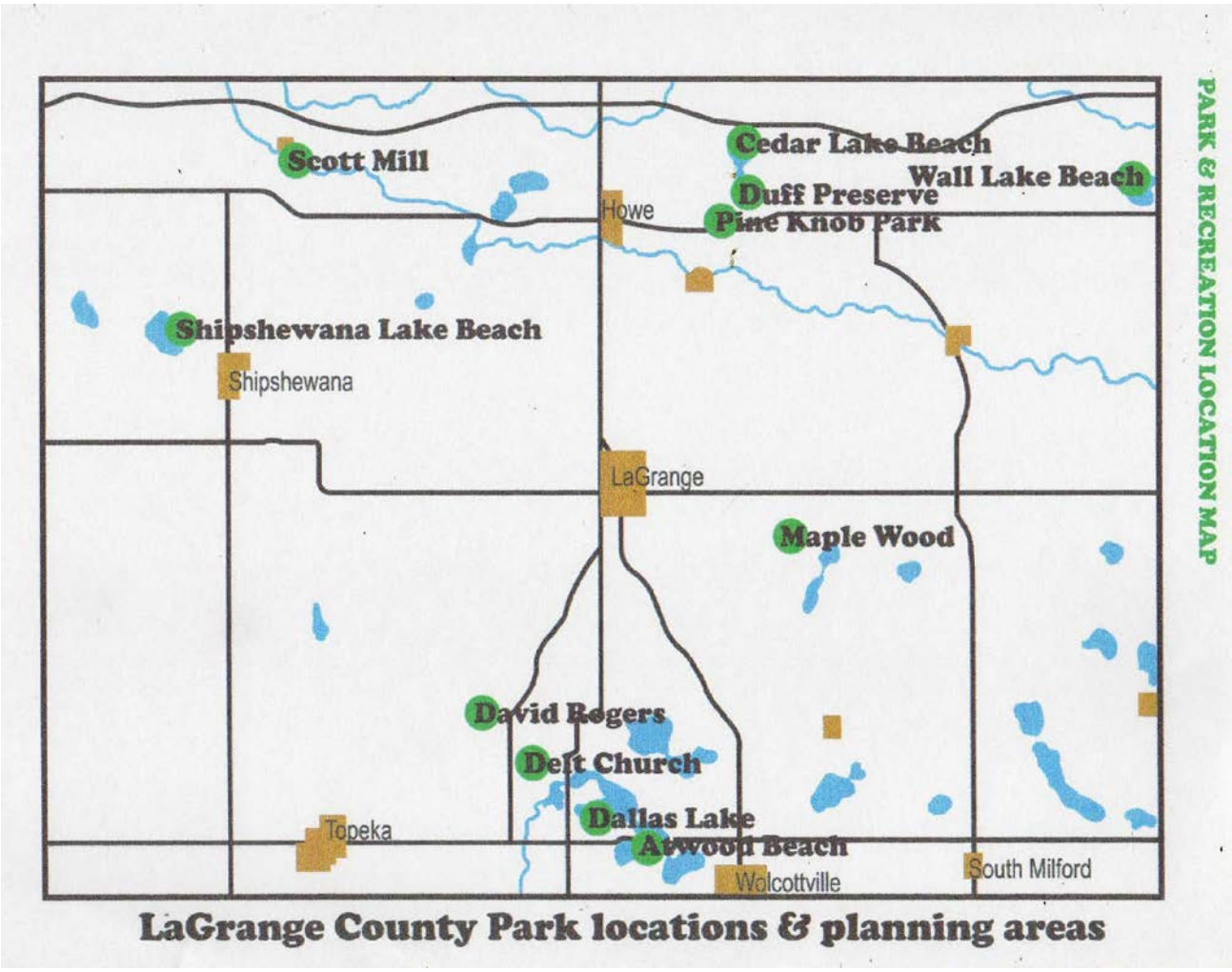

Figure 13: LaGrange County Managed Parks

There are no communities located within the project area that have combined sewer outfalls. Combined sewer outfalls can pose a serious threat to surface waters as they are sewers that collect rainwater runoff, domestic sewage, and industrial waste in the same pipe. Typically all the water is treated at a waste water treatment plant (WWTP), however during periods of heavy rain or snowmelt, the WWTP cannot treat the large volume of water entering the plant and much of it bypasses the WWTP and is discharged directly into a waterway. The town of LaGrange used to have combined sewers but recognized this as a problem and updated the sewer system in 2003, prior to the requirement for a Long Term Control Plan, and eventual implementation, by the State.

Most of the population in the project area receives their drinking water from the vast supply of ground water present in the area. In fact, LaGrange County is ranked second in Indiana for supplying drinking water via ground water. There are nine community public water supply systems (CPWSS) in the project area (three in St. Joseph County, MI and six in LaGrange County, IN) which draw their water through groundwater wells. A CPWSS is designated as such if it has 15 service connections or supplies drinking water to at least 25 people, according to the federal

Safe Drinking Water Act. In Indiana a CPWSS, the entity controlling the system, is required to develop a Wellhead Protection Plan (WHPP); it is a voluntary process in Michigan. A WHPP must contain seven elements according to the MI Department of Environmental Quality, which is more stringent than IDEM's requirements; 1) Roles and Responsibilities of those involved in the WHPP, 2) Wellhead Protection Area Delineation of where ground water is being drawn from, 3) Potential Sources of Contamination to identify known and potential areas of contamination within the wellhead protection area, 4) Wellhead Protection Area Management to provide ways to reduce the risks found in step three, 5) Contingency Plan in case of a water supply emergency, 6) New Wells to identify the ability to meet existing and future water needs will be examined, and 7) Public Education and Outreach to outline a plan to educate the public on ground water quality and wellhead protection.

Indiana has two phases of wellhead protection. Phase I is the development of the WHPP and Phase II is the first WHPP update; one is required every five years from Phase II on. All communities located within LaGrange County have completed Phase I of the requirement and are slated to be working on Phase II. One community in St. Joseph County, White Pigeon, is currently in the work plan stage of the project, which is when they begin delineating the 10 year time of travel for water within the aquifer in question. According to the wellhead protection program of the MI DEQ, White Pigeon is currently not doing any work on their WHPP. There are two mobile home parks in St. Joseph County which should develop a work plan, but have not yet begun the planning process. Table 13 identifies those CPWSSs located within the project area and which phase they are currently in.

Table 14: Wellhead Protection Plans in Process

System Name	Population	Phase	Approval Date	Next Phase Due Date (if known)
Lakeside Manor Mobile Home Park	215	Phase I	8/2/2004	8/2/2014
LaGrange Department of Water Works	2919	Phase I	10/5/2005	10/5/2015
Shipshewana Water Works	536	Phase I	9/15/2003	9/14/2013
Pioneer Country Estates	60	Phase I	10/5/2004	10/5/2014
Autumn Grove	55	Phase I	2/23/2007	2/23/2017
Hickory Grove Mobile Home Park	25	Phase I	6/16/2004	6/16/2014
White Pigeon	1640	Work Plan	N/A	Unknown
River Forest Mobile Home Park	140	N/A	N/A	Unknown
White Pines Mobile Home Park	90	N/A	N/A	Unknown

The federal Clean Water Act requires storm water discharges from larger urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. These communities are referred to as Municipal Storm Sewer System (MS4) Communities and are required to develop a Storm Water Quality Management Plan.

Elkhart County is the only entity located within the project area designated as an MS4 community. IDEM describes a MS4 as "a conveyance or system of conveyances owned by a

state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water." The reason that MS4s are required is that urban storm water runoff has one of highest potentials for carrying pollutants to our waterways and as such, the Federal Clean Water Act requires that certain storm water dischargers acquire a National Pollutant Discharge Elimination System (NPDES) permit. Being a MS4 community, Elkhart County was required to develop a Storm Water Quality Management Plan (SWQMP) for the cities of Goshen and Elkhart. However, proactively, the county government extended the boundaries of the Plan to include the entire Elkhart County. The SWQMP must include six management techniques, referred to as "minimum control measures" (MCMs) including; 1) Public education and outreach; 2) Public participation and involvement; 3) Illicit discharge, detection and elimination; 4) Construction site runoff control; 5) Post-construction site runoff control; and 6) Pollution prevention and good housekeeping. Essentially, the MCMs list several management practices to limit the amount of storm water entering the sewers on a regular basis. Since the portion of the Pigeon River Watershed project area that is located within Elkhart County is exclusively rural, the SWQMP does not contain any MCMs relevant to this project.

2.8 Endangered and Threatened Species

The Pigeon River watershed is home to many federally and state listed endangered and threatened species. The US Fish and Wildlife Service (USFWS) maintains a database of those species that are either endangered or candidates to become endangered on the federal level which can be seen in Table 15. Two species of significance are the Indiana Bat and the Eastern Massassauga rattlesnake, both of which rely on wetland and upland forested areas for habitat. According to the USFWS, the Indiana Bat population has decreased by over half since it was originally listed as endangered in 1967. This decrease in population can be attributed to human activities disturbing the Indiana Bat's habitat. The reason the bats population has declined in northern Indiana is mainly due to their breeding and feeding grounds, riparian and upland forests, being cleared for agricultural purposes and expanding urban areas. The Massassauga Rattlesnake is endangered due to the clearing of its wetland habitat for agricultural purposes.

Table 15: Federally listed Endangered Species

County	Species	Common Name	Status	Habitat
Birds				
St. Joseph (MI)	*Numenius borealis*	Eskimo Curlew	Endangered	Open fields of grasses, sedges, and low shrubs
MAMMALS				
DeKalb, Elkhart, LaGrange, Noble, Steuben, St. Joseph (MI)	*Myotis sobalis*	Indiana Bat	Endangered	Hibernation in caves, swarming in wooded areas and stream riparian corridors
St. Joseph (MI)	*Canis lupus*	Gray Wolf	Threatened	Forests
MUSSELS				
DeKalb, St. Joseph (MI)	*Pleurobema clava*	Clubshell	Endangered	Rivers
DeKalb, St. Joseph (MI)	*Epioblasma torulosa rangiana*	Northern riffleshell	Endangered	Rivers
DeKalb	*Villosa fabalis*	Rayed Bean	Proposed as Endangered	Smaller headwater creeks, sometimes larger rivers
DeKalb, St. Joseph (MI)	*Epioblasma obliquata perobliqua*	White cat's paw pearlymussel	Endangered	Rivers
INSECTS				
LaGrange	*Neonympha mitchellii mitchellii*	Mitchell's satyr butterfly	Endangered	Fens
St. Joseph (MI)	*Nicrophorus americanus*	American burying Beetle	Endangered	Oak-pine woodlands, forests grasslands, prairies (feeding generalists)
St. Joseph (MI)	*Brychius hungerfordi*	Hungerford's crawling water beetle	Endangered	Cool riffles of clean, slightly alkaline waters

County	Species	Common Name	Status	Habitat
REPTILES				
Steuben, St Joseph (MI)	*Nerodia erythrogaster neglecta*	Copperbelly water snake	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches and floodplain woods
Elkhart, LaGrange, Noble, Steuben, St. Joseph (MI)	*Sistrurus c. catenatus*	Eastern Massassauga	Candidate	Wetlands and adjacent uplands
PLANTS				
St. Joseph (MI)	*Plantathera leucophaea*	Eastern prairie fringed orchid	Threatened	Mesic to wet prairies and meadows
St. Joseph (MI)	Asplenium scolopendrium var. americanum	American hart's tongue Fern	Threatened	Neutral and lime rich substrates
St. Joseph (MI)	*Platanthera leucophaea*	Small whorled Pogonia	Threatened	Older hardwood stands of beech, birch, maple, oak, and hickory with an open understory

The IN DNR, Division of Nature Preserves maintains a list of federally and state endangered and threatened species. The list also contains species that are considered rare, extirpated, of special concern, significant, and on a watch list for the state.

2.9 Summary of Project Area Inventory

All of the elements described above, when overlapped, can provide a larger picture of how the watershed functions and what activities may pose a greater threat to our water resources. This section will summarize all the characteristics of the project area and describe how they relate to each other. This will be examined more closely in subsequent sections.

Despite the low rolling hills of the project area, the predominant land use is agriculture, either row crops or pasture and hay fields, and many of the soils in the area are considered to be HEL or PHEL. For this reason, it is important that special precautions be taken by those producers working that land to limit the amount of soil erosion. As soil erodes, it can increase stream and lake sedimentation. The eroding soil particles often carry nutrients that bind to the particles to open water sources as well. This may cause an increase in phosphorus and nitrogen levels within the water system, leading to unsuitable water quality.

The major population centers within the project area are the only areas where sanitary sewer treatment facilities are in use: LaGrange is serviced by the LaGrange Waste Water Treatment Plant, which uses an oxidation ditch to treat the sewage; Shipshewana and Shipshewana Lake are serviced by the Shipshewana Waste Water Treatment Plant which also uses an oxidation ditch to treat the sewage. Several lake communities in the area are serviced by the LaGrange County Regional Utility District Region B and Region F. Region F services Fish and Royer Lake which uses an innovative wetland sewage treatment system. However, this leaves the majority of the rural areas, and some lake communities, to treat their sewage with on-site systems. With the expansive aquifer under the project area, high water table, and nearly every soil type in the project area being rated as not suitable for septic system usage, there is a serious risk to both ground and surface water. If the ground water becomes contaminated by septic leakage, the drinking water supply within the project area is at risk of becoming polluted and unsafe for consumption.

As stated earlier, the majority of the land within the project area is used for agriculture and many of the wetlands that were once present have been drained for pasture land or row crops. However, wetlands play an important role in our ecosystem, not only as flood water traps and pollution sinks, but also as prime habitat for many of the species listed as endangered or threatened. For instance, the Indiana Bat, Mitchell's Satyr Butterfly, Copperbelly Watersnake, Massassauga Rattlesnake, and Eastern Prairie Fringed Orchid all prefer the habitat provided by wetlands. Forest land, much of which has been cleared for agriculture, also is vital for more keystone endangered species, such as the Grey Wolf. Leaving some agricultural land fallow and letting that landscape return to forest or wetland will provide more vital habitat for those endangered and threatened species.

Table 16, below, links those concerns that stakeholders from the public meetings had regarding the project area and water resources to evidence found during the initial project area inventory. More evidence will be provided in subsequent sections at the 12 digit HUC level.

Table 16: Stakeholder Concerns and Relevant Evidence for Concern

Concerns	Evidence	Potential Problem
Livestock access to open water	Amish farms which would have at a minimum 2 buggy horses. Many of these farms use the ditches and streams as a drinking water source for their livestock.	*E. coli* contamination, excess nutrients, impaired biota, streambank erosion and sediment
Stormwater runoff from barnyards	15 CFO/CAFOs in the watershed and many small Amish farms which would have at a minimum 2 buggy horses. The gently rolling hills of the landscape would allow for more runoff to occur.	*E. coli* contamination, excess nutrients, impaired biota, and sediment
Increase in impervious surfaces	15 built-up lakes which increases the number of driveways, patios, and access roads. Expansion of urban centers (LaGrange and Shipshewana).	Oil and grease, sediment, and nutrients
Fertilizer used on urban lawns	15 built-up lakes in the project area. Many lake residences have lush and green lawns which indicate the use of commercial fertilizers.	Excess nutrients and impaired biotic communities
Lakes in the area becoming more built-up	15 built-up lakes, many with onsite sewage treatment systems placed in soil unsuitable for septic systems. Also, increase in imperviousness around lakes allowing direct runoff from driveways, patios and access roads.	Excess sediment, nutrients and impaired biotic communities, *E. coli*
Septic system discharge	There are not enough sanitary sewer treatment facilities to handle all residents living in rural areas. Nearly all soils are rated as “very limited” for septic system usage.	Excess nutrients, *E. coli*
Horse manure on public roads	Large Amish population in the project area.	*E. coli* contamination, excess nutrients

3.0 Watershed Inventory

3.1 Water Quality Data

An important aspect of the watershed planning process is to examine current water quality data as well as historic data to understand the issues present in the watershed. The historic data, some of which has been collected since as early as 1989, though only data collected since 2000 will be presented in this WMP, will provide a baseline in which to compare the data collected by the LaGrange County SWCD in 2011. The historical data of consequence was combined with the watershed assessment that was done as part of this project to characterize water quality problems and their sources and tie them to stakeholder concerns. The following sections will provide a detailed description of all water quality data that has been collected in the watershed from 2000 through 2011.

3.1.1 Water Quality Parameters

Water quality analysis of adjacent subwatersheds within the St. Joseph River Watershed (HUC 04050001) has historically shown that certain water quality pollutants are prevalent in the water system. For this reason, particular parameters where chosen to be examined as part of the Pigeon River-Pigeon Creek project. Those parameters are dissolved oxygen (DO), temperature, *E. coli*, turbidity, total dissolved solids (TDS), total suspended solids (TSS), total phosphorus, nitrate, biological oxygen demand (BOD), and pH. The LaGrange County SWCD is also interested in determining the Qualitative Habitat Evaluation Index (QHEI) and the macro-invertebrate Index of Biotic Integrity (mIBI). Provided below is a description of why each of those parameters are important to the quality of water. Please note the standard or target provided in the description of each parameter below is the standard that was chosen by the Pigeon River Watershed steering committee to use for the purposes of determining loads and necessary reductions.

<u>Dissolved Oxygen</u>

Dissolved oxygen (DO) is the measure of oxygen in the water available for uptake by aquatic life. Typically, streams with a DO level greater than 8 mg/L are considered very healthy and streams with DO levels less than 2 mg/L are very unhealthy as there is not enough oxygen to supply to aquatic life. DO is affected by many factors including: temperature - the warmer the water the harder it is for oxygen to dissolve; flow –more oxygen can enter a stream where the water is moving faster and turning more; and aquatic plants – an influx of plant growth will use more oxygen than normal which does not leave enough available DO for other aquatic life, however photosynthesis will add oxygen to the water during the day. Thus, DO levels may change frequently when there is excessive aquatic plant growth. Excessive amounts of suspended or dissolved solids will decrease the amount of DO in the water. The state of Indiana has set a standard of an average of at least 5 mg/L /day but not less than 4 mg/L of DO for warm water streams. The US EPA recommends that DO not exceed 9 mg/L so as to avoid super-saturation of DO.

Temperature

Temperature can affect many aspects of the health of the water system. Water temperature is a controlling factor for aquatic organisms. If there are too many swings in water temperature, metabolic activities of aquatic organisms may slow, speed up, or even stop. Many things can affect water temperature including stream canopy, dams, and industrial discharges. The state of Indiana has set a standard for water temperature depending on if the waterbody is a cold or warm water system. Michigan has a state standard maximum of between 40 and 85 degrees Fahrenheit for cold water streams, depending on the month that sampling has taken place.

Escherichia coli

E. coli is a bacteria found in all warm-blooded animal and human waste. *E. coli* testing is used as an indicator of fecal contamination in the water. While not all *E. coli* is harmful, there are certain strains that can cause serious illness in humans. *E. coli* may be present in the surface water system due to faulty septic systems, CSO overflows, wildlife (particularly geese) and from contaminated stormwater runoff from animal feeding operations. Due to the serious health risks from fecal contamination of waterways, the state of Indiana has developed the full body contact standard of 235 cfu/100 ml for any one water sample and 125 cfu/100 ml as a geometric mean for five (5) equally spaced samples taken over a 30 day period.

Turbidity

Turbidity is the measure of the cloudiness of the water which may be caused by sediment, urban runoff, resurfaced sediment from the stream bottom, or an overgrowth of aquatic plants or animals. High levels of turbidity can block out essential sunlight for submerged plants and animals and may raise water temperatures, which then can decrease DO. Sediment in the water causing it to be turbid can clog fish gills and smother nests when it settles, thus effecting the overall health of the aquatic biota. Turbid water may be caused from farm field erosion, feedlot or urban stormwater runoff, eroding stream banks, and/or excessive aquatic plant growth, including excessive algae growth. The US EPA recommends that the turbidity in the water measure less than 10.4 NTUs.

Total Dissolved Solids

TDS's are solid particles within the water system that can flow through a 2 micrometer sieve. TDS is typically related to aesthetic value of drinking water but can be used as an indicator of other pollutants, such as magnesium, sodium, and sulfates. When TDS is measured the sum of cations and anions is determined. However, the type of dissolved ion cannot be determined from the TDS analysis. For this reason, TDS is measured to provide a general measure of water quality. Both Indiana and Michigan have set a standard of less than 750 mg/L of TDS to represent good water quality.

Total Suspended Solids

The amount of Total Suspended Solids (TSS) in the water system is typically due to stream bank erosion or runoff from agricultural fields and will have the same type of deleterious effect on water quality as mentioned above under turbidity. The US EPA recommends a target of less than 25 mg/L of TSS to maintain a healthy aquatic ecosystem. The Pigeon River steering committee has decided to use the US EPA recommendation as it set to be more stringent than the IDEM or MI DEQ targets or standards.

Phosphorus

Phosphorus is an essential nutrient for aquatic plants however, too much phosphorus can create an over growth of plants and algae which can lower the DO in a water system and decrease the amount of light that penetrates the surface thus killing other aquatic life that depends on these for survival. Some types of aquatic plants that thrive when phosphorus levels are high, such as blue-green algae, are toxic. Humans and animals can be effected by blue-green algae and associated toxins by ingesting the algae, inhaling it's toxins or by dermal contact with the algae and/or it's toxins. Excessive amounts of phosphorus have also been found in ground water thus increasing the bacteria growth in underground water systems. Phosphorus can reach surface and ground water through fertilizer runoff from row crop fields, barnyard runoff from animal feeding operations, faulty septic systems, and the disposal of cleaning supplies containing phosphorus in landfills or down the drain. The state of Indiana has set a target of 0.3 mg/L of phosphorus in a water sample for listing a stream segment as impaired.

Nitrate

Nitrates can have the same effect on the water system as phosphorus, only to a much lesser degree. Nitrates can be found at levels up to 30mg/L in some waters before detrimental effects on aquatic life occur. However, due to the fact that infants who consume water with nitrate levels exceeding the US EPA MCL of 10 mg/L can become ill, nitrates in drinking water should be of particular concern to people who use wells as their drinking water source. The most common sources of nitrates in the project area are from fertilizer runoff from row crop fields, naturally leaching from worked agricultural land, faulty septic systems, and sewage. The Pigeon River steering committee is using the US EPA reference level for nitrates in the water system, which is set at 1.5 mg/L.

Biological Oxygen Demand

BOD is used as a general measure of the amount of organic pollution present within the water system. BOD analysis will provide the amount of pollution that is consumed by microbes within the water system by determining the amount of dissolved oxygen consumed by microbes over a five day period. BOD measuring greater than 50% indicates a higher amount of pollution in the water sample.

pH

pH is the measure of a substance's acidity or alkalinity and is an important factor in the health of a water system as if a stream is too acidic or basic it will affect the aquatic organisms' biological functions. A healthy stream typically has a pH between 6 and 9, depending on soil type and substances that come from dissolved bedrock. The pH can also change the water's chemistry. For example, a higher pH means that a smaller amount of ammonia in the water may make it harmful to aquatic organisms and a lower pH may increase the amount of metal present in the water. For these reasons, the state of Indiana has set a standard for pH of between 6 and 9.

Macroinvertebrate Index of Biotic Integrity

The Macroinvertebrate Index of Biotic Integrity (mIBI) is used as an indicator of water quality. Macroinvertebrates are collected from the water system and classified down to the genus level. The number and type of macroinvertebrates found show the overall health of the water as some macroinvertebrates can only survive when little to no contaminants are present. The Pigeon River steering committee set a target of the index ranking to be greater than 35, which is based on the IDEM reference level.

Qualitative Habitat Evaluation Index

The Qualitative Habitat Evaluation Index is another method used to determine the quality of a waterway. Various aspects of aquatic habitat are evaluated including in-stream habitat and the surrounding landuse, to determine the waterway's ability to support aquatic life such as fish and macroinvertebrates. A score greater than 61 is considered to be a stream that fully supports aquatic life, and a score between 51 and 61 is considered a stream that partially supports aquatic life.

3.1.2 Water Quality Targets

For the purpose of interpreting inventory data and defining problems, target values were identified for water quality parameters of concern (Table 17).

Table 17: Water Quality Targets

Parameter	Target	Source
Dissolved Oxygen	> 6 mg/L and not > 9 mg/L	327 IAC 2-1-6/US EPA recommendation
Temperature	40-85 degrees F	MI – R.323.1075
Escherichia coli	< 235 CFU/100 ml per single sample and < 125 CFU/100 ml per the geometric mean of 5 equally spaced samples over a 30 day period	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
Total Dissolved Solids	< 750 mg/L	MI – R.323.1051 / 327 IAC 2-1-6
Total Suspended Solids	< 25 mg/L	US EPA recommendation
Total Phosphorus	< 0.3 mg/L	IDEM 303d listing criteria
Nitrate	< 1.5 mg/L	US EPA reference level (2000)
Nitrate-Nitrite	< 1.5 mg/L	Dodds et al. (1998)
TKN	<0.076 mg/L	Dodds et al. (1998)
Biological Oxygen Demand	< 50%	Hoosier Riverwatch Protocol
pH	> 6 or < 9	327 IAC 2-1-6
macroinvertebrate Index of Biotic Integrity (mIBI)	>23 points / >36 points	Hoosier Riverwatch Protocol / IDEM (2008)
Qualitative Habitat Evaluation Index (QHEI)	> 51 pts	IDEM (2008)
Index of Biotic Integrity (IBI) (fish)	$\geq$ 36 points	IDEM (2006)

3.2 Water Quality Sampling Efforts

A variety of water quality assessment projects have been completed within the Pigeon River/Pigeon Creek and its tributaries. These include the Indiana and Michigan Integrated Reports, the Indiana TMDL Report, the Michigan Department of Environmental Quality's Surface Water Protection Report, the Steuben County SWCD's water quality monitoring program, and LaGrange County SWCD's water quality monitoring program as part of this project. A summary of each study's methodology and general results are discussed below. Subsequent sections detail specific study information as it relates to each subwatershed. Figure 14 displays all the historic sampling locations in the project area.

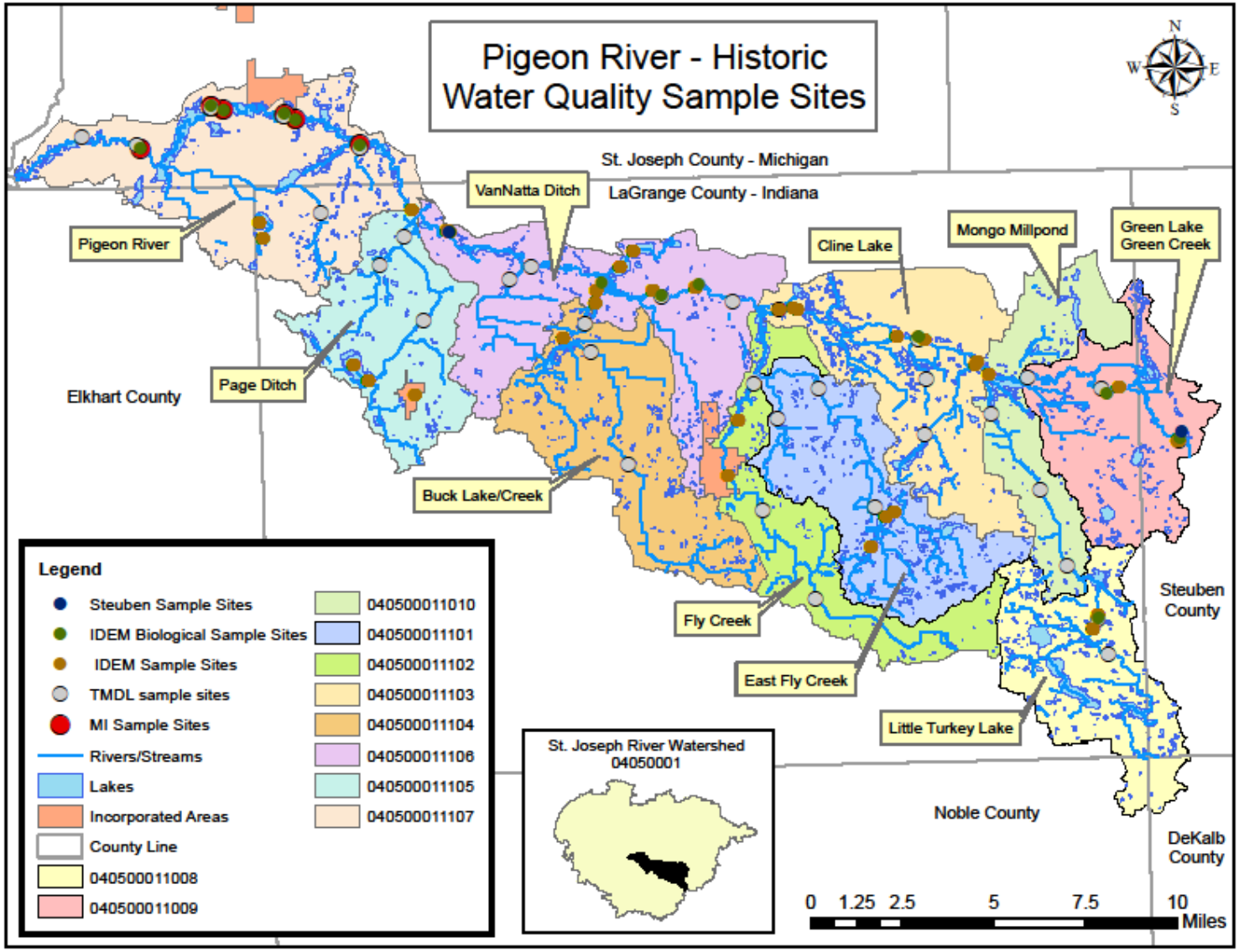

Figure 14: Pigeon River-Pigeon Creek Historic Sampling Locations

3.2.1 Integrated Water Quality Assessment (305(b) Report)

Each state is required to perform water quality analysis of its surface waters and report their findings to EPA in a report called the "Integrated Report" (IR) on a biannual basis, as mandated by the CWA§305(b). Prior to compiling the IR, a list of water bodies that do not meet state standards is developed as mandated by the CWA§303(d). This has become commonly known as the 303(d) list. IDEM's 2010 IR has not yet been approved for release by EPA. However, the Pigeon River is on the 2008 IDEM 303(d) list of impaired waters for dissolved oxygen, *E. coli,* impaired biotic community, mercury and PCBs in fish tissue, phosphorus, and ammonia. Michigan lists the Pigeon River as being impaired for mercury and PCBs in fish tissue and PCBs in the water table in the 2010 MI Department of Environmental Quality (DEQ) IR. A full list of those waters impaired, as designated by the State, can be found in Table 18.

As part of the IDEM monitoring process, water samples are analyzed for numerous substances. Those relevant to this WMP include: nitrogen, pH, phosphorous, DO, turbidity, QHEI, and mIBI. IDEM has been collecting data since 1989, however only data collected since 2000 was analyzed and sorted for the purpose of this project.

Michigan uses a similar monitoring protocol as Indiana, however, the MI DEQ tested for different parameters; mostly heavy metals. The only data collected by the MI DEQ assessments program relevant to this WMP were collected in 2000 at three sites, and 2005 at one site within the Pigeon River subwatershed. For the purposes of this WMP, analysis of MI DEQ water quality data will only include total suspended solids, nitrate-nitrite, TKN, nitrite, ortho-phosphate, and total phosphorus.

Table 18: Waterbodies Listed in the Indiana and/or Michigan Integrated Report

14-DIGIT HUC	COUNTY	ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
INDIANA				
4050001110110	LAGRANGE	INJ01BB_T1007	Turkey Creek - Unnamed Tributary	DISSOLVED OXYGEN
4050001110110	LAGRANGE	INJ01BB_T1007	Turkey Creek - Unnamed Tributary	E. COLI
4050001110120	LAGRANGE	INJ01BC_T1298	PIGEON CREEK	E. COLI
4050001120010	LAGRANGE	INJ01C1_03	Pigeon River (Downstream of Ontario Millpond)	E. COLI
4050001120020	LAGRANGE	INJ01C2_00	FLY CREEK-HEADWATERS (LAGRANGE)	E. COLI
4050001120050	LAGRANGE	INJ01C5_01	Pigeon River	E. COLI

14-DIGIT HUC	COUNTY	ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
4050001120060	LAGRANGE	INJ01C6_01	PIGEON RIVER (UPSTREAM OF SCOTT IN)	PCBs in Fish Tissue
4050001120060	LAGRANGE	INJ01C6_02	Pigeon River (Downstream of Scott, IN)	E. COLI
4050001120060	LAGRANGE	INJ01C6_02	PIGEON RIVER (DOWNSTREAM OF SCOTT, IN)	PCBs in Fish Tissue
4050001120060	LAGRANGE	INJ01C6_T1001	VAN NATTA DITCH	PCBs in Fish Tissue
4050001120060	LAGRANGE	INJ01C6_T1001A	VAN NATTA DITCH - UNNAMED TRIBUTARY	PCBs in Fish Tissue
4050001110110	LAGRANGE CO	INJ01P1093_00	LAKE OF THE WOODS	IMPAIRED BIOTIC COMMUNITIES
4050001110110	LAGRANGE CO	INJ01P1093_00	LAKE OF THE WOODS	Mercury in Fish Tissue
4050001110110	LAGRANGE CO	INJ01P1098_00	PRETTY LAKE	Mercury in Fish Tissue
4050001110110	LAGRANGE CO	INJ01P1101_00	Little Turkey Lake	PHOSPHORUS
4050001120030	LAGRANGE CO	INJ01P1132_00	ROYER LAKE	IMPAIRED BIOTIC COMMUNITIES
4050001120030	LAGRANGE CO	INJ01P1133_00	FISH LAKE	IMPAIRED BIOTIC COMMUNITIES
4050001120030	LAGRANGE CO	INJ01P1133_00	FISH LAKE	Mercury in Fish Tissue
4050001120050	LAGRANGE CO	INJ01P1157_00	NORTH TWIN LAKE	IMPAIRED BIOTIC COMMUNITIES
4050001110080	STEUBEN CO	INJ01B8_T1027	PIGEON CREEK	IMPAIRED BIOTIC COMMUNTIES
MICHIGAN	**COUNTY**	**STREAM MILES**	**ASSESSMENT UNIT NAME**	**CAUSE OF IMPAIRMENT**
4050001110701	ST. JOSEPH CO	32.543073 Miles	PIGEON RIVER	Mercury in Fish Tissue
4050001110701	ST. JOSEPH CO	32.543073 Miles	PIGEON RIVER	PCBs in Fish Tissue
4050001110701	ST. JOSEPH CO	32.543073 Miles	PIGEON River	PCBs in Water Table

3.2.2 Total Maximum Daily Load Report

Once a waterbody is listed as impaired on the 303(d) list, the State is required to write a Total Maximum Daily Load (TMDL) report for the waterbody that is impaired. A TMDL outlines the

maximum amount of the parameter causing the impairment that can be present in the waterbody before it affects the integrity of the water resource. A TMDL also provides potential sources of the impairment and ways to address the problems. All contributing sources of the pollutants (point and nonpoint sources) are identified and are allocated a portion of the allowable load. The waterbody usually requires a reduction in pollution discharge in order to help solve the problem. Natural background sources, seasonal variations and a margin of safety are all taken into account in the allocations. TMDLs must clearly identify the links between the waterbody use impairment, the causes of impairment, and the pollutant load reductions needed to meet the applicable water quality standards. A TMDL is currently being developed by IDEM for the Pigeon Creek and Pigeon River watersheds in Indiana for *E. coli*.

A comprehensive survey of the Pigeon River and Pigeon Creek watersheds was conducted by Indiana Department of Environmental Management (IDEM) in 2010. The TMDL development process includes water chemistry data collection and analysis, and collection of data to determine an Index of Biotic Integrity (IBI) for fish, as well as rank aquatic habitat using the Qualitative Habitat Evaluation Index (QHEI). A stream's IBI score represents the degree to which a body of water is capable of supporting a "well-balanced aquatic community." This is further defined as "an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species" [327 IAC 2-1-9(49)]. A stream segment is non-supporting for Aquatic Life Use (ALUS) when the monitored fish community receives an Index of Biotic Integrity (IBI) score of less than 35 which is considered "Poor" or "Very Poor". Table 19 below, modified from a table developed by Karr et al. 1986, shows how streams and rivers in Indiana are ranked using the IBI ranking system for fish.

Water quality samples are taken using a randomized grab sample and analyzed by IDEM before the development of the TMDL begins. Nutrient samples were collected three times during the summer of 2010, and IBI and QHEI samples were collected once during the summer of 2010 at certain sample sites. Samples were taken at 60 locations total within the Pigeon Creek and Pigeon River watersheds, with 34 of those sites located within this project area. Samples were analyzed for *E. coli*, nitrate-nitrite, TKN, total nitrogen, total phosphorus, total suspended solids, fish IBI and habitat.

After examining the results of the survey it was determined that the primary cause of impairment was *Escherichia coli* bacteria (*E. coli*) and nutrients. Pollution sources in the watersheds include non-point sources (e.g. row crop agriculture and pastures), urban and rural runoff, land application of manure, and point sources (e.g. straight pipe dischargers), septic systems, and combined sewer overflow outlets (in Steuben County only; not in this project area).

Table 19: IDEM IBI Ranking System

Total IBI Score	Integrity Class	Attributes
53-60	Excellent	Comparable to “least impacted” conditions, exceptional assemblage of species.
45-52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
35-44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23-34	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
<12	No Fish	No fish captured during sampling.

3.2.3 Fish Consumption Advisory (FCA)

The Indiana Department of Environmental Management, the Indiana Department of Natural Resources and the Indiana Department of Health have worked together since 1972 on a collaborative effort to compile the Indiana Fish consumption advisory. The Michigan Department of Community Health (MDCH) is responsible for the Michigan Fish Consumption Advisory. The advisories are mostly based on fish tissue samples. It is important to note that a fish advisory for a body of water does not mean that the water is unsafe for other recreational activities.

The state of Indiana has assigned one of five groups to fish that are on the fish consumption advisory. Those groups are listed in Table 20.

Table 20: Indiana Fish Consumption Advisory Groups

Advisory Groups of the Indiana Fish Consumption Advisory	
Group 1	Unrestricted consumption. One meal per day for women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15.
Group 2	Limit to one meal per week for adults. One meal per month for women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15.
Group 3	Limit to one meal per month for adults. Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 DO NOT EAT.
Group 4	Limit to one meal every 2 months for adults. Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 DO NOT EAT.
Group 5	No consumption (DO NOT EAT).

Common carp is on the fish consumption advisory for all water bodies within Indiana. Depending on the size of the fish, it is either placed in the group 3, 4, or 5 advisory group. Visit, www.in.gov/isdh/files/2010_FCA.pdf for more information. The Michigan Fish Consumption Advisory for the Pigeon River notes consumption warnings for smallmouth bass and suckers. More information can be found at, www.michigan.gov/fishandgameadvisory. FCA's for specific waterbodies are discussed in section 3.3 under the respective subwatershed.

3.2.4 Michigan Biosurveys

The Surface Water Assessment Section, Water Bureau, MI DEQ, conducted qualitative biological surveys and collected water and sediment samples in 2000 and 2005 to assess point and non-point source pollution throughout the upper St. Joseph River watershed. Both chemical and biological integrity data was collected.

Biological communities respond to the cumulative effects of multiple environmental stressors, so this monitoring component is an important tool for water quality evaluation. Good water quality is indicated if the diversity of macroinvertebrates and fish is high, and poor water quality is generally indicated by low biota diversity and/or abundance.

The surveys were conducted according to the guidelines of Great Lakes Environmental Assessments Section (GLEAS) Procedure #51 (MDEQ, 1997). The macroinvertebrate communities were scored with metrics that rate waterbodies from excellent (+5 to +9) to poor (-5 to –9). However, ratings ranging from +4 to –4 are considered acceptable ratings. Those ratings that are in the negative, but have not reached -5, are indicative of waterbodies that are strongly tending toward poor quality, while those with positive ratings, but have not reached a

rating of +5 are indicative of only a slight impairment. Stream habitat was qualitatively evaluated using a scoring system that ranged in value from 0 to 135.

Only the portion of the Pigeon River subwatershed located in Michigan was involved in the Michigan Biosurvey project and will be discussed under the respective subwatershed in Section 3 of this WMP.

3.2.5 Steuben County SWCD Water Quality Monitoring Program

The Steuben County SWCD has collected and analyzed water quality samples throughout the county on a limited basis since 1996. Testing was done using both the Hoosier Riverwatch protocol and professional laboratories. Steuben County SWCD tested for several parameters relevant to the work being conducted for this project including, *E. coli,* total phosphorus, TSS, dissolved oxygen, pH, temperature, and specific conductance. One sample site that Steuben County SWCD has been collecting data at since 2007 is located within this project area, in the Green Lake/Green Creek subwatershed.

3.2.6 LaGrange County SWCD Water Quality Monitoring Program

The LaGrange County SWCD began water sampling at 60 sites throughout the Pigeon River watershed project area in November, 2010. Grab samples were collected once monthly and were taken back to the SWCD's approved laboratory for analysis. A flow meter was also used in the field. Parameters analyzed include pH, temperature, dissolved oxygen, total dissolved solids, turbidity, *E. coli*, nitrates, total phosphorus, and total suspended solids. Flow was also measured at a minimum of one site in each subwatershed to aid in load calculations. Water quality monitoring by the LaGrange County SWCD will continue as long as funds are available to support the task.

3.3 Water Quality Data Analysis at the Subwatershed Level

An analysis of historical data was performed breaking the data down to the subwatershed level. The following sections describe the results of each of the water quality studies mentioned in section 3.2 at the subwatershed level. Please note that sample sites identified on the map are only numbered if those particular sample sites are discussed in the narrative.

3.3.1 Green Lake/Green Creek Subwatershed

There are fifteen total water quality sampling sites located within the Green Lake/Green Creek subwatershed, as can be seen in Figure 15. Three sites were used by IDEM for the 303(d) list; three sites were used by IDEM for the TMDL report; two sites were used by IDEM to collect biological data; one site was used by Steuben County SWCD for their water quality monitoring program, and five sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

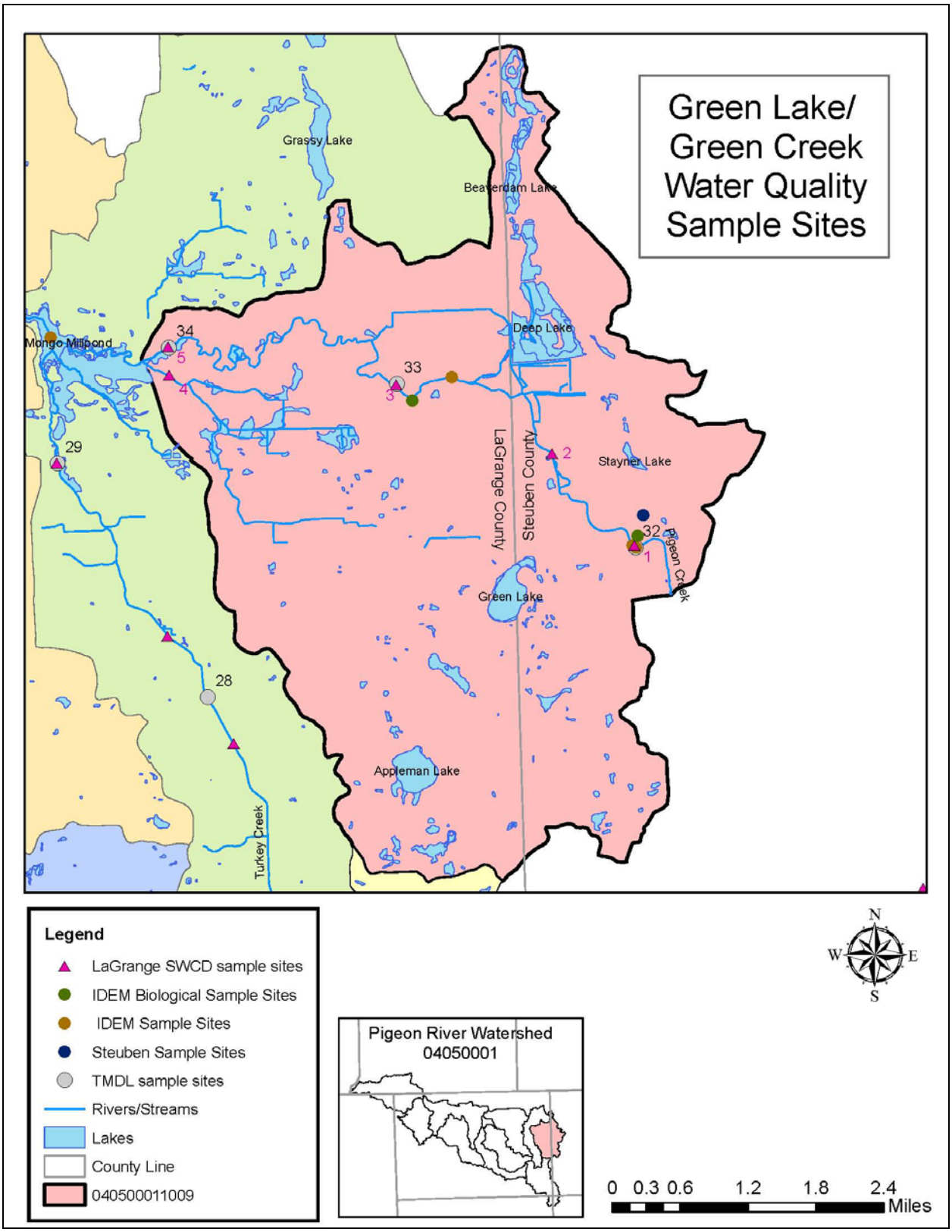

Figure 15: Green Lake/Green Creek Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis weekly in June, July, and September in 2000 and monthly from June through October in 2010. As can be seen in Table 21, nearly every parameter exceeded the set target during the testing cycles. Of particular note is that *E. coli* exceeded the state standard of 235 cfu/100ml 40% of the time and it exceeded the geometric mean standard of 125 CFU/100 ml, and TKN exceeded the target of 0.076mg/L 37% of the time.

Table 21: Green Lake/Green Creek: IDEM 303(d) List Monitoring Data Analysis

Green Lake/Green Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.395	mg/L	3/26
Total Kjeldahl Nitrogen	0.567	mg/L	11/30
Nitrate-Nitrite	0.636	mg/L	3/28
Suspended Solids, Total	5.333	mg/L	0/3
Dissolved Solids, Total	227.167	mg/L	0/12
Turbidity	7.065	NTU	3/17
Phosphorus, Total	0.116	mg/L	3/28
Dissolved Oxygen	6.406	mg/L	6/53
pH	7.615	SU	0/33
E. coli	(geo mean) 244.94	CFU/100 ml	1/1

IDEM TMDL Study

Three sample sites were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. Each site was sampled in June, July and September, 2010. As can be seen in Table 22, nitrate-nitrite exceeded the target level of 1.5 mg/L in 11% of the samples, and dissolved oxygen exceeded the Indiana state standard in 11% of the samples. It should also be noted that IBI and QHEI was determined for this subwatershed, and the resulting scores indicate a healthy aquatic ecosystem.

