# VFC Index - Watershed (Plan)

**Program:** Watershed

**IDEM Document Type:** Plan

**Document Date:** 10/29/2015

**Security Group:** Public

**Project Name:** Lower Salamonie River WMP

**Plan Type:** Watershed Management Plan

**HUC Code:** 05120102 Salamonie

**Sponsor:** Huntington County SWCD

**Contract #:** 3-9

**County:** Huntington

**Cross Reference ID:** 67880486

**Comments:** Wabash, Grant, Blackford, Wells

## Additional WMP Information

**Checklist:** 2009 Checklist

**Grant type:** 319

**Fiscal Year:** 2012

**IDEM Approval Date:** 10/29/2015

**EPA Approval Date:** 10/29/2015

**Project Manager:** Jessica Faust

# *Lower Salamonie River Watershed Management Plan*

*Completed and Edited by*
*Kroeker Consulting LLC*
*for the*
*Huntington County Soil and Water Conservation District*
EDS#A305-3-9

This Watershed Management Plan and Implementation Project has been funded in part through the Indiana Department of Environmental Management 319 Nonpoint Source Management Program under agreement C9975482-12 to the Huntington County Soil and Water Conservation District for Lower Salamonie River Watershed Management Plan. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Recommended Citation:

Huntington County Soil and Water Conservation District. 2014. *Lower Salamonie River Watershed Management Plan.* Prepared by Kroeker Consulting LLC for the 319 Nonpoint Source Management Program (Indiana Department of Environmental Management).

Special Thanks:

Special thanks to the Lower Salamonie River Watershed Steering Committee; Huntington, Wabash, Wells, Blackford, and Grant County SWCDs; the Indiana Department of Environmental Management; the Indiana Department of Natural Resources; the US Army Corps of Engineers; the Indiana State Department of Agriculture; Taylor University; Krista Rose (initial Watershed Coordinator); and the many other stakeholders involved in this planning effort. For your insight, technical skills and service we are grateful.

**Table of Contents**

**Table of Figures**

**Table of Tables**

## 1.0 Watershed Community Initiative

A watershed is an area of land that drains to a common point. The United States is divided into successively smaller watersheds or hydrologic units. Each of these hydrologic units is given a Hydrologic Unit Code or HUC as a way of classifying that particular watershed. HUCs are arranged or nested within each other, from the largest geographic areas to the smallest, and range from 2 to 12 digits. The more digits, the smaller the watershed. The Lower Salamonie River watershed consists of two 10-digit HUCs (0512010203 and 0512010204).

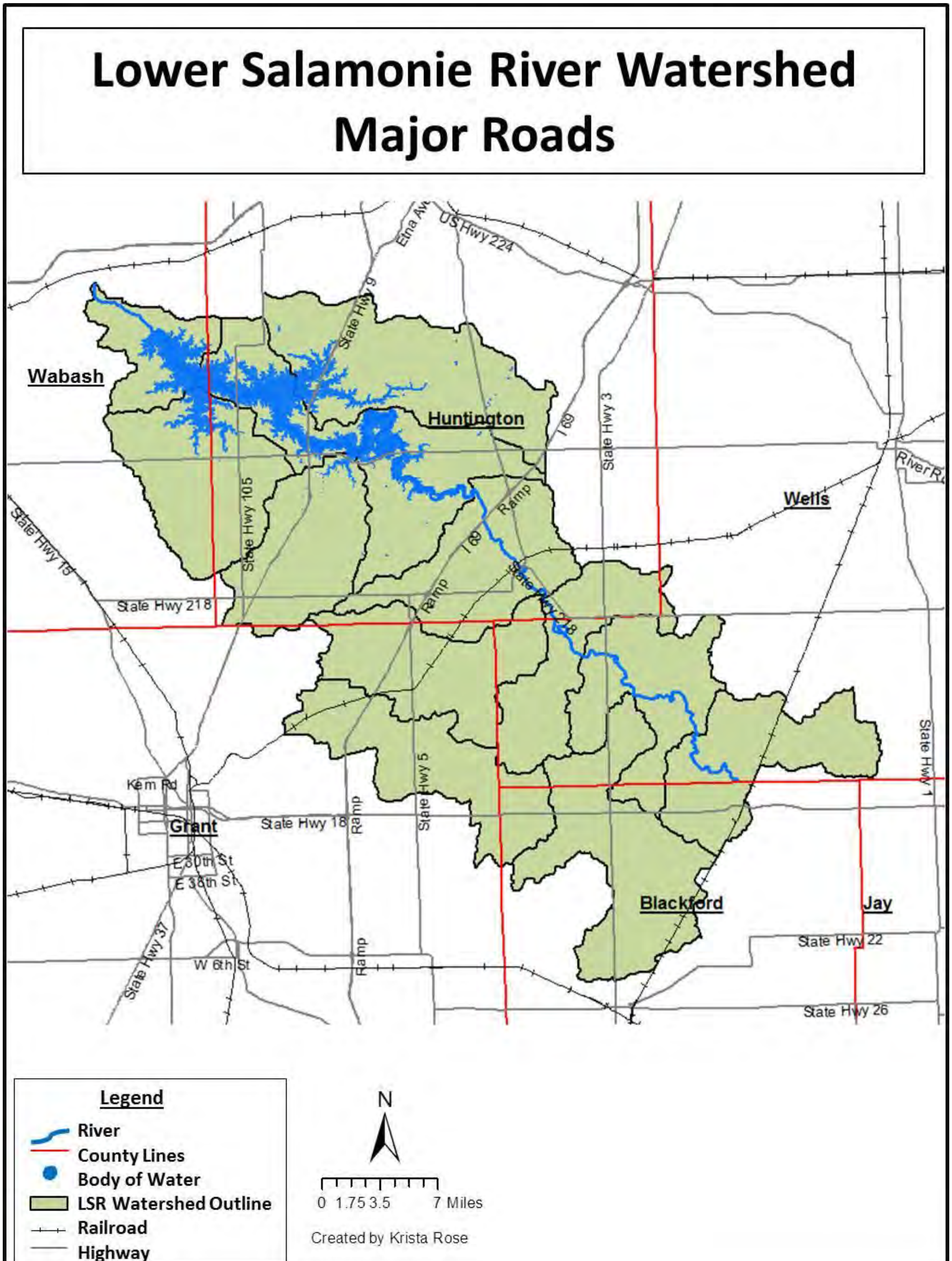
In general, all precipitation that falls on a watershed will either be absorbed into the soil and move into the ground water system, or flow vertically across the landscape, where it will collect in low spots or enter a river or stream. As water flows across the land surface it may pick up contaminants and transport these into local waterbodies. Therefore, any activity on the land has the potential to contribute to water quality problems.