Table 22: Green Lake/Green Creek: IDEM TMDL Study Data Analysis

Green Lake/Green Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.939	mg/L	0/9
Nitrate-Nitrite	1.11	mg/L	1/9
Suspended Solids, Total	2.000	mg/L	0/9
Phosphorus, Total	0.020	mg/L	0/9
Dissolved Oxygen (site 25)	7.540	mg/L	2/18
pH (site 25)	7.950	SU	0/18
IBI - Site 32/33/34	50/48/56		
QHEI - Site 32/33/34	Good/Good/Good to Excellent		

Steuben County Water Quality Monitoring Program

As part of the Steuben County SWCD's ongoing water quality monitoring program, water quality data was collected ten times during the recreational season between 2007 and 2010 at one location in the Green Creek/Green Lake subwatershed. As can be seen in Table 23, both TSS and D.O. exceeded the target level in 10% of the samples, and *E. coli* exceeded the state standard in 20% of the samples.

Table 23: Green Lake/Green Creek: Steuben County SWCD Water Quality Data Analysis

Green Lake/Green Creek - Pigeon Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Suspended Solids, Total	8.080	mg/L	1/10
Phosphorus, Total	0.037	mg/L	0/10
Dissolved Oxygen	8.063	mg/L	1/10
pH	7.809	SU	0/10
E. coli	204.000	CFU/100 ml	2/10

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at five sites within Green Lake/Green Creek subwatershed from November 2010 through August 2011. As can be seen in Table 24, temperature, D.O, TDS, turbidity, E. coli, nitrates, total phosphorus and TSS all exceeded the target levels. However, special consideration should be given to temperature, D.O. and nitrates, as they all exceed target levels nearly 50% of the time and are all closely related. It is also important to note that temperature exceeded the maximum of 85 degrees Fahrenheit in 50% of the samples analyzed. The SWCD also sampled the macroinvertebrate community located at each of the five sample sites located in Green Lake/Green Creek. Sites 1, 2, 3, and 5 all scored high enough to indicate an excellent aquatic ecosystem. Site 4 also scored high indicating a good aquatic ecosystem.

Table 24: Green Lake/Green Creek: LaGrange County Water Quality Data Analysis

Green Lake/Green Creek			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	7.7	SU	0.0%
Temp	10.9	Celsius	50.0%
D.O.	9.3	mg/L	52.0%
Total Dissolved Solids	444.5	mg/L	6.0%
Turbidity	5.5	NTU	10.0%
E. coli	211.0	CFU/100 ml	32.0%
Nitrate	2.0	mg/L	46.0%
Phosphorus, Total	0.2	mg/L	8.0%
Total Suspended Solids	8.0	mg/l	4.0%
Macroinvertebrates	43	River Watch	0.0%
Habitat	87	River Watch	0.0%

3.3.2 Little Turkey Lake Subwatershed

There are ten total water quality sampling sites located within the Little Turkey Lake/Turkey Creek subwatershed, as can be seen in Figure 16. Two sites were used by IDEM for the 303(d) list; two sites were used by IDEM for the TMDL report; one site was used by IDEM to collect biological data, and five sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

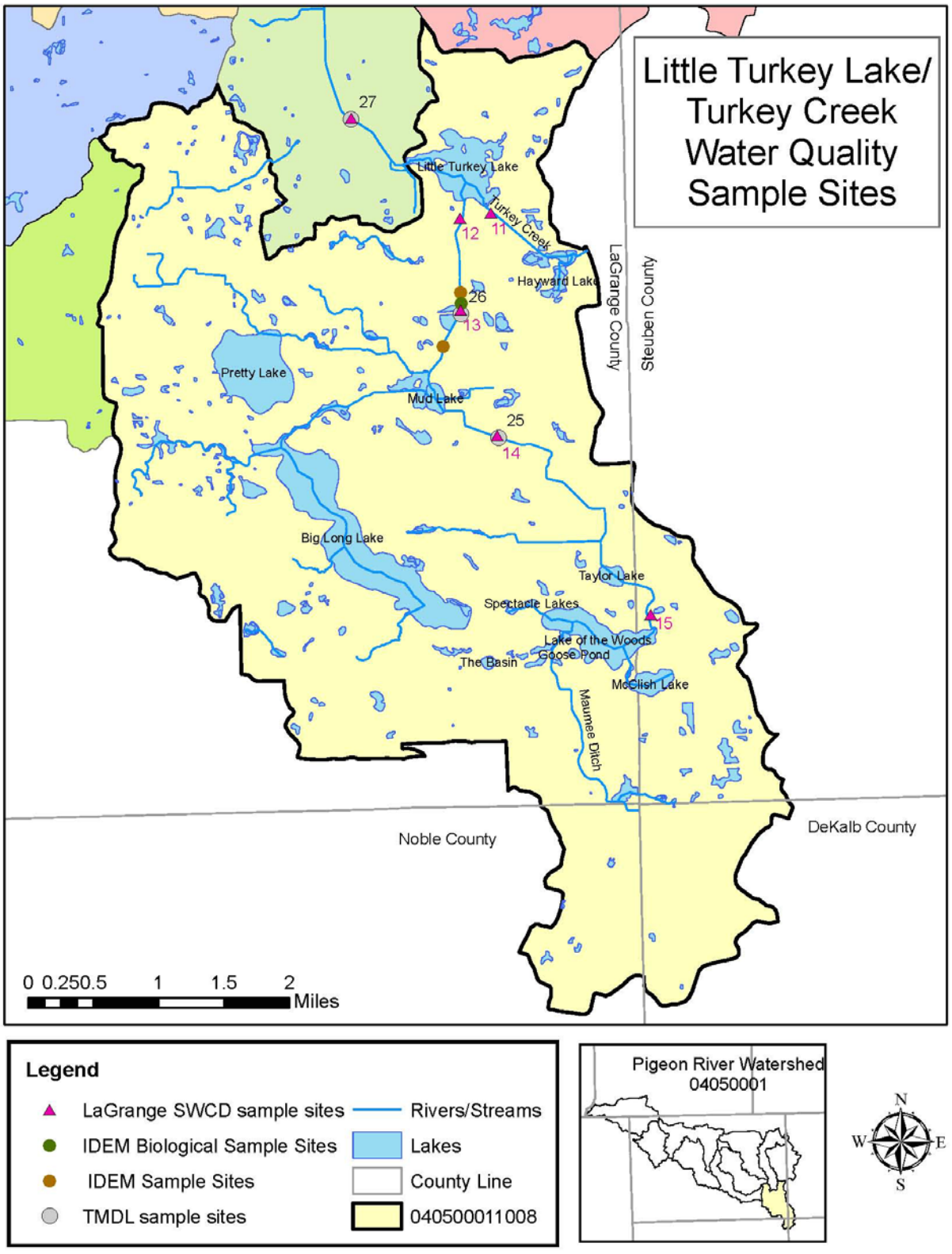

Figure 16: Little Turkey Lake/Turkey Creek Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in Little Turkey Lake/Turkey Creek subwatershed in 2005 and 2010. As can be seen in Table 25, TKN exceeded the target level of 0.076 mg/L in 33% of the samples, TSS exceeded the target of 25 mg/L in 50% of the samples, and *E. coli* exceeded the geometric mean state standard of 125 cfu/100ml.

Table 25: Little Turkey Lake/Turkey Creek: IDEM 303(d) Monitoring Data Analysis

Little Turkey Lake			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.048	mg/L	0/5
Total Kjeldahl Nitrogen	0.367	mg/L	2/6
Nitrate-Nitrite	0.267	mg/L	0/6
Suspended Solids, Total	4.333	mg/L	0/3
Turbidity	5.799	NTU	0/18
Phosphorus, Total	0.085	mg/L	0/6
Dissolved Oxygen	6.160	mg/L	6/18
pH	7.873	SU	0/18
E. coli	(geo mean) 155.38	CFU/100 ml	1/1

IDEM TMDL Study

Two sample sites within Little Turkey Lake/Turkey Creek subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. Each site was sampled in June, July and September, 2010. As can be seen in Table 26, TKN exceeded the target level of 0.076 mg/L in 50% of the samples, nitrate-nitrite exceeded the target level of 1.5 mg/L in 33% of the samples, TSS exceeded the target level of 25 mg/L in one sample, and dissolved oxygen exceeded the Indiana state standard in 50% of the samples. It should be noted that the high level of D.O. in the water column may be directly related to the high level of nitrogen found in the water column. IBI and QHEI were determined for Little Turkey Lake/Turkey Creek and the scores indicate a very poor aquatic ecosystem.

Table 26: Little Turkey Lake/Turkey Creek: IDEM TMDL Study Data Analysis

Little Turkey Lake (Sites 25 and 26)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.558	mg/L	3/6
Nitrate-Nitrite	2.432	mg/L	2/6
Suspended Solids, Total	10.333	mg/L	1/6
Phosphorus, Total	0.085	mg/L	0/6
Dissolved Oxygen	7.700	mg/L	6/12
pH	7.850	SU	0/12
Site 25-IBI	12		
Site 25-QHEI	Very Poor		

Fish Consumption Advisory

Little Turkey Lake, Lake of the Woods and McClish Lake, located in the Little Turkey Lake/Turkey Creek subwatershed, are listed on the Fish Consumption Advisory for Black Crappie and Bluegill, both of which are a Group 1 advisory. Lake of the Woods, also located in the Little Turkey Lake/Turkey Creek subwatershed, is also listed for Bluegill, which is a Group 1 advisory.

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at five sites within Little Turkey Lake/Turkey Creek subwatershed from November 2010 through August 2011. As can be seen in Table 27, all parameters exceeded the target levels at some point during the sampling cycle. However, it should be noted that pH and D.O. exceeded the target levels in at least 60% of the samples, nitrate exceeded the target level 43% of the time, and *E. coli* and total phosphorus exceeded the target levels in at least 20% of the samples. The SWCD also sampled the macroinvertebrate community located at each of the five sample sites located in Little Turkey Lake/Turkey Creek. Sites 11, 12, 13, and 15 all scored high enough to indicate an excellent aquatic ecosystem. Site 14 also scored high indicating a good aquatic ecosystem.

Table 27: Little Turkey Lake/Turkey Creek: LaGrange County Water Quality Data Analysis

Little Turkey Lake			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.3	SU	60.0%
Temp	11.7	Celsius	40.0%
D.O.	9.6	mg/L	68.0%
Total Dissolved Solids	342.1	mg/L	2.0%
Turbidity	5.3	NTU	8.0%
E. coli	276.0	CFU/100 ml	22.0%
Nitrate	1.5	mg/L	43.0%
Phosphorus, Total	0.2	mg/L	20.0%
Total Suspended Solids	10.0	mg/L	8.0%
Macroinvertebrates	31	River Watch	0.0%
Habitat	82	River Watch	0.0%

3.3.3 Mongo Millpond Subwatershed

There are ten total water quality sampling sites located within the Mongo Millpond subwatershed, as can be seen in Figure 17. Two sites were used by IDEM for the 303(d) list; two sites were used by IDEM to collect biological data; three sites were used by IDEM for the TMDL report, and five sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

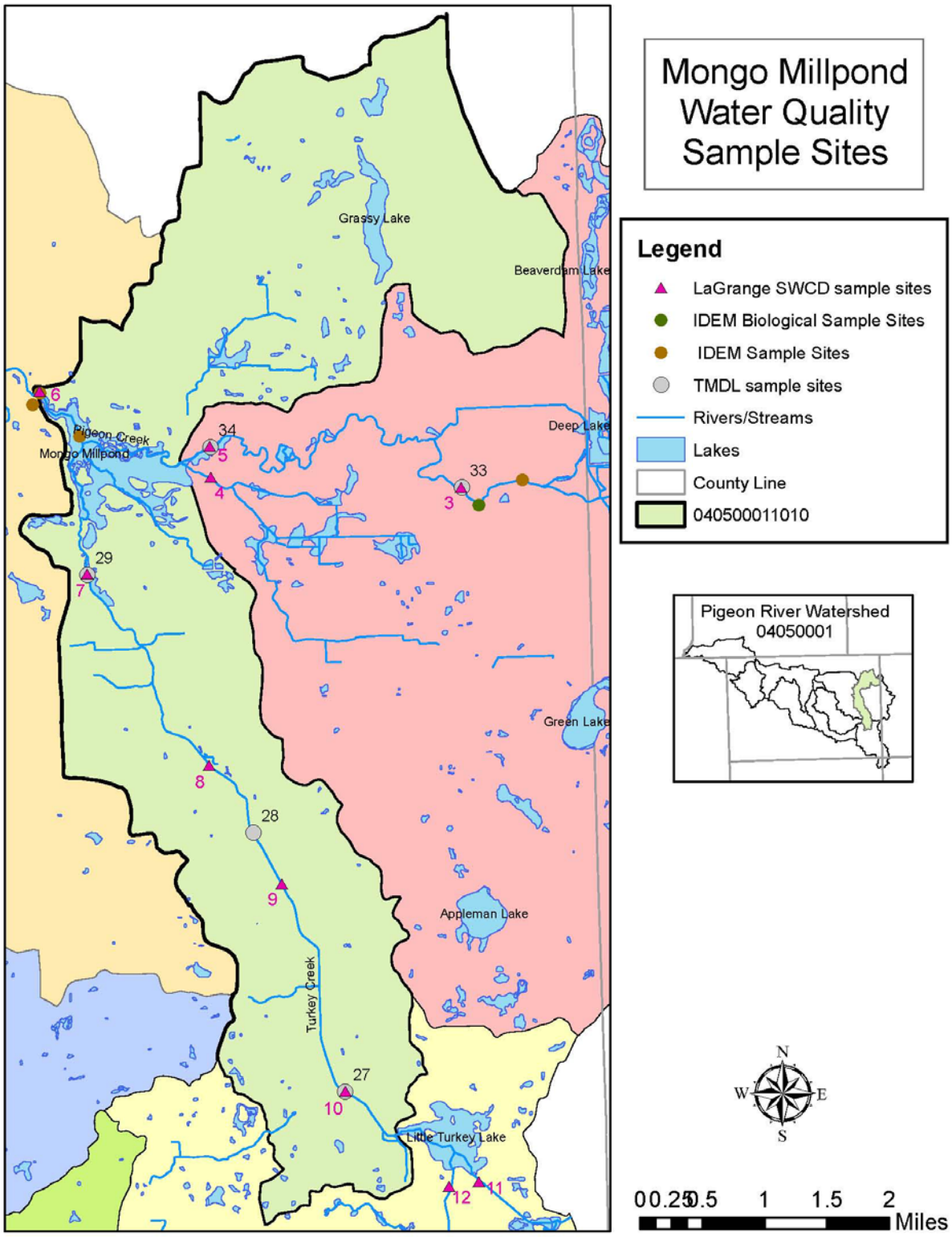

Figure 17: Mongo Millpond Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in Mongo Millpond subwatershed in 2000. Samples were taken from Mongo Millpond and the Pigeon River. The sample analysis is presented in separate tables below as the hydrology of the millpond and river are very different. Table 28 shows the data analysis for the Mongo Millpond and as can be seen in the table, nitrogen levels exceeded the target levels and turbidity exceeded the target level of 10.4 NTU in 13% of the samples.

Table 28: Mongo Millpond: IDEM 303(d) Monitoring Data Analysis

Mongo Millpond - Mongo Millpond			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.537	mg/L	1/2
Nitrate-Nitrite	2.597	mg/L	1/1
Turbidity	5.689	NTU	2/15
Phosphorus, Total	0.044	mg/L	0/1
Dissolved Oxygen	7.979	mg/L	0/17

Table 29 below shows the data analysis of the Pigeon River sampling site located within the Mongo Millpond subwatershed. As can be seen in the table, turbidity exceeded the target levels in one sample. Five *E.coli* samples were collected spaced evenly within a 30 day period to determine the geometric mean.

Table 29: Mongo Millpond-Pigeon River: IDEM 303(d) Monitoring Data Analysis

Mongo Millpond - Pigeon River			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Turbidity	4.980	NTU	1/5
Dissolved Oxygen	7.979	mg/L	0/17
pH	7.740	SU	0/5
E. coli	(geo. Mean) 159.57	CFU/100 ml	1/1

IDEM TMDL Study

Three sample sites within Mongo Millpond subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. Each site was sampled in June, July and September, 2010. As can be seen in Table 30, nitrate-nitrite and D.O. were the only two parameters that exceeded the target level. Nitrate-nitrite and D.O. exceeded the target levels each twice. Therefore, it is reasonable to suspect that the spikes in D.O. may be due to the spikes in nitrogen levels which can increase algae production and increase dissolved oxygen in the water column. It should also be noted that biological data was collected at two sites in Mongo Millpond. The IBI and QHEI scores indicate a healthy aquatic ecosystem in the Mongo Millpond subwatershed.

Table 30: Mongo Millpond: IDEM TMDL Study Data Analysis

Mongo Millpond (Sites 27, 28, and 29)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.939	mg/L	0/9
Nitrate-Nitrite	3.272	mg/L	2/9
Suspended Solids, Total	2.000	mg/L	0/9
Phosphorus, Total	0.020	mg/L	0/9
Dissolved Oxygen	7.580	mg/L	2/18
pH	7.950	SU	0/18
IBI - Site 28/29	52/54		
QHEI - Site 28/29	Good/Good to Excellent		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at five sites within Mongo Millpond subwatershed from November 2010 through August 2011. As can be seen in Table 31, all parameters exceeded the target levels at some point during the sampling cycle except for pH which never exceeded the target level. However, it should be noted temperature and nitrate exceeded the target levels set by this project in 50% and 56%, respectively, of the samples. D.O. exceeded target levels in 62% of the samples, and total phosphorus and *E. coli* exceeded the targets levels in at least 10% of the samples. The SWCD also sampled the macroinvertebrate community located at each of the five sample sites located in the Mongo Millpond subwatershed. All five sites scored high enough to indicate an excellent aquatic ecosystem.

Table 31: Mongo Millpond: LaGrange County Water Quality Data Analysis

Mongo Millpond			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.1	SU	0.0%
Temp	11.4	Celsius	50.0%
D.O.	9.5	mg/L	64.0%
Total Dissolved Solids	386.8	mg/L	2.0%
Turbidity	4.7	NTU	2.0%
E. coli	147.0	CFU/100 ml	16.0%
Nitrate	1.7	mg/L	56.0%
Phosphorus, Total	0.2	mg/L	10.0%
Total Suspended Solids	8.0	mg/L	2.0%
Macroinvertebrates	41	River Watch	0.0%
Habitat	88	River Watch	0.0%

3.3.4 Cline Lake Subwatershed

There are sixteen total water quality sampling sites located within the Cline Lake subwatershed, as can be seen in Figure 18. Six sites were used by IDEM for the 303(d) list; four sites were used by IDEM for the TMDL report, of which three were used to collect biological data, and six sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

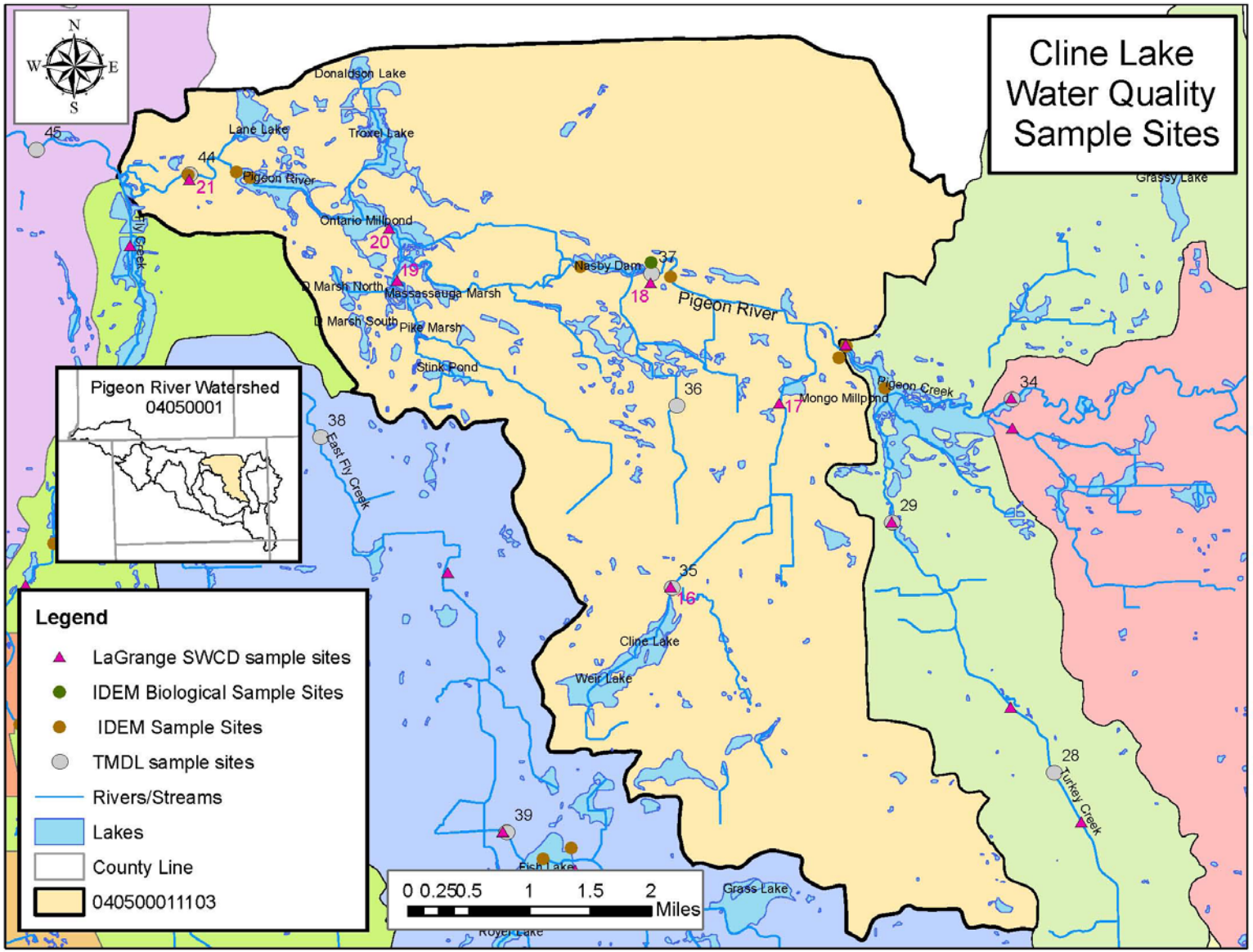

Figure 18: Cline Lake Subwatershed Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in Cline Lake subwatershed in 2000 and 2005. Samples were taken from Nasby and Ontario Millponds and the Pigeon River. The sample analysis is presented in separate tables below as the hydrology of the millpond and river are very different. Table 32 shows the data analysis for the Nasby and Ontario Millponds and as can be seen in the table, nitrate-nitrite exceeded the target level in 100% of the samples. Samples were collected in July 2000 from each pond once for most parameters. Two samples from each pond were collected for analysis of TKN and three samples were collected from Nasby Dam and four samples from Ontario Millpond for analysis of DO.

Table 32: Cline Lake – Nasby and Ontario Millponds: IDEM 303(d) Monitoring Data Analysis

Cline Lake - Nasby and Ontario Millponds			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.107	mg/L	0/2
Total Kjeldahl Nitrogen	0.335	mg/L	2/4
Nitrate-Nitrite	2.404	mg/L	2/2
Phosphorus, Total	0.066	mg/L	0/5
Dissolved Oxygen	7.271	mg/L	0/7
pH	8.000	SU	0/2

Table 33 below shows the data analysis of the Pigeon River sampling site located within the Cline Lake subwatershed. As can be seen in the table, TKN exceeded the target level in one sample, turbidity exceeded the target level in two samples, and *E. coli* exceeded geometric mean state standard of 125 cfu/100ml.

Table 33: Cline Lake-Pigeon River: IDEM 303(d) Monitoring Data Analysis

Cline Lake - Pigeon River			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.000	mg/L	0/2
Total Kjeldahl Nitrogen	0.333	mg/L	1/3
Nitrate-Nitrite	0.823	mg/L	0/3
Suspended Solids, Total	0.000	mg/L	0/3
Dissolved Solids, Total	383.333	mg/L	0/3
Turbidity	5.689	NTU	2/15
Phosphorus, Total	0.070	mg/L	0/3
Dissolved Oxygen	7.979	mg/L	0/17
pH	7.837	SU	0/17
E. coli	(geo mean) 173.94	CFU/100 ml	1/1

IDEM TMDL Study

Four sample sites within Cline Lake subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. Each site was sampled in June, July and September, 2010. As can be seen in Table 34, nitrate-nitrite and D.O. were the only two parameters that exceeded the target level. Nitrate-nitrite and D.O. exceeded the target levels each once. TKN exceeded the target level of 0.076 mg/L in 82% of the samples and TSS exceeded the target level of 25 mg/L in 27% of the samples. It should also be noted that biological data was collected at three sites in Cline Lake. The IBI and QHEI for site 35, a headwater stream, indicate a healthy aquatic ecosystem. However, downstream at sites 37 and 44, both located on the main stem of the Pigeon River, the IBI and QHEI scores indicate a very poor aquatic ecosystem.

Table 34: Cline Lake: IDEM TMDL Study Data Analysis

Cline Lake (Sites 35, 36, 37, and 44)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.787	mg/L	9/11
Nitrate-Nitrite	1.147	mg/L	1/11
Suspended Solids, Total	12.636	mg/L	3/11
Phosphorus, Total	0.031	mg/L	0/11
Dissolved Oxygen	7.500	mg/L	1/23
pH	7.670	SU	0/3
IBI - Site 35/37/44	54/12/34		
QHEI - Site 35/37/44	Good to Excellent/Very Poor/ Poor		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at six sites within Cline Lake subwatershed from November 2010 through August 2011. As can be seen in Table 35, all parameters did not meet the target levels at some point during the sampling cycle except for TSS which never exceeded the target level. D.O. did not meet target levels 64% of the time, with 7% of those that did not meet the target level falling below 4 mg/L and all other samples measuring above 9 mg/L. It should also be noted that E. coli exceeded the state standard of 235 cfu/100 ml in 20% of the samples and nitrates exceeded the target level of 1.5 mg/L in 46% of the samples. The SWCD also sampled the macroinvertebrate community located at each of the six sample sites located in the Cline Lake subwatershed. All six sites scored high enough to indicate an excellent aquatic ecosystem.

Table 35: Cline Lake: LaGrange County Water Quality Data Analysis

Cline Lake			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.5	SU	14.0%
Temp	11.7	Celsius	37.0%
D.O.	10.0	mg/L	64.0%
Total Dissolved Solids	391.6	mg/L	2.0%
Turbidity	5.1	NTU	3.0%
E. coli	140.0	CFU/100 ml	20.0%
Nitrate	1.8	mg/L	46.0%
Phosphorus, Total	0.2	mg/L	8.0%
Total Suspended Solids	7.0	mg/L	0.0%
Macroinvertebrates	41	River Watch	0.0%
Habitat	84	River Watch	0.0%

3.3.5 East Fly Creek Subwatershed

There are thirteen total water quality sampling sites located within the East Fly Creek subwatershed, as can be seen in Figure 19. Three sites were used by IDEM for the 303(d) list; three sites were used by IDEM for the TMDL report, of which two were used to collect biological data, and seven sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

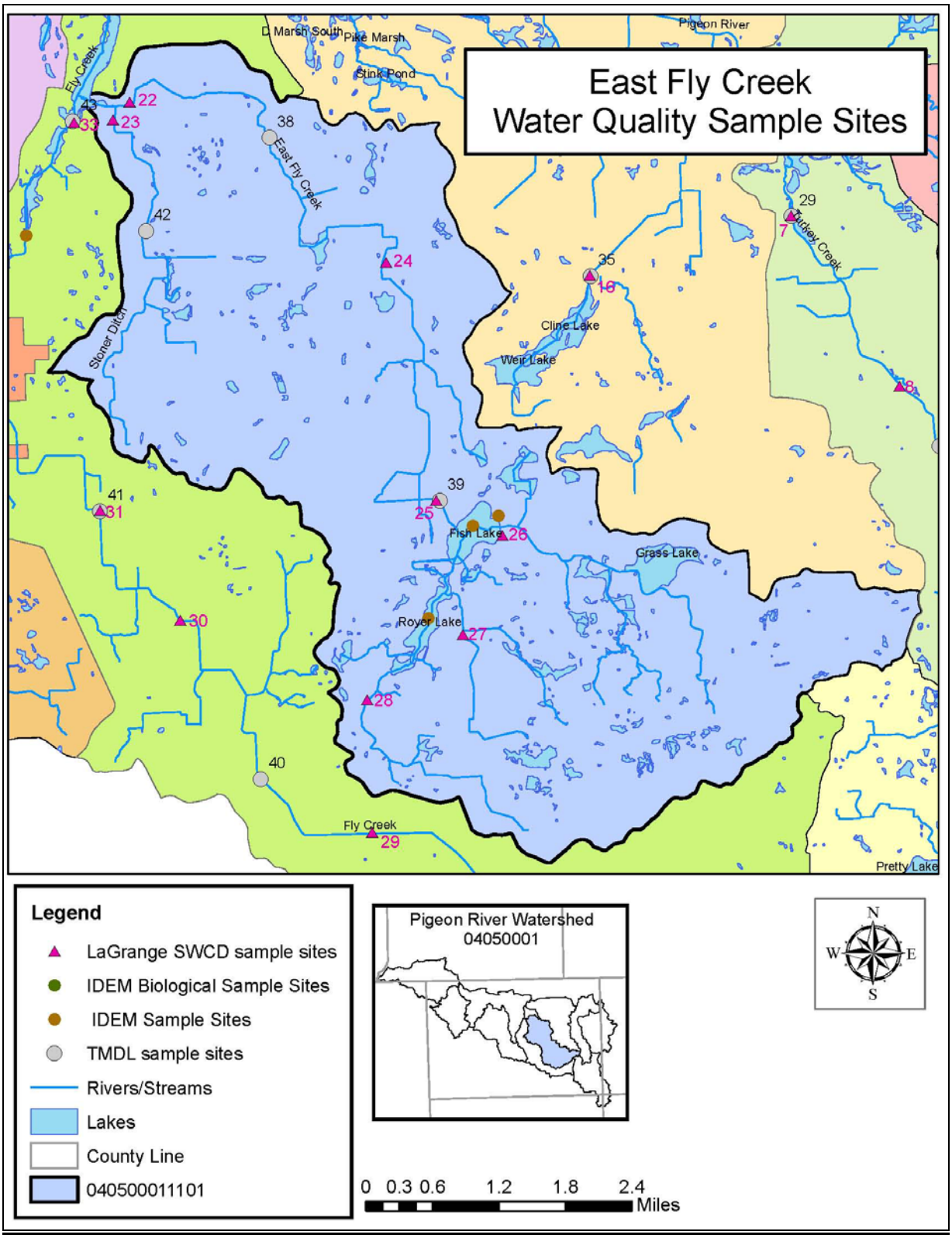

Figure 19: East Fly Creek Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in East Fly Creek subwatershed in 2000. As can be seen in Table 36, TKN, and turbidity exceeded the target levels once during the sampling cycle.

Table 36: East Fly Creek: IDEM 303(d) Monitoring Data Analysis

East Fly Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
E. coli	(geo mean) 41.84	mg/L	0/1
Total Kjeldahl Nitrogen	1.074	mg/L	1/2
Turbidity	4.980	mg/L	1/5
Dissolved Oxygen	6.674	mg/L	0/9
pH	7.767	SU	0/6

IDEM TMDL Study

Four sample sites within East Fly Creek subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. One of the four sites was taken from the Fish and Royer Lake WWTP outfall. The results of the analysis are separated into two different tables below, one for the stream sample sites, and one for the WWTP outfall site. The stream sample sites were sampled in June, July and September, 2010 and the WWTP was tested once in September, 2010. As can be seen in Table 37, nitrate-nitrite, TKN, and TSS all exceeded the target levels. Nitrate-nitrite exceeded the target level of 1.5 mg/L in 33% of the samples, TKN exceeded the target level of 0.076 mg/L in 67% of the samples and TSS exceeded the target level of 25 mg/L in 11% of the samples. It should also be noted that biological data was collected at two sites in East Fly Creek subwatershed. The IBI and QHEI for site 39, located on the main channel of East Fly Creek, indicate a healthy aquatic ecosystem. However, site 42, a headwater stream to Pigeon River had lower IBI and QHEI scores which indicate a very poor aquatic ecosystem.

Table 37: East Fly Creek: IDEM TMDL Study Data Analysis

East Fly Creek (Sites 38, 39, and 42)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.827	mg/L	6/9
Nitrate-Nitrite	1.544	mg/L	3/9
Suspended Solids, Total	6.667	mg/L	1/9
Phosphorus, Total	0.052	mg/L	0/9
Dissolved Oxygen	6.680	mg/L	0/18
pH	7.870	SU	0/18
IBI - Site 39/42	48/12		
QHEI - Site 39/42	Good/Very Poor		

Table 38 shows the results of the data analysis for the Fish and Royer Lake WWTP outfall. TKN and nitrate-nitrite each exceeded the target levels during the sampling cycle. This indicates that the WWTP is not completely eliminating the release of nitrogen into the stream. According to the US EPA, the WWTP had one violation of nitrogen in January, 2011. This violation has since been resolved. The violation reported by the US EPA does not coincide with the excessive nitrate-nitrite levels observed during the TMDL water quality analysis as that sample was taken in September of 2010.

Table 38: East Fly Creek-Fish and Royer Lake WWTP Outfall: IDEM TMDL Study Data Analysis

East Fly Creek (Fish and Royer Lake WWTP outfall)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.800	mg/L	1/1
Nitrate-Nitrite	20.400	mg/L	1/1
Suspended Solids, Total	0.000	mg/L	0/1
Phosphorus, Total	0.000	mg/L	0/1
Dissolved Oxygen	8.450	mg/L	0/1
pH	7.540	SU	0/1

Fish Consumption Advisory

Fish Lake, located within the East Fly Creek subwatershed, is listed on the 2010 Fish Consumption Advisory for Golden Redhorse and White Sucker. Both are Group 1 advisories.

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at seven sites within East Fly Creek subwatershed from November 2010 through August 2011. As can be seen in Table 39, all parameters did not meet the target levels at some point during the sampling cycle except for TDS which never exceeded the target level. D.O. did not meet target levels 72% of the time, with 5% of those that did not meet the target level falling below 4 mg/L and all other samples measuring above 9 mg/L. It should also be noted that E. coli exceeded the state standard of

235 cfu/100 ml in 45% of the samples, total phosphorus exceeded the target level of 0.3 mg/L in 24% of the samples, and nitrates exceeded the target level of 1.5 mg/L in 91% of the samples. The high nitrates are due to direct animal access, lack of filter strips or streambank buffering, barnyards with direct runoff into ditches, and to a lesser extent field tiling and faulty or improperly installed septic systems. It would not be unreasonable to assume the high levels of D.O. are associated to the high levels of nutrients found in the water column as high levels of nutrients can contribute to excessive algae growth (observed at many sites) which will produce a lot of dissolved oxygen. The SWCD also sampled the macroinvertebrate community located at each of the seven sample sites located in the East Fly Creek subwatershed. Six of the sites scored high enough to indicate an excellent aquatic ecosystem and one site, located at the headwaters, scored only enough to indicate a fair aquatic ecosystem.

Table 39: East Fly Creek: LaGrange County Water Quality Data Analysis

East Fly Creek			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.6	SU	16.0%
Temp	11.1	Celsius	30.0%
D.O.	10.4	mg/L	72.0%
Total Dissolved Solids	386.2	mg/L	0.0%
Turbidity	6.1	NTU	12.0%
E. coli	617.0	CFU/100 ml	45.0%
Nitrate	3.5	mg/L	91.0%
Phosphorus, Total	0.5	mg/L	24.0%
Total Suspended Solids	10.0	mg/L	6.0%
Macroinvertebrates	36	River Watch	0.0%
Habitat	86	River Watch	0.0%

3.3.6 Fly Creek Subwatershed

There are eleven total water quality sampling sites located within the Fly Creek subwatershed, as can be seen in Figure 20. Two sites were used by IDEM for the 303(d) list; three sites were used by IDEM for the TMDL report, of which two were used to collect biological data, and six sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

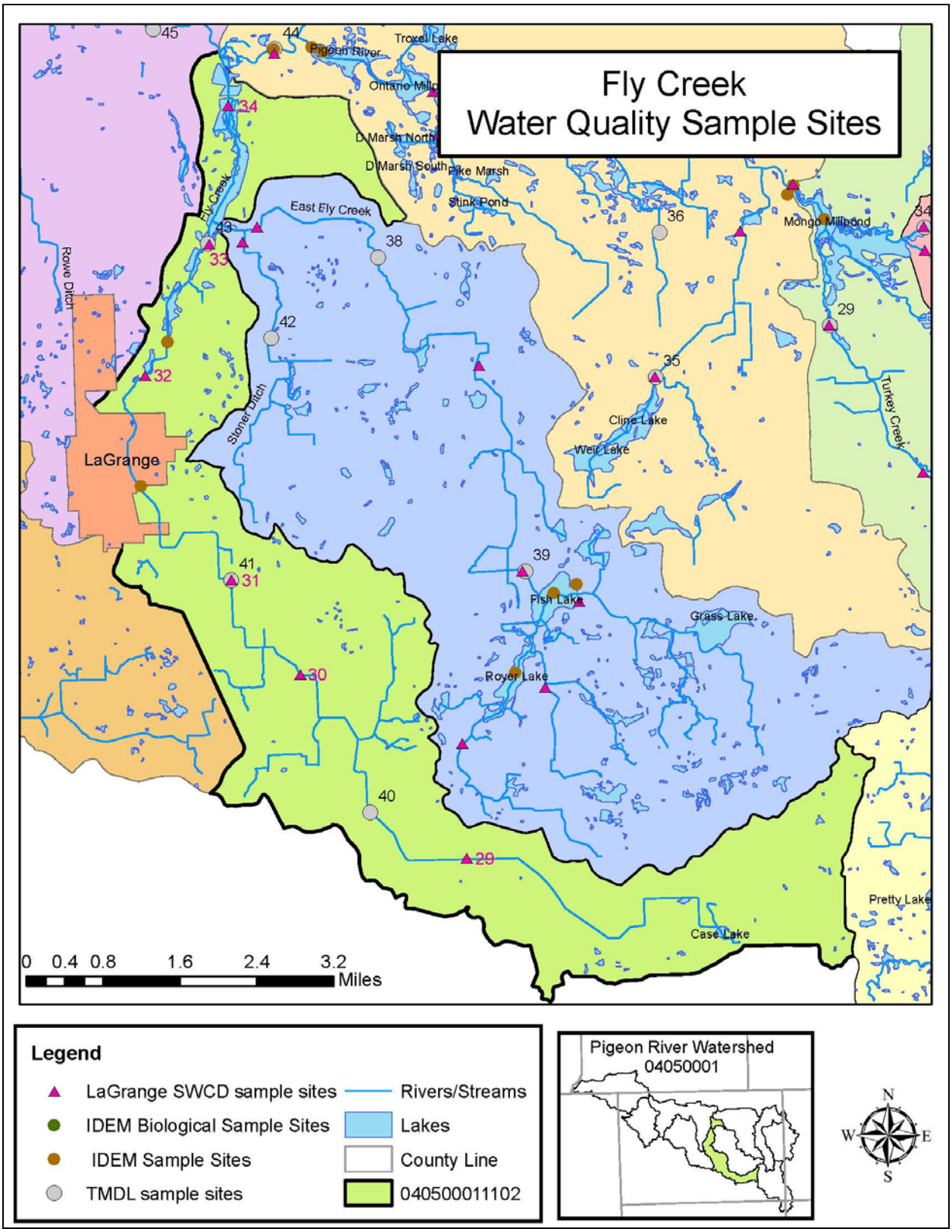

Figure 20: Fly Creek Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in East Fly Creek subwatershed in 2000. As can be seen in Table 40, *E. coli*, D.O, and turbidity exceeded the target levels during the sampling cycle. Of particular note is that D.O. exceeded the target of 9 mg/L in 90% of the samples. *E. coli* did not exceed the geometric mean standard of 125 cfu/100ml. However, IDEM's Consolidated Assessment and Listing Methodology would consider this subwatershed impaired since *E.coli* samples collected in late June and July, 2000 resulted in very high readings averaging 1,370 cfu/100ml exceeding 576 cfu/100ml for a single sample.

Table 40: Fly Creek: IDEM 303(d) Monitoring Data Analysis

Fly Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Turbidity	14.259	NTU	2/10
Dissolved Oxygen	10.346	mg/L	9/10
pH	7.932	SU	0/10
E. coli	(geo mean) 50.45	CFU/100 ml	0/1

IDEM TMDL Study

Three sample sites within Fly Creek subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. The sites were sampled in June, July and September, 2010. As can be seen in Table 41, nitrate-nitrite, TKN, and D.O. were the only parameters that exceeded the target levels. TKN exceeded the target level of 0.076 mg/L in 11% of the samples, nitrate-nitrite exceeded the target level of 1.5 mg/L in 100% of the samples, and D.O. exceeded the target level of < 9mg/L in one sample. It should also be noted that biological data was collected at one site in Fly Creek subwatershed. The IBI and QHEI scores for site 43, located on the main channel of Fly Creek, indicate a poor to very poor aquatic ecosystem.

Table 41: Fly Creek: IDEM TMDL Study Data Analysis

Fly Creek (Sites 40, 41, and 43)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.079	mg/L	1/9
Nitrate-Nitrite	2.322	mg/L	9/9
Suspended Solids, Total	2.444	mg/L	0/9
Phosphorus, Total	0.011	mg/L	0/9
Dissolved Oxygen	7.460	mg/L	1/18
pH	7.790	SU	0/18
IBI - Site 43	26		
QHEI - Site 43	Very Poor to Poor		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at six sites within Fly Creek subwatershed from November 2010 through August 2011. As can be seen in Table 42, all parameters did not meet the target levels at some point during the sampling cycle except for TDS which never exceeded the target level. D.O. did not meet target levels 73% of the time, with 1% of those that did not meet the target level falling below 4 mg/L and all other samples measuring above 9 mg/L. It should also be noted that *E. coli* exceeded the state standard of 235 cfu/100 ml in 58% of the samples, total phosphorus exceeded the target level of 0.3 mg/L in 17% of the samples, and nitrates exceeded the target level of 1.5 mg/L in 100% of the samples. The high nitrates are due to direct animal access, lack of filter strips or streambank buffering, barnyards with direct runoff into ditches, and to a lesser extent field tiling and faulty or improperly installed septic systems. It would not be unreasonable to assume the high levels of D.O. are associated with the high levels of nutrients found in the water column as high levels of nutrients can contribute to excessive algae growth which will produce a lot of dissolved oxygen. The SWCD also sampled the macroinvertebrate community located at each of the six sample sites located in the Fly Creek subwatershed. All six of the sites scored high enough to indicate an excellent aquatic ecosystem.

Table 42: Fly Creek: LaGrange County Water Quality Data Analysis

Fly Creek			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.5	SU	12.0%
Temp	10.5	Celsius	27.0%
D.O.	10.7	mg/L	73.0%
Total Dissolved Solids	437.8	mg/L	0.0%
Turbidity	6.2	NTU	13.0%
E. coli	1020.0	CFU/100 ml	58.0%
Nitrate	3.5	mg/L	100.0%
Phosphorus, Total	0.2	mg/L	17.0%
Total Suspended Solids	10.0	mg/L	33.0%
Macroinvertebrates	29	River Watch	0.0%
Habitat	81	River Watch	0.0%

3.3.7 Buck Lake/Buck Creek Subwatershed

There are twelve total water quality sampling sites located within the Buck Lake/Buck Creek subwatershed, as can be seen in Figure 21. One site was used by IDEM for the 303(d) list; three sites were used by IDEM for the TMDL report, of which one was used to collect biological data, and eight sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

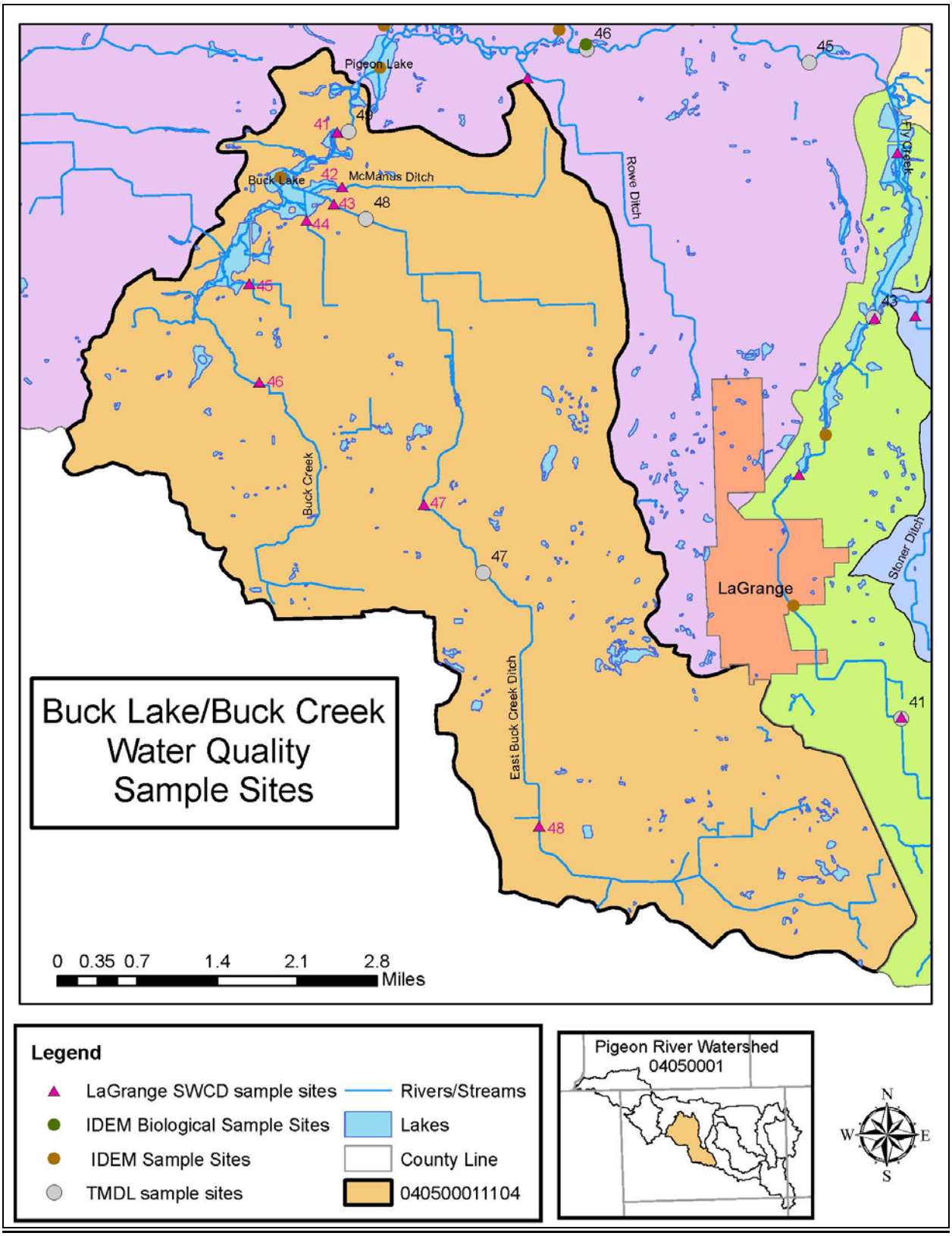

Figure 21: Buck Lake/Buck Creek Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis in Buck Lake/Buck Creek subwatershed in 2000. As can be seen in Table 43, TKN, nitrate-nitrite, and D.O. did not meet target levels during the sampling cycle. TKN and nitrate-nitrite exceeded the target levels in 100% of the samples, and D. O. did not meet target levels in 71% of the samples with 43% of that falling below 4 mg/L. Excessive nutrient loading from livestock related issues is the likely cause for observed algal growth at most of the sample sites. The excessive algal growth is the most reasonable cause of low D.O. readings.

Table 43: Buck Lake/Buck Creek: IDEM 303(d) Monitoring Data Analysis

Buck Lake/Buck Creek			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.084	mg/L	0/2
Total Kjeldahl Nitrogen	1.194	mg/L	2/2
Nitrate-Nitrite	2.636	mg/L	2/2
Phosphorus, Total	0.065	mg/L	0/2
Dissolved Oxygen	6.829	mg/L	5/7
pH	8.025	SU	0/2

IDEM TMDL Study

Three sample sites within Buck Lake/Buck Creek subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. The sites were sampled in June, July and September, 2010. As can be seen in Table 44, nitrate-nitrite, TKN, and D.O. were the only parameters that exceeded the target levels. TKN exceeded the target level of 0.076 mg/L in 100% of the samples, nitrate-nitrite exceeded the target level of 1.5 mg/L in 67% of the samples, and D.O. exceeded the target level of < 9mg/L in 33% of the samples. It should also be noted that biological data was collected at one site in Buck Lake/Buck Creek subwatershed. The IBI and QHEI scores for this site located on the main channel of Buck Creek indicate an excellent aquatic ecosystem.

Table 44: Buck Lake/Buck Creek: IDEM TMDL Study Data Analysis

Buck Lake - Buck Creek (Sites 47, 48, and 49)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.831	mg/L	9/9
Nitrate-Nitrite	2.312	mg/L	6/9
Suspended Solids, Total	2.778	mg/L	0/9
Phosphorus, Total	0.032	mg/L	0/9
Dissolved Oxygen	7.950	mg/L	5/15
pH	8.010	SU	0/15
IBI - Site 49	60		
QHEI - Site 49	Excellent		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at eight sites within Buck Lake/Buck Creek subwatershed from November 2010 through August 2011. As can be seen in Table 45, all parameters did not meet the target levels at some point during the sampling cycle. D.O. did not meet target levels 76% of the time, with all of those that did not meet the target level exceeding 9 mg/L. It should also be noted that *E. coli* exceeded the state standard of 235 cfu/100 ml in 64% of the samples, total phosphorus exceeded the target level of 0.3 mg/L in 40% of the samples, and nitrates exceeded the target level of 1.5 mg/L in 67% of the samples. It would not be unreasonable to assume the high levels of D.O. are associated with the high levels of nutrients found in the water column as high levels of nutrients can contribute to excessive algae growth which will produce a lot of dissolved oxygen initially, but can cause D.O. depletion as excessive algae die and decompose. The SWCD also sampled the macroinvertebrate community located at each of the eight sample sites located in the Buck Lake/Buck Creek subwatershed. Six sites scored high enough to indicate an excellent aquatic ecosystem, while site 44, a small headwater stream leading into Buck Lake scored only to be in poor aquatic health, and site 46, another headwater stream on the western edge of the subwatershed leading into Buck Lake scored to be in fair aquatic health.

Table 45: Buck Lake/Buck Creek: LaGrange County Water Quality Data Analysis

Buck Lake - Buck Creek			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.3	SU	6.0%
Temp	11.3	Celsius	23.0%
D.O.	10.3	mg/L	76.0%
Total Dissolved Solids	439.3	mg/L	3.0%
Turbidity	9.9	NTU	27.0%
E. coli	1039.0	CFU/100 ml	64.0%
Nitrate	3.0	mg/L	67.0%
Phosphorus, Total	0.4	mg/L	40.0%
Total Suspended Solids	16.0	mg/L	12.0%
Macroinvertebrates	33	River Watch	12.5%
Habitat	79	River Watch	12.5%

3.3.8 VanNatta Ditch Subwatershed

There are twenty-two total water quality sampling sites located within the VanNatta Ditch subwatershed, as can be seen in Figure 22. Eight sites were used by IDEM for the 303(d) list; four sites were used by IDEM for the TMDL report, IDEM also collected biological data at four sites for use in developing the TMDL report, and six sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

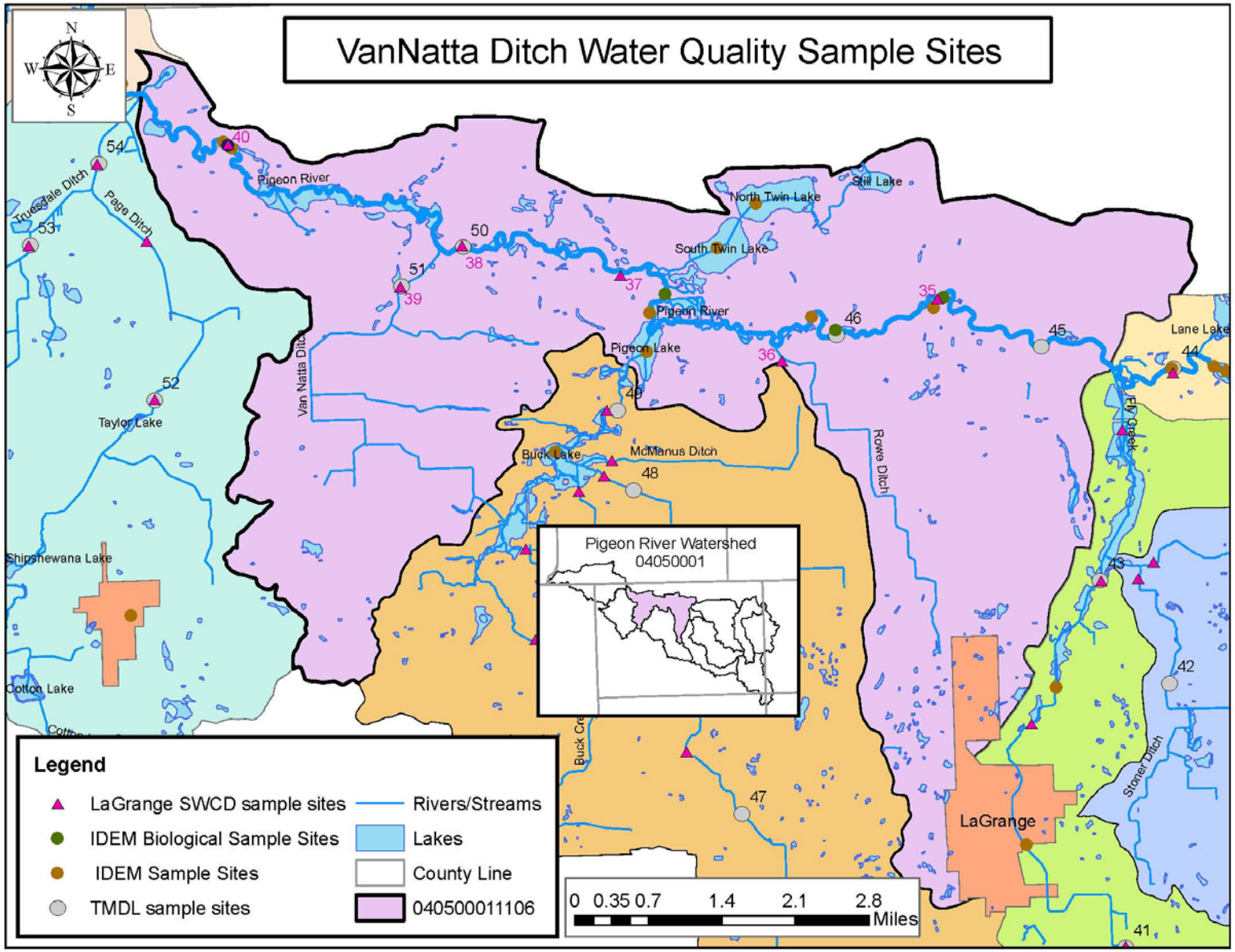

Figure 22: VanNatta Ditch Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM has been collecting water samples for analysis in VanNatta Ditch subwatershed at least monthly since 2000. Data is available to the public from June 2000 through November 2010. As can be seen in Table 46, nearly all parameters did not meet the target levels at some point during the sampling cycle, except for TDS which never exceeded the target level. It should be noted that TKN exceeded the target level of 0.076 mg/L in 85% of the samples, nitrate-nitrite exceeded the target level of 1.5 mg/L in 40% of the samples, and D.O. did not meet target levels during the sampling cycle in 46% of the samples, with only 6% of that falling below 4 mg/L and 40% measuring greater than 9 mg/L. Algal growth was observed at sampling sites with low D.O. readings due to algal decomposition.

Table 46: VanNatta Ditch: IDEM 303(d) Monitoring Data Analysis

VanNatta Ditch			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.036	mg/L	4/144
Total Kjeldahl Nitrogen	0.698	mg/L	139/147
Nitrate-Nitrite	1.529	mg/L	59/147
Suspended Solids, Total	3.785	mg/L	1/130
Dissolved Solids, Total	379.567	mg/L	0/141
Turbidity	7.641	NTU	24/160
Phosphorus, Total	0.030	mg/L	0/106
Dissolved Oxygen	8.558	mg/L	94/206
pH	8.075	SU	1/302
E. coli	94.125	CFU/100 ml	1/20

IDEM TMDL Study

Four sample sites within VanNatta Ditch subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. The sites were sampled in June, July and September, 2010. As can be seen in Table 47, TKN is the only parameter that did not meet the target level. TKN exceeded the target level of 0.076 mg/L in 75% of the samples. It should also be noted that biological data was collected at four sites in VanNatta Ditch subwatershed. The IBI scores indicated a fair to good representation of fish in the ecosystem. The QHEI scores for this subwatershed indicate a fair to poor aquatic habitat.

Table 47: VanNatta Ditch: IDEM TMDL Study Data Analysis

VanNatta Ditch (Sites 45, 46, 50, and 51)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.543	mg/L	9/12
Nitrate-Nitrite	1.069	mg/L	0/12
Suspended Solids, Total	8.833	mg/L	0/12
Phosphorus, Total	0.039	mg/L	0/12
Dissolved Oxygen	7.240	mg/L	0/22
pH	7.950	SU	0/22
IBI - Site 46/50/51	40/42/38		
QHEI - Site 46/50/51	Fair/Fair/Fair to Poor		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at six sites within VanNatta Ditch subwatershed from November 2010 through August 2011. As can be seen in Table 48, only TDS and TSS did not exceed target levels during the sampling cycle. Nitrate exceeded the target level of 1.5 mg/L in 48% of the samples, and total phosphorus exceeded the target level of 0.3 mg/L in 10% of the samples. D.O. did not meet target levels 55% of the time, with all of those that did not meet the target level exceeding 9 mg/L. It should also be noted that *E. coli* exceeded the state standard of 235 cfu/100 ml in 64% of the samples. It would not be unreasonable to assume the high levels of D.O. are associated to the high levels of nutrients found in the water table as high levels of nutrients can contribute to excessive algae growth which will produce a lot of dissolved oxygen initially, but can cause D.O. depletion as excessive algae die and decompose. The SWCD also sampled the macroinvertebrate community located at each of the six sample sites located in the VanNatta Ditch subwatershed. All six sites mIBI scores were high enough to indicate an excellent aquatic ecosystem.

Table 48: VanNatta Ditch: LaGrange County Water Quality Data Analysis

VanNatta Ditch			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	7.8	SU	3.0%
Temp	11.0	Celsius	28.0%
D.O.	9.9	mg/L	55.0%
Total Dissolved Solids	393.9	mg/L	0.0%
Turbidity	5.6	NTU	5.0%
E. coli	187.0	CFU/100 ml	27.0%
Nitrate	1.7	mg/L	48.0%
Phosphorus, Total	0.2	mg/L	10.0%
Total Suspended Solids	8.0	mg/L	0.0%
Macroinvertebrates	44	River Watch	0.0%
Habitat	87	River Watch	0.0%

3.3.9 Page Ditch Subwatershed

There are thirteen total water quality sampling sites located within the Page Ditch subwatershed, as can be seen in Figure 23. Three sites were used by IDEM for the 303(d) list; three sites were used by IDEM for the TMDL report, IDEM also collected biological data at two sites for use in developing the TMDL report, and seven sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

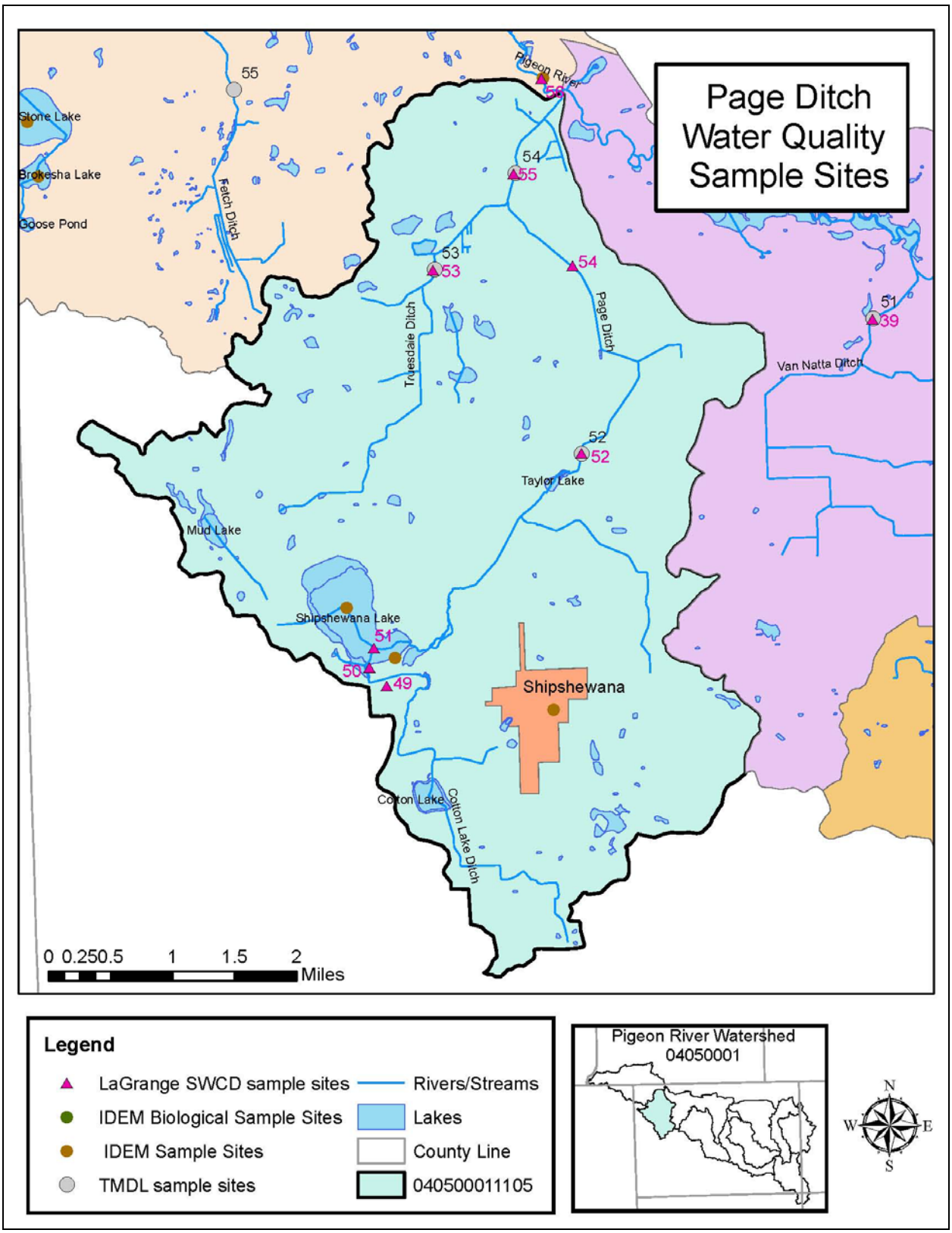

Figure 23: Page Ditch Water Quality Sample Sites

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis from three sites in Page Ditch subwatershed in 2000. As can be seen in Table 49, turbidity, D.O, and pH did not meet their respective target. Turbidity exceeded the target level of 10.4 mg/L in 24% of the samples, D.O. did not meet the target level in 70% of the samples with 7% of those samples measuring below 4 mg/L and 63% of those samples measured over 9 mg/L, and pH exceeded the state standard in 22% of the samples.

Table 49: Page Ditch: IDEM 303(d) Monitoring Data Analysis

Page Ditch			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.051	mg/L	0/2
Turbidity	6.061	NTU	5/21
Phosphorus, Total	0.130	mg/L	0/2
Dissolved Oxygen	9.015	mg/L	19/27
pH	8.352	SU	5/23
E. coli	2.6	CFU/100 ml	0/1

IDEM TMDL Study

Three sample sites within Page Ditch subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. The sites were sampled in June, July and September, 2010. As can be seen in Table 50, TKN, nitrate-nitrite, TSS, and total phosphorus all exceeded target levels. TKN exceeded target levels in 100% of the samples, nitrate-nitrite exceeded the target level of 1.5 mg/L in 78% of the samples, TSS exceeded the target level of 25 mg/L in 44% of the samples, and total phosphorus exceeded the target level of 0.3 mg/L in 33% of the samples. It should also be noted that biological data was collected at two sites in Page Ditch subwatershed. Site 53, a headwater stream had an IBI score indicative of an excellent macroinvertebrate community while site 54 scored much lower indicating a poor macroinvertebrate community. The same pattern was seen with the QHEI scores where site 53 scored high enough to be considered an excellent aquatic habitat, and site 54 scored much lower indicating a poor aquatic ecosystem. Several differences help explain such a wide gap in scores between sites. Site 53 has many wetland areas adjacent to the ditch system and fewer livestock influences while site 54 has fewer wetland buffers allowing greater livestock influences. In addition site 54 is directly influenced by the town of Shipshewana and a much higher rural population.

Table 50: Page Ditch: IDEM TMDL Study Data Analysis

Page Ditch (Sites 52, 53, and 54)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	1.978	mg/L	9/9
Nitrate-Nitrite	2.344	mg/L	7/9
Suspended Solids, Total	69.667	mg/L	4/9
Phosphorus, Total	0.241	mg/L	3/9
Dissolved Oxygen	7.190	mg/L	0/12
pH	7.920	SU	0/12
IBI - Site 53/54	60/32		
QHEI - Site 53/54	Excellent/Poor		

Fish Consumption Advisory

Lake Shipshewana, Truesdale Ditch, Page Ditch, and Cotton Lake Ditch, located in Page Ditch subwatershed, are listed on the 2010 Fish Consumption Advisory specifically for Carp which is a Group 3 advisory.

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at seven sites within Page Ditch subwatershed from November 2010 through August 2011. As can be seen in Table 51, all parameters did not meet target levels at least once during the sample cycle. It should be noted that nitrate exceeded the target level of 1.5 mg/L in 78% of the samples, and total phosphorus exceeded the target level of 0.3 mg/L in 70% of the samples. This may account for D.O. not meeting target levels in 61% of the samples with only 1% of those falling below 4 mg/L. *E. coli* exceeded the state standard of 235 cfu/ml in 51% of the samples. Turbidity exceeded the target level of 10.4 NTU in 29% of the samples and TSS exceeded the target level of 25 mg/L in 17% of the samples which indicates there may be some erosion issues, raw sewage entering the water column, livestock access or barnyard runoff in the Page Ditch subwatershed. The SWCD also sampled the macroinvertebrate community at each of the seven sample sites located in the Page Ditch subwatershed. All seven sites mIBI scores were high enough to indicate a good to excellent aquatic ecosystem.

Table 51: Page Ditch: LaGrange County Water Quality Data Analysis

Page Ditch			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.2	SU	4.0%
Temp	11.7	Celsius	30.0%
D.O.	9.8	mg/L	61.0%
Total Dissolved Solids	379.3	mg/L	1.0%
Turbidity	10.3	NTU	29.0%
E. coli	864.0	CFU/100 ml	51.0%
Nitrate	3.1	mg/L	78.0%
Phosphorus, Total	0.5	mg/L	70.0%
Total Suspended Solids	16.0	mg/L	17.0%
Macroinvertebrates	25	River Watch	0.0%
Habitat	76	River Watch	0.0%

3.3.10 Pigeon River Subwatershed

There are twenty-six total water quality sampling sites located within the Pigeon River subwatershed, as can be seen in Figure 24. Three sites were used by IDEM for the 303(d) list; six sites were used by IDEM for the TMDL report, IDEM also collected biological data at six sites for use in developing the TMDL report, six sites were used by the MI DEQ for the 303(d) list, and five sample sites were used by LaGrange County SWCD to collect water quality data for the purposes of this WMP project.

IDEM Integrated Report Water Quality Assessment

IDEM collected water samples for analysis from three sites in Pigeon River subwatershed in 2000. Two sample sites were located in Brokesha and Stone Lakes and one site was located on the Pigeon River. The lakes were analyzed separately from the river as the two different water sources have very different hydrology. Table 52 shows the analysis of the Pigeon River sample site. As can be seen in the table, turbidity, D.O, and *E. coli* did not meet the target levels. Turbidity exceeded the target level of 10.4 mg/L in one of the samples, D.O. did not meet the target level in 44% of the samples with all of those samples measuring above 9 mg/L. Table 53 shows the data analysis for the lakes. Only TKN exceeded the target level, but it exceeded in 100% of the samples.

Table 52: Pigeon River – Pigeon River: IDEM 303(d) Monitoring Data Analysis

Pigeon River - Pigeon River			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Turbidity	4.430	NTU	1/16
Dissolved Oxygen	8.679	mg/L	7/16
pH	8.045	SU	0/16

Table 53: Pigeon River – Brokesha and Stone Lakes: IDEM 303(d) Monitoring Data Analysis

Pigeon River - Brokesha and Stone Lakes			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Ammonia	0.027	mg/L	0/3
Total Kjeldahl Nitrogen	0.316	mg/L	3/3
Nitrate-Nitrite	0.022	mg/L	0/3
Phosphorus, Total	0.033	mg/L	0/3
Dissolved Oxygen	7.819	mg/L	0/17
pH	6.300	SU	0/4

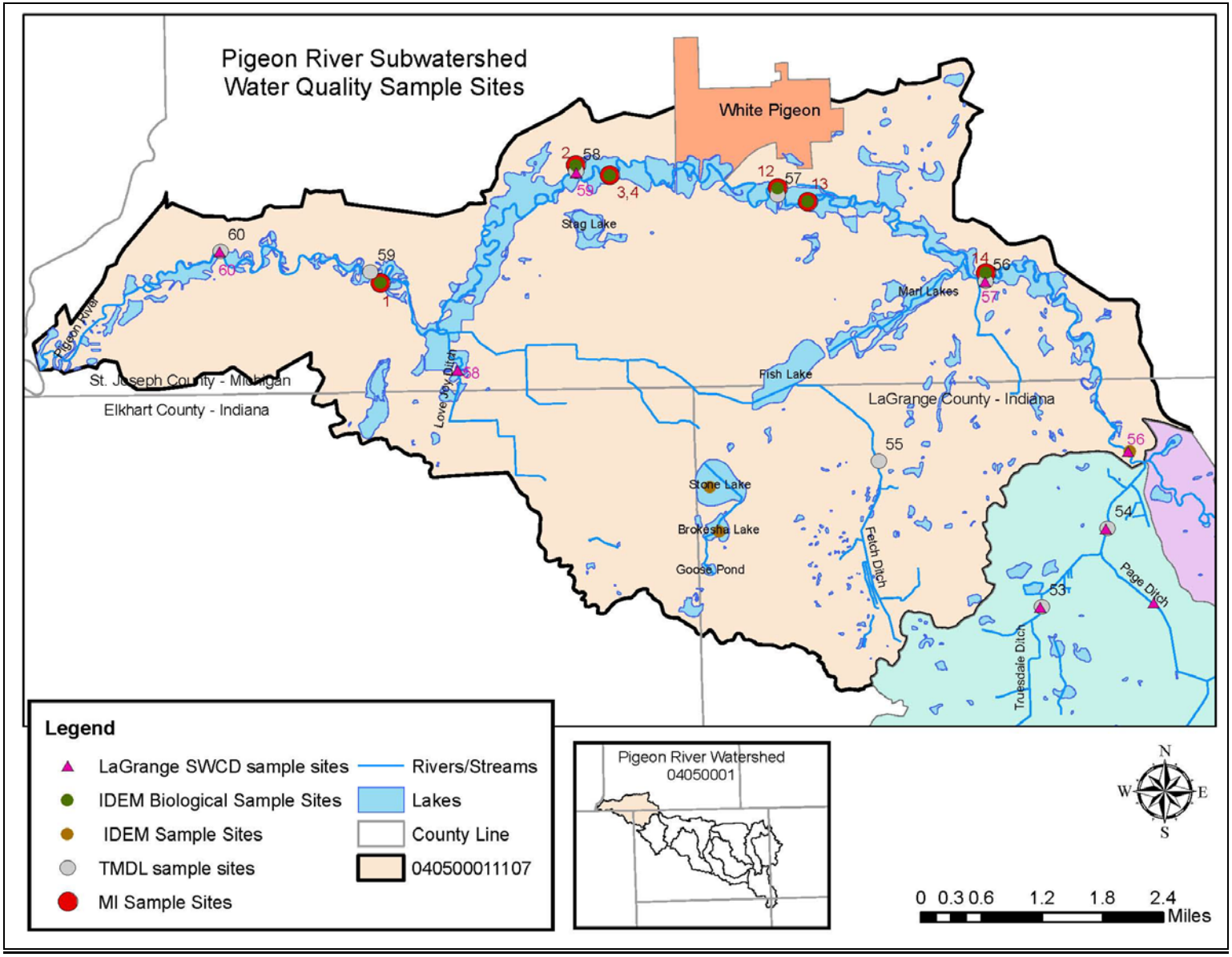

Figure 24: Pigeon River Subwatershed Water Quality Sample Sites

IDEM TMDL Study

Six sample sites within Pigeon River subwatershed were selected and analyzed by IDEM for the Pigeon Creek and Pigeon River TMDL. The sites were sampled in June, July and September, 2010. As can be seen in Table 54, TKN, TSS, and D.O. all exceeded target levels. TKN exceeded target levels in 94% of the samples which can be attributed to traditional farming practices and the ditch system containing many tile outflows. TSS exceeded the target level of 25 mg/L in one of the samples, and D.O. exceeded the target level in 34% of the samples. It should also be noted that biological data was collected at four sites in Pigeon River subwatershed. All four sites are located on the Pigeon River main stem with sites 56 and 57 upstream of White Pigeon and sites 58 and 59 downstream of White Pigeon. The IBI score for site 56 ranked the fish community to be in fair health, and the QHEI score for site 56 ranked the aquatic habitat to be in poor to fair health. The IBI score for sites 57 and 58 were both 22 which indicates a poor fish community and the QHEI score for both sites indicate a very poor aquatic habitat. The IBI score for site 59 was very high indicating an excellent fish community and the QHEI score was also very high indicating an excellent aquatic ecosystem.

Table 54: Pigeon River: IDEM TMDL Study Data Analysis

Pigeon River (Sites 55, 56, 57, 58, 59, and 60)			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.816	mg/L	17/18
Nitrate-Nitrite	1.025	mg/L	0/18
Suspended Solids, Total	10.722	mg/L	1/18
Phosphorus, Total	0.040	mg/L	0/18
Dissolved Oxygen	6.810	mg/L	12/35
pH	8.060	SU	0/35
IBI - Site 56/57/58/59	36/22/22/60		
QHEI - Site 56/57/58/59	Poor to Fair/Very Poor/Very Poor/ Excellent		

Michigan Biosurvey

MI DEQ sampled water chemistry at four sites, including sites 4, 12, 13, and 14 in the Pigeon River subwatershed. They also sampled four sites for biological and/or habitat quality at sites 1, 2, 3 and 4 located in the Pigeon River subwatershed. Data was collected once in July 2000 at sites 1, 2, 3, and 4 and once in September, 2005 at sites 12, 13, and 14. As can be seen in Table 55, TKN and nitrate+nitrite exceeded the target levels during the sampling cycle. TKN exceeded the target of 0.076 mg/L in 100% of the samples and nitrate+nitrite exceeded the target level of 1.5 mg/L in 75% of the samples. Biological data was also collected at all six sites in 2005. All six sites scored high enough to indicate an excellent aquatic habitat.

Table 55: Pigeon River subwatershed: MI Biosurvey Data Analysis

Pigeon River			
Parameter	**Mean**	**Unit**	**# Does Not Meet Target**
Total Kjeldahl Nitrogen	0.970	mg/L	4/4
Nitrate-Nitrite	1.660	mg/L	3/4
Nitrite	0.010	mg/L	0/4
Suspended Solids, Total	5.750	mg/L	0/4
Phosphorus, Total	0.046	mg/L	0/4
pH	8.210	SU	0/4
IBI (Site 1)	Excellent		
mIBI (Sites 2/3/4)	Excellent/Excellent/Excellent		
QHEI (Sites 1/2/3/4)	Excellent/Excellent/Excellent/Excellent		

LaGrange County SWCD Water Quality Monitoring Program

LaGrange County SWCD sampled water quality monthly at five sites within Pigeon River subwatershed from November 2010 through August 2011. As can be seen in Table 56, all parameters did not meet target levels at least once during the sample cycle except for TDS which never exceeded the target level. It should be noted that nitrate exceeded the target level of 1.5 mg/L in 52% of the samples, and D.O. exceeded 9mg/l in 44% of the samples. It should also be noted that temperature exceeded the maximum target level in 26% of the samples analyzed. However, when compared to recent water quality analysis in other subwatersheds, Pigeon River subwatershed ranks higher in overall water quality. The SWCD also sampled the macroinvertebrate community located at each of the five sample sites located in the Pigeon River subwatershed. All five sites mIBI scores were high enough to indicate an excellent aquatic ecosystem.

Table 56: Pigeon River: LaGrange County Water Quality Data Analysis

Pigeon River			
Parameter	**Mean**	**Unit**	**% that does not meet target**
pH	8.3	SU	2.0%
Temp	11.5	Celsius	0.0%
D.O.	9.8	mg/L	44.0%
Total Dissolved Solids	360.4	mg/L	0.0%
Turbidity	5.5	NTU	2.0%
E. coli	141.0	CFU/100 ml	20.0%
Nitrate	1.6	mg/L	52.0%
Phosphorus, Total	0.2	mg/L	4.0%
Total Suspended Solids	9.0	mg/L	38.0%
Macroinvertebrates	47	River Watch	0.0%
Habitat	93	River Watch	0.0%

Fish Consumption Advisory

The Pigeon River subwatershed appears on the Michigan Department of Community Health's 2011-2012 Fish Consumption Advisory for mercury and PCBs in Brown Trout and PCBs in Suckers.

3.4 Water Quality Analysis Summary

The water quality in the Pigeon River watershed has been analyzed over the past several decades, though only data collected since 2000 was used for the purposes of this WMP. When historic data is compared to current data collected by this project, there are some apparent persistent problems, and a few new issues. The reasons for why there have been some changes will become apparent after reviewing the landuse in the watershed. Tables 57 and 58 below, show the average water quality for each parameter tested. Those cells that are highlighted in grey represent parameter averages that exceed the target levels, those cells that are blacked out represent parameters that were not tested for the corresponding subwatershed. After reviewing the tables, it is clear that *E. coli* remains a severe impairment to the water resources, especially in Fly Creek subwatershed and nitrogen remains a severe impairment throughout the watershed. The 2011 data collection performed by the LaGrange County SWCD also found that oversaturation of dissolved oxygen is a severe impairment throughout the watershed.

Table 57: Historic Water Quality Analysis Averages

Parameter	Unit	Green Lake	Little Turkey	Mongo Millpond	Cline Lake	Fly Creek	East Fly Creek	VanNatta Ditch	Buck Lake	Page Ditch	Pigeon River
Ammonia	mg/L	0.395	0.048					0.036	0.084	0.051	
Total Kjeldahl Nitrogen	mg/L	0.753	0.463	0.939	0.56	0.079	0.951	0.621	1.013	1.978	0.893
Nitrate-Nitrite	mg/L	0.873	1.350	3.272	0.985	2.322	1.544	1.299	2.474	2.344	1.343
Nitrite	mg/L										0.010
Suspended Solids, Total	mg/L	5.137	7.333	2.0	6.318	2.444	6.667	6.309	2.778	69.667	8.236
Dissolved Solids, Total	mg/L	227.167			383.333			379.567			
Turbidity	NTU		5.799	4.980	5.689	14.259		7.641		6.061	
Phosphorus, Total	mg/L	0.058	0.085	0.020	0.051	0.011	0.052	0.035	0.049	0.186	0.043
pH	SU	7.791	7.862	7.845	7.754	7.861	7.819	8.013	8.018	8.136	8.105
DO	mg/L	7.336	6.93	7.780	7.740	8.903	6.677	7.899	7.390	8.103	7.745
E. coli	CFU/100 ml	224.47	155.38	159.57	173.94	50.45	41.84	94.125		2.6	

Table 58: LaGrange County SWCD's 2011 Water Quality Analysis Averages

Parameter	Unit	Green Lake	Little Turkey	Mongo Millpond	Cline Lake	Fly Creek	East Fly Creek	VanNatta Ditch	Buck Lake	Page Ditch	Pigeon River
Nitrate	mg/L	2.0	1.5	1.7	1.8	3.5	3.5	1.7	3.0	3.1	1.6
Suspended Solids, Total	mg/L	8	10	8	7	10	10	8	16	16	9
Dissolved Solids, Total	mg/L	444.47	342.06	386.78	391.63	437.8	386.21	393.9	439.3	379.3	360.4
Turbidity	NTU	5.5	5.31	4.66	5.12	6.2	6.12	5.6	9.9	10.3	5.5
Phosphorus, Total	mg/L	0.20	0.23	0.23	0.17	0.22	0.47	0.20	0.39	0.45	0.17
pH	SU	7.74	8.3	8.13	8.48	8.5	8.59	7.8	8.3	8.2	8.3
DO	mg/L	9.3	9.58	9.46	9.99	10.7	10.36	9.9	10.3	9.8	9.8
E. coli	CFU/100 ml	211	276	147	140	1020	617	187	1039	864	141

3.5 Landuse Inventory by Subwatershed

This section will provide information that was obtained through windshield and desktop surveys of each subwatershed, as well as information that has been gathered via government agencies (i.e. IDEM and MDEQ) and historic data found through research at the subwatershed level. However it is important to note that there are particular trends that have been found watershed wide as described below.

Pigeon River has a diverse stakeholder community that influences the nonpoint source pollutant dynamics. The Amish community comprises the largest landowner group throughout the majority of the subwatersheds and has the greatest influence on the ditch systems feeding into the main channel of Pigeon River. The Amish community is the fastest growing population throughout the project area and comprises the bulk of livestock influences on the water resources. Many Amish landowners are splitting their properties into smaller holdings to allow for the younger generation to build a home and stay close to the family. For this reason, cropland is decreasing and more small animal feeding operations are being erected throughout the project area.

As determined by the use of the Purdue University L-THIA program, the predominant landuse in the project area is agriculture. This is illustrated in Figure 25 and Table 59, as agriculture encompasses nearly 66% of the total land use in the project area. Landowners using modern farming practices are scattered throughout the project area but primarily have the largest agricultural influences on water quality in the most eastern and western subwatersheds. The landuse inventory conducted as part of this project revealed that in most cases, buffering ditch banks, and livestock exclusion fencing are the major BMP requirements. It is important to note that in this community, practices tend to remain stable with few land-use changes over large time periods (with the exception of the Shipshewana area).

Although there are few urban areas in the project area, it has been found that urban and lake resident stakeholders do have influence on the water system in the project area. Educational outreach is ongoing with groups such as the Steuben and Lagrange County Lake Associations, and working with the growing community of Shipshewana is planned for the future. Working with the built-up communities in the project area will play a major role in reducing NPS from urban and lake resident sources. However, the quickest and most dramatic results in reducing nonpoint source pollutants lie in utilizing BMP installation within the agricultural community. Below is a breakdown of land use gathered in the project area including NPDES permitted facilities, potential pollution sources, and areas of concern which were identified through an extensive watershed survey. Looking at the land use practices and issues at a subwatershed level will help to identify where efforts should be focused to reduce NPS in surface water.

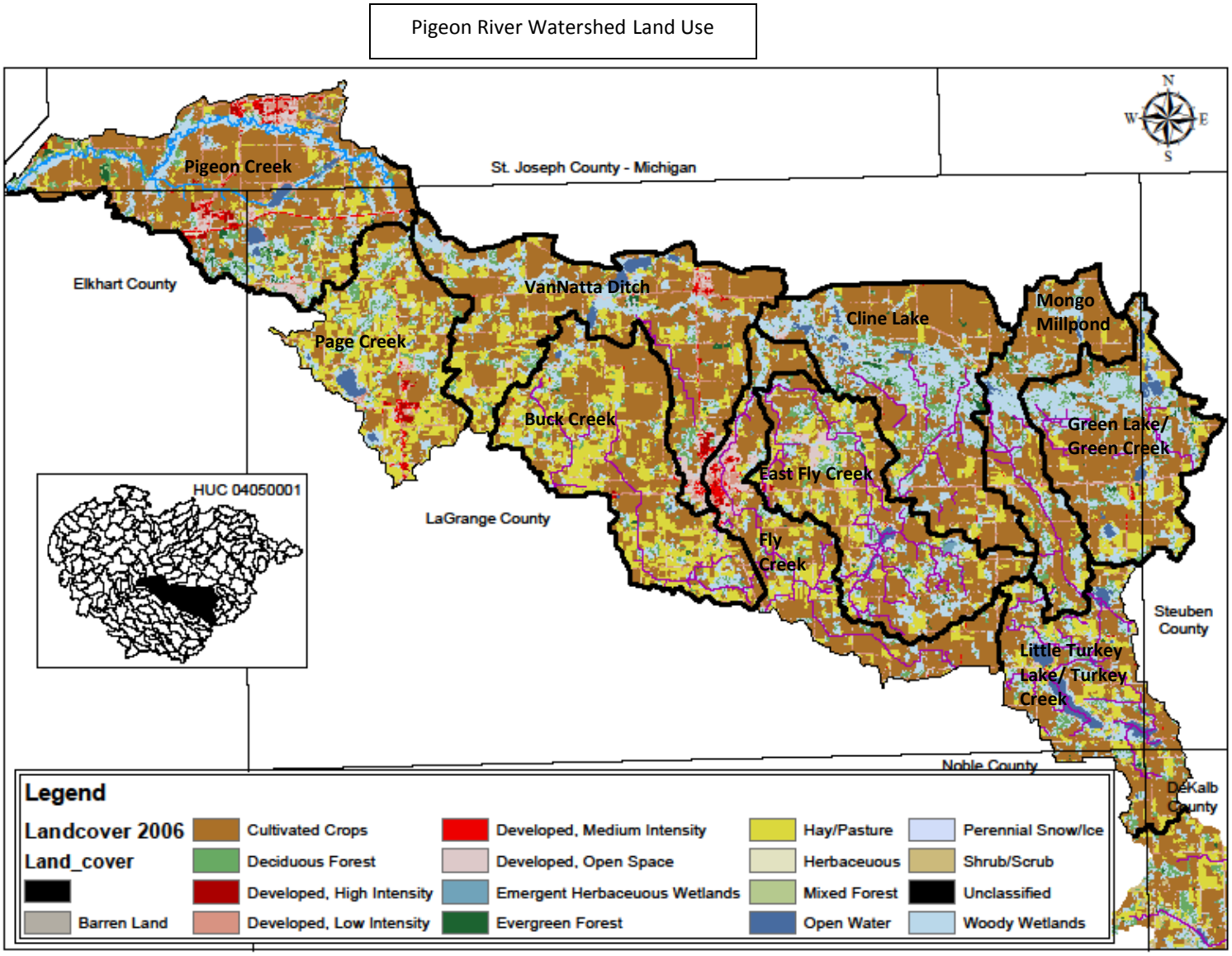

Figure 25: Land Use in the Pigeon River Project Area

Table 59: Land Use in the Pigeon River Project Area

Land use	Total	% of Project Area
Water	**26,246.6**	**16.9%**
Developed - High Density (HD)	**5062.4**	**3.3%**
Developed - Low Density (LD)	**7,197.83**	**4.6%**
Industrial	**314.4**	**0.2%**
Cultivated Crops	**74,468.6**	**47.9%**
Grass/ Pasture	**27,429.3**	**17.6%**
Forest	**13,465.4**	**8.7%**
Other	**1,358.57**	**0.9%**
Total	**155,543**	**100%**

3.5.1 Green Lake Land Use

The Green Lake-Green Creek subwatershed is located on the east edge of the project area in Steuben and LaGrange counties (Figure 26). The watershed is 13,562 acres (5488.35 hectares) in size and contains Green Lake, Deep Lake, and Appleman Lake. The major influence on water quality in Green Lake – Green Creek subwatershed is agriculture as cultivated crops and grass and/or pasture take up approximately 60% of the land (Table 60).

The Pigeon River Fish and Wildlife Area (PRFWA), a major recreational area in the project area, is partially located within the Green Lake-Green Creek subwatershed. Nearly 28% of the subwatershed is covered by surface water. This is likely due to the fact that the PRFWA itself contains 529 acres of lakes and impoundments, and over 17 miles of free flowing river.

Table 60: Green Lake-Green Creek Land Use

	Water	Developed -HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	3766.3	240.9	494	28.7	6382	1688.5	960.1	1.5	13562
%	27.8	1.8	3.6	0.2	47	12.5	7.1	<1	100

Pigeon Creek, located within Green Lake-Green Creek subwatershed, is listed on the 2008 303(d) list of impaired waters for *E. coli* and Impaired Biotic Communities. Pigeon Creek is also listed in the Indiana Fish Consumption Advisory. Figure 27 displays those waterways that are listed as impaired by the state of Indiana.