A healthy river contributes to a healthy community and local economy, and the first step toward a healthy river is maintaining its watershed. Watershed planning is important to help prevent future water resource problems, preserve watershed functions, and results in long-term economic, environmental and public health benefits. Every person who lives in the watershed affects watershed health, even if they are not aware of their impact. This watershed management plan (WMP) is intended to benefit the local communities by improving the environment through comprehensive water resource planning, and by helping stakeholders understand the links between their actions and watershed health.

The Salamonie River Watershed is an eight-digit HUC (05120102) that covers just over 352,900 acres. It encompasses portions of six different Indiana counties and is divided into 23 sub-basins. The Salamonie River originates near the Indiana-Ohio border in Jay County, Indiana, and flows to the northwest for approximately 60 miles before discharging into the Wabash River upstream of Lagro, Indiana. The focus area for this WMP is the Lower Salamonie River (LSR) watershed which covers approximately half of the entire Salamonie watershed, including the Salamonie Reservoir. The LSR watershed consists of approximately 196,494 acres in Huntington, Wabash, Grant, Wells, and Blackford counties (Figure 1). The LSR watershed area extends from Montpelier in Blackford County to where it discharges into the Wabash River upstream of Lagro, Indiana. Twelve HUC 12 sub-watersheds fall within the LSR watershed.

The motivation behind preparing a watershed management plan for the LSR stems from known water quality problems within the Salamonie Reservoir. Sampling conducted by the Army Corps of Engineers (USACE) has indicated that excess nutrients are entering the reservoir via the Salamonie River and its tributaries. Sampling since 2009 has shown particularly high levels of phosphorous, nitrogen, sulfates, total organic carbon, and total suspended solids. These elements increase the turbidity and fertility of the waters flowing into the Salamonie Reservoir, where blue-green algae blooms occur 2 to 3 times per year. The following local agencies worked with the USACE on the project: Soil and Water Conservation Districts (SWCD) of Huntington, Wells, Blackford, Wabash, Jay, and Grant Counties, Huntington County Commissioners, County Health Departments, Indiana Department of Natural Resources (IDNR), Taylor University's Department of Earth and Science, Purdue Extension, Indiana Department of Environmental Management (IDEM), The Nature Conservancy, and Natural Resource Conservation Service (NRCS).

**Figure 1 Lower Salamonie River Watershed County Map**



### 1.1 Project History

The watershed study was initiated by the Huntington and Wells County SWCDs after sampling done by the USACE and its partners indicated that water quality issues within the Salamonie Reservoir were originating from the Salamonie River. Meetings concerning issues in the Salamonie River and reservoir began in 2010 and were held to generate stakeholder involvement. The project area covers the lower section of the Salamonie River and includes areas in Blackford, Grant, Wells, Huntington and Wabash counties. Along with excess nutrient run-off, additional concerns expressed included failing septic systems, endangered species protection, stream bank erosion, and the need for more agricultural best management practices (BMPs) such as no-till and cover crops. Upon receiving a Section 319 Non-point Source Program grant from IDEM in 2013, the Huntington County SWCD board hired a watershed specialist to develop a WMP and promote implementation of conservation practices. The grant's purpose was fourfold:

1. Produce a Watershed Management Plan for the Lower Salamonie River (HUCs 0512010203 and 0512010204).

2. Develop, promote, and implement a cost-share program for best management practices (BMPs) that address the water quality concerns identified in the watershed management plan.

3. Conduct a water quality monitoring program to identify chemical, biological, and physical conditions, define areas of concern, and monitor changes over time.

4. Conduct an education and outreach program designed to bring about behavioral