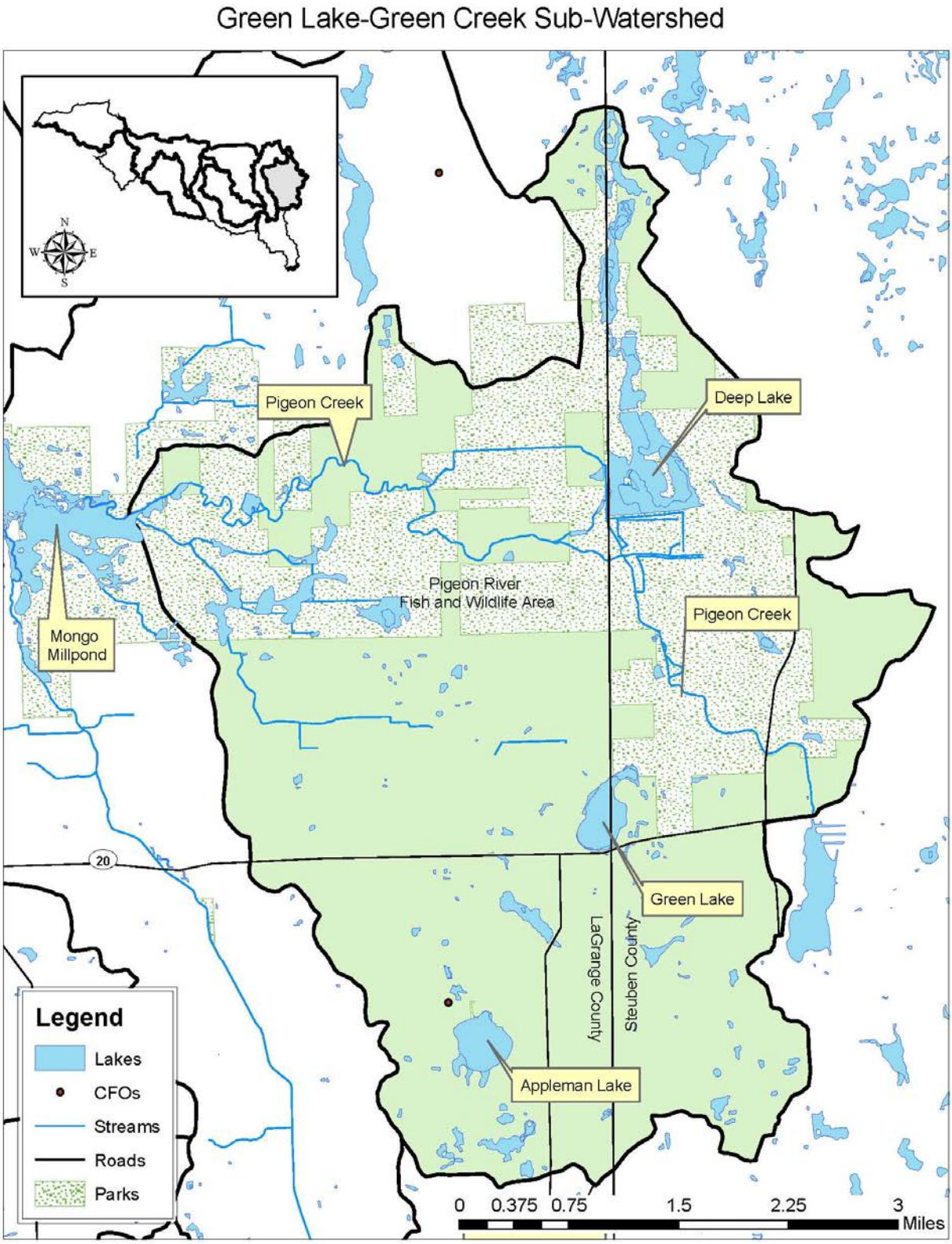

Figure 26: Green Lake-Green Creek Sub-Watershed

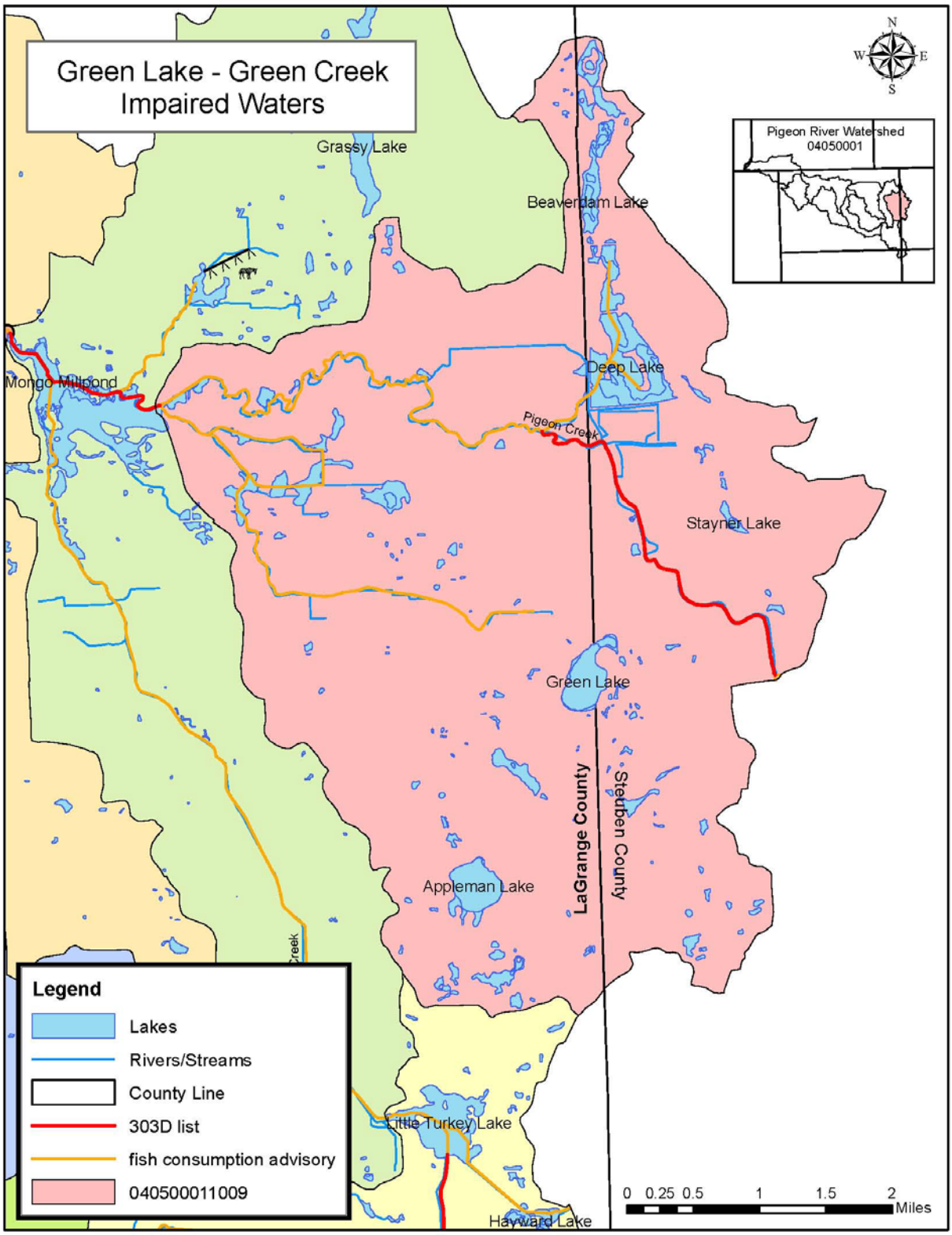

Figure 27: Green Lake – Green Creek Impaired Waters

There is not a National Pollution Discharge Elimination System (NPDES) permitted facility located within this subwatershed. However, there are a few sites located in this subwatershed that may pose a pollution risk to water resources. There is one swine operation that is a registered CFO with the state of Indiana located within the Green Lake – Green Creek subwatershed. There are also two underground storage tanks (USTs) located within this subwatershed. While USTs do not pose an immediate threat to water resources, they do run the risk of leaking if not properly inspected and maintained. Table 61 lists the potential pollution threats in the Green Lake – Green Creek subwatershed. Figure 28 shows the location of the CFO and USTs in the Green Lake – Green Creek subwatershed.

Table 61: Potential Water Quality Pollution Threats in Green Lake-Green Creek

Type of Threat	Potential Contaminant	Number in Watershed
Underground Storage Tank	Oil/Gas	1
Confined Feeding Operations	Manure runoff/sedimentation	1

Windshield (direct observation from the public road system) and desktop (using satellite and aerial photography) surveys revealed that Green Lake is primarily influenced by several lateral ditch systems. There was one site in particular that exhibited a lot of erosion and lack of a vegetative riparian buffer. This site is in need of a filter strip to help prevent NPS from reaching the stream. The remaining portion of the effected ditch system does not have farm fields adjacent to the ditchbank. This site is outlined in Table 62 and labeled in Figure 29. The surveys also revealed the large amount of soil located within Green Lake – Green Creek subwatershed that is ranked as either HEL or PHEL. Special care will need to be taken by landowners who are farming this land. The vast majority of the system flows through wetlands with the main channel and majority of lateral ditches lying within the Pigeon River Fish and Wildlife Area.

Table 62: Little Turkey Lake Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Lack of Riparian Buffer	Sediment, nutrient runoff	1 mile

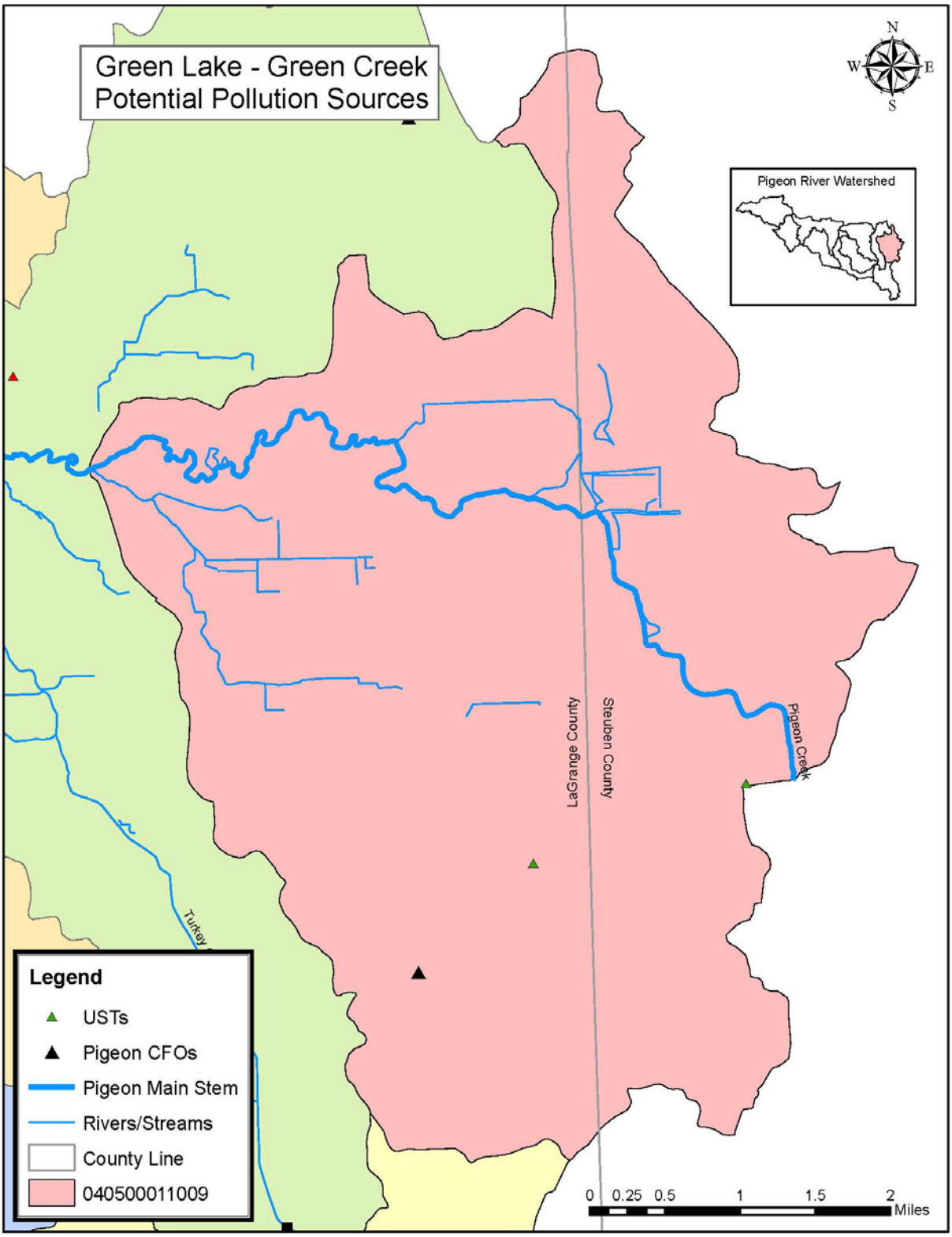

Figure 28: Green Lake-Green Creek Potential Pollution Issues

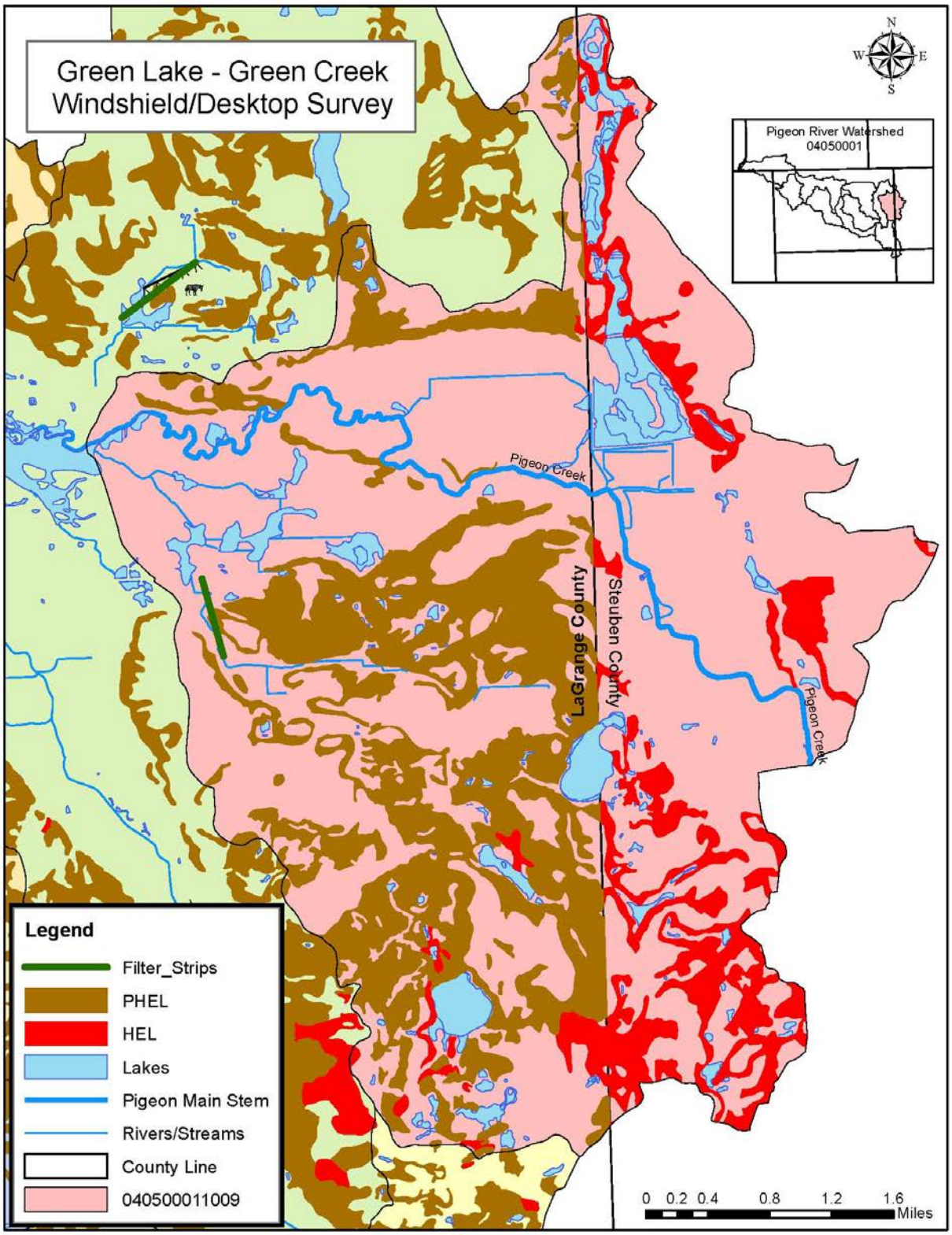

Figure 29: Green Lake – Green Creek Windshield/Desktop Survey Map

3.5.2 Little Turkey Lake Land Use

The Little Turkey Lake subwatershed is the most southeasterly subwatershed in the project area. It is located within DeKalb, Noble, Steuben, and LaGrange counties, with the majority of the watershed in LaGrange County (Figure 30). It is approximately 13,283 acres (5375.44 hectares) in size and contains many lakes including Pretty, Big Long, and Big and Little Turkey Lakes. Major waterways in this subwatershed are Turkey Creek and Maumee Ditch. The predominant land use in the subwatershed is agriculture encompassing nearly 62% of the area. However, due to the large number of large lakes in this subwatershed, 24% of the subwatershed is water. Table 63 is a summary of the land use in the subwatershed.

Table 63: Little Turkey Lake – Turkey Creek Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	3248.8	313.4	517.9	4.4	5874.5	2343.5	970.3	10.2	13283
%	24.5	2.4	3.9	<1	44.2	17.6	7.3	<1	100

An unnamed tributary to Turkey Creek is listed on Indiana's 2008, 303(d) list of impaired waters for dissolved oxygen and *E. coli*. Lake of the Woods and McClish Lake are listed for an impaired biotic community (IBC), Lake of the Woods and Pretty Lake are listed for mercury in fish tissue, and Little Turkey Lake is listed for phosphorus. Turkey Creek, Maumee Ditch and three unnamed tributaries are on the Indiana Fish Consumption advisory for black Crappie and Bluegill, both ranked as a Group 1 advisory. These impairments can be seen on Figure 31.

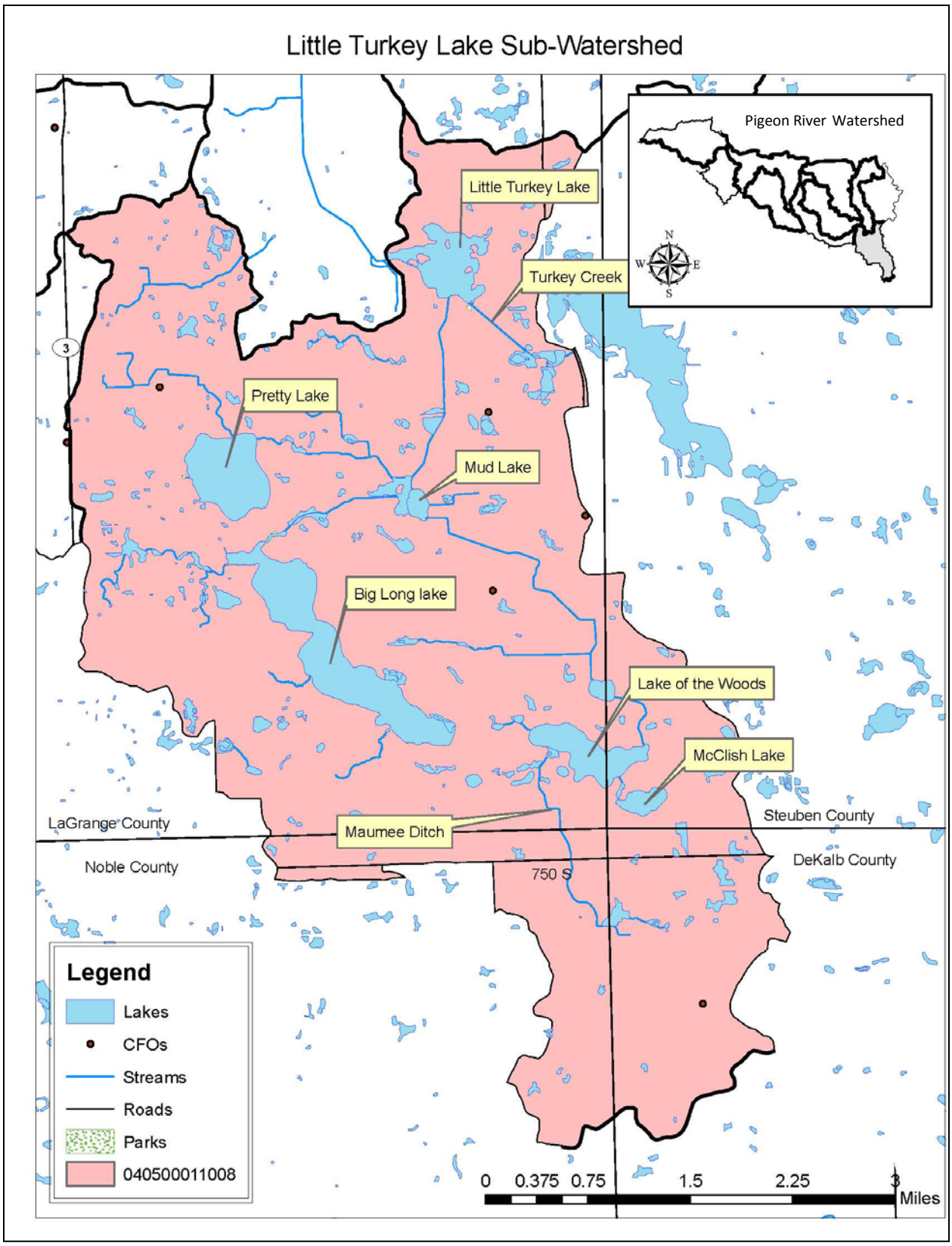

Figure 30: Little Turkey Lake Subwatershed

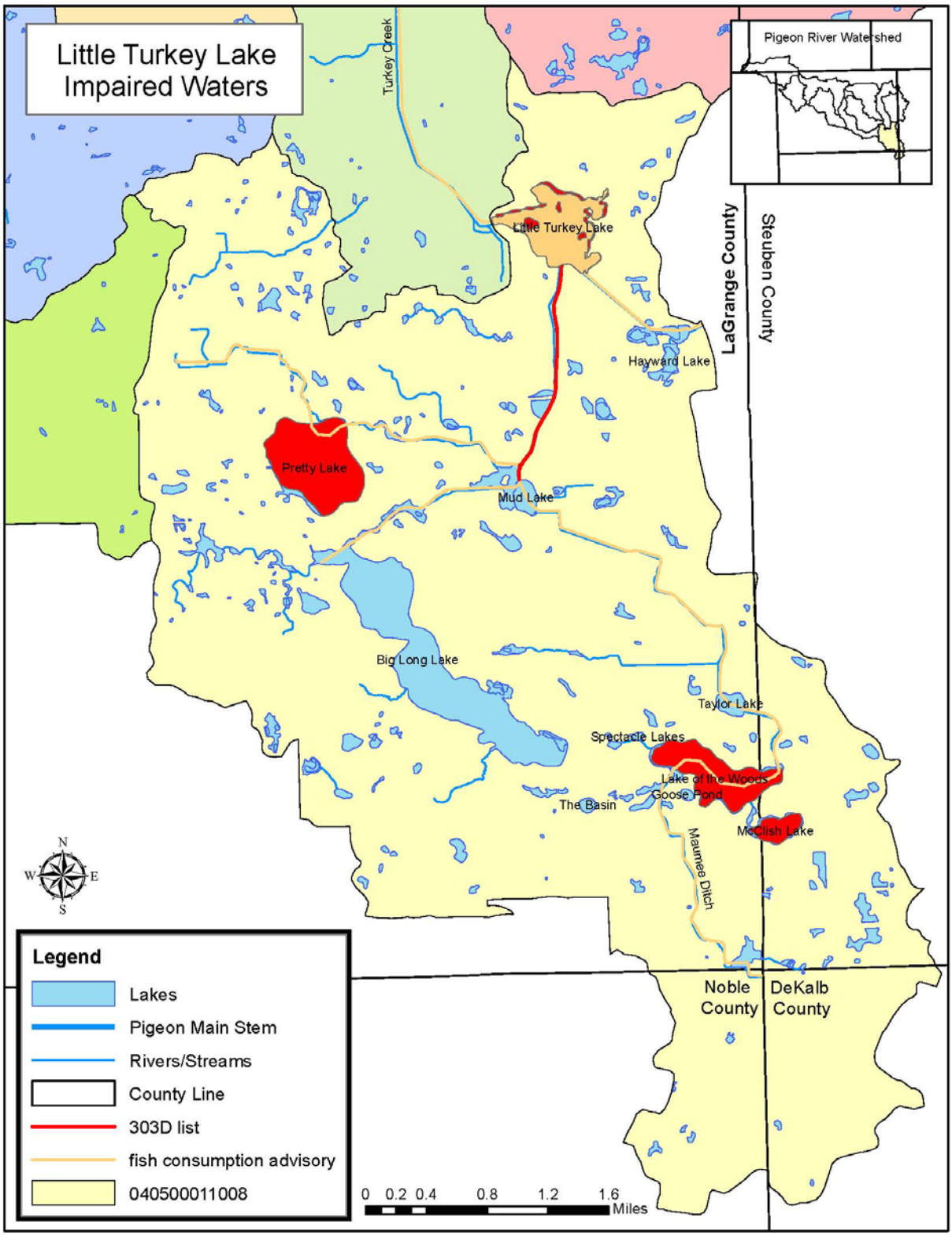

Figure 31: Little Turkey Lake Impaired Waters

Little Turkey Lake is primarily influenced by agricultural fields and several large livestock operations. There are five CFOs located wholly in the subwatershed, and one CFO located on the boundary of the drainage area. This subwatershed has many large and small lakes. The largest and most populated lakes, including Little and Big Turkey Lakes, Lake of the Woods, Pretty Lake and Big Long Lake have a centralized sewer system which is maintained by the LaGrange County Utility District, Region B. Region B has an NPDES permit and has not had any noncompliance events reported within the past decade. However, the Utility Districts discharge point is to Turkey Creek located in the Mongo Millpond subwatershed. It should be noted here that many lake residents use lawn fertilizers to maintain the beautiful turf grass that is prevalent around the larger, more populated lakes. The fertilizer does have the potential to runoff of the property and enter the lake thus increasing the potential for aquatic plant growth, including the harmful blue-green algae.

The Big Long Lake Marina, located in the Little Turkey Lake subwatershed, is a LUST site. The underground storage tank has been closed so no longer poses a threat. However, there are other USTs on this site that are currently monitored by the IDEM UST program. Table 64 shows the potential pollution risks in the Little Turkey Creek subwatershed, and Figure 32 shows the location of the potential pollution risks.

Table 64: Potential Water Quality Pollution Threats in Little Turkey Lake

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	1
Confined Feeding Operations	Manure runoff/sedimentation	5

Windshield and desktop surveys revealed that Little Turkey Lake is primarily influenced by agriculture, including many animal feeding operations. Several sites were noted while performing the windshield survey which can be seen in Table 65 and Figure 33. The surveys also revealed the large amount of soil located within Little Turkey Lake subwatershed that is ranked as either HEL or PHEL. Special care will need to be taken by landowners who are farming this land.

Table 65: Little Turkey Lake Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	2
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	2000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	5 miles
Barnyard Runoff	Sediment, Bacteria, Nutrient	1

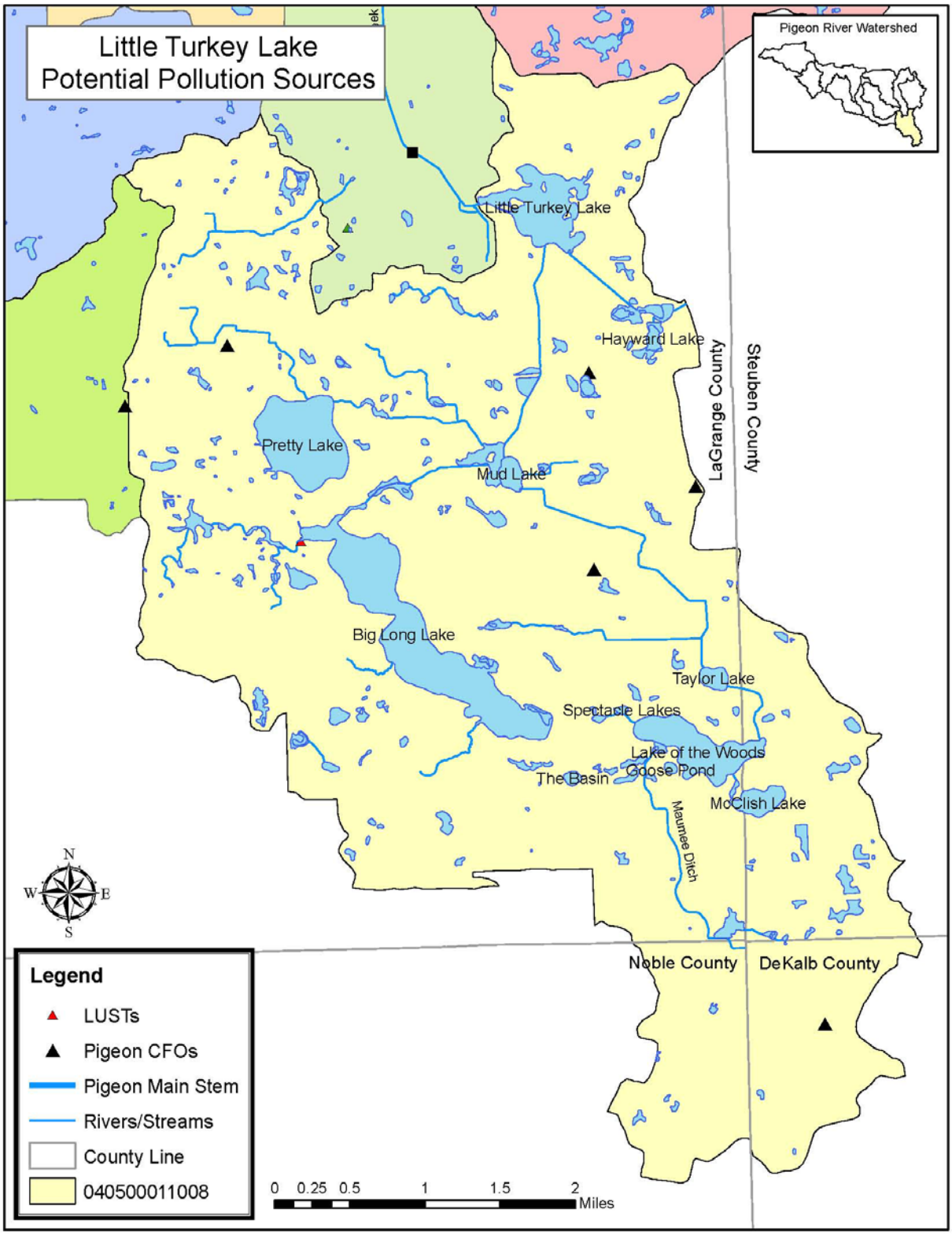

Figure 32: Little Turkey Lake Potential Pollution Issues

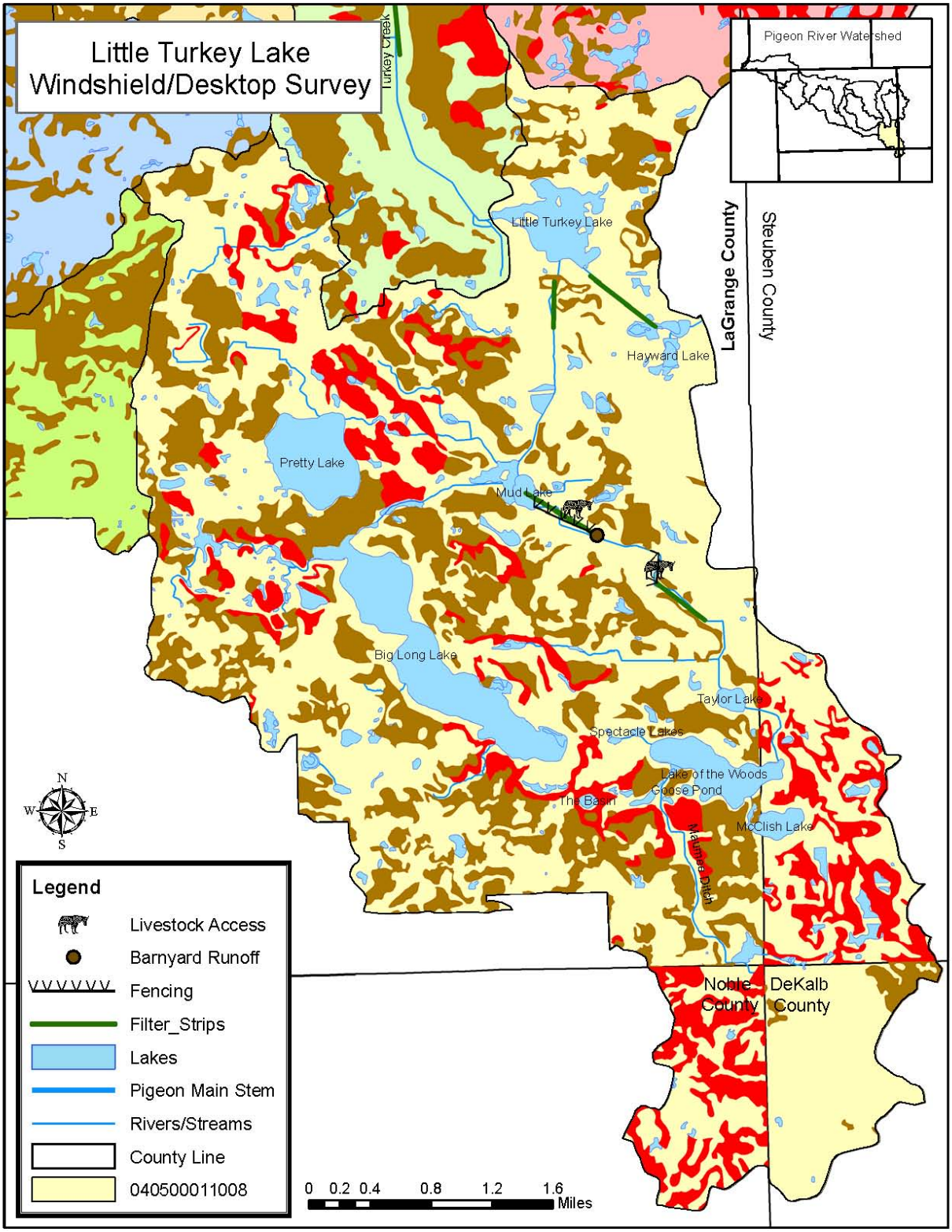

Figure 33: Little Turkey Lake – Turkey Creek Windshield/Desktop Survey

3.5.3 Mongo Millpond-Pigeon Creek Land Use

The Mongo Millpond subwatershed is located entirely in LaGrange County and is just west of Green Lake subwatershed (Figure 34). It is approximately 10,492 acres (4245.96 hectares) in size and contains the Mongo Millpond reservoir. The major waterways located within this subwatershed are the Pigeon and Turkey Creek. The predominant land use in the subwatershed is agriculture, which is nearly 67% of the total land use. The eight acre Turkey Creek Wetland Conservation Area, a part of the Pigeon River Fish and Wildlife Area, is located in the Mongo Millpond subwatershed. Both of these recreational areas are managed by the Fish and Wildlife Department of the IN DNR. Table 66 displays the distribution of land use in the Mongo Millpond subwatershed.

Table 66: Mongo Millpond Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	2390.9	185.4	288.6	N/A	6146.7	859.9	620.6	0	10492
%	22.8	1.8	2.7	N/A	58.6	8.2	5.9	0	100

The land use with the most influence on water quality in the Mongo Millpond subwatershed is agriculture. But as with the Green Lake subwatershed, Mongo Millpond is also largely composed of water, which takes up nearly 23% of the surface area, due to the 77 acre Millpond and the surrounding wetland areas that are located within the PRFWA which is located within this subwatershed. The small town of Mongo (P=300) is located within the drainage area, but the growth rate is stagnant and urban NPS does not seem to be a major issue within the subwatershed.

Pigeon Creek, located east of the Mongo Millpond, is listed on the Indiana 2008, 303(d) list of impaired waters for *E. coli*. Turkey Creek and an unnamed tributary to Mongo Millpond are listed on the Indiana fish consumption advisory (Figure 35).

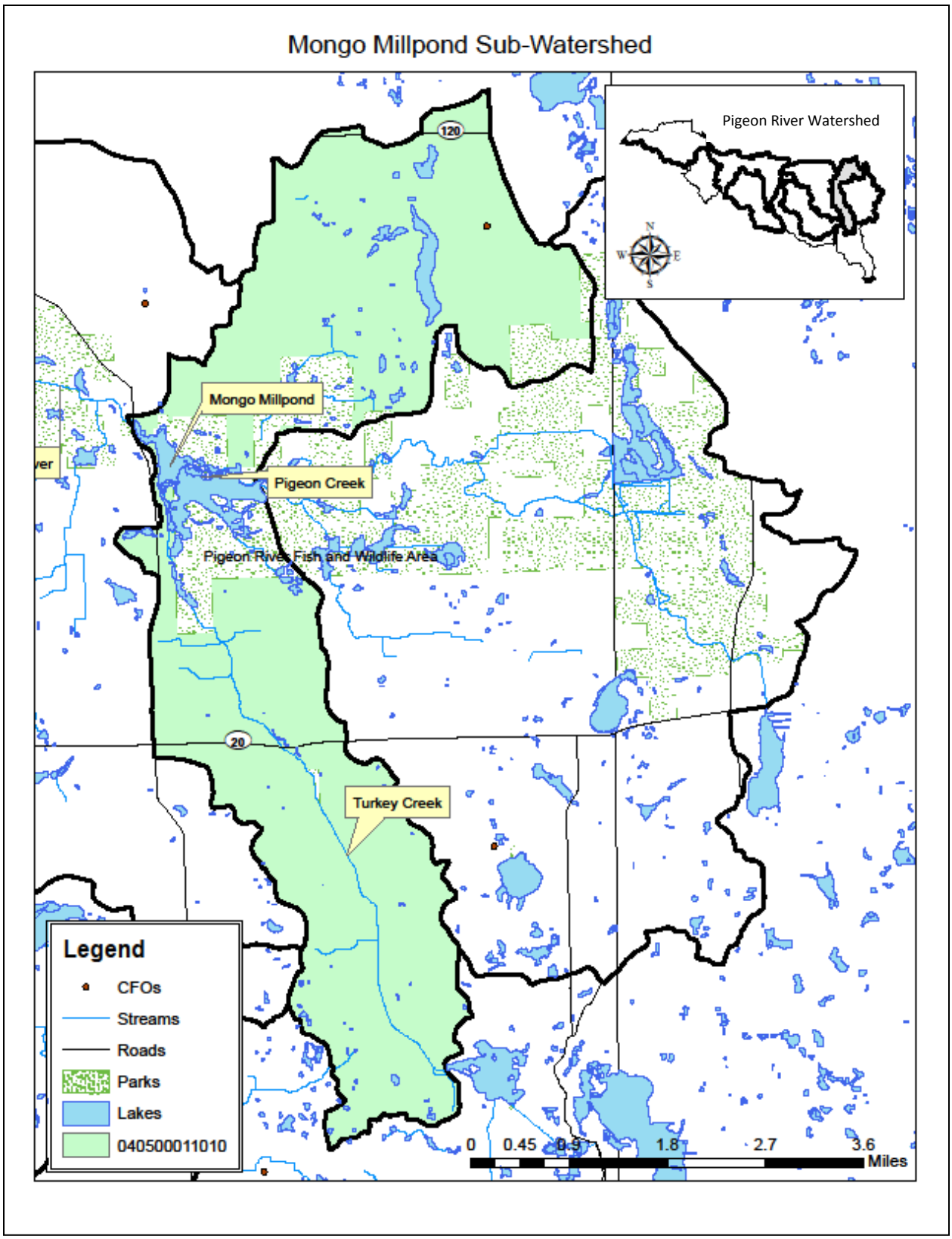

Figure 34: Mongo Millpond Subwatershed

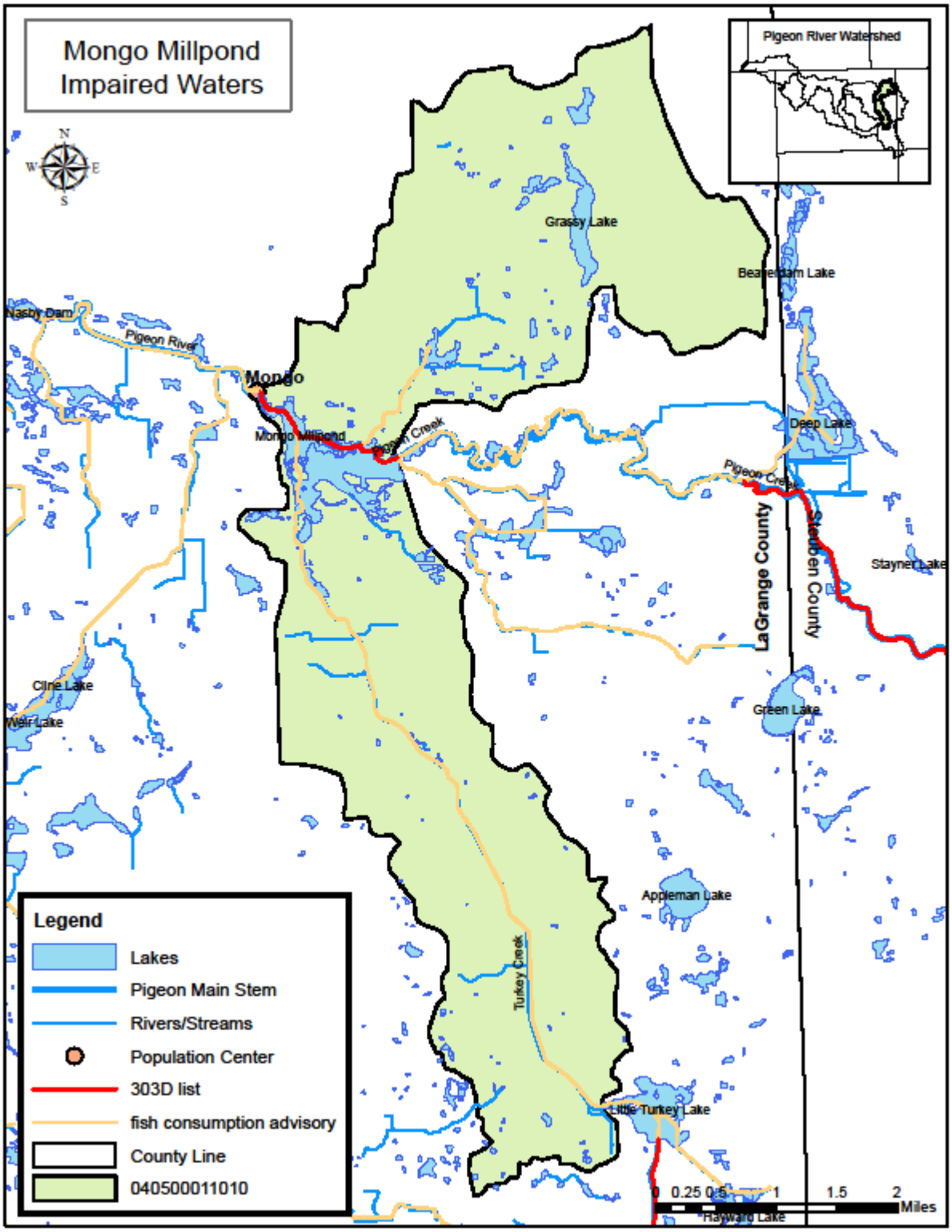

Figure 35: Mongo Millpond Impaired Waters

The LaGrange County Utility District, Region B, which services the built-up lakes located in the Mongo Millpond subwatershed is the only NPDES permitted facility located in the subwatershed. Region B has one Sanitary Sewer Outfall (SSO) which discharges into Turkey Creek and has not reported any overflows within the past decade. While there has not been a reported overflow from Region B in the past ten years, it is important to monitor the discharge point and educate the public on water conservation in their homes to keep from having any unnecessary overflows.

There are two LUST site located within the Mongo Millpond subwatershed; the Pigeon River Fish and Wildlife Area, and the Mongo Country Store. Both LUST sites are located in, or around, the town of Mongo. The PRFWA and Mongo Country Store LUSTs are still active. This means that IDEM is still working with these organizations to remediate the problem by either upgrading the UST or closing it all together.

There is one CFO located in the northeastern portion of the subwatershed. This facility is a dairy operation and is not located near any major waterways and does not seem to pose a significant threat to water quality. Table 67 and Figure 36 display the potential pollution risks in the Mongo Millpond subwatershed and their location, respectively.

Table 67: Potential Water Quality Pollution Threats in Mongo Millpond

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	2
Confined Feeding Operations	Manure runoff/sedimentation	1
NPDES Permitted Facility	Nutrients, Bacteria, Sediment	1

The windshield and desktop survey revealed that the Mongo Millpond is primarily influenced by agricultural fields along Pigeon Creek south of the main channel which flows through Pigeon River Fish and Wildlife Area. The north lateral ditch is filtered through a series of wetlands. While the majority of the town of Mongo is located in the Cline Lake subwatershed, it is important to this project as the town of Mongo surrounds the tail-waters and is not on a centralized sewer system. Improperly maintained or faulty septic systems may have some influence on pollutants entering the main river channel. As was mentioned in section 2.6, the LaGrange County Health Department estimates that nearly 75% of installed septic systems are currently failing. However, visual observations of Mongo Millpond revealed one area in particular where livestock have direct access to open water as a drinking water source which can lead to significant sedimentation and high nutrient and *E. coli* levels in the water column. Where the livestock have access to the stream, the bank has become completely denuded of vegetation and is in need of a riparian buffer. The survey also revealed the large amount of soil rated as PHEL. Table 68 and Figure 37 show the results of the windshield and desktop surveys for the Mongo Millpond subwatershed.

Table 68: Mongo Millpond Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	1
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	1500 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	3 miles

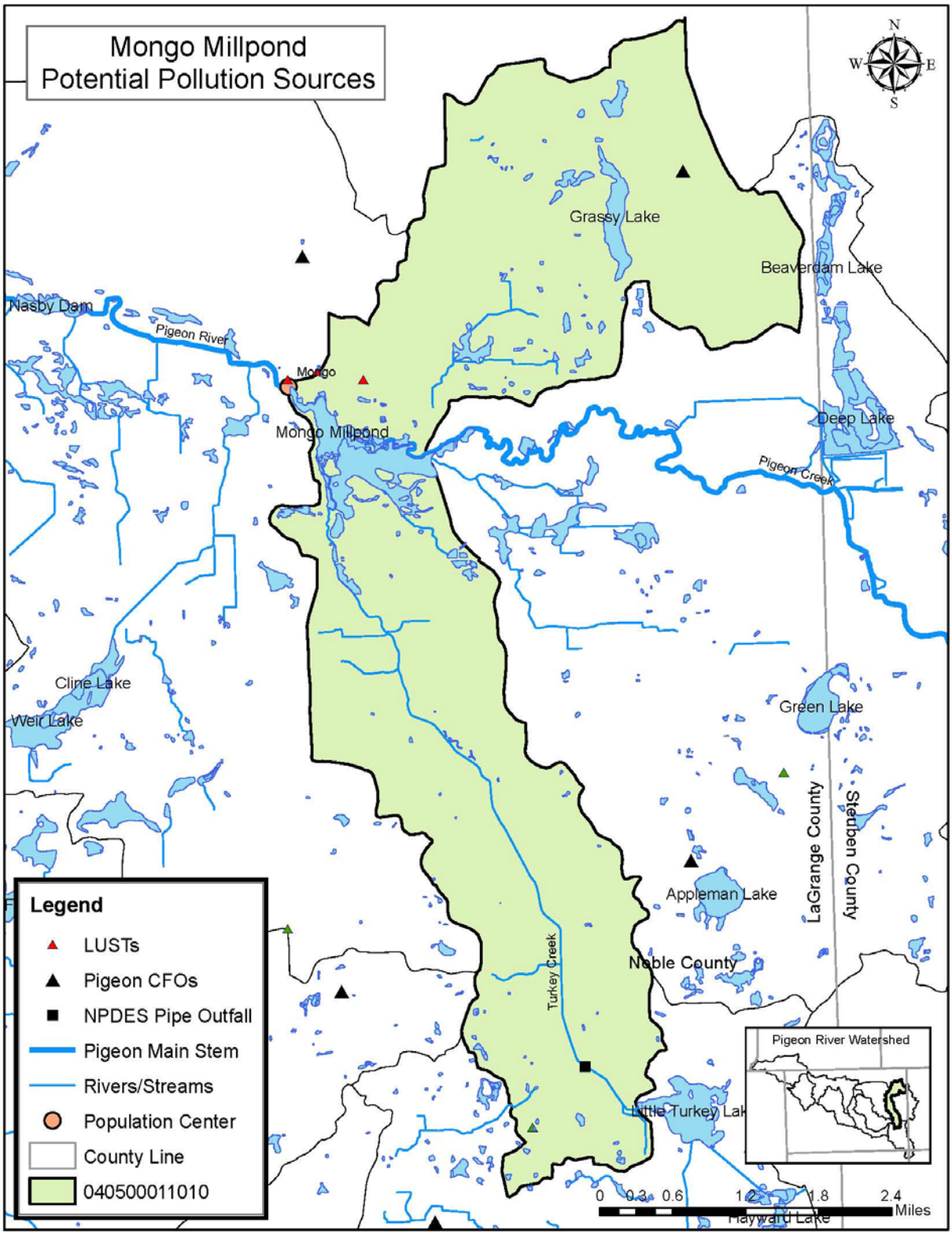

Figure 36: Mongo Millpond Potential Pollution Issues

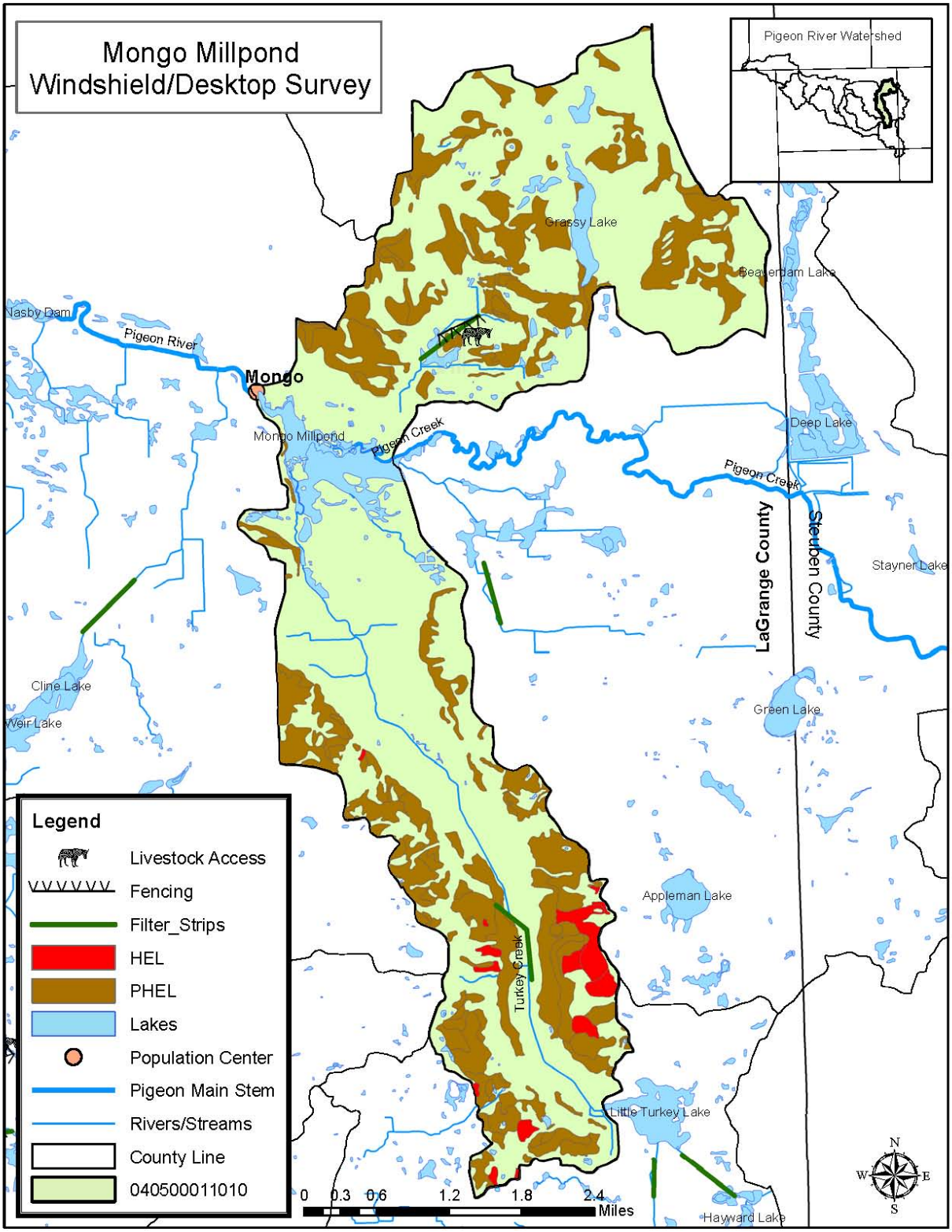

Figure 37: Mongo Millpond Windshield/Desktop Survey Results

3.5.4 Cline Lake-Pigeon River Land Use

The Cline Lake subwatershed is located west of the Mongo Millpond subwatershed but also shares watershed boundaries with East Fly Creek, Fly Creek, and VanNatta Ditch subwatersheds (Figure 38). It is approximately 17,303 acres (7002.28 hectares) in size. This subwatershed contains the Nasby Dam and Ontario Millpond. The major waterway running through the subwatershed is the Pigeon River. The predominant land use in the subwatershed is agriculture taking up nearly 59% of the total land use and with traditional tillage techniques being utilized there is potential for some erosion issues in the subwatershed. However, as with the previous subwatersheds discussed, a very large portion of the drainage area (27%) is designated as open water due to the fact that over half of the PRFWA is located within the Cline Lake drainage. The 124 acre Cline Lake Fen, managed by The Nature Conservancy, is also located in the subwatershed, as well as the 100 acre Ontario Millpond and 40 acre Nasby Millpond. The Cline Lake Fen is restricted and not open for public recreational use. Table 69 shows the distribution of land use in the Cline Lake subwatershed.

Table 69: Cline Lake Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	4705.8	303.5	722.7	0.9	8992.8	1158.7	1412.4	6.2	17303
%	27.2	1.8	4.1	<1	52.0	6.7	8.2	<1	17303

Pigeon River, located downstream of the Ontario Millpond in Cline Lake subwatershed, is listed on Indiana's 2008 303(d) list of impaired waters *E. coli*. The Pigeon River, and many of its tributaries, are listed on the Indiana 2010 fish consumption advisory for Carp. Figure 39 displays those waterways that are designated as impaired by the state of Indiana.

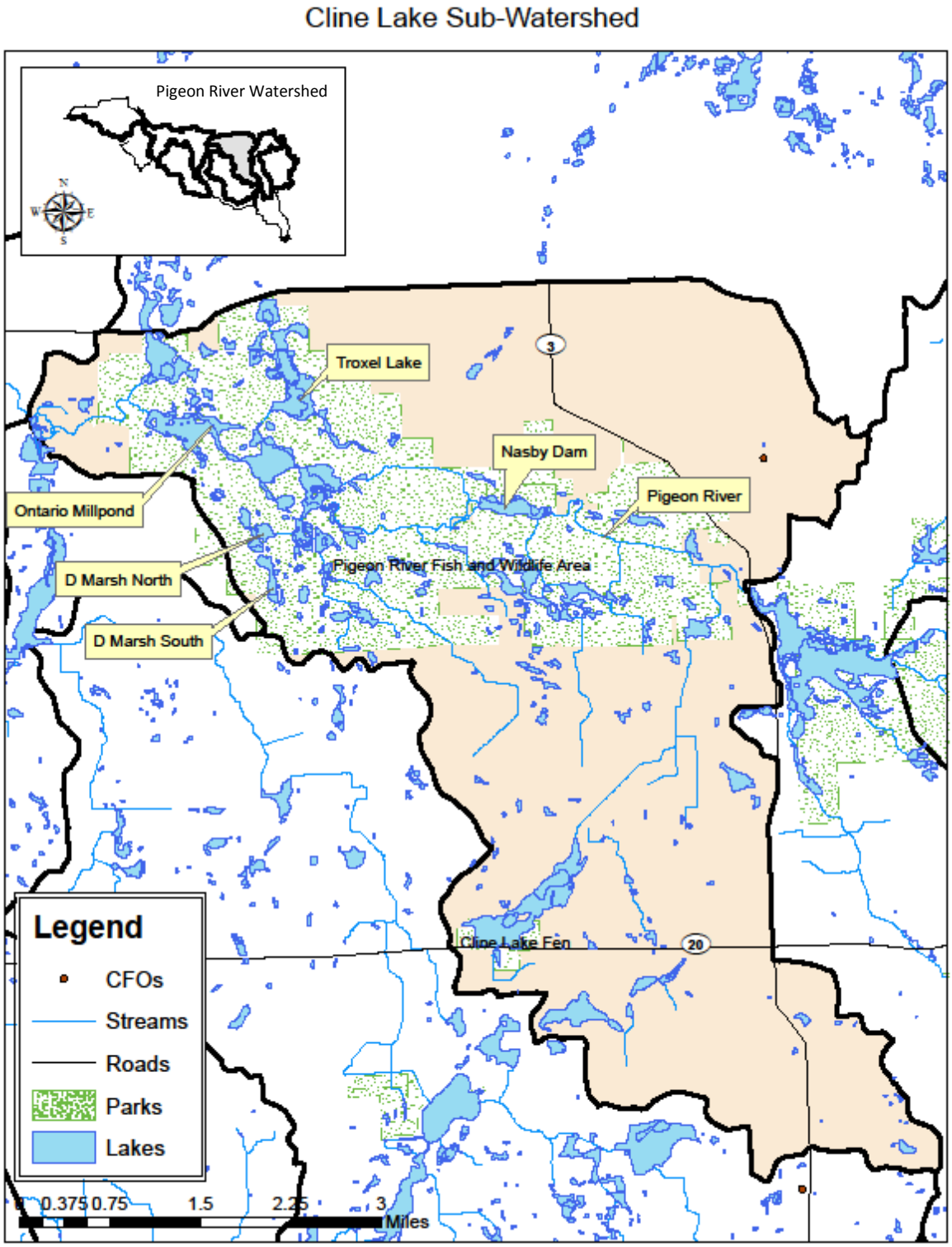

Figure 38: Cline Lake Subwatershed

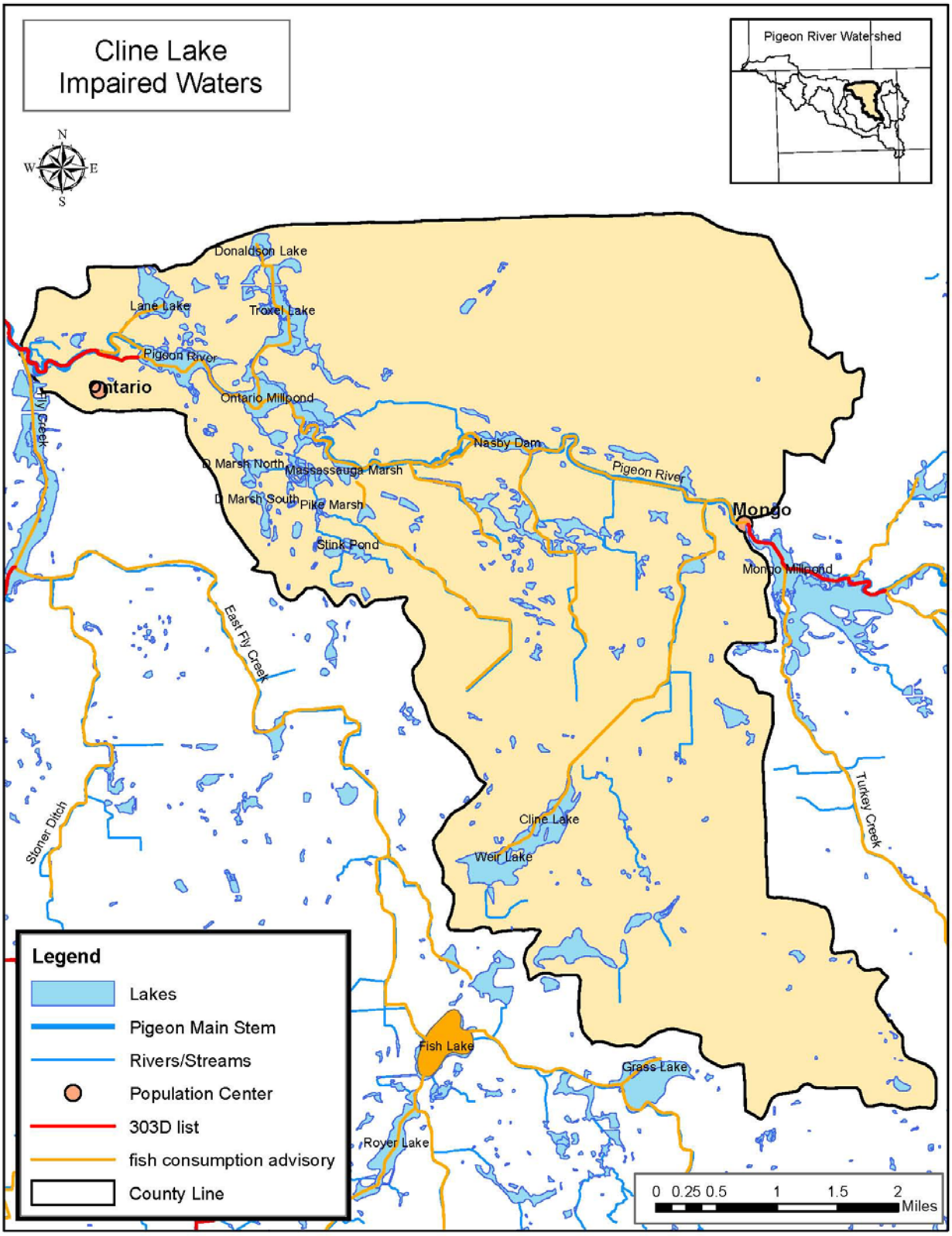

Figure 39: Cline Lake Impaired Waters

There are no NPDES permitted facilities located within the Cline Lake subwatershed. There are two LUSTs located in the Cline Lake drainage area; the Curtis Creek Trout Rearing Facility which is managed by the IN DNR, just west of the Ontario Millpond, and Weiss Trucking Co. which has been closed and remediated. The Curtis Creek Trout Rearing Facility LUST is still active and is designated as a medium level priority for the UST program to remediate. There is one UST located wholly within the Cline Lake subwatershed and one located on the border of Cline Lake and East Fly Creek subwatersheds. While these USTs are currently safe, there is the potential for them to leak and cause a pollution concern.

One CFO is located within the Cline Lake subwatershed. The CFO houses over 1000 swine on site and is located in the northeastern portion of the subwatershed. Windshield and desktop surveys do not provide evidence that NPS is a concern from this facility. Table 70 and Figure 40 display the potential pollution risks in the Cline Lake subwatershed and their location, respectively.

Table 70: Potential Water Quality Pollution Threats in Cline Lake

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	2
Confined Feeding Operations	Manure runoff/sedimentation	1

The Pigeon River itself runs through the PRFWA, Nasby Dam, Cline Lake Fen, and the Ontario and Nasby Millponds, all of which act as sediment traps and can lessen the impact of soil erosion on surface water quality. Therefore, traditional row cropped fields have only a slight impact on streams, however the impact on the ponds and lakes is great as they may be filling in more quickly than nature would do alone. The lateral ditch system flows through a series of wetlands and areas that have established riparian zones. One area of concern was noted during the windshield survey where the landowner was planting up to the edge of the stream. Therefore, a filter strip is needed at the site. Table 71 and Figure 41 display the results of the windshield/desktop survey. The desktop survey revealed the large amount of soil designated as PHEL. Special precaution will need to be taken by landowners farming the PHEL and HEL land.

Table 71: Cline Lake Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Lack of Riparian Buffer	Sediment, nutrient runoff	1 mile

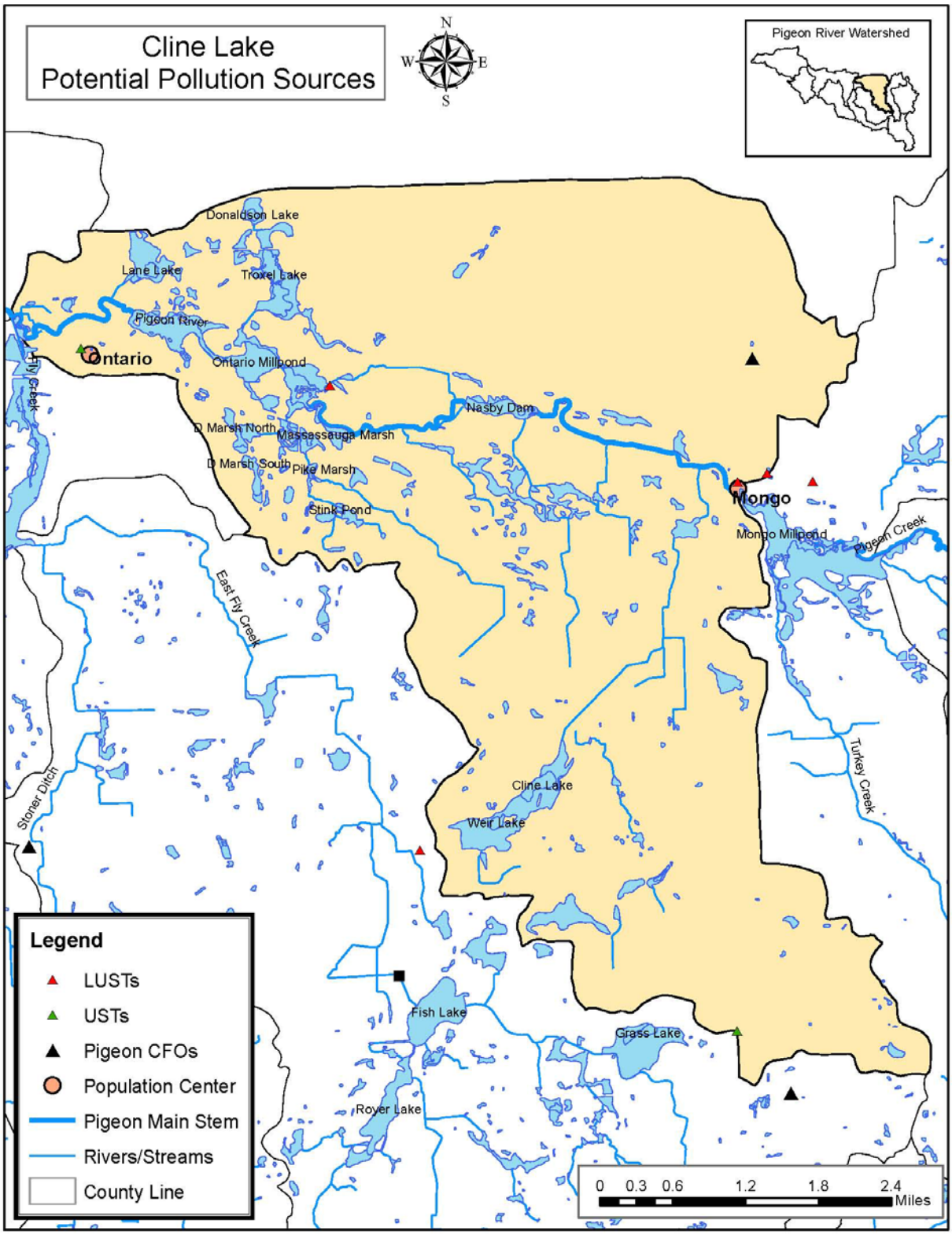

Figure 40: Cline Lake Potential Pollution Issues

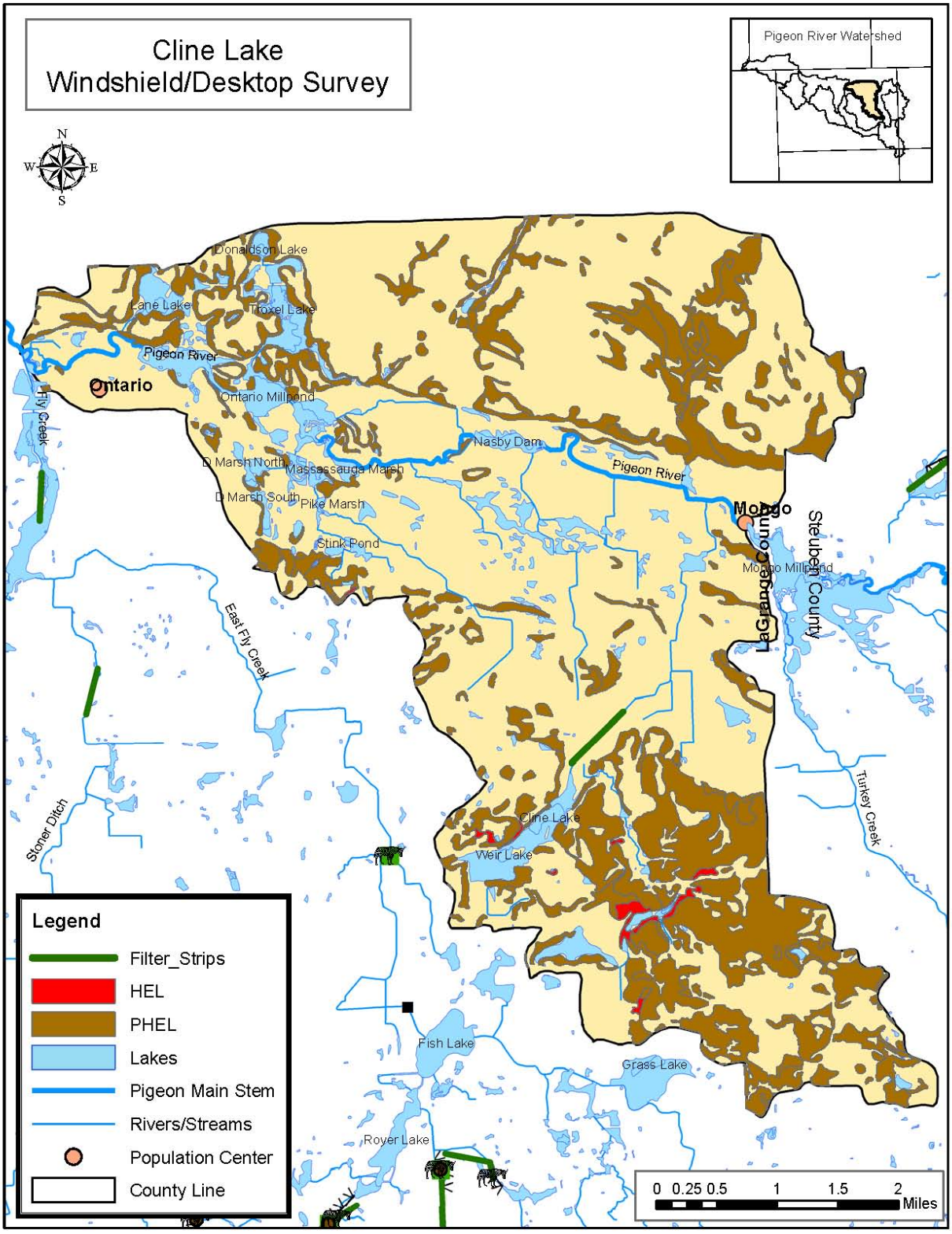

Figure 41: Cline Lake Windshield/Desktop Survey Results

3.5.5 East Fly Creek Land Use

The East Fly Creek subwatershed is located east of the Fly Creek and west of the Cline Lake subwatersheds (Figure 42). It is approximately 16,722 acres (6787.39 hectares) and contains the major waterbodies East Fly Creek, Stoner Ditch, Fish Lake, and Royer Lake. The predominant land use in the subwatershed is agriculture which encompasses 65% of the total land use. The 30 acre Maplewood Natural Area, maintained by the LaGrange County Parks and Recreation Department, is located within the East Fly Creek subwatershed. The only built-up areas in the drainage area are Fish and Royer Lakes. Table 72 shows the distribution of land use within the East Fly Creek subwatershed.

Table 72: East Fly Creek Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	3378.6	353	909.8	17.9	7805.7	3137.9	1169.1	0	16772
%	20.1	2.1	5.4	<1	46.5	18.7	7.0	0	100

Fish and Royer Lake are both listed on the Indiana 2008, 303(d) list of impaired waters for IBC and Fish Lake is also listed for mercury in fish tissue. For this reason, Fish Lake is also listed on the Indiana fish consumption advisory. Also, Stoner Ditch, East Fly Creek, and several tributaries to East Fly Creek are listed on the fish consumption advisory for Carp. Figure 43 displays those waterways that are designated as impaired by the state of Indiana.

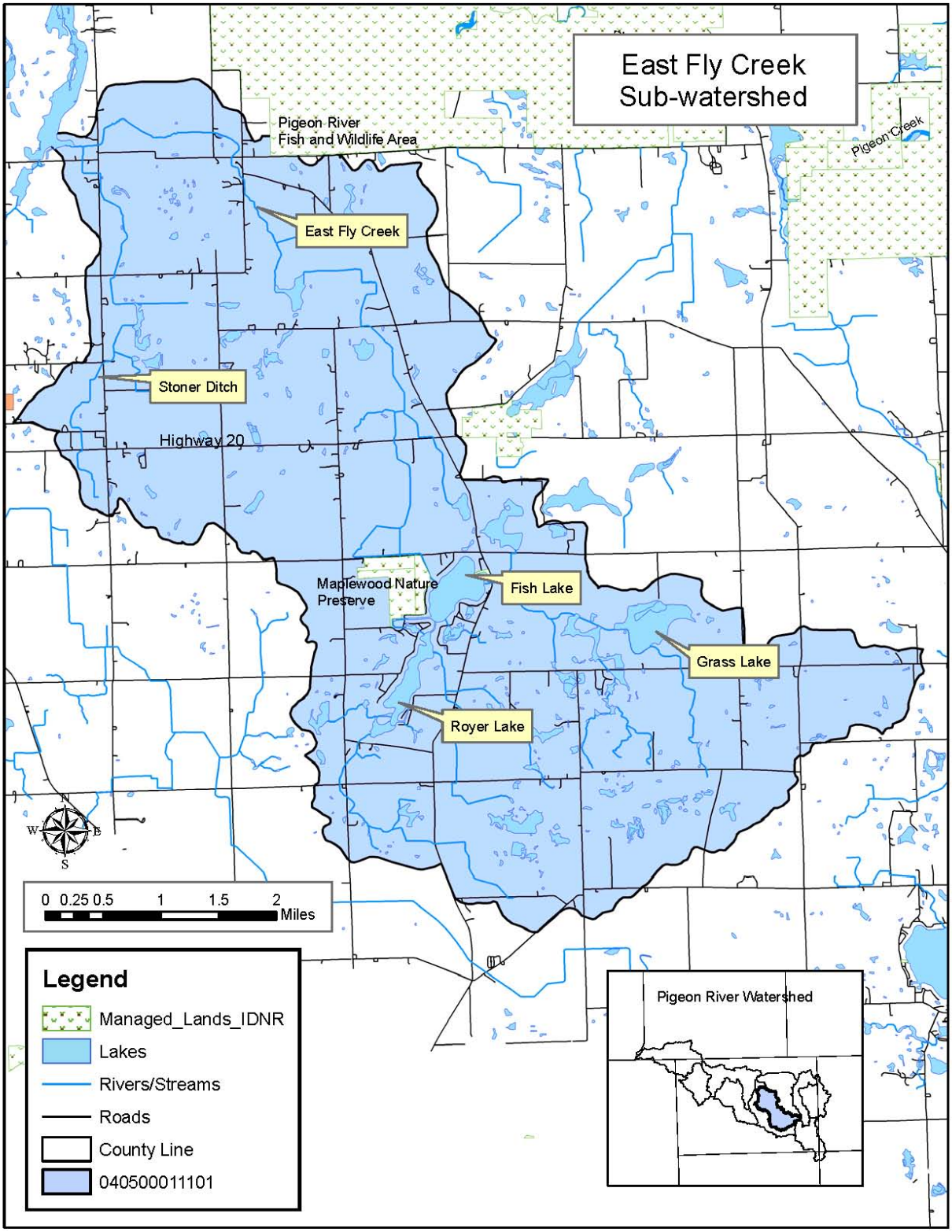

Figure 42: East Fly Creek Subwatershed

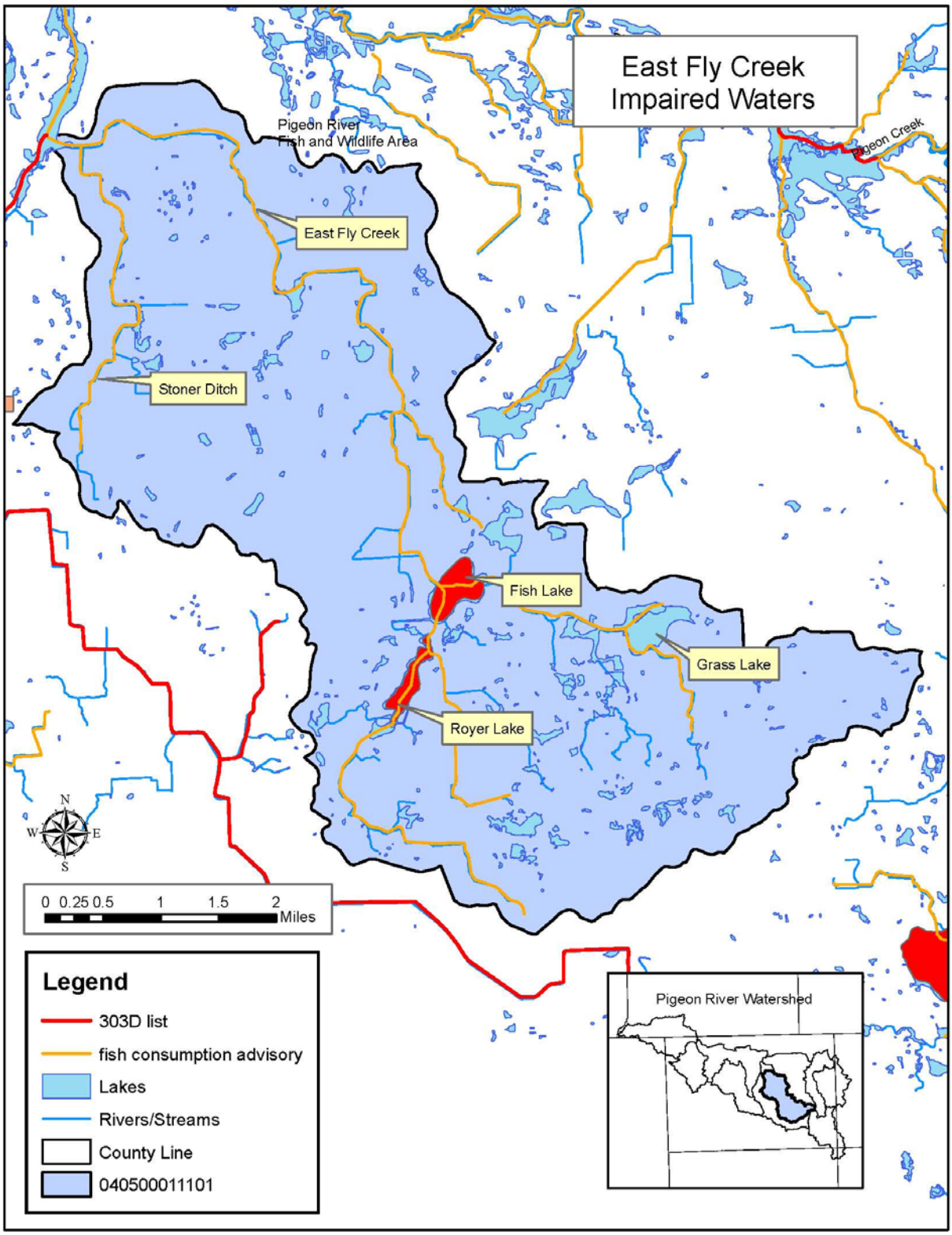

Figure 43: East Fly Creek Impaired Waters

The Fish and Royer Lake Waste Water Treatment Plant, serviced by the LaGrange County Regional Utility District-Region F, is the only NPDES permitted facility located within East Fly Creek subwatershed. They have an innovative way of waste water treatment by filtering it through a constructed wetland. The process is fairly new to them, but the Utility District feels that it is working very well. There is one SSO which discharges into the East Fly Creek. There have been no overflows reported in the past decade. However, the SSO should be carefully monitored and the residents of Fish and Royer Lakes should be educated on water conservation in their homes.

There is one LUST located in the East Fly Creek subwatershed. The LUST is owned by Don Meyer's Property and is currently active and assigned a high priority level by the state of Indiana. There is also one UST located on the border of Cline Lake and East Fly Creek subwatershed. While the UST is currently safe, there is the potential for it to leak and cause a pollution concern.

There are two CFOs located within East Fly Creek. There is one current CFO and one recently closed. Although one is closed, it should be monitored to be sure there are no residual pollutants leaching from the property. There is a swine house in the southeastern portion of the subwatershed which houses nearly 200 hogs. From visual inspection, the CFO does not appear to be a current issue in regards to NPS. All potential pollution concerns are outlined in Table 73 and the location of each site is shown in Figure 44.

Table 73: Potential Water Quality Pollution Threats in East Fly Creek

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	1
Underground Storage Tank	Oil/Gas	1
Confined Feeding Operations	Manure runoff/sedimentation	2
NPDES Permitted Facility	Nutrients, Bacteria, Sediment	1

Windshield and desktop surveys revealed several small animal operations, many of which allowed livestock direct access to surface water and had improperly handled manure stacks. These practices promote increased sedimentation due to streambanks becoming denuded of vegetation from livestock trampling the vegetation and increased *E. coli* contamination and nutrient levels in the waterway. The surveys also revealed that there are row crop influences on water quality in the East Fly Creek subwatershed as there is an even mix of traditional English and Amish farming practices throughout the drainage area. The desktop survey revealed that there is a fair amount of soil which is ranked as either HEL or PHEL. Special precaution will need to be taken by landowners farming this soil. Table 74 and Figure 45 display the results of the windshield/desktop survey.

Table 74: East Fly Creek Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	6
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	7000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	6 miles
Barnyard Remediation Needed	Sediment, Bacteria, Nutrients	3
Streambank Erosion	Sediment	240 feet

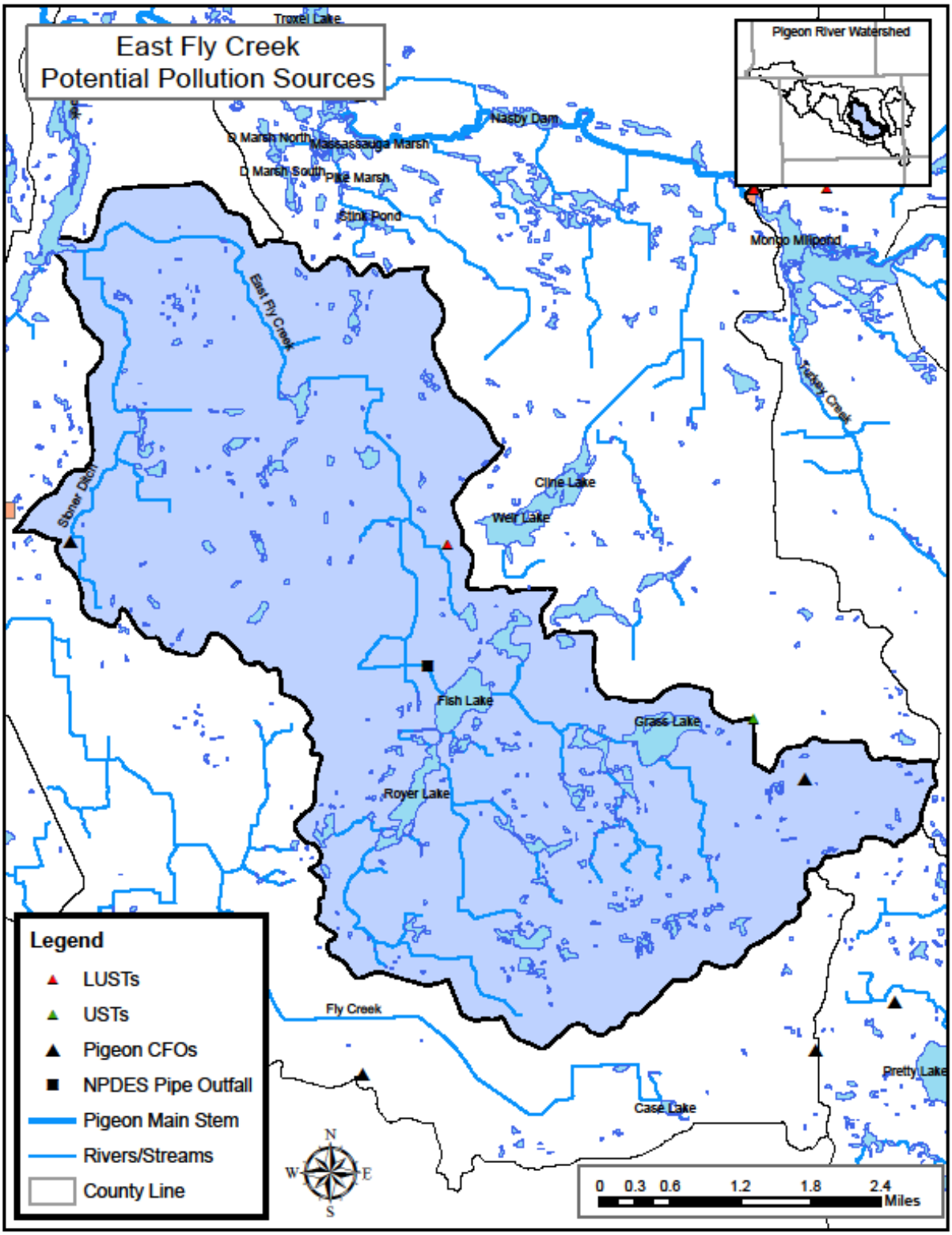

Figure 44: East Fly Creek Potential Pollution Issues

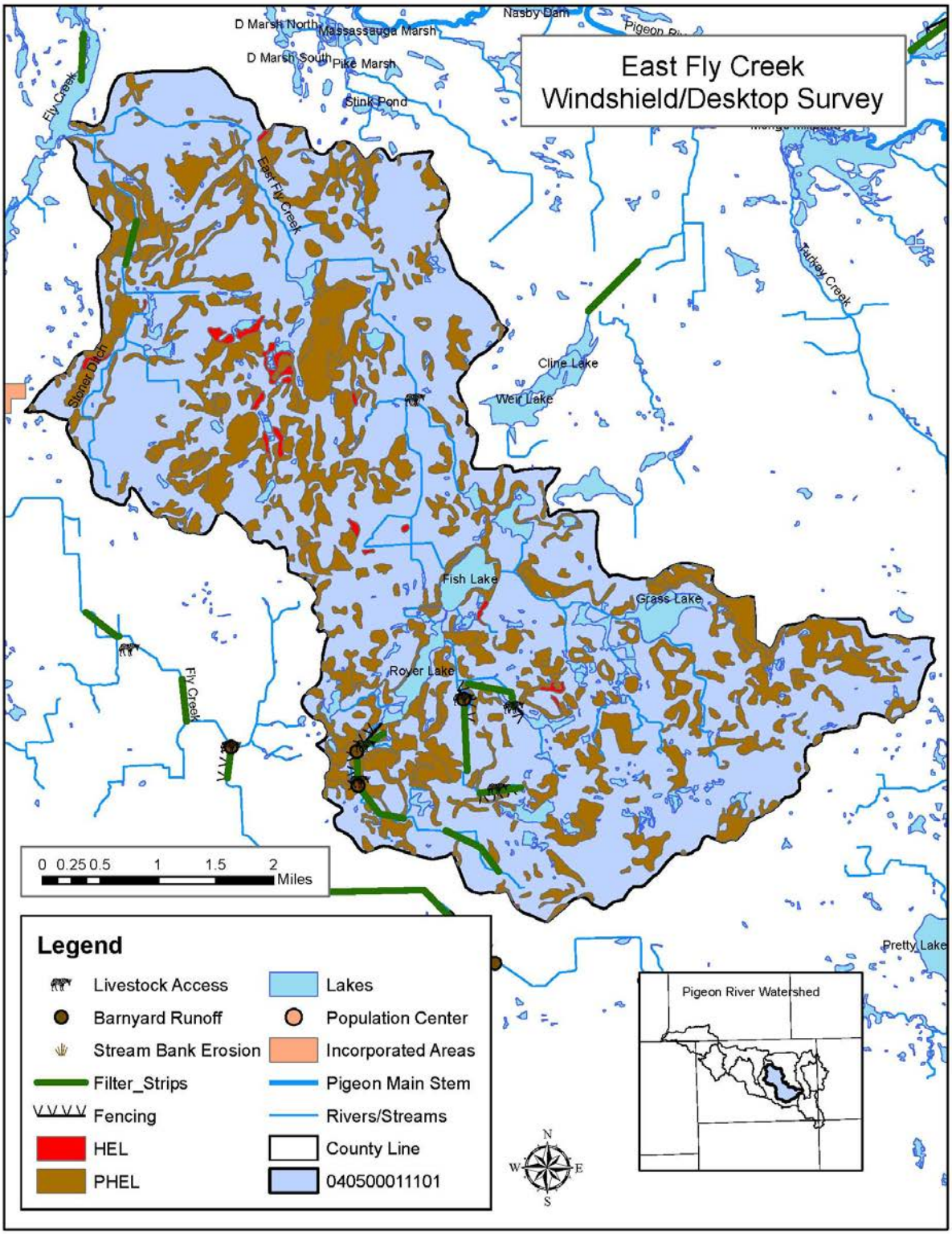

Figure 45: East Fly Creek Windshield/Desktop Survey Results

3.5.6 Fly Creek Land Use

The Fly Creek subwatershed is located west of East Fly Creek subwatershed and is also bordered by Buck Lake-Buck Creek, VanNatta Ditch, and Cline Lake subwatersheds (Figure 46). It is approximately 10,906 acres (4,414 hectares) and encompasses about 80% of the town of LaGrange. The major waterway located within the subwatershed is Fly Creek.

Fly Creek is the most heavily populated drainage area within the project area as it houses the majority of the county seat, LaGrange (P=2625). An analysis of land use in the project area revealed that 15% of the Fly Creek subwatershed is developed. While the urban influence on water quality is relatively small in comparison to the agricultural influence, it is important to begin urban BMP education and start implementing urban BMPs to promote lifestyle changes to help improve our water resources. Such pollutants that are common in urban areas are oil, salt, and pet waste. However, LaGrange is unique in that a large Amish population lives and/or frequents the town which results in horse manure being left on roadways to wash into roadside drains and surface waters. Even though 15% of the land use is deemed developed, agriculture is still the major influence on this subwatershed, as 70% of the land use is either in row crops or pasture and hayland (Table 75).

Table 75: Fly Creek Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	1138.9	774.3	845.7	53.8	5852	1796.2	443	2.1	10906
%	10.4	7.1	7.8	<1	53.7	16.5	4.1	<1	100

Fly Creek, located within the Fly Creek subwatershed, is listed in Indiana's 2008 303(d) list of impaired waters for *E. coli*. Fly Creek is also listed on the 2010 fish consumption advisory for the consumption of Carp. Figure 47 shows the location of the water bodies that are designated as impaired by the state of Indiana.

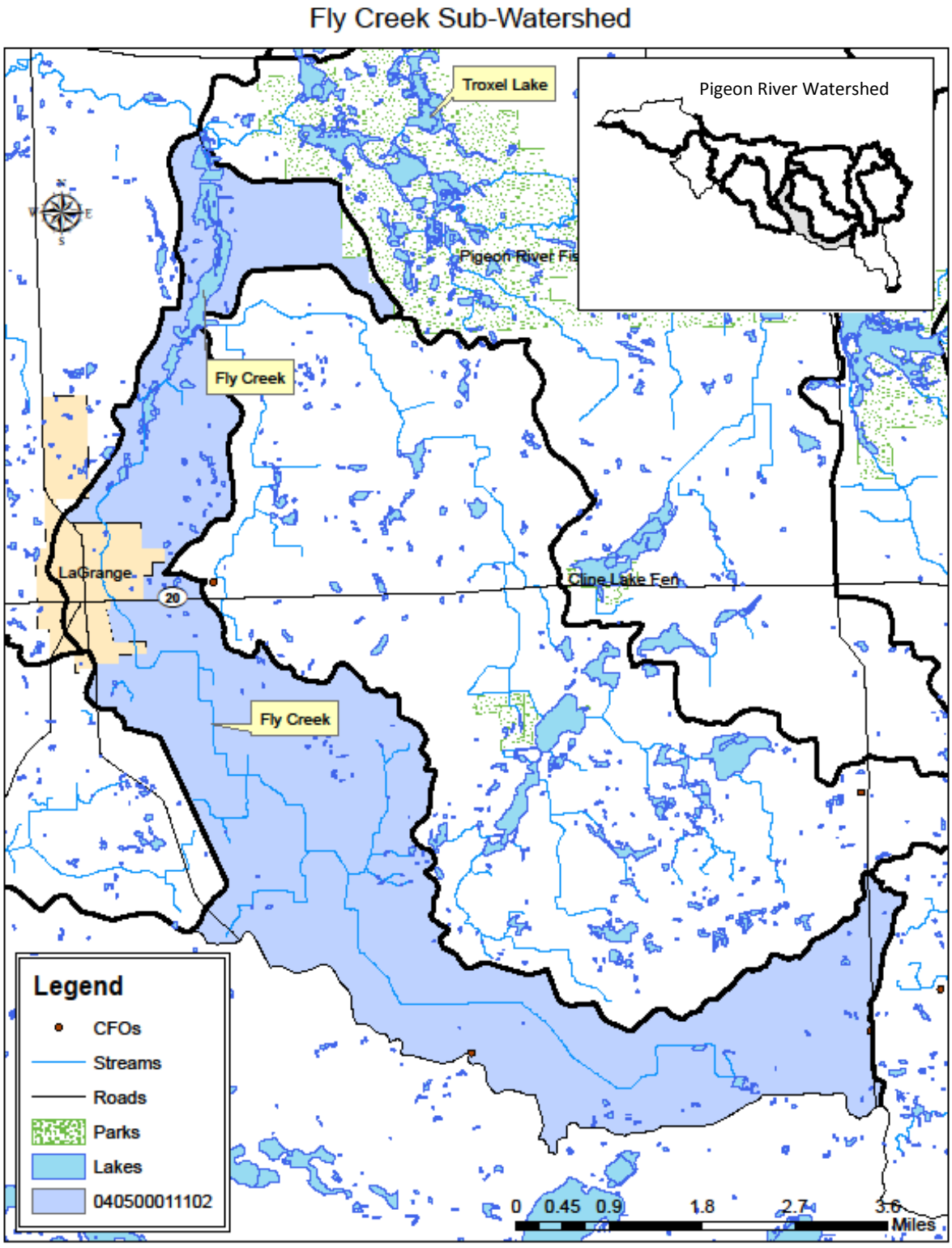

Figure 46: Fly Creek Subwatershed

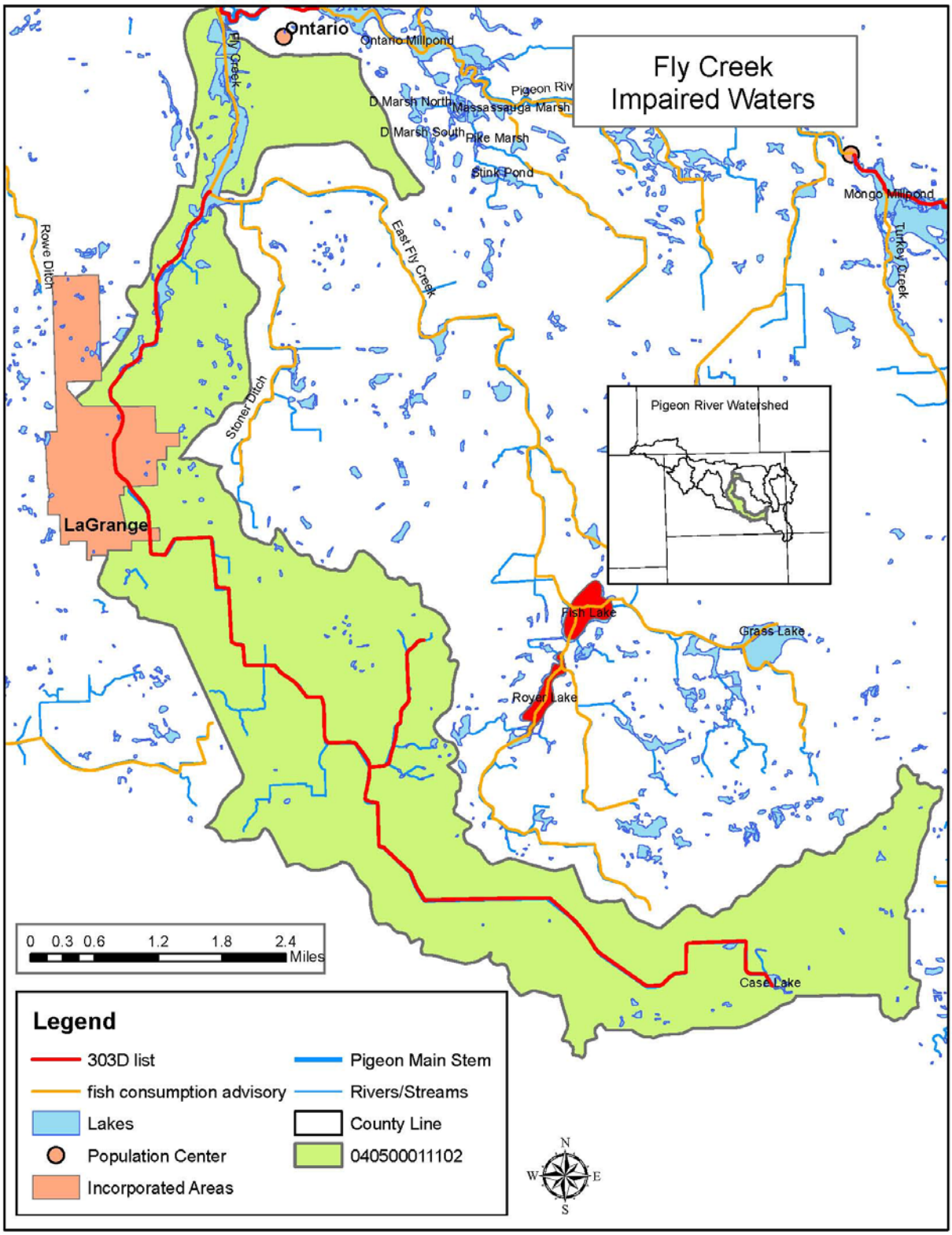

Figure 47: Fly Creek Impaired Waters

The LaGrange Sewer District (LSD) services LaGrange and the surrounding area. The LSD is the only NPDES permitted facility within Fly Creek subwatershed and has one SSO which discharges into Fly Creek, although there has not been a reported overflow within the past decade. The town of LaGrange had five CSOs prior to 2003. However, the town officials recognized the risk to human health and the environment from CSOs prior to the State requirement to develop a Long Term Control Plan and separated their municipal and residential sewers in 2003.

There are three industrial waste sites located in LaGrange, however only two are located within Fly Creek subwatershed. Industrial waste sites are those sites that are at risk of, or do, discharge hazardous wastes from the site and are therefore required to clean up the waste through the Resource Conservation and Recovery Act. All sites are currently following the RCRA for clean-up issues.

According to the IN UST program there are 10 LUSTs located within the Fly Creek subwatershed, all of which are located in or around the town of LaGrange (figure 35, section 2.6). Table 76 below provides the location, priority, and parameter posing the potential contamination for each of the LUSTs. As can be seen in the table the LUST facilities range from gas stations to schools to landfills. There are also three UST sites located in LaGrange in the Fly Creek subwatershed. While the USTs are currently safe, there is the potential for them to leak and cause a pollution concern in the future.

There are two CFOs located within the Fly Creek subwatershed. From visual inspection, the CFOs do not appear to be a current issue in regards to NPS. All potential pollution concerns are outlined in Table 77 and the location of each site is shown in Figure 48.

Table 76: Potential Water Quality Pollution Threats in Fly Creek

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	10
Underground Storage Tank	Oil/Gas	3
Confined Feeding Operations	Manure runoff/sedimentation	2
NPDES Permitted Facility	Nutrients, Bacteria, Sediment	1
Industrial Waste Site	A Variety of Toxic Chemicals	3

Table 77: Fly Creek LUST Sites

UST FACILITY ID	NAME	STREET ADDRESS	CITY	PRIORITY	AFFECTED AREA	DESCRIPTION
11527	Mid States	112 E Central	LaGrange	High	Wellhead Protection Area, Soil, Groundwater, Free product, C5H12O	Active
20318	Shipshewana Insure/Lincoln Bank	219 S Detroit	Lagrange	Low	Soil	Closed
22792	Lagrange Sheriff Office	101 N High St	Lagrange	Low	Soil	Closed
1511	Domestic Corp	509 South Poplar Street	Lagrange	Medium	Soil, Groundwater	Active
16418	Lagrange 9 & 20	103 E Central	Lagrange	High	Wellhead Protection Area, Soil, Groundwater, Free product	Active
24313	MMM Investments Inc. Property	104 E Central	Lagrange	Medium	Soil, Groundwater, C5H12O	Closed
5326	Lakeland High School	0805 E 075 N	Lagrange	Medium	Soil, Groundwater, C5H12O	Closed
16281	Walters Dimmick Shell Spee-D-mart #240	101 W Central	Lagrange	High	Wellhead Protection Area, Soil, Groundwater, Free product, C5H12O	Active
509	Martinrea Industries Inc	411 E Central Ave	Lagrange	High	Wellhead Protection Area, Vapors, Surface water, Soil, C5H12O, Groundwater	Active
17068	Lagrange County Hwy Dept	300 E Factory	Lagrange	High	Wellhead Protection Area, Soil, Groundwater, C5H12O, Ecologically Sensitive Area	Closed

Windshield and desktop surveys revealed that the Fly Creek subwatershed has one of the largest Amish populations of the project area. For this reason, several small animal operations were noted during the windshield and desktop survey and it was determined that Amish landowners are the primary influence in the Fly Creek drainage area. There were several sites where the livestock had direct access to the stream, indicating the need for exclusion fencing to be installed. There were also several sites found where there were no existing filter strips. The Desktop survey revealed that a large portion of the subwatershed was designated as having PHEL, including the majority of the town of LaGrange. Special precaution will need to be taken by landowners farming this soil. Table 78 and Figure 49 display the results of the windshield/desktop survey.

Table 78: Fly Creek Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	3
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	7000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	5 miles
Barnyard Remediation Needed	Sediment, Bacteria, Nutrients	2
Streambank Erosion	Sediment	60 feet

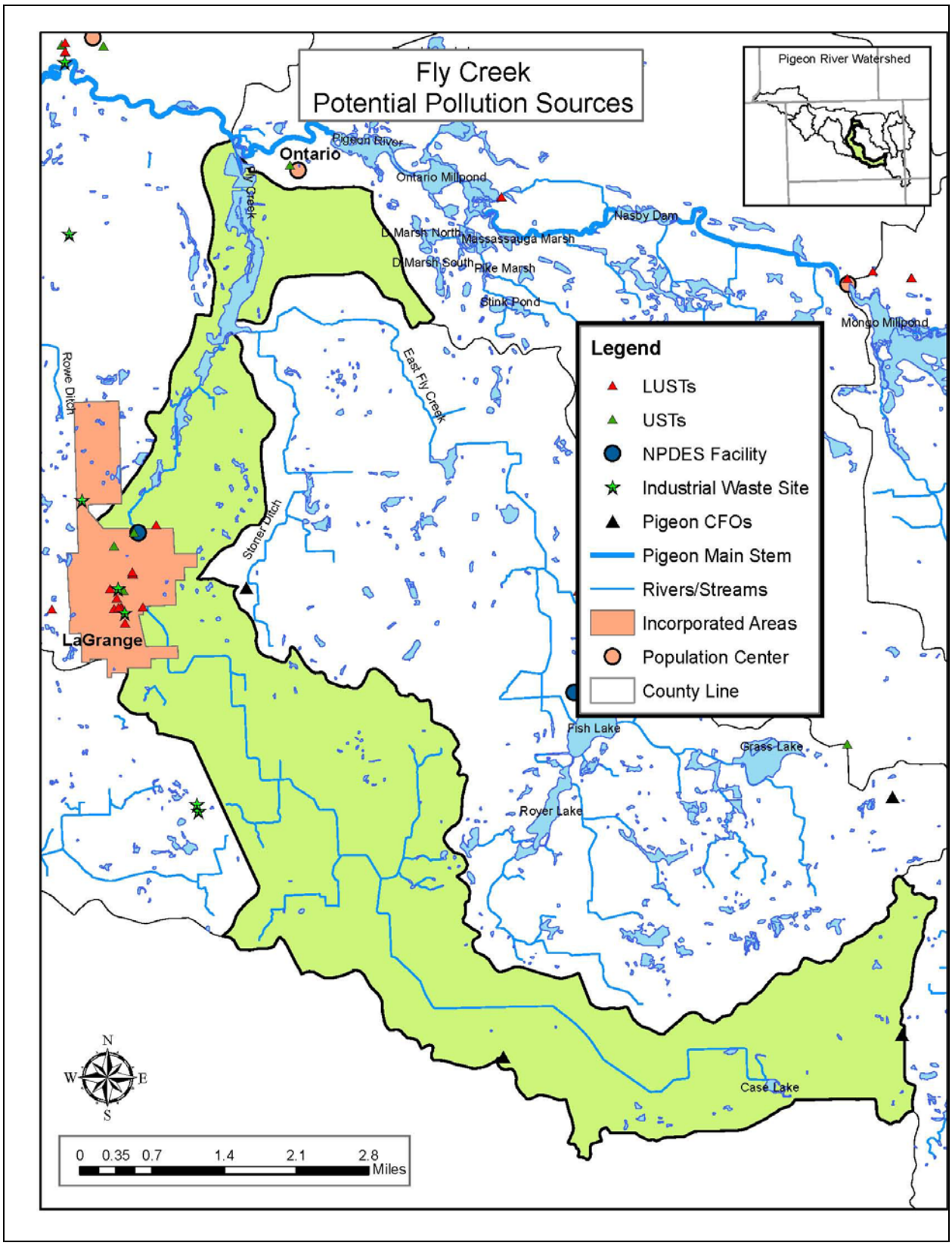

Figure 48: Fly Creek Potential Pollution Issues

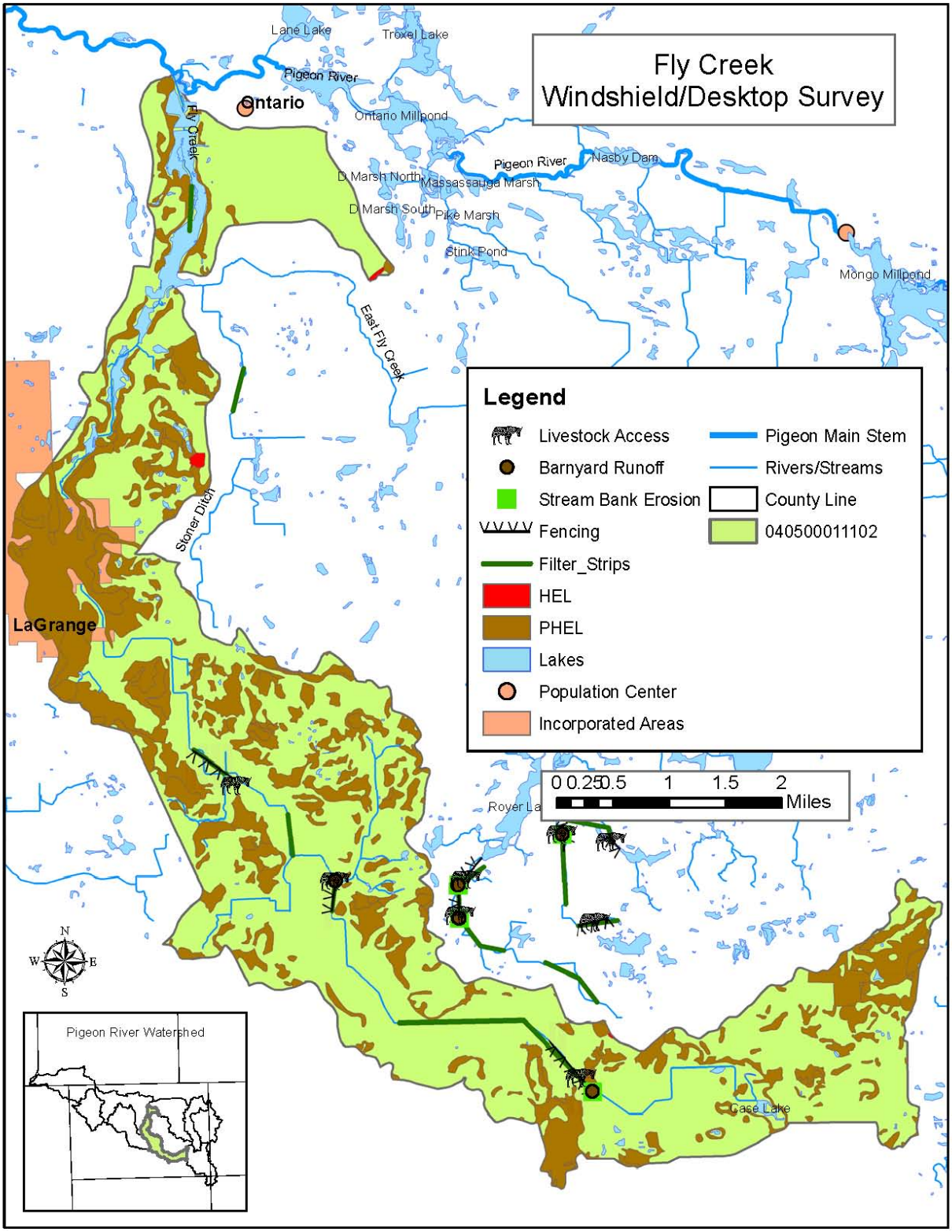

Figure 49: Fly Creek Windshield/Desktop Survey Results

3.5.7 Buck Lake-Buck Creek Land Use

The Buck Lake-Buck Creek subwatershed is located south of VanNatta subwatershed (Figure 50). It is approximately 16,482 acres (6,670 hectares) and contains major waterways Buck Creek, East Buck Creek, McManus Ditch and Buck Lake. The predominant land use in the subwatershed is agriculture with nearly 80% of the land being in either row crops or pasture/grassland. Table 79 shows the distribution of land use in the Buck Lake – Buck Creek subwatershed.

Table 79: Buck Lake-Buck Creek Landuse

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	1761.9	471.5	569.6	5.5	7341.3	5618.1	709.4	4.7	16482
%	10.6	2.8	3.5	<1	44.5	34.1	4.3	<1	100

There are no waterbodies located in the Buck Lake – Buck Creek subwatershed that are listed on Indiana's 303(d) list. However, East Buck Creek Ditch, Buck Creek, McManus Ditch, and all tributaries are listed on Indiana's fish consumption advisory for Carp. Figure 51 shows the location of all water bodies listed on the fish consumption advisory.

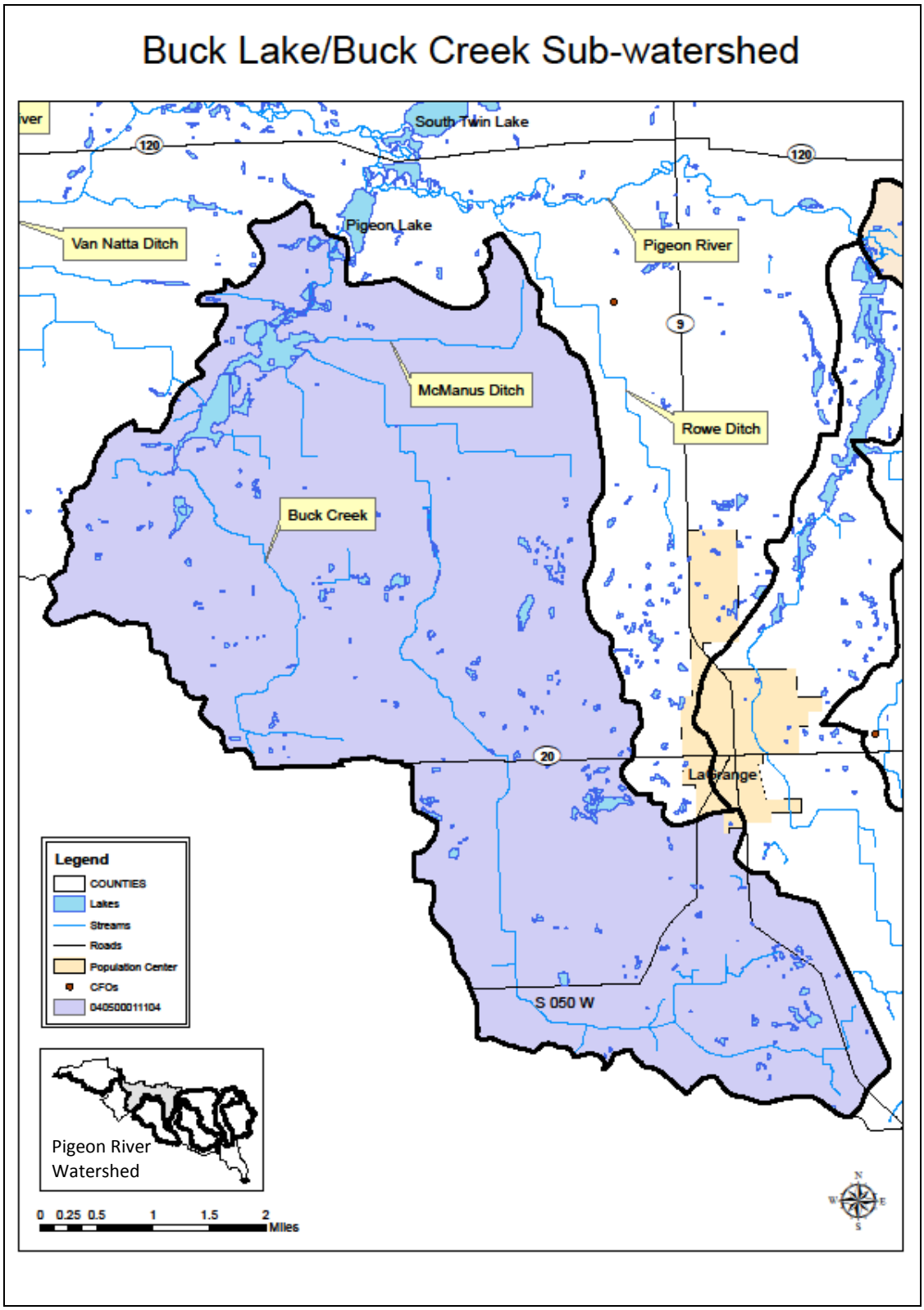

Figure 50: Buck Lake – Buck Creek Subwatershed

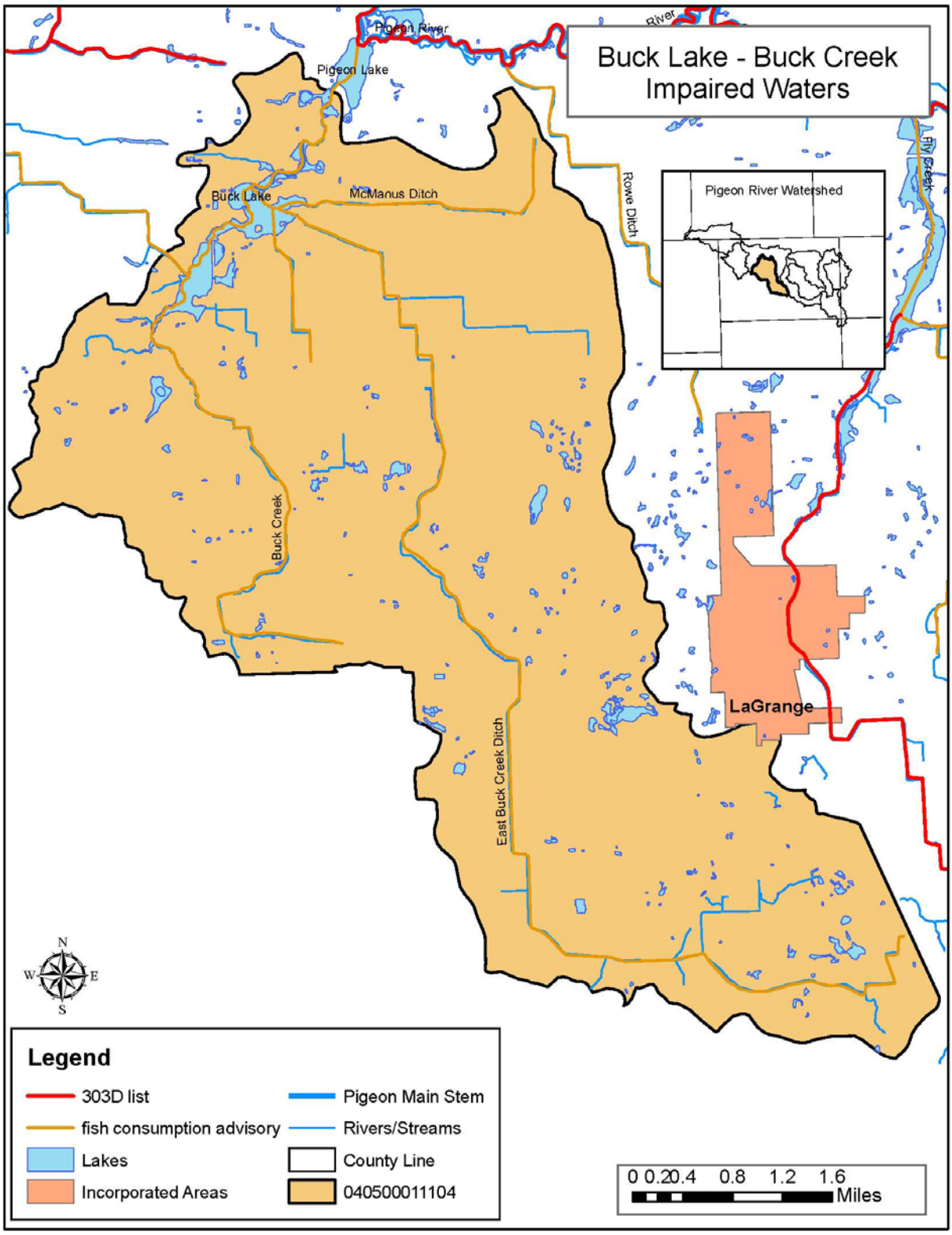

Figure 51: Buck Lake – Buck Creek Impaired Waters

There is one LUST site located within the Buck Lake-Buck Creek subwatershed located on US 20 as can be seen in Figure 52. The LUST is still active, needing remediated by either closing the UST or upgrading it. The IN UST program considers this site to be a medium priority for contamination of soil and groundwater.

There are three industrial waste sites located in the Buck Lake – Buck Creek subwatershed. Industrial waste sites are those sites that are at risk of, or do, discharge hazardous wastes from the site and are therefore required to clean up the waste through the Resource Conservation and Recovery Act. All sites are currently following the RCRA for clean-up issues.
There are no CFOs located in Buck Lake – Buck Creek subwatershed. All potential pollution concerns are outlined in Table 80 and the location of each site is shown in Figure 52.

Table 80: Potential Water Quality Pollution Threats in Buck Lake – Buck Creek

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	1
Industrial Waste Site	A Variety of Toxic Chemicals	3

The windshield and desktop survey revealed several small, unregulated livestock operations in the drainage area, due to the high Amish population. There are also many ditches that drain the agricultural land, which feed into Pigeon Lake on the west edge of the subwatershed. However, it is important to note that the main channel of Buck Creek is well protected by riparian buffer. There were several sites where the livestock had direct access to the stream, indicating the need for exclusion fencing to be installed and several barnyards that do not have adequate manure runoff control measures. There were also several sites found where there were no existing filter strips. The Desktop survey revealed that a large portion of the subwatershed was designated as having PHEL, mostly on the west edge of the subwatershed. Special precaution will need to be taken by landowners farming this soil. Table 81 and Figure 53 display the results of the windshield/desktop survey.

Table 81: Buck Lake – Buck Creek Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	4
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	7000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	2 miles
Barnyard Remediation Needed	Sediment, Bacteria, Nutrients	4
Streambank Erosion	Sediment	120 feet

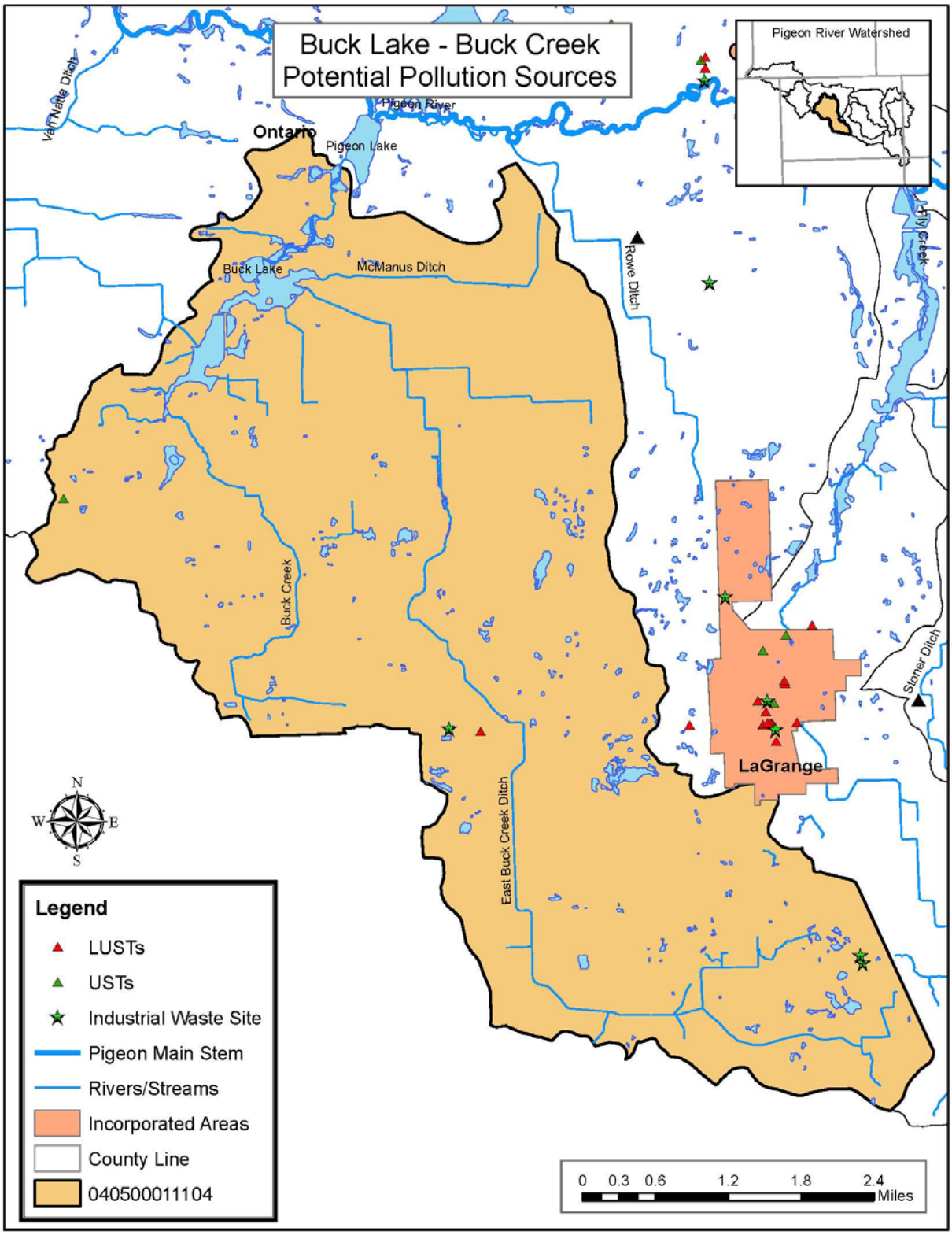

Figure 52: Buck Lake – Buck Creek Potential Pollution Issues

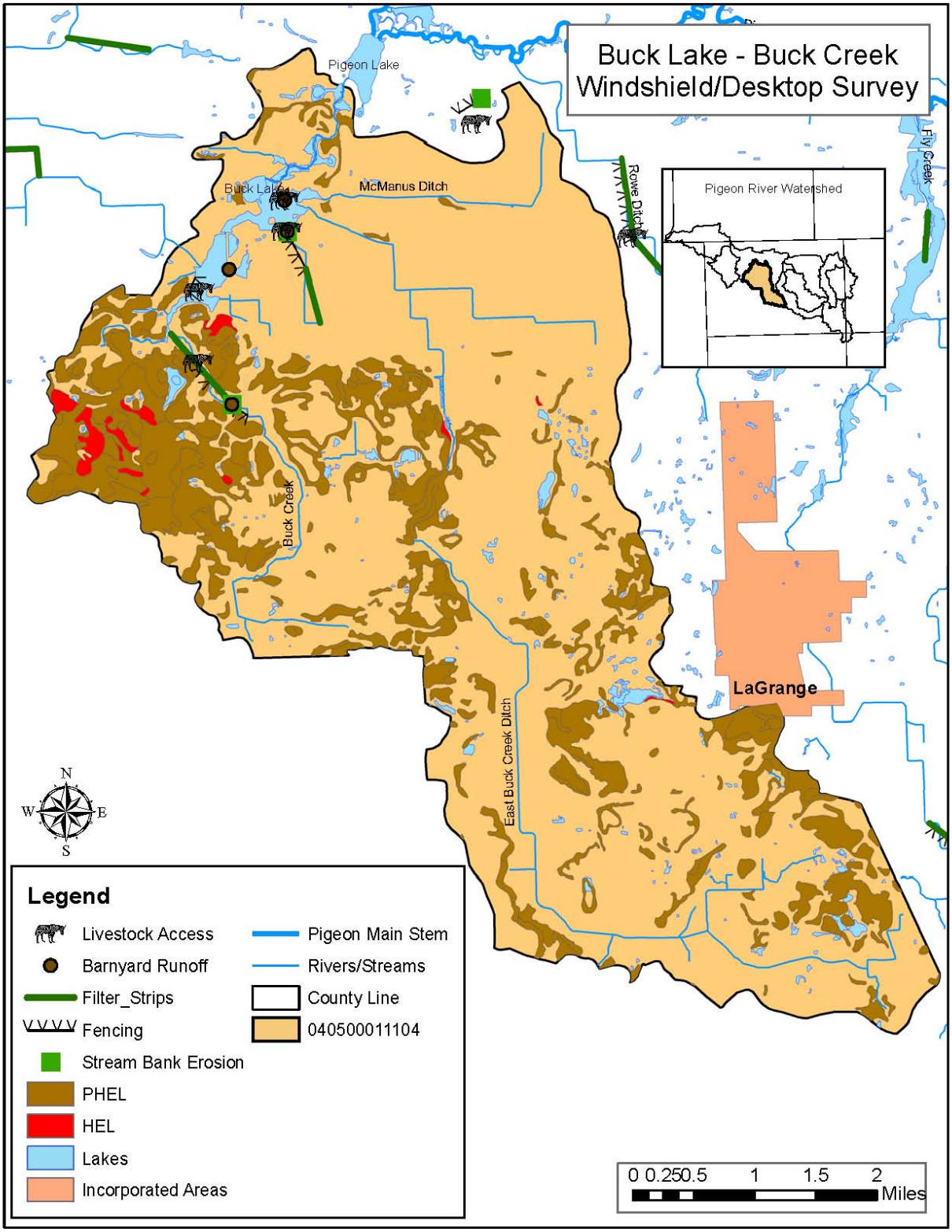

Figure 53: Buck Lake – Buck Creek Windshield/Desktop Survey

3.5.8 VanNatta Ditch Land Use

The VanNatta Ditch subwatershed is located northwest of Fly Creek subwatershed, north of Buck Lake-Buck Creek subwatershed and east of Page Ditch subwatershed (Figure 54). It is approximately 20,316 acres (8221.6 hectares) in size and encompasses the rest of the town of LaGrange that is not located within the Fly Creek subwatershed. The major waterbodies located within this subwatershed are North and South Twin Lakes and Pigeon Lake, as well as, the Pigeon River, Rowe Ditch and VanNatta Ditch. VanNatta Ditch also contains the Scott Mill Pond Park which is managed by the LaGrange County Parks Department.

The predominant land use in the VanNatta subwatershed is agriculture taking up nearly 70% of the total land (Table 82). The 127 acre Scott Mill Pond Public Fishing Area is located within the western portion of the VanNatta Ditch subwatershed. This recreational area is maintained by the Fish and Wildlife Department of the IN DNR. The small towns of Howe, IN (P=550), and Scott, IN (P=200) are located within the VanNatta Ditch subwatershed, which would account for the 10% of land that is currently developed.

Table 82: VanNatta Ditch Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	3234.9	1064.7	1005.6	94.4	10485.8	3527	903.6	0	20316
%	15.9	5.2	4.9	<1	51.6	17.4	4.4	0	100

The Pigeon River is listed on Indiana's 2008, 303(d) list of impaired waters for PCBs in fish tissue and downstream of Scott, IN the Pigeon River is listed as impaired for *E. coli*. North Twin Lake, located in North central VanNatta Ditch, is listed as impaired for impaired biotic communities. All streams located in VanNatta Ditch subwatershed are listed on Indiana's fish consumption advisory for Carp. Figure 55 displays the location of the impaired waterways found in VanNatta Ditch subwatershed.

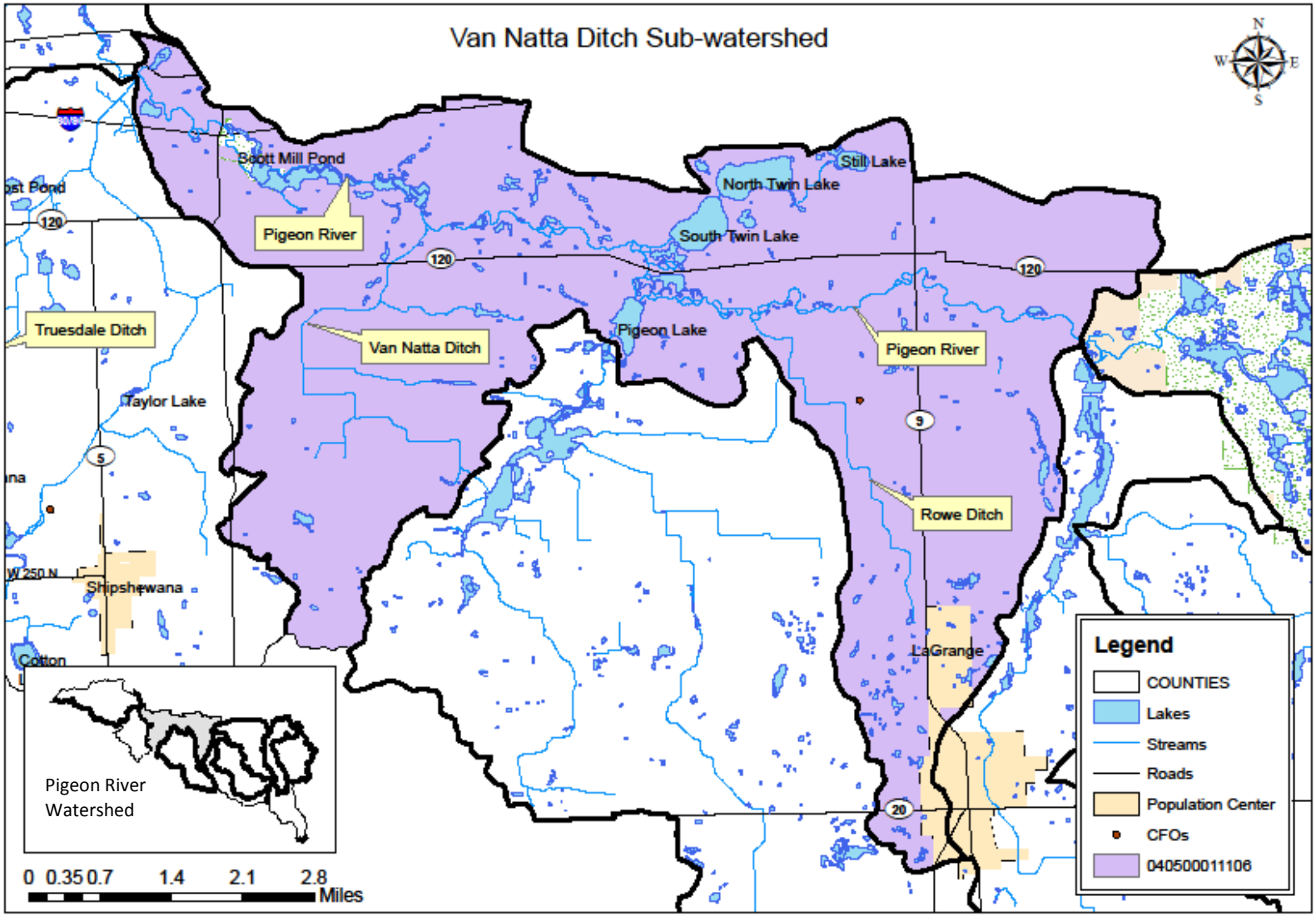

Figure 54: VanNatta Ditch Subwatershed

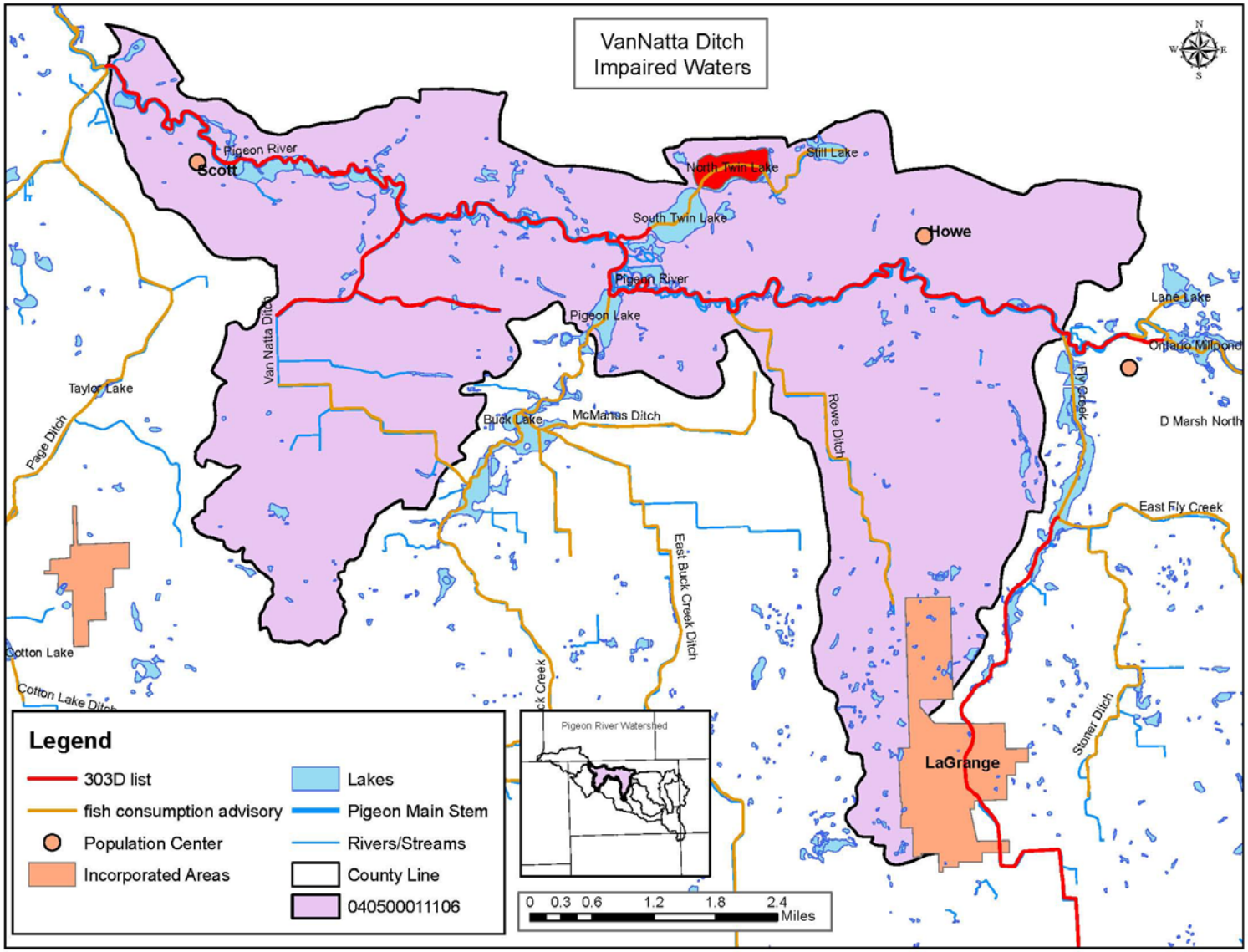

Figure 55: VanNatta Ditch Impaired Waters

There are no NPDES permitted facilities located within VanNatta Ditch subwatershed. The Howe-LaGrange Waste Water Treatment Plant services LaGrange, Howe, and the surrounding area, but it is located north of VanNatta Ditch subwatershed, and discharges outside of the project area.

There are three LUSTs located within the drainage area. One of the LUSTs has been remediated and is closed, however there are still two LUSTs that must either be closed or upgraded to stop contamination from entering the soil or ground water. A list of the LUSTs located within the VanNatta Ditch drainage area is presented in Table 83. There are also three UST sites located in the VanNatta Ditch subwatershed. While the USTs are currently safe, there is the potential for them to leak and cause a pollution concern in the future.

Table 83: VanNatta Ditch LUST Sites

UST FACILITY ID	NAME	STREET ADDRESS	CITY	PRIORITY	AFFECTED AREA	DESCRIPTION
9297	Howe Amoco	5445 N Sr 9	Howe	Low	Soil	Active
22199	Howe Marathon Express	5355 N Sr 9	Howe	Low	Soil	Closed
3837	Travel Plaza 7 South	CR 350 E Milepost 12538	Howe	High	Soil, Groundwater, C5H12O, Free Product	Active

There are three industrial waste sites located in VanNatta Ditch subwatershed. Industrial waste sites are those sites that are at risk of, or do, discharge hazardous wastes from the site and are therefore required to clean up the waste through the Resource Conservation and Recovery Act. All sites are currently following the RCRA for clean-up issues.

One CFO is located within the VanNatta Ditch drainage area. The CFO is located just east of Rowe Ditch and the facility houses over 1200 finishers. Since the CFO being located so close to surface water, the CFO may pose a threat to water quality if manure is not properly maintained on the property. All potential pollution concerns are outlined in Table 84 and the location of each site is shown in Figure 56.

Table 84: Potential Water Quality Pollution Threats in VanNatta Ditch

Type of Threat	Potential Contaminant	Number in Watershed
Leaking Underground Storage Tank	Oil/Gas	3
Underground Storage Tank	Oil/Gas	3
Confined Feeding Operations	Manure runoff/sedimentation	1
Industrial Waste Site	A Variety of Toxic Chemicals	3

During the windshield and desktop surveys it was revealed the predominant landowners in the VanNatta Ditch subwatershed are Amish. With that, several small animal operations were viewed during the survey, posing a potential threat of elevated sediment, bacteria, and nutrient levels in the water column. However, row crops take up the majority of agricultural land within the drainage area. It is important to note that the main channel of the Pigeon River running through this subwatershed is well protected by riparian buffer. Several sites were noted during the windshield survey where livestock had direct access to surface water and exclusion fencing will need to be installed to prevent the livestock from entering the stream. There were also several sites where there was a lack of riparian buffer and where severe bank erosion was present, as can be seen in Table 84.

The desktop survey revealed the large amount of soil designated as PHEL, especially on the west side of the subwatershed, which is where there is heavy row cropping. Landowners farming soil designated as PHEL will need to take special precautions to prevent erosion of the crop fields. The majority of the drainage has heavy riparian buffer that is filtering sediment loading. However during high water events sediment loading from fields will increase into the main channel without increased field buffering. Table 85 and Figure 57 show the results of the windshield and desktop surveys.

Table 85: VanNatta Ditch Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	3
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	5000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	3 miles
Streambank Erosion	Sediment	120 feet

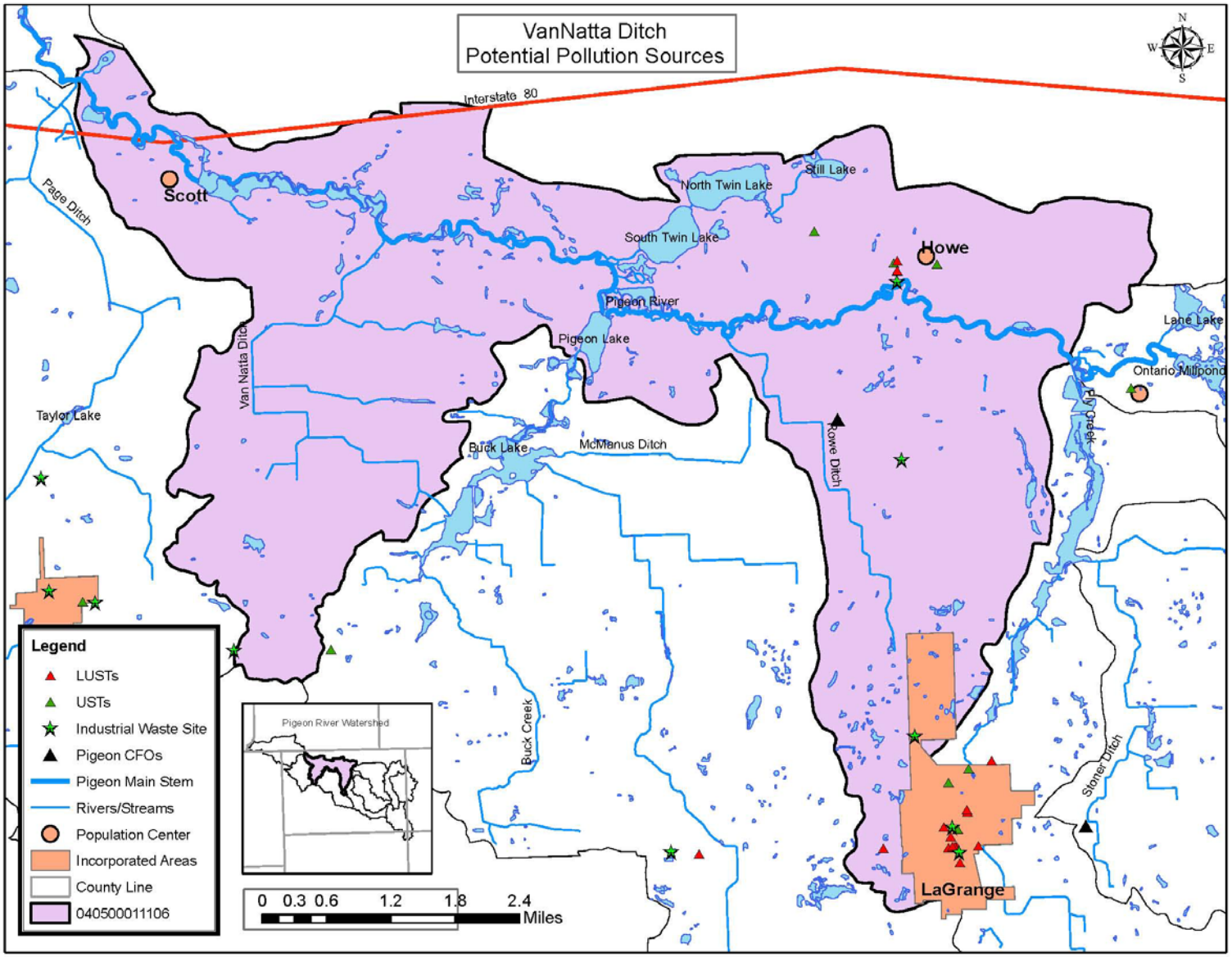

Figure 56: VanNatta Ditch Potential Pollution Issues

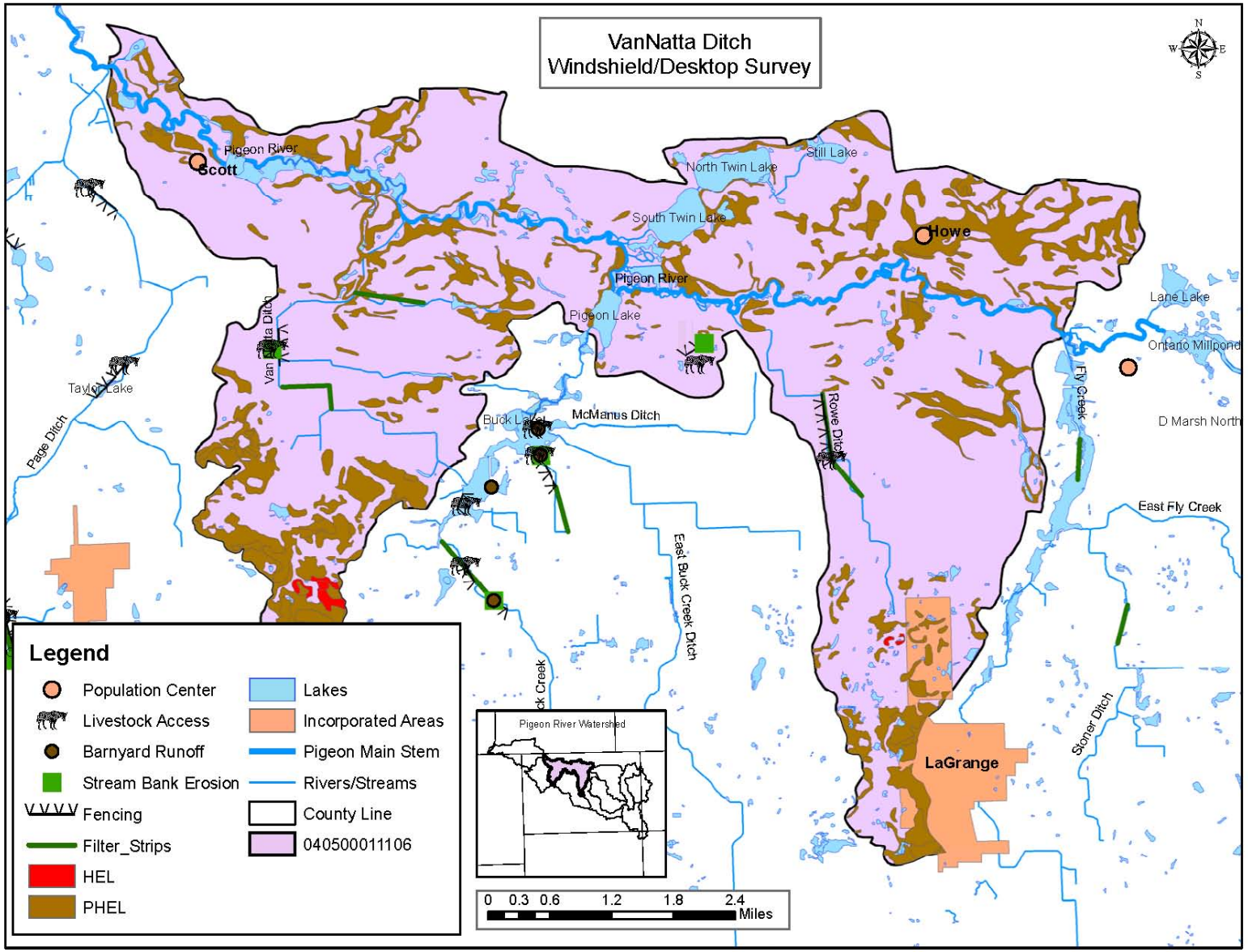

Figure 57: VanNatta Ditch Windshield/Desktop Survey Results

3.5.9 Page Ditch Land Use

The Page Ditch subwatershed is located west of the VanNatta Ditch subwatershed and southeast of the Pigeon River subwatershed (Figure 58). It is approximately 12,663 acres (5,124.5 hectares) in size and encompasses the town of Shipshewana (P=529). The major waterbodies located within this subwatershed include Shipshewana Lake, Truesdale Ditch and Page Ditch. The Page Ditch subwatershed contains the Yost Pond Nature Preserve. This 35 acre nature preserve is restricted to the public and is managed by the Department of Nature Preserves of the IN DNR. Page Ditch subwatershed is also home to the Shipshewana Lake Beach which is managed by the LaGrange County Parks Department.

The predominate land use in the Page Ditch subwatershed is agriculture which takes up approximately 70% of the total land use in the subwatershed as can be seen in Table 86.

Table 86: Page Ditch Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	1948.8	677.5	471.8	108.8	4116.8	4659.8	676.2	3.3	12663
%	15.4	5.4	3.7	<1	32.5	36.8	5.3	<1	100

There are no waterbodies in the Page Ditch subwatershed listed on Indiana's 2008 303(d) list of impaired waters. However, Cotton Lake Ditch, Truesdale Ditch, Page Ditch and Shipshewana Lake are all listed on Indiana's fish consumption advisory. A map showing the location of all impaired waterbodies can be seen in Figure 59.

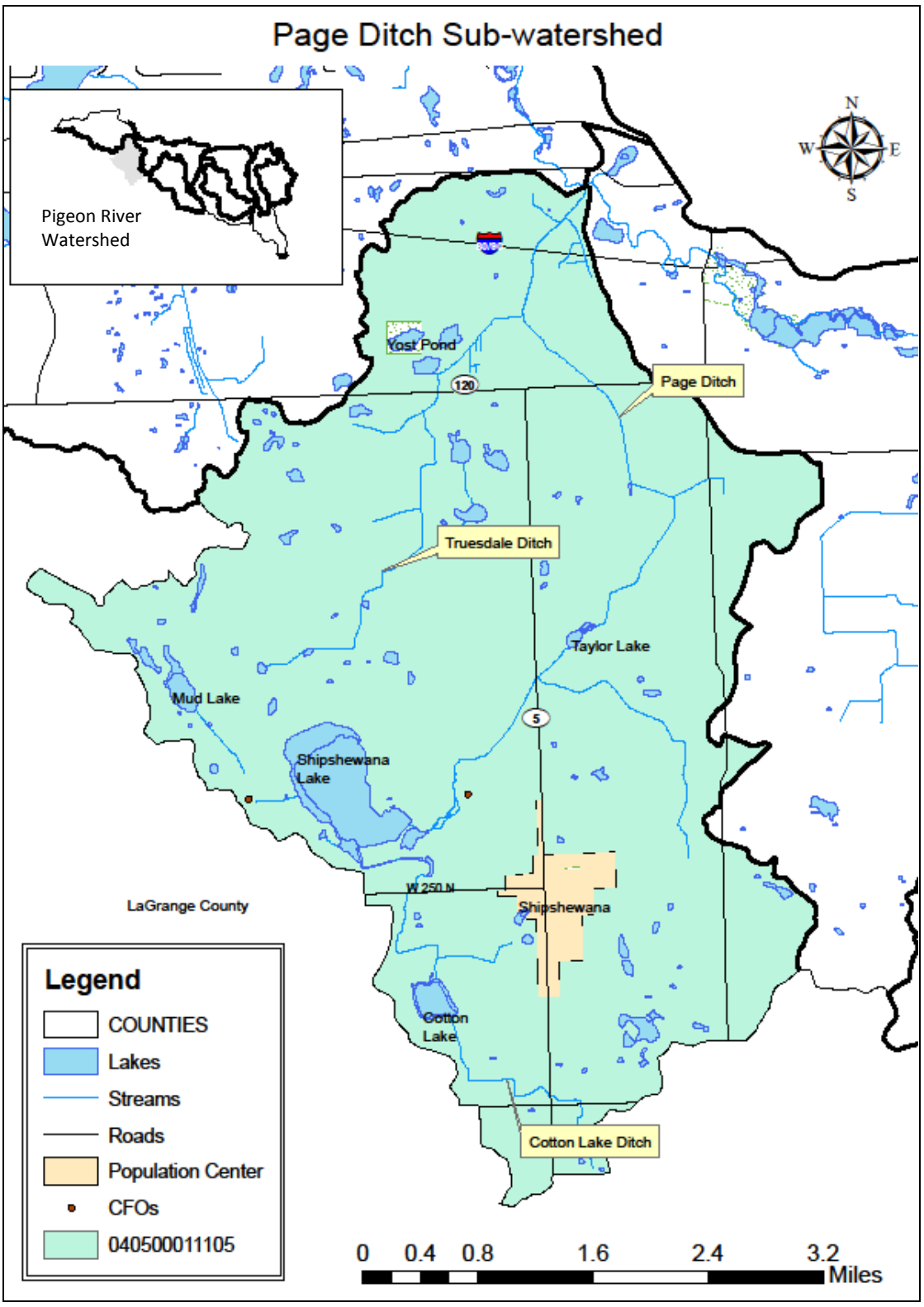

Figure 58: Page Ditch Subwatershed

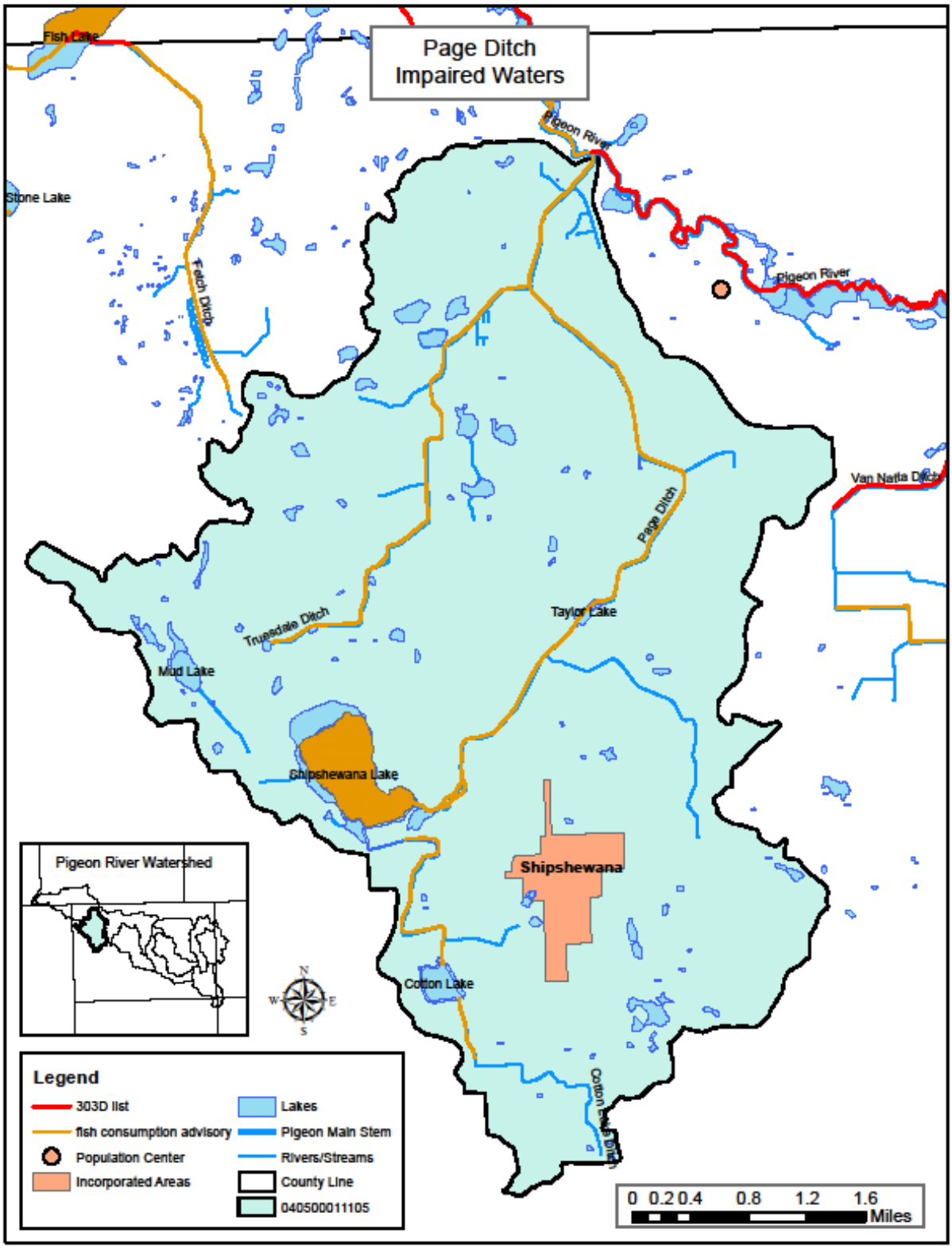

Figure 59: Page Ditch Impaired Waters

The Shipshewana Sewage Treatment Plant (STP) is the only NPDES permitted facility located within the Page Ditch subwatershed. There is one SSO that leads from the oxidation ditch used by the STP to the Page Ditch and they experienced one overflow in February, 2009 due to flooding of the facility. The issues allowing the plant to become flooded have been addressed and the superintendent does not foresee future SSO issues. The Shipshewana STP also had a leakage from the lift station several years ago, but the problem has been resolved.
There are two CFOs located within the Page Ditch drainage area. One is located at the headwaters of a small ditch draining into the Shipshewana Lake (580 swine), and the other is directly adjacent to Page Ditch (1100 dairy cows). Although during visual observations, no apparent issues were noted at these properties, their proximity to surface water may be an issue if there is ever a leak of their manure storage facilities or if the manure is improperly handled.

Three USTs are located in the Page Ditch subwatershed. While the USTs are currently safe, there is the potential for them to leak and cause a pollution concern in the future.
There are four industrial waste sites located in the Page Ditch subwatershed. Industrial waste sites are those sites that are at risk of, or do, discharge hazardous wastes from the site and are therefore required to clean up the waste through the Resource Conservation and Recovery Act. All sites are currently following the RCRA for clean-up issues. All potential pollution concerns are outlined in Table 87 and the location of each site is shown in Figure 60.

Table 87: Potential Water Quality Pollution Threats in Page Ditch

Type of Threat	Potential Contaminant	Number in Watershed
Underground Storage Tank	Oil/Gas	3
Confined Feeding Operations	Manure runoff/sedimentation	2
NPDES Permitted Facility	Nutrients, Bacteria, Sediment	1
Industrial Waste Site	A Variety of Toxic Chemicals	4

Shipshewana is a fast growing community. While the population is increasing only very little, it is the most industrialized subwatershed in the project area with nearly 100 acres in or around the town of Shipshewana designated as “industrial”. The main industry found in the area is the recreational vehicle industry. There is little concern for runoff from this type of industry. Also, Shipshewana is a huge tourist attraction in the region due to the monthly flea markets, weekly sales, and the “Amish Country” tourist attractions. These activities also increase Amish transportation which leads to a large amount of manure being left on the roadways to be washed off into roadside ditches and sewers. For this reason, urban BMPs must be introduced within the town of Shipshewana to minimize NPS runoff from roads, parking lots, and residential lots.

There are several nature preserves located within the Page ditch drainage including the 35 acres Yost Pond Nature Preserve and the 100 acre Scott Mill County Park. The Shipshewana Lake Beach is also open for public recreational use. Shipshewana Lake has received a lot of attention over the past ten years as it was once considered a "dead" lake due to heavy sedimentation and nutrients discharging into the lake. The lake was dredged and other measures, including installing a centralized sewer system have been proposed to insure the lake thrives: though little improvement has been seen in the lake to date. The residents located on the lake use on-site waste water treatment and it is expected that many of the septic systems are leaking directly into the Shipshewana Lake. The town of Shipshewana is currently constructing a waste water treatment plant that will address the problem of faulty septic systems around the lake. Once the facility is built, improvements will likely be seen in the Shipshewana Lake water quality.

The windshield and desktop survey indicated that Page Ditch is primarily influenced by the Amish community due to many small and unregulated livestock operations, and conventional tillage practices. However, it is important to mention that the main channel of Page Ditch is well protected by riparian buffer. Five sites were identified during the windshield survey where livestock had direct access to an open stream which indicates the need for exclusion fencing. There were also two site identified where an adequate riparian buffer was lacking, two sites where severe streambank erosion could be observed, and three sites where barnyards did not have adequate manure runoff control. It should also be noted that the desktop survey revealed a lot of land designated as PHEL, especially around Shipshewana Lake. Landowners farming this land will need to take special precautions to prevent soil erosion from their crop fields. In addition heavy construction has increased dramatically around the town of Shipshewana. Table 88 and Figure 61 show the results of the windshield and desktop surveys.

Table 88: Page Ditch Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	5
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	8000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	2 miles
Streambank Erosion	Sediment	120 feet
Barnyard Runoff	Sediment, nutrient runoff	3

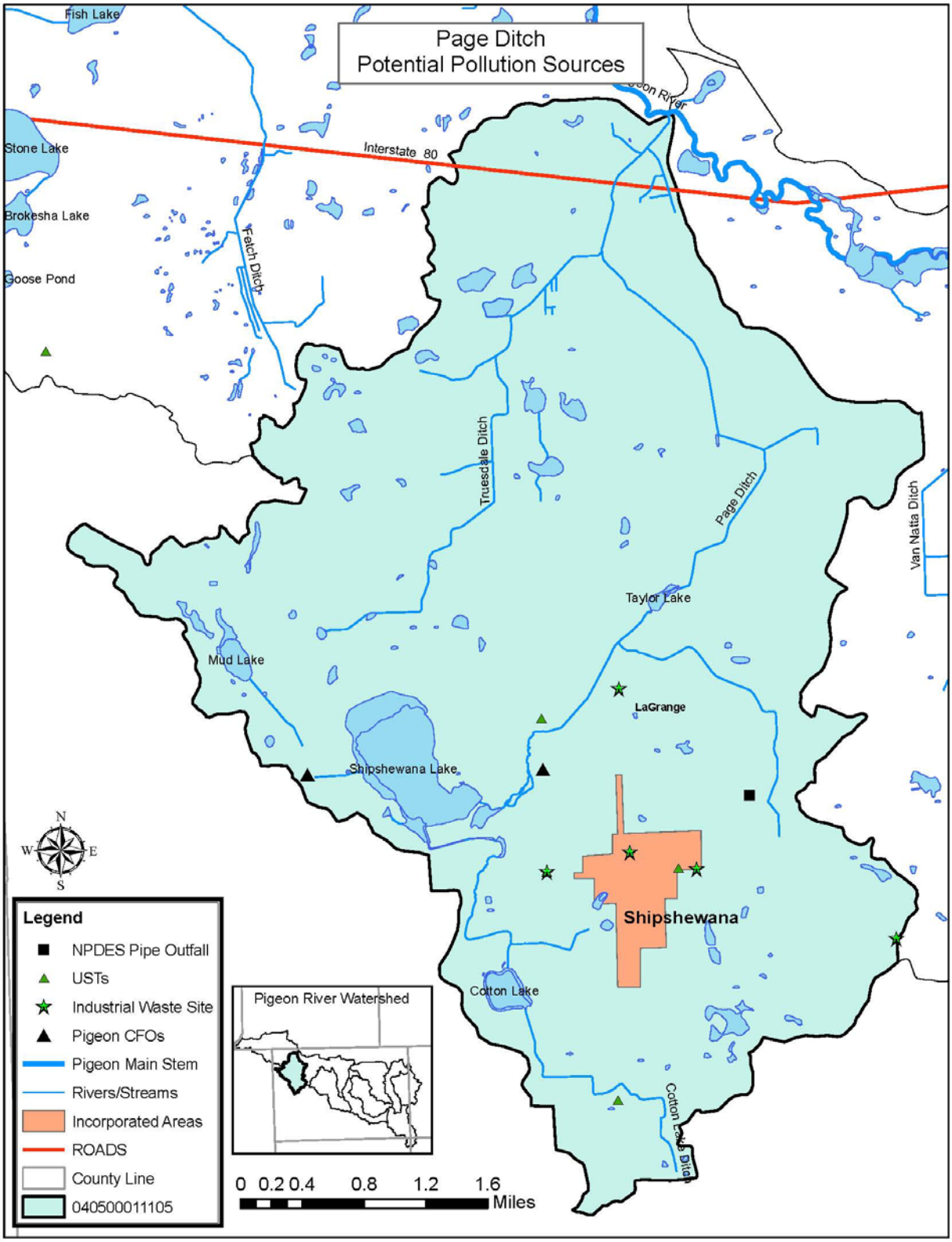

Figure 60: Page Ditch Potential Pollution Issues

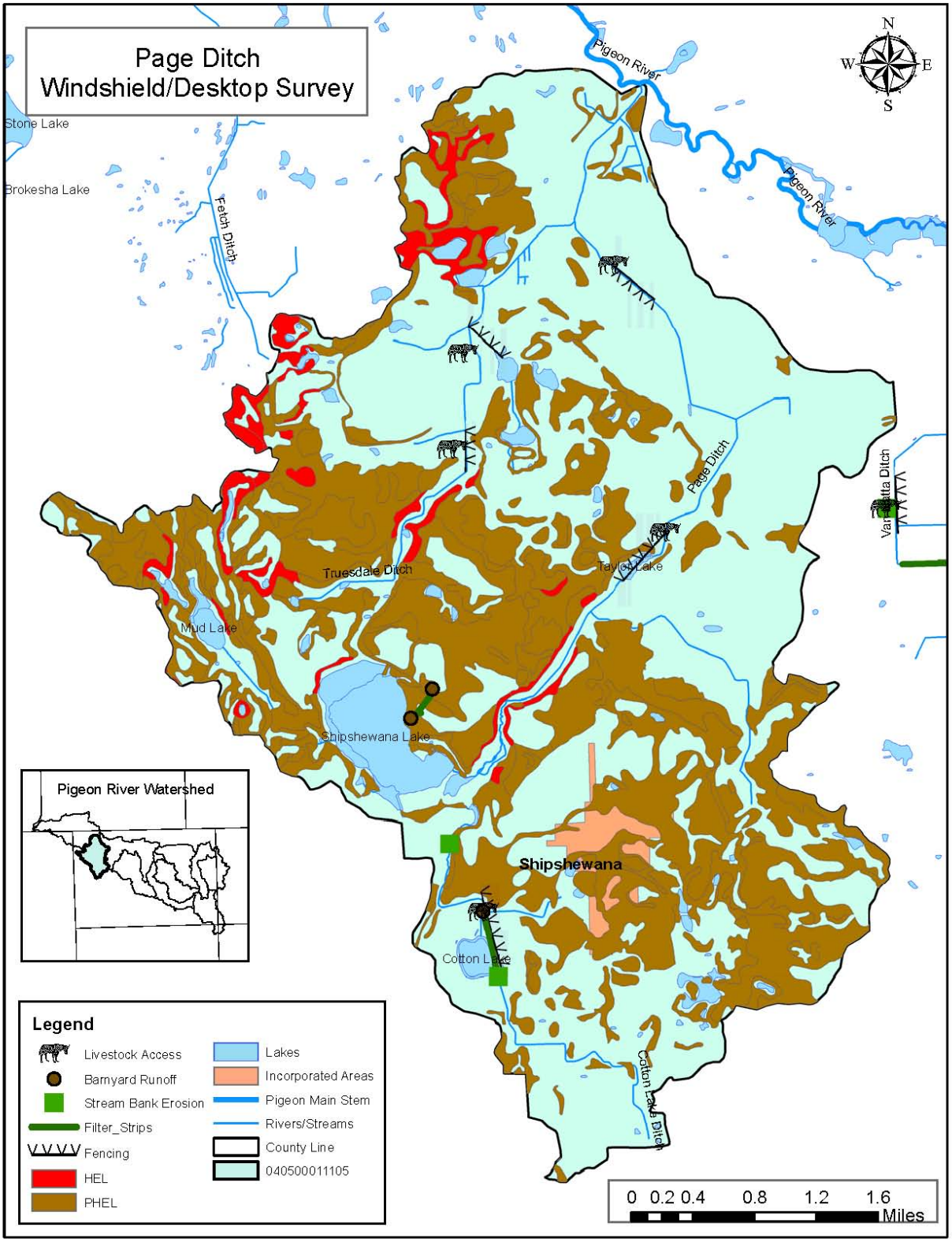

Figure 61: Page Ditch Windshield/Desktop Survey Results

3.5.10 Pigeon River Land Use

The Pigeon River subwatershed is located northwest of the Page Ditch subwatershed and is split in half by the Indiana – Michigan border (Figure 62). It is approximately 23,764 acres (9,617 hectares) in size and contains about 85% of the city of White Pigeon, MI. Major waterbodies located within this subwatershed include Fish and Marl Lake, and the Pigeon River. The Pigeon River subwatershed is primarily influenced by agricultural practices with 48% of the land use being cultivated crops and 11% of the land use being pasture and hayland (most of which is located in the Indiana portion of the subwatershed). 8% of the subwatershed is considered to be developed due to the majority of the Village of White Pigeon being located within this drainage area. The total percentage of each type of land use is listed in Table 89.

Table 89: Pigeon River Subwatershed Land Use

	Water	Developed - HD	Developed - LD	Industrial	Cultivated Crops	Grass/ Pasture	Forest	Other	Total
Acres	671.7	678.2	1372.13	N/A	11471	2639.7	5600.7	1330.57	**23764**
%	2.8	2.8	5.8	N/A	48.3	11.1	23.6	5.6	**100**

The Pigeon River, and all its tributaries (Figure 63), is listed on the Michigan 2010, 303(d) list of impaired waters for mercury and PCBs in the water table. All lakes in the Michigan portion of Pigeon River subwatershed are listed on the Michigan fish consumption advisory for mercury and PCBs found in fish tissue. Love Joy Ditch and Fetch Ditch are listed on the 2010 Indiana fish consumption advisory for Carp.

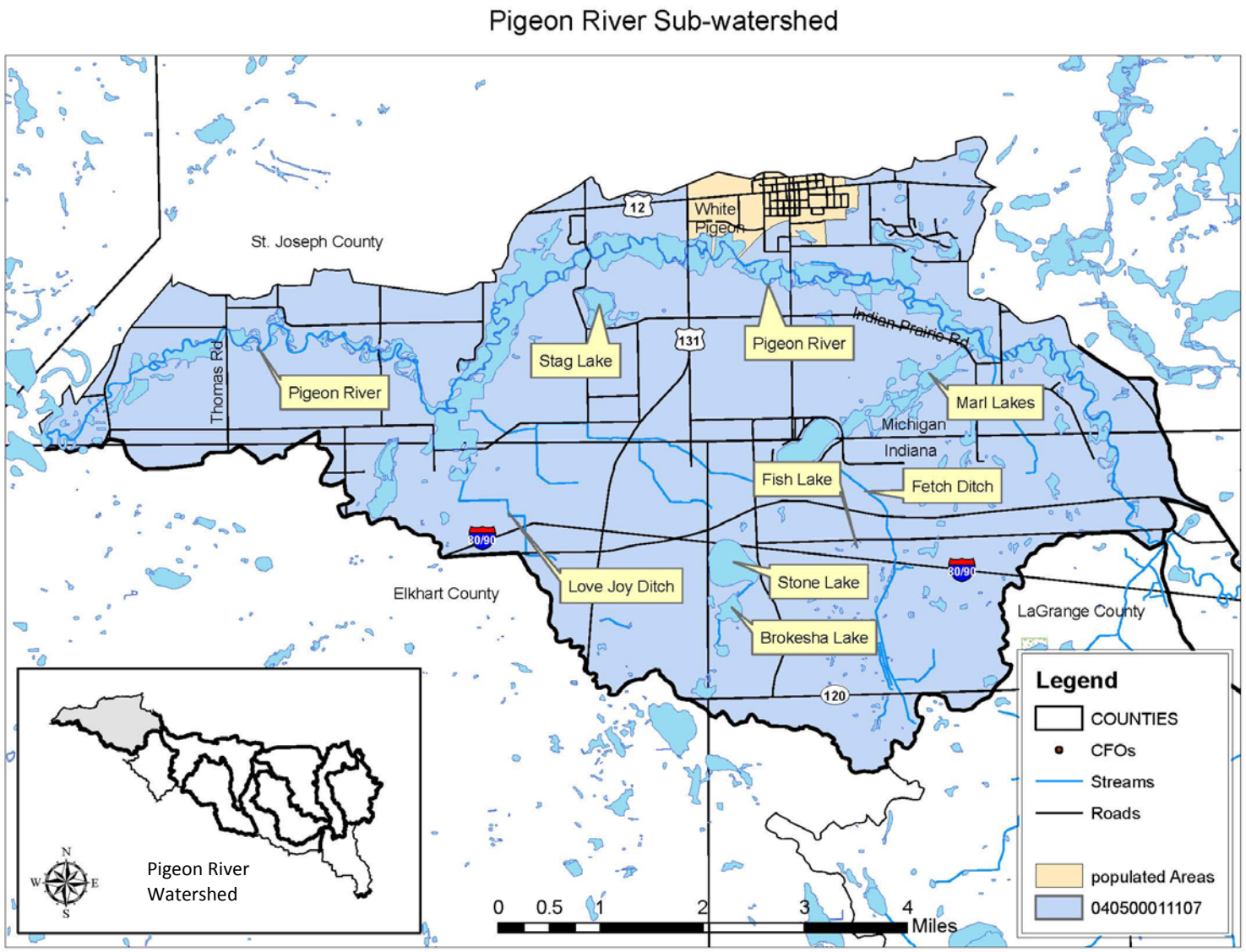

Figure 62: Pigeon River Sub-watershed

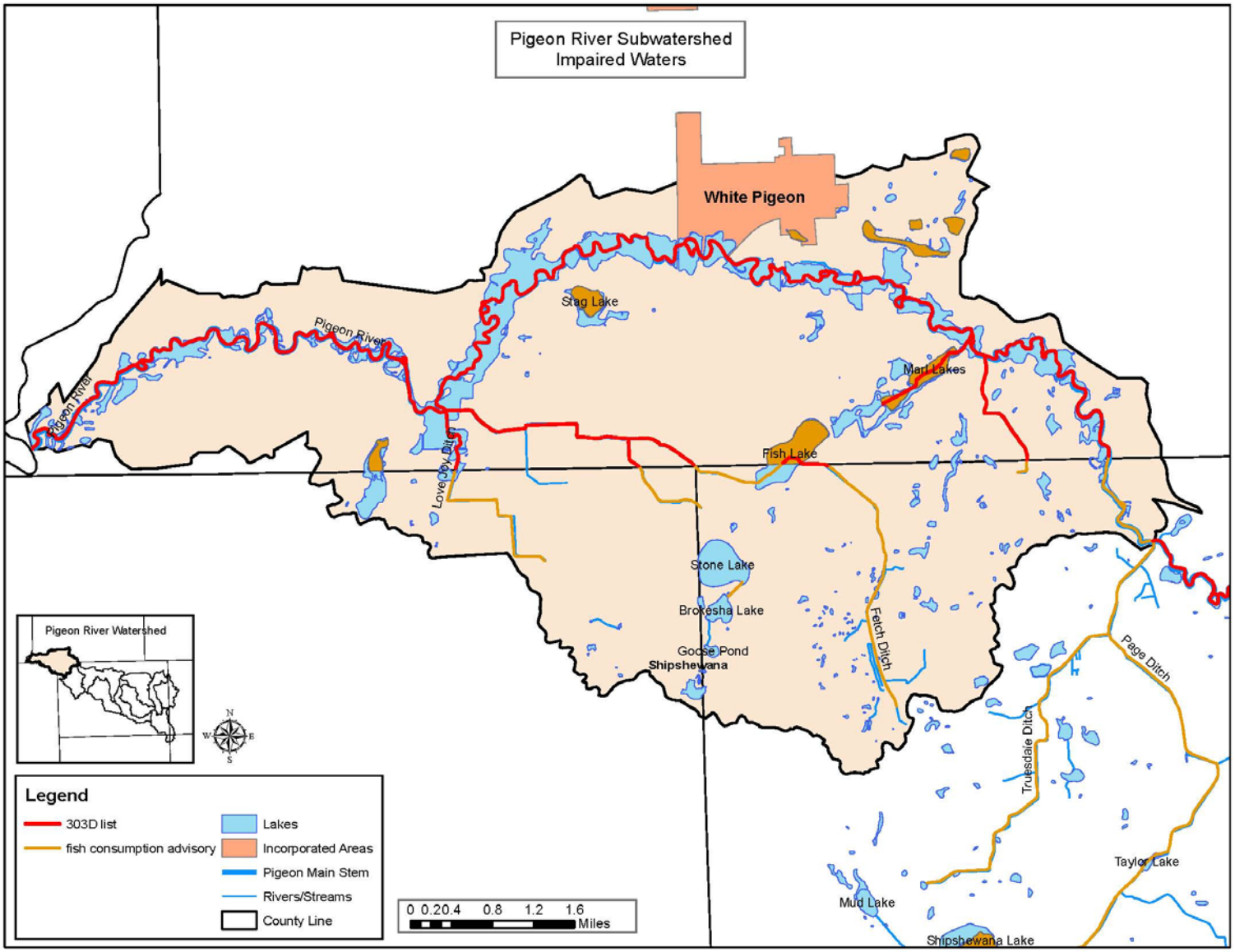

Figure 63: Pigeon River Subwatershed Impaired Waters

There are several NPDES permitted facilities located in this subwatershed (Table 90), which are regulated by the Michigan Department of Environmental Quality (DEQ). The permitted facilities include the White Pigeon Sanitary Systems, Gray Brothers, Dexter Chassis Group, Michigan Southern Railroad, Southern Michigan Canine, Universal Consumer Products Incorporated, and the White Pigeon Paper Company.

The White Pigeon Sanitary System has two SSOs. They have experienced three overflows in the past decade; one in 2003, 2008, and 2009. It was discovered through discussions with a MI DEQ representative that the discharges were due to a break in the conveyance line, rather than from the treatment plant not being able to handle the amount of waste water being processed. The problem is not expected to occur again.

There are thirteen industrial waste sites located in Pigeon River subwatershed. Industrial waste sites are those sites that are at risk of, or do, discharge hazardous wastes from the site and are therefore required to clean up the waste through the Resource Conservation and Recovery Act. All three sites are currently following the RCRA for clean-up issues.

Nine LUST sites are located in the Pigeon River subwatershed; two in Elkhart County which have been closed, and seven in St Joseph County, MI. The table below is a list of the LUST sites located within the Pigeon River subwatershed in St. Joseph County. Note that one LUST is not a registered tank UST with the MI DEQ, and all but one LUST has been remediated through closure of the UST.

There are no other USTs or CFOs located in the Pigeon River subwatershed.

Table 90: Pigeon River Subwatershed LUST sites

UST FACILITY ID	NAME	STREET ADDRESS	CITY	COUNTY NAME	Contaminant	DESCRIPTION
13154	Libby Atherton	16578 E Chicago Rd Rt-1	White Pigeon	St. Joseph	gasoline	Removed from Ground
50005733	Grant's Auto Clinic	400 W Chicago Rd	White Pigeon	St. Joseph	unknown	Non-registered Tank
8270	Mottville Stop & Go	10269 US-12	White Pigeon	St. Joseph	gasoline	Removed from Ground
39526	Platz Excavating	69025 US-131	White Pigeon	St. Joseph	diesel	Removed from Ground
9960	Shell-spee-D-Mart	215 E Chicago Rd	White Pigeon	St. Joseph	gasoline, kerosene	Currently in Use, Removed from Ground, or Closed in Ground
9637	Emro #7428	14973 US 12	White Pigeon	St. Joseph	gasoline	Removed from Ground
38890	White Pigeon Fruit Market	15093 US-12 and US-131	White Pigeon	St. Joseph	diesel	Removed from Ground

Over half of the Village of White Pigeon (P=1544) is located within the Pigeon River subwatershed. White Pigeon is a growing community. Therefore, it is important to introduce urban BMPs to the community and village officials to help reduce the risk of urban NPS from reaching the Pigeon River, which runs just south of the Village. As mentioned above, there are a total of seven NPDES permitted facilities located within the Pigeon River subwatershed. Those NPDES facilities are listed in Table 91 and can be seen on Figure 64.

Table 91: Pigeon River Subwatershed NPDES Permits (White Pigeon, MI)

Facility Location Name	Address	City	Permit Type	Issue Date
Dexter Chassis Group Plant 55	501 South Miller Drive	White Pigeon	NEC	7/19/2010
Gray Brothers	424 West Chicago Road	White Pigeon	COC	1/24/2007
Michigan Southern Railroad	69065 South Kalamazoo Street	White Pigeon	COC	3/28/2007
Southern Michigan Canine	17844 Indian Prairie Road	White Pigeon	2211	1/3/2011
Universal Consumer Products Incorporated	68956 US 131	White Pigeon	COC	1/24/2007
White Pigeon Paper Company	15781 River Street	White Pigeon	COC	2/8/2007
White Pigeon Sanitary System	16220 Indian Prairie Road	White Pigeon	COC	11/17/2009

The windshield and desktop surveys revealed that several small and unregulated livestock operations, south of the main channel in Indiana, have a large influence on the Pigeon River and its tributaries. The surveys also revealed three sites where traditional farming techniques have led to the removal of any riparian buffer. One site in particular was noted as lacking a riparian buffer and adequate barnyard manure runoff control measures, and that livestock had direct access to the stream. However, it should be noted that the main channel of the Pigeon River is well protected by riparian buffers. The desktop survey revealed that the majority of the PHEL and HEL are located in LaGrange County. Landowners farming land designated as PHEL or HEL will need to take special precautions to prevent severe soil erosion from their crop fields. Table 92 and Figure 65 show the results of the windshield and desktop surveys.

Table 92: Pigeon River Subwatershed Windshield Survey Observations

Type of Threat	Potential Contaminant	Number in Watershed
Livestock Access to Ditch	Sediment, Bacteria, Nutrients	1
Need for Exclusion Fencing	Sediment, Bacteria, Nutrients	3000 feet
Lack of Riparian Buffer	Sediment, nutrient runoff	4 miles
Barnyard Runoff	Sediment, nutrient runoff	1

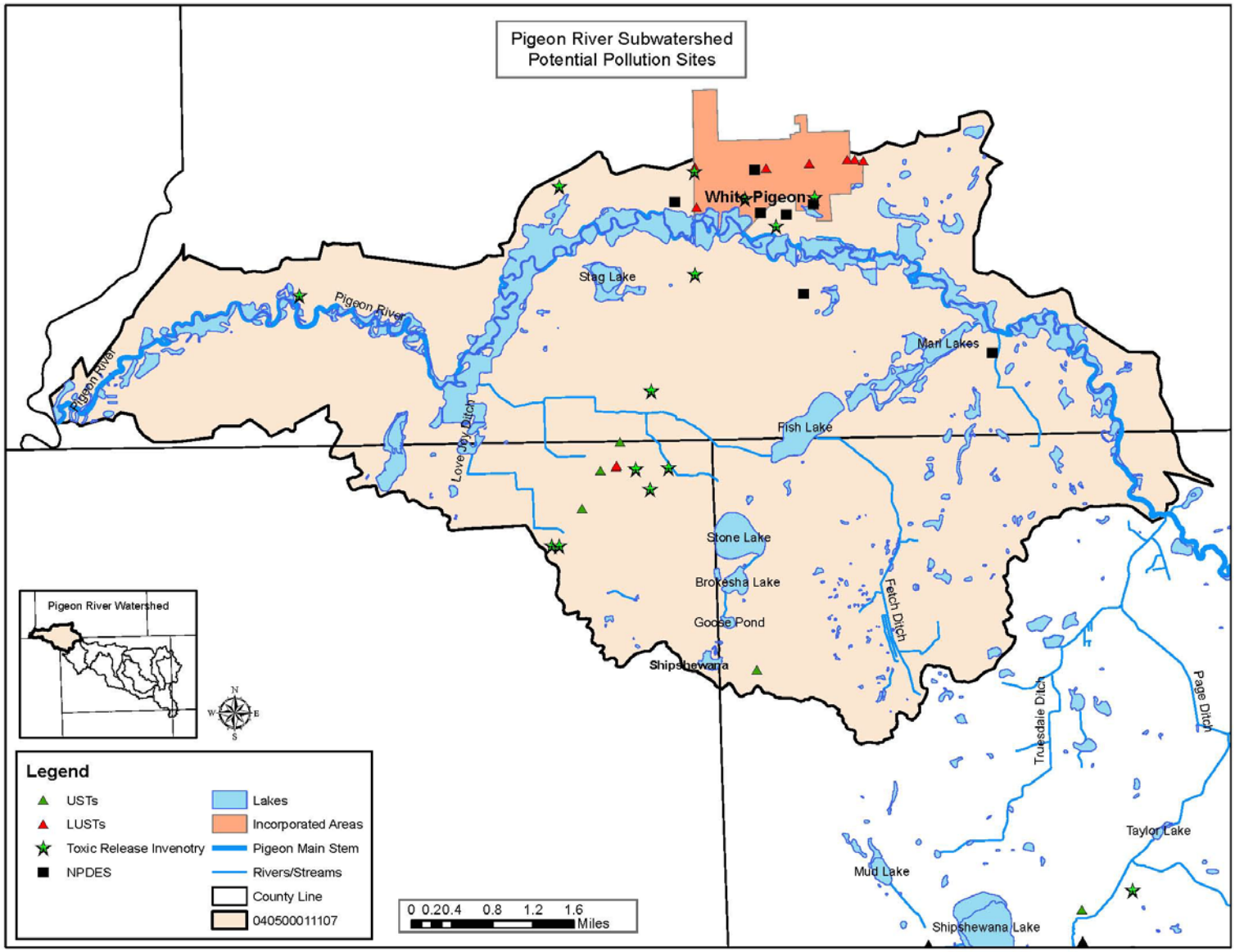

Figure 64: Pigeon River Subwatershed Potential Pollution Issues

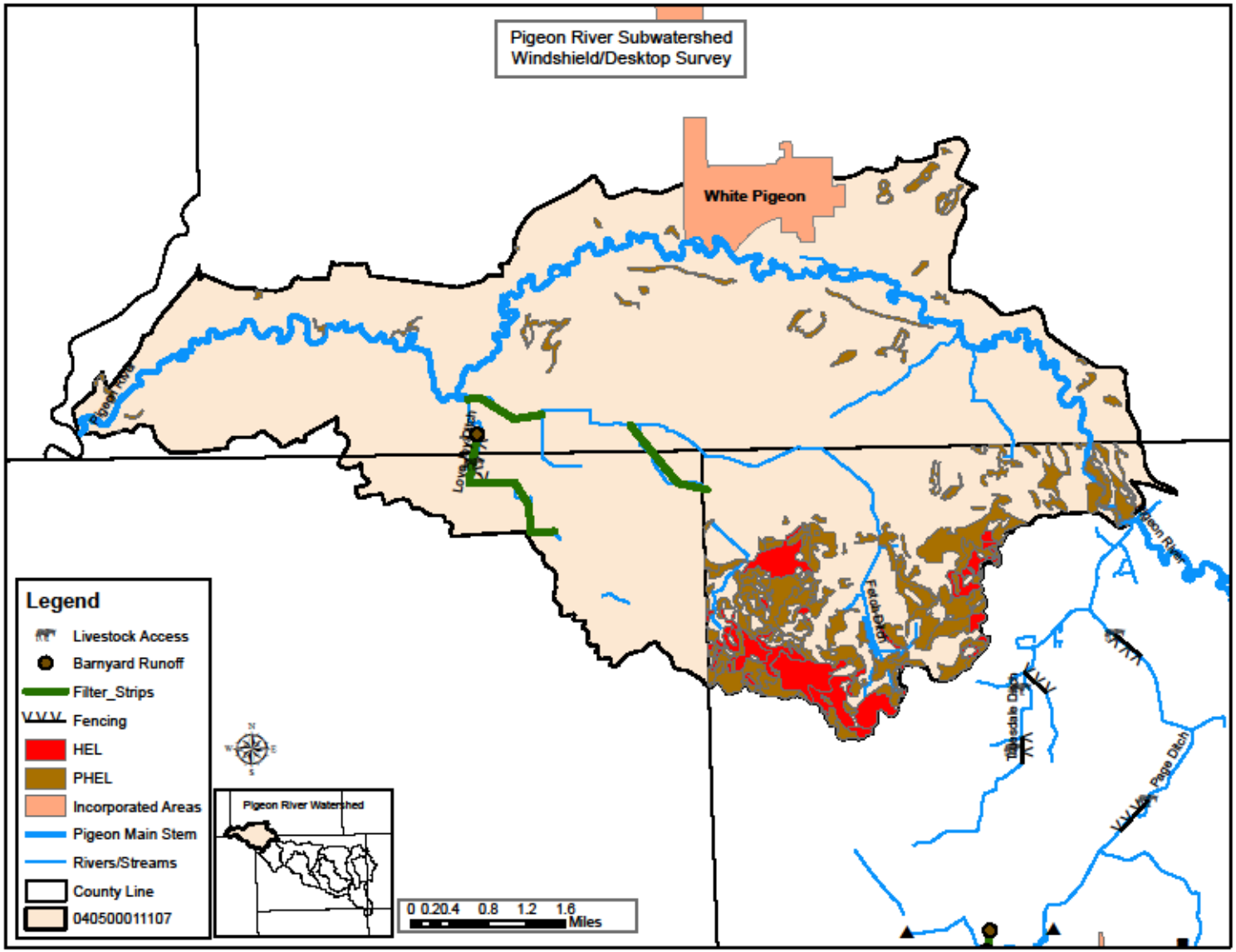

Figure 65: Pigeon River Subwatershed Windshield/Desktop Survey Results

3.6 Watershed Inventory Summary

To better understand the water quality problems in the Pigeon River project area and what influences may be contributing to those problems, a map was developed outlining the water quality issues in each subwatershed as well as showing the results of the windshield survey (Figure 66). As can be seen in the figure, nitrogen levels were elevated in every subwatershed located within the project area, except for Little Turkey Lake, and phosphorus levels averaged to be greater than the target level in East Fly Creek, Buck Lake-Buck Creek, and Page Ditch. When comparing the water quality results to the windshield survey, there is no apparent reason that nitrogen levels were so high, it could be a result of faulty septic systems combined with livestock access to open water and over application of fertilizer on crop fields. However, the high levels of phosphorus in the three subwatersheds coincide with the large number of livestock that have direct access to open water in East Fly Creek, Buck Lake – Buck Creek, and Page Ditch.

D.O. levels averaged to be > 9mg/L in all subwatersheds in the project area which may be a result of the high nutrient content in the water column contributing to overgrowth of aquatic plants, including cyanobacteria (a.k.a. blue green algae). *E. coli* is a current issue in Green Lake-Green Creek, Little Turkey Lake, East Fly Creek, Fly Creek, Buck Lake-Buck Creek, and Page Ditch subwatersheds. Elevated *E. coli* levels may be a result of livestock access to open water (Figure 66), faulty septic systems, inadequate barnyard runoff control (especially in Little Turkey Lake, East Fly Creek, Fly Creek, Buck Lake-Buck Creek, and Page Ditch), and manure runoff from horse and buggy use on roadways.

Historic water quality data shows similar results to what was found during the 2011 water quality testing performed by the LaGrange County SWCD except that sediment was an issue in Fly Creek and Page Ditch. This is likely a result of heavy agriculture production on PHEL and HEL, though much of the area population is beginning to produce more livestock than row crops which may be why sediment has not been a major problem in recent years.

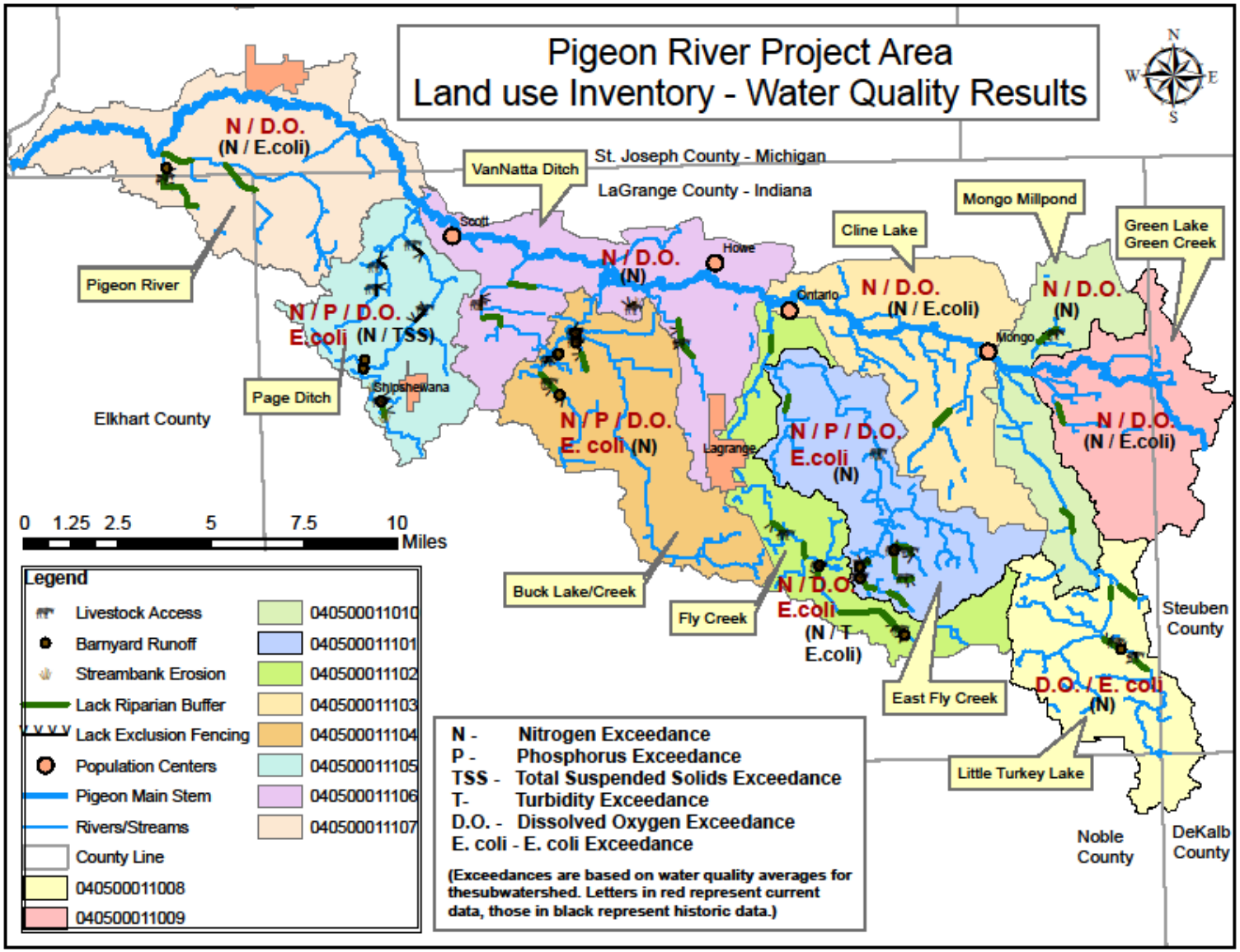

Figure 66: Land use and Water Quality Summary

3.7 Analysis of Stakeholder Concerns

Stakeholders in the Pigeon River project area expressed concerns regarding water quality and land uses during the public meeting held in late 2010 and additional concerns were raised while performing the watershed inventory. These concerns are outline in Table 92 as well as whether or not the concerns are supported by the collected data, quantifiable, outside the scope of this project, and whether or not the steering committee would like to focus on the concerns. The steering committee does not feel that most of the concerns listed in Table 93 are outside the scope of the project and wants to focus on those concerns. Some concerns will be addressed through education alone, while others will be addressed by implementing best management practices as well as an education and outreach program. The concern related to the fish consumption advisory is outside the scope of this project as most fish are listed due to mercury and PCBs in fish tissue which is mostly due to particles from the air containing mercury and PCBs depositing in the water table. The Steering Committee also decided that updating the Shipshewana Master Plan is outside the scope of this project; however, water quality informational support will be provided to the Town of Shipshewana when needed.

Table 93: Analysis of Watershed Concerns

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Livestock Access to Open Water	Yes	25 locations were found during the windshield survey where livestock had direct access to open water.	Yes	No	Yes
Stormwater Runoff From Barnyards	Yes	14 locations found during the windshield survey where inadequate, or no, barnyard runoff control measures were in place.	Yes	No	Yes
Increase in Impervious Surfaces	Yes	Shipshewana's population is on the rise and more tourist attractions are being built. White Pigeon is designated as an "industrial" town, indicating an increase in impervious surfaces.	No	No	Yes
Fertilizer Used on Urban Lawns	No	No particular evidence was collected, however it is common knowledge that as lakes become more developed, more fertilizer is being spread on urban lawns.	No	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Lakes in the Area Becoming More Developed	No	No particular evidence was collected, however it is known by local stakeholders that more residences are being constructed around the lakes in the area.	No	No	Yes
Septic System Discharge	Yes	The LaGrange County Health Department did a study which indicated nearly 75% of all septic systems in the county are faulty. The majority of soil found within the project area is designated as either somewhat or very limited for septic system usage. Most of the project area is rural and not connected to a centralized sewer system, meaning that most of the population uses on-site sewage treatment.	Yes	No	Yes
Horse Manure on Public Roads	Yes	While performing the windshield survey manure was regularly seen on public roads. There is a large Amish population, who uses horse and buggy as a means of transportation, residing within the project area.	No	No	Yes
Stream Bank Erosion	Yes	Six locations were found during the windshield survey where extreme stream bank erosion had taken place.	Yes	No	Yes
Lack of Riparian Buffer	Yes	31 locations were found during the windshield survey where an adequate filter strip or riparian buffer was not in place.	Yes	No	Yes
Landowners Farming PHEL or HEL	Yes	The desktop survey revealed a large portion of the project area is comprised of soil on PHEL or HEL and the majority of the land use in the project area is agriculture.	No	No	Yes
Water Contact is Unhealthy	Yes	E. coli exceeded the state standard in East Fly Creek, Buck CLake-Buck Creek, and Page Ditch Subwatersheds.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Fish Consumption from Local Waterways is Unhealthy	Yes	There are several lakes and streams listed on Michigan's and Indiana's fish consumption advisory.	Yes	Yes	No
The Shipshewana Master Plan Needs Updated	Yes	The Master Plan was written in 1993 and the town office does not have a copy of the entire document. The town is currently under new management.	Yes	Yes	No
Endangered and Threatened Plants and Animals That Rely on Water Resources as Their Habitat	Yes	There are 15 species of plants and animals federally listed as endangered or threatened.	Yes	No	Yes

4.0 Water Quality Problems, Causes, and Sources

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Table 94 shows the connection between stakeholder concerns, problems found in the watershed, and the potential causes of those problems. Table 95 takes it a step further by identifying potential sources to the problems found in the watershed.

Table 94: Concerns, Problems, and Potential Causes

Concern(s)	Problem	Potential Cause(s)
- Livestock have access to open water. - Stormwater runoff from barnyards. - Septic system discharge. - Horse manure on public roads. - Water contact is unhealthy.	Area streams are impaired for recreational contact, as a result of *E. coli*, on Indiana's 303(d) list of impaired waters.	- *E. coli* levels exceed the state standard. - Area producers are unaware of the water quality threat of allowing livestock direct access to open water. - Stakeholders are unaware of proper septic system maintenance.
- Livestock have direct access to open water. - Stormwater runoff from barnyards. - Septic system discharge. - Horse manure on public roads. - Fertilizer used on urban lawns. - Lack of riparian buffer.	Area streams have nitrogen and phosphorus levels exceeding the target level of this project.	- Nitrogen levels exceed target levels. - Phosphorus levels exceed target levels. - Lack of riparian buffer
- Increase in impervious surfaces. - Lakes in the area becoming more built-up. - Streambank erosion. - Landowners farming PHEL and HEL.	Streams in the area appear turbid. Excessive algae.	- Historic water quality analysis showed high levels of TSS and turbidity. - Nutrient levels exceed target levels. (Nutrients attach to sediment particles and discharge to open water).
- Endangered and threatened plants and animals rely on water resources as their habitat.	There are 15 endangered and/or threatened species on the federal endangered species list.	- Nutrient levels and dissolved oxygen levels exceed target levels and state standards, respectively thus lowering the quality of the water habitat.

Now that stakeholder concerns have been linked to water quality problems and potential causes of those problems, and a thorough watershed inventory has been conducted, sources to the problems can be outlined. Outlining the sources to the problems found in the watershed will help to narrow the land area of where to focus efforts that will have the greatest impact on improving water quality.

Table 95: Problems, Potential Causes, and Potential Sources

Problem	Potential Cause(s)	Potential Source(s)
Area streams are impaired for recreational contact, as a result of *E. coli*, on Indiana's 303(d) list of impaired waters.	- *E. coli* levels exceed the state standard. - Area producers are unaware of the water quality threat of allowing livestock direct access to open water. - Stakeholders are unaware of proper septic system maintenance.	- Stakeholders have observed animal feeding operations being erected, especially in the entire project area west of LaGrange. - Five sites were noted at the headwaters of East Fly Creek where livestock have direct access to open water. - Four sites were noted where livestock have access to open water in Buck Lake-Buck Creek subwatershed, five sites were noted in Page Ditch, two sites were noted in Little Turkey Lake, and three sites were noted in Fly Creek. - LaGrange County Health Dept. stated that 75% of all septic systems in LaGrange County are faulty. - Large Amish population in the watershed (especially west of LaGrange) using horse and buggy as main source of transportation. - 14 sites were noted throughout the watershed where there were inadequate barnyard runoff control measures in place.
Area streams have nitrogen and phosphorus levels exceeding the target level of this project.	- Nitrogen levels exceed target levels. - Phosphorus levels exceed target levels.	- 32 miles were noted throughout the watershed where there was a lack of riparian buffer as producers were planting crops up to the stream's bank. - Large Amish population in the watershed (especially west of LaGrange) using horse and buggy as main source of transportation. - 25 sites throughout the watershed were noted where livestock had direct access to open water. - LaGrange County Health Dept. stated that 75% of all septic systems in LaGrange County are faulty. - Several sources of manure contamination were noted during the windshield survey as described in row one of this Table.

Problem	Potential Cause(s)	Potential Source(s)
		- There are 13 built-up lakes in the watershed where lawn fertilizer may contribute to excess nutrients reaching surface waters.
Streams in the area appear turbid. Excessive algae.	- Historic water quality analysis showed high levels of TSS and turbidity. - Nutrient levels exceed target levels. (Nutrients attach to sediment particles and discharge to open water).	- LaGrange County Health Dept. stated that 75% of all septic systems in LaGrange County are faulty. - Six locations were noted in the watershed as having extreme stream bank erosion; 1 in Little Turkey Lake, 1 in East Fly Creek, 2 in VanNatta Ditch, and 2 in Page Ditch. - Producers are farming PHEL and HEL throughout the watershed. - 32 miles were noted throughout the watershed where there was a lack of riparian buffer due to producers working land up to the stream bank. - 13 lakes are built-up and construction of new homes continue which increases impervious surfaces in the watershed.
There are 15 endangered and/or threatened species on the federal endangered species list.	- Nutrient levels and dissolved oxygen levels exceed target levels and state standards, respectively thus lowering the quality of the water habitat.	- 32 miles were noted throughout the watershed where producers planted crops within the riparian corridor. - Increase in aquatic plant growth due to the increase in nutrient levels from the sources described in row one and two on this Table.

4.1 Water Quality Conclusion

Up to this point problems have been discussed throughout the document. Below is a consolidated list for quick reference. Although there are many isolated situations causing degradation, **eight major contributors** have been identified. These sources have been expressed by the public, by the steering committee, by historical data, water testing program, and through the land use inventory. First, it is important to review the water testing results that reveal the NPS pollution problems. The list below indicates degraded water quality and outlines the **problem causes** within the region:

- Total Phosphorus exceeds the target of 0.3 mg/l average at many sites.
- Nitrates exceed the target of 1.5 mg/l average at many sites.
- Average sedimentation exceeds yearly target loading of 6229 tons.
- *E.coli* consistently exceeds the human health standard of 235 colonies per 100mls of water at many sites.

Now that we know what the problems are, what land uses are causing the degradation? Below are the major sources of pollutants that need to be addressed in order to improve water quality to target levels.

1. *Direct livestock access to surface water system.* During the land-use inventory over 20% of surface waters within the target Hydrologic Unit Codes have livestock present with direct access to streams resulting in high total phosphorus, nitrates, *E.coli*, and sedimentation levels. The sedimentation is a result of livestock induced ditch bank erosion and nutrients from animal waste.
2. *Direct barnyard runoff into surface waters.* One barnyard was identified with cemented surface tapering directly into the ditch. This is a significant source of nutrient and *E.coli* loading even after minor rainfall events.
3. *Areas in Need of Livestock Manure Management*. LaGrange County has ordinances addressing manure management for new or expanding livestock operations with 50 or more livestock. However, a great number of landowners within the target area have fewer than 50 animals and are not required to have a filed manure management plan (MMP) approved by a specialist. MMPs address nutrient loading in manure. The purpose is to plan land applications of manure to reduce soil saturation of nutrients and reduce surface water contamination.
4. *Lack of Proper Ditch-Bank Buffering.* Approximately 25% of the ditch-bank systems that contain row crops have proper filter strips to reduce sediment runoff. The remaining 75% of row crops adjacent to a ditch-bank system need a riparian buffer installed.
5. *Areas in Need of Nutrient and Sediment Management.* Conventional grain crop practices continue to dominate many agriculture fields in the watershed. Research has clearly demonstrated that no-till and reduced-till practices significantly reduce nutrient and sediment runoff from reaching surface waters.

6. *Improper or Faulty Septic Systems.* Although not specific to the Pigeon River drainage, studies conducted (LaGrange County Health Department 2005) have shown up to 75% of septic systems do not operate properly. It was found that they were either improperly installed (including improper locations), not maintained, or are completely inoperative. Due to the porous soils in the watershed, it is suspected that lateral movement of NPS pollutants from faulty septic systems into moving surface waters is a likely scenario. Several sites with evidence of septic system "straight-piping" or tile connections were reported to the LaGrange County health department.
7. *Urban Runoff.* It is speculated that lawn fertilization is the likely cause of nutrient loading induced from these urban areas. Although not tested for, other potential problematic toxins that enter surface waters through storm water runoff may be present.
8. *Impervious Surfaces.* The impervious surface area has reached 4% in the target area and continues to grow annually. This is due to the increasing population and industrialization. Impervious surfaces increase runoff flow levels after rainfall events resulting in increased NPS pollutants moving into surface waters. The unique aspect of this region is horse drawn vehicles make up a significant portion of the traffic. After moderate to significant rain events manure runoff from roads and parking lots is suspect in contributing nutrient/*E.coli* loading in surrounding surface waters.

5.0 Critical Areas

The previous sections have described the framework to define critical areas more precisely. The watershed problems and sources section lists water quality problems that are ranked according to priority for implementation. The first five, direct livestock access, direct barnyard runoff, areas in need of livestock manure management, lack of proper ditch-bank buffering, and areas in need of nutrient management constitute the critical area definition for initial implementation dollars. Agricultural landowners with these NPS pollution issues are scattered across the entire watershed. The initial land use inventory identified these locations; however, land use is a fluid environment which will result in additional locations being identified for BMP implementation on a periodic basis. Due to changing land use conditions, Figure 66 is not all inclusive for BMP implementation. Water quality testing and the land use inventory clearly demonstrated that the most dramatic effect on reducing NPS pollution is to address the above issues immediately upon plan implementation. BMP installation is an equally fluid environment with many target locations requiring multiple and in some cases innovative BMPs. Development of the cost-share criteria for the implementation phase will undoubtedly require updates with additional BMPs on a periodic basis.

5.1 Critical Area Conclusion

Water quality testing and the land use inventory clearly demonstrated the most dramatic effect on reducing NPS pollution is to address critical area issues immediately upon plan

implementation. BMP priority is listed below; however this is not an all-inclusive list of BMPs but are general categories addressing specific problems. For example, waste management on barnyards may involve many additional BMPs such as roof guttering, alternative watering facilities, water diversions, grassed waterways, and dry stack facilities for manure storage. Only after landowner inputs and engineering designs have been completed will the full extent of a BMP implementation list be realized.

1. Fence livestock from surface waters. This will have an immediate impact in reducing nutrient, sedimentation, and *E.coli* loading. Alternative watering source installation may be required.
2. Repair ditch bank damage. After livestock have been fenced from surface waters, stabilizing bank damage will reduce sedimentation after heavy rainfall events.
3. Install filter/buffer strips. In many cases this BMP will be included with fencing/bank repair. After fencing/bank repair issues have been addressed, ditch bank buffering in association with traditional row crop practices should follow. Conservation tillage will be encouraged in conjunction with buffering.
4. Install waste management systems on barnyards adjacent to surface waters. This is an important BMP but will require time to implement. Special engineering designs are required.

Using the EPA Region 5 load model a significant reduction in nitrates, total phosphorus and sediment can be achieved by implementing all BMPs associated with the problems discussed in the previous paragraph. According to calculations a 55% reduction in sedimentation and nitrates will occur. This equates to 7613.359 tons/year reduction in sediments, and 1637.34 tons/year in nitrates for the region. The model indicated a 71% reduction in phosphorus can be achieved which equates to a reduction of 321.331 tons/year in phosphorus loading. *E.* coli reductions are based on the EPA approved Pigeon Creek-Pigeon River TMDL. Tables 96 below correlates BMPs with critical area definitions and associated estimate for load reductions. Table 97 below helps visualize the **current loading, target load, and yearly reduction** of each contaminant with the exception of *E.coli*. The *E.coli* reduction target of 235 cfu/100ml will be achieved in conjunction with nutrient and sedimentation reduction targets.

Table 96: BMPs Correlated to Critical Areas and Load Reduction Estimates

Critical Area	Reason for Being Critical	BMP or Management Measure	Estimated Load Reduction per BMP/Acre		
			Sediment	**Phosphorus**	**Nitrogen**
Livestock Access to Open Water/Small Scale Feeding Operations	Nitrogen, Total Phosphorus, Sedimentation, *E.coli*	Education Program Geared Toward Livestock Operators	N/A	N/A	N/A
		Limited Access Stream Crossing/Exclusion Fencing*	16 tons/yr	15 lbs/yr	29 lbs/yr
		Rotational Grazing	***	***	***
		Dry Stack Areas**	27 tons/yr	15 lbs/yr	40 lbs/yr
		Conservation Tillage**	32 tons/yr	22 lbs/yr	58 lbs/yr
		Comprehensive Nutrient Management Plans	N/A	N/A	N/A
Rapair Ditch Bank Damage	Nitrogen, Total Phosphorus, Sedimentation, *E.coli*	Ditch Bank Stabilization	***	***	***
		Education Program Geared Toward Livestock Operators	N/A	N/A	N/A
Filter/Buffer Strips (Riparian Buffers)	Nitrogen, Total Phosphorus, Sedimentation, *E.coli*	Riparian Buffers of at least 20' 40' on a 2-4% slope 60' on >4% slope**	27 tons/yr	23 lbs/yr	60 lbs/yr
		Education Program on Benefits of Riparian Buffers	N/A	N/A	N/A
Install Waste Management Systems on Barnyards	Nitrogen, Total Phosphorus, Sedimentation, *E. coli*	Stormwater Diversions	***	***	***
		Barnyard Tiling	***	***	***
		Structure Gutters	***	***	***
		Dry Stack Areas**	27 tons/yr	15 lbs/yr	40 lbs/yr
		Alternative Watering Systems	N/A	N/A	N/A

*Estimated from the Region 5 model assuming 1 acre of land input (unless otherwise noted)

**Estimated from the STEPL model

***Too many variables, or too new of a technology, to accurately estimate load reductions

Table 97: Current and reduced loading in tons per year after BMP Implementation

HUC 12	Nitrates			Phosphorus			Sediment			*E. coli (TMDL Data)*		
Watersheds	Current Load	Target Load	Yearly Reduction Needed	Current Load	Target Load	Yearly Reduction Needed	Current Load	Target Load	Yearly Reduction Needed	Current Load	Target Load	% Reduction Needed
Green Lake	345.691	155.561	190.13	34.569	10.025	24.544	1382.766	622.245	760.521	183	125	32
Mongo Millpond	240.645	108.29	132.355	32.558	9.442	23.116	1132.449	509.602	622.847	188	125	34
Little Turkey Lake	26.678	12.005	14.673	4.091	1.187	2.904	177.856	80.035	97.821	2165	125	94
Cline Lake	579.388	260.725	318.663	54.72	15.869	38.851	2253.175	1013.93	1239.247	910	125	86
East Fly Creek	40.374	18.168	22.206	5.422	1.573	3.849	115.355	51.91	63.445	621	125	80
Fly Creek	148.82	66.969	81.851	9.354	2.712	6.642	425.199	191.339	233.86	1593	125	92
VanNatta Ditch	619.534	278.79	340.744	72.886	21.137	51.749	2915.454	1311.95	1603.5	1156	125	89
Buck Lake	82.766	37.245	45.521	10.76	3.121	7.639	441.4205	198.64	242.781	1354	125	91
Page Ditch	53.488	24.07	29.418	7.764	2.251	5.513	276.065	124.229	151.836	4988	125	97
Pigeon River	839.597	377.819	461.778	89.207	25.87	63.337	4722.73	2125.23	2597.502	617	125	80
Total	2976.98	1339.64	1637.34	321.331	93.186	228.145	13,842.47	6229.11	7613.359	13775		77.5

Watershed Management Plan Implementation Costs

The cost estimate for implementation is as follows:

Filter Strips (200 acres)	$ 145,000
Fencing (40,000 feet)	$ 120,000
Alternative Watering (8)	$ 48,000
Bank Stabilization (12)	$ 50,000
Waste Management Systems (9)	$ 90,000
Barnyard Remediation (13)	$ 130,000
Conservation Tillage	$ 100,000
Monitoring (Supplies/Equipment)	$ 45,000
Contracted Personnel	$ 200,000
TOTAL	**$ 928,000**

There are many sources of funding available to accomplish implementation. Currently, an EPA 319 Grant through the Indiana Department of Environmental Management is available to begin implementation of this watershed management plan. The recent Farm Bill will be employed in the region to compliment the current grant. Technical assistance will be provided by county SWCDs, NRCS and contracted personnel.

6.0 Goals and Objectives

The Pigeon River Watershed Management Plan seeks to improve water quality in the river by addressing non-point source pollution in the region. To accomplish the goals and objectives mentioned below, a broad stakeholder group must be established and maintained throughout the implementation phase. Partnering with private and government institutions is vital and entails crossing county jurisdictions. This of course is a complicated task that requires astute leaders within the oversight group.

The following goals and objectives address the primary concerns of: nutrients, sediment, pathogens and toxins. These are universal concerns throughout the river drainage. Objectives are prioritized as high (implemented in zero to three years), moderate (implemented in four to seven years), and low (implemented in seven to eleven years). It is important to note that many tasks, once begun, must be maintained to prevent a "backslide" in improvements made to water quality. An easy to read, action register, Tables 97 - 101, describing goals and objectives follows this section of the Plan.

Goal #1

Establish a stakeholder group to oversee watershed management plan implementation, promote public awareness, and sustain funding to meet goals and objectives within timelines.

A Expand current steering committee to include additional key stakeholders as identified by the current committee within the watershed to enhance implementation success.

Priority
High

Implementation Timeframe
Within the first six months

Partners
Stakeholder group

Milestones
Continued semiannual meetings

Indicators of Success
Consensus reached on responsibilities of stakeholder group for coordinating implementation of the watershed management plan.

B Develop funding strategy to sustain implementation and administration operations costs.

Priority
High

Implementation Timeframe
Ongoing

Partners
Stakeholder group

Milestones
- Identify funding sources (6 months)
- Design funding strategy (6 months)
- Implement funding strategy (6 months)
- Secure operational funding (Year 2/Ongoing)

Indicators of Success
- Documented funding sources
- Grant proposals submitted
- Private funding solicited
- Records of funding received and solicited

Goal #2

Reduce agriculture induced non-point source pollution from the region to reduce sediment and nitrates by 55%, *E. coli* by 78% and phosphorus by 71% by year 2018.

A Install 40,000 feet of fence to keep livestock out of surface waters and provide alternative watering sources for owners identified in the watershed.

Priority
High

Implementation Timeframe
1-3 years

Partners
County SWCDs
NRCS
Friends of the St. Joe River Association
Indiana Department of Environmental Management
Indiana Department of Agriculture
Indiana Division of Fish and Wildlife
Producers

Milestones
- 25% reduction of nitrates after 3 years
- 55% nitrates load reduction after 5 years
- 30% reduction of total phosphorus after 3 years
- 71% reduction of total phosphorus after 5 years
- 10% reduction of total suspended solids after 3 years
- 15% reduction of total suspended solids after 5 years
- 25% reduction of *E.coli* after 3 years
- 78% reduction of *E.coli* after 5 years

Indicators of Success
- Provide cost-share incentives to landowners (Year 1-3)

- Feet of fence installed
- Develop a comprehensive outreach program for continued education (Ongoing)

B Repair 12 sites that have livestock induced ditch bank damage with bank stabilization BMPs.

Priority
High

Implementation Timeframe
1-3 years

Partners
County SWCDs
NRCS
Friends of the St. Joe River Association
Indiana Department of Environmental Management
Indiana Department of Agriculture
Indiana Division of Fish and Wildlife
Producers

Milestones
- 5% reduction in total suspended solids by year 3
- 10% reduction of total suspended solids by year 4
- 15% reduction of total suspended solids by year 5

Indicators of Success
- Number of sites installed

C Install 9 waste management systems (barnyards with direct runoff).

Priority
High

Implementation Timeframe
1-3 years

Partners
LaGrange County SWCD
Elkhart County SWCD
NRCS
Friends of the St. Joe River Association
Indiana Department of Environmental Management

Indiana Department of Agriculture
Indiana Division of Fish and Wildlife
Producers

Milestones
- 2 waste management systems installed by year 2
- 3 waste management systems installed by year 3

Indicators of Success
- Number of waste management systems installed
- Number of NRCS approved designs

D Plant 200 acres filter/buffer strips where required adjacent to surface waters.

Priority
High

Implementation Timeframe
1-3 years

Partners
County SWCDs
NRCS
Friends of the St. Joe River Association
Indiana Department of Environmental Management
Indiana Department of Agriculture
Indiana Division of Fish and Wildlife
Producers

Milestones
- 15% reduction of total suspended solids after 3 years
- 25% reduction of total suspended solids after 5 years

Indicators of Success
- Cost-share incentives provided
- Acres of filter strips installed
- Ongoing outreach program for continued education

E Promote no-till and reduced-till practices on all fields adjacent to surface waters.

Priority
High

Implementation Timeframe
Ongoing

Partners
County SWCDs
NRCS
Friends of the St. Joe River Association
Indiana Department of Agriculture
Producers

Milestones
- 100% landowner contact that practice conventional tillage (Year 2)
- Develop a comprehensive outreach program for continued education (Year 2)

Indicators of Success
- Number of producers that enroll in incentive programs
- Increase in no-till/reduced-till acreage documented with tillage transects

F Continue the water quality testing program to monitor goal success.

Priority
High

Implementation Timeframe
Ongoing

Partners
County SWCDs
Hoosier River Watch

Milestones
- Solicit funding sources to continue testing program (Year 1)
- Develop public involvement program (Year 1)
- Publish testing results (Yearly)

Indicators of Success
- Funding secured to continue monitoring program
- Public participation in testing program
- Media releases and brochure

Combined BMP Installation Milestones
- A 25% reduction in nitrates and sedimentation after 3 years
- A 30% reduction in total phosphorus after 3 years
- A 25% reduction in *E.coli* after 3 years
- A 55% reduction in nitrates and sedimentation after 5 years
- A 71% reduction in total phosphorus after 5 years
- A 78% reduction in *E.coli* after 5 years

Goal #3

Reduce non-point source pollution from faulty or improper septic systems to reduce sediment and nitrates by 55%, *E. coli* by 78%, and phosphorus by 71% by year 2018.

A Work with county leadership to develop a comprehensive septic system ordinance.

Priority
Moderate

Implementation Timeline
4 years

Partners
County SWCDs
County Commissioners
County Health Departments
County Planning Commissions
County Health Boards
County Sewer Districts

Milestones
- Meetings with county commissioners and appropriate county boards (Year 4-7)
- Develop outreach program (Year 4)
- Develop Comprehensive plan (Year 6)

Indicators of Success
- Semi-annual meetings with county officials
- Educational brochure development
- Change to county comprehensive plan

B Develop a county-wide septic system inspection program

Priority
Low

Implementation Timeline
8 years

Partners
County SWCDs
County Health Departments

Milestones
- Consensus from county leadership that inspection program is needed (Year 8)
- Consolidate information on existing inspection programs (Year 8)
- Educate septic system owners (Year 9)
- Faulty septic systems repaired or replaced (Year 10)

Indicators of Success
- Inspection program developed
- Number of septic system owners contacted about inspection
- Number of faulty septic systems repaired or replaced
- Improved water quality

Goal #4

Reduce urban run-off induced non-point source pollution from the region to reduce sediment, and nitrates by 55%, *E. coli* by 78%, and phosphorus by 71% by year 2018.

A Develop a comprehensive outreach program to educate urban/lake residents on NPS pollution concerns and how they can participate to improve surface waters surrounding their communities.

Priority
High

Implementation Timeline
2 years

Partners
LaGrange County SWCD
Elkhart County SWCD
Town Leadership
Friends of the St. Joe River Association

LaGrange County Lakes Council

Milestones
- Yearly media articles outlining urban runoff and its effects
- Yearly brochures and flyers for urban residents
- Yearly workshops/tours for urban/lake residents
- Bi-annual urban resident survey developed

Indicators of Success
- Annual media articles
- Number of brochures and flyers circulated
- Attendance at workshops/tours by town and lake residents
- Survey results

Goal #5

Monitor and control impervious surfaces development in the region so that water quality is maintained.

A Develop a program to monitor impervious surface development within the watershed.

Priority
Moderate

Implementation Timeline
4 years

Partners
County SWCDs
NRCS
County Planning Commissions
Purdue University

Milestones
- Geo Database of impervious surfaces for GIS systems (Year 4)

Indicators of Success
- Monitoring program

B Work with county planning commission to minimize effects of new construction on surface waters within the watershed and protect sensitive areas.

Priority
Moderate
Implementation Timeline
4 years

Partners
County SWCDs
County Planning Commissions
Purdue University

Milestones
- Runoff effects on surface waters considered for new building permits within 2 years

Indicators of Success
- Change to county comprehensive plan ordinance

Table 98: Action Register for Goal 1

Goal #1: Establish a stakeholder group to oversee watershed management plan implementation, promote public awareness, and sustain funding to meet goals and objectives within timelines					
Indicator #1: Consensus reached on responsibilities of stakeholder group for coordinating implementation of the watershed management plan Indicator #2: Documented funding sources solicited Indicator #3: Grant proposal submitted Indicator #4: Private funding solicited Indicator #5: Records of funding solicited and received					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Cost Estimate**	**Partners/Technical Assistance**
Expand current steering committee to include additional key stakeholders to enhance implementation success	Pigeon River Watershed Stakeholders	Within the first six months after WMP approval	Hold steering committee meeting within first quarter	$15,000	Stakeholder Group
Develop funding strategy to sustain implementation and administration operation costs	Pigeon River Watershed Stakeholders	Ongoing	Identify funding sources (6 months)		Stakeholder Group
			Design funding strategy (6 months)		
			Implement funding strategy (2 years)		
			Secure operational funding (2 years)		

Table 99: Action Register for Goal 2

Goal #2: Reduce agriculture induced nonpoint source pollution from the region to reduce sediment and nitrates by 55%, *E.coli* by 78% and phosphorus by 71% by year 2018.					
Indicator #1: Provide cost-share incentives to landowners Indicator #2: Feet of fence installed Indicator #3: A comprehensive outreach program for continued education is developed Indicator #4: Number of ditch bank sites repaired and waste management systems installed Indicator #5: Acres of filter strips installed Indicator #6: Outreach program for continued education Indicator #7: Number of producers that enroll in incentive programs					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Cost Estimate**	**Partners**
Install 40,000 feet of fence to keep livestock out of surface waters and provide alternative watering sources where identified in the watershed	Livestock owners and/or operators with in the watershed	1 - 3 years for those identified during the landuse inventory; ongoing for any additional areas of concern found in the watershed	25% N reduction (3 yrs) 30% P reduction (3 yrs) 10% TSS reduction (3 yrs) 25% *E. coli* reduction (3 yrs) 55% N reduction (5 yrs) 71% P reduction (5 yrs) 15% TSS reduction (5 yrs) 78% *E. coli* reduction (5 yrs)	$184,000	County SWCDs NRCS Friends of the St. Joe River Assoc. IDEM ISDA IN DNR Producers
Repair 12 sites that have livestock induced ditch damage	Livestock owners and/or operators with in the watershed	1 - 3 years for those identified during the landuse inventory; ongoing for any additional areas of concern found in the watershed	5% TSS reduction (3 yrs) 10% TSS reduction (4 yrs) 15% TSS reduction (5 yrs)	$65,000	County SWCDs NRCS Friends of the St. Joe River Assoc. IDEM ISDA IN DNR Producers

Objective	Target Audience	Implementation Timeframe	Milestone	Cost Estimate	Partners
Install 9 waste management systems and remediate 13 barnyards with direct runoff	Livestock owners and/or operators with in the watershed	1 - 3 years for those identified during the landuse inventory; ongoing for any additional areas of concern found in the watershed	2 waste management systems installed (2 yrs) 3 waste management systems installed (3 yrs)	$235,000	County SWCDs NRCS Friends of the St. Joe River Assoc. IDEM ISDA IN DNR Producers
Plant 200 acres of filter/buffer strips where required adjacent to surface waters	Landowners adjacent to open water with in the watershed	1 - 3 years for those identified during the landuse inventory; ongoing for any additional areas of concern found in the watershed	15% TSS reduction (3 yrs) 25% TSS reductions (5 yrs)	$160,000	County SWCDs NRCS Friends of the St. Joe River Assoc. IDEM ISDA IN DNR Producers
Promote no-till and reduced-till practices on all fields adjacent to surface waters	Landowners adjacent to open water with in the watershed	1 - 3 years	100% landowner contact who practice conventional tillage (2 yrs) Develop a comprehensive outreach program for continued education (2 yrs)	$115,000	County SWCDs NRCS Friends of the St. Joe River Assoc. ISDA Producers

Objective	Target Audience	Implementation Timeframe	Milestone	Cost Estimate	Partners
Continue the water quality testing program to monitor goal success	County SWCDs and the funding partners	ongoing	solicit funding sources to continue monitoring program (1 yr) Develop public involvement program (1 yr) Publish monitoring results annually (ongoing) <u>Total Reductions after 3 yrs</u> 25% N reduction 25% TSS reduction 30% TP reduction 25% *E. coli* reduction <u>Total Reductions after 5 yrs</u> 55% N reduction 55% TSS reduction 71% TP reduction 78% E. coli reduction	$60,000	County SWCDs Hoosier Riverwatch

Table 100: Action Register for Goal 3

Goal #3: Reduce nonpoint source pollution from faulty or improperly installed septic systems to reduce sediment and nitrates by 55%, *E.coli* by 78% and phosphorus by 71% by year 2018					
Indicator #1: Semi-annual meetings with county officials Indicator #2: Educational brochure developed Indicator #3: There is a change to the county comprehensive plan to address septic issues including development of a new inspection program Indicator #4: Number of septic system owners contacted Indicator #5: Number of faulty septic systems repaired or replaced					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Cost Estimate**	**Partners**
Work with county leaders to develop a comprehensive septic system ordinance	County Leaders	4 - 7 years	Meet with county commissioners and appropriate county boards (4 - 7 yrs) Develop outreach septic system outreach program (year 4) Develop a septic system comprehensive plan (year 6)	$16,000	County SWCDs County Commissioners County Health Departments County Planning Commissions County Boards of Health County Sewer District

Develop a county-wide septic system inspection program	Watershed stakeholders who utilize an on-site waste management system	8 - 10 years	Consensus from county leaders that an inspection program is needed (year 8) Consolidate information on existing inspection programs (year 8) Educate septic system owners (year 9) Faulty septic systems repaired or replaced (year 10)	$15,000	County SWCDs County Health Departments

Table 101: Action Register for Goal 4

Goal #4: Reduce urban run-off induced nonpoint source pollution from the region to reduce sediment and nitrates by 55%, *E.coli* by 78% and phosphorus by 71% by year 2018					
Indicator #1: Annual media articles written and disseminated Indicator #2: Number of urban NPS brochures and flyers circulated Indicator #3: Attendance at workshops/tours by town and lake residents Indicator #4: Survey results indicating a behavioral change and/or more knowledge regarding urban NPS					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Cost Estimate**	**Partners**
Develop a comprehensive outreach program to educate urban/lake residents on NPS pollution concerns and how they can participate to improve surface waters surrounding their communities	Urban and lake residents	2 years	Yearly media articles outlining urban runoff and its effects	$15,000	County SWCDs Town Leaders Friends of the St. Joe River Association LaGrange County Lakes Council
			Yearly urban NPS brochures and flyers for urban residents		
			Yearly workshops/tours for urban and lake residents		
			Bi-annual urban resident survey developed		

Table 102: Action Register for Goal 5

Goal #5: Monitor and control impervious surface development in the region so that water quality is maintained					
Indicator #1: Development and implementation of a program to monitor impervious surface development within the watershed Indicator #2: A change to the County Comprehensive Plan to implement Low Impact Design					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Cost Estimate**	**Partners**
Develop a program to monitor impervious surface development within the watershed	County Planning Commissions	4 years	Shapefile of impervious surfaces for GIS systems	$15,000	County SWCDs NRCS County Planning Commissions Purdue University
Work with county planning commission to minimize effects of new construction on surface waters within the watershed and protect sensitive areas	County Planning Commissions Builders/Construction Companies with in the watershed	4 years	Runoff effects on surface waters considered for new building permits (2 yrs)	$15,000	County SWCDs County Planning Commissions Purdue University

7.0 Monitoring Plan

Continued monitoring for land use changes and water quality is essential for success. County SWCDs should be the lead organization to provide continuity of the data collected. A minimum of 7 years continuous monitoring is critical. This is necessary for several reasons. First, validate the effectiveness of BMP implementation. Second, document if target loadings are achieved and maintained. Samples from historical sites established during the development of this management plan should be taken on a quarterly basis to ensure dry and wet periods are represented.

Monitoring land use changes is equally essential. Since this area has a rapidly growing population, land use changes will occur on a rapid scale. These changes can and will likely affect the water quality of the Pigeon River drainage if not properly monitored and managed. Many Counties in the drainage have or are in the process of developing a comprehensive GIS system to help monitor and manage important influences such as new construction. Using these GIS layers coupled with visual data collection will provide useful information.

The steering committee, meeting on a semi-annual basis, will develop and oversee the landuse and water monitoring plan. The committee will determine if water quality and land use changes warrant modifications to the existing watershed management plan. The criteria used will be consistent water sampling data, coupled with land use changes, indicating water quality degradation. Land use changes can stand alone as an indicator to modify the plan, if those changes clearly indicate a future degradation in water quality. The committee provides the leadership and community link to help insure future success.

The Lagrange County SWCD, primarily responsible for the watershed management plan development, will take the lead as point of contact concerning this plan and for coordinating modifications to the plan. The LaGrange County SWCD contact information is: LaGrange County SWCD (Soil and Water Conservation District), 910 S. Detroit Street, LaGrange IN. 46761, phone: 260-463-3471 ext.3.

References

Andrew Degraves for Friends of the St. Joe River Association. St. Joseph River Watershed Management Plan. 2005

Ball State University. Shipshewana Master Plan. 1993

Center for Shared Solutions and Technology Partnerships. 2011. Michigan Department of Technology, Management, and Budget. 2011 < http://www.mcgi.state.mi.us>.

City-Data.com. 2011. < http://www.city-data.com>.

Consumer Confidence Reports. 2011. U.S. Environmental Protection Agency. 2011 < http://cfpub.epa.gov/safewater/ccr/index.cfm?action=ccrsearch>.

Department of Environmental Quality. 2011. Michigan Government. 2011 < http://www.michigan.gov/deq>.

Earth Source Inc. Big Long Lake, Lake of the Woods, McClish Lake, and Pretty Lake; A Study for Their Improvement, Restoration, and Protection. 1991

Environmental Dataset Gateway. 2011. US Environmental Protection Agency. 2011 < https://edg.epa.gov/metadata/catalog/main>.

EPA Geospatial Data Download Service. U.S. Environmental Protection Agency. 2011 < http://www.epa.gov/enviro/geo_data.html>.

Harza Engineering Company. Big Turkey and Little Turkey Lake Enhancement Feasibility Study. 1990

Indiana Department of Environmental Management. 2011. Indiana Government. 2011 < http://www.in.gov/idem/>.

Indiana Department of Environmental Management. 2012. Pigeon River Watershed TMDL. < http://www.in.gov/idem/>.

Indiana Department of Natural Resources. 2011. Indiana Government. 2011 < http://www.in.gov/dnr/>.

Indiana Geological Survey. 2011. Indiana University. 2011 <www. http://igs.indiana.edu/>.

IndianaMap. 2011. Indiana Geographic Information Council. 2011 <IndianaMap.org>.

JF New Associates, Inc. Pretty Lake Diagnostic Study. 2007.

JF New Associates, Inc. Pretty Lake Engineering Feasibility Study. 2009

JF New Associates, Inc. Monitoring Study for the Turkey Creek Land Treatment Project. 2001.

L-THIA. 2011. Purdue University. 2011< https://engineering.purdue.edu/mapserve/LTHIA7/index.html>.

LaGrange County Economic Development Corporation. 2010. < http://www.lagrangecountyedc.com>.

LaGrange County Parks Department. LaGrange County Parks Department Master Plan. 2008

Land Resource Center. 2011. St. Joseph County Michigan. 2011 < http://www.stjosephcountymi.org/lrc/maps.htm>.

McBride Dale Clarion. LaGrange County Comprehensive Plan. 2005

National Climatic Data Center. 2011. National Oceanic and Atmospheric Agency. 2011 < http://www.ncdc.noaa.gov/oa/ncdc.html>.

National Map Viewer. 2011. United States Geological Survey. 2011 < http://viewer.nationalmap.gov/viewer/>.

National Water Information System-Web Interface. 2011. United State Geological Survey. 2011 < http://waterdata.usgs.gov/nwis>.

National Wetlands Inventory. 2011. U.S. Fish and Wildlife Service. 2011 < http://www.fws.gov/wetlands/>.

Saint Joseph County Michigan Planning Commission. St. Joseph County Master Plan. 1998; updated 2007.

Soil Data Mart. 2011. United States Department of Agriculture, Natural Resource Conservation Service. 2011 < http://soildatamart.nrcs.usda.gov/>.

The Water Science School. 2011. United States Geological Survey. 2011 < http://ga.water.usgs.gov/edu/wateruse.html>.

V3 for Steuben County Soil and Water Conservation District. Pigeon Creek Watershed Management Plan. 2006.

Watershed Assessment, Tracking, and Environmental Results. 2011. US Environmental Protection Agency. 2011 < http://www.epa.gov/waters/>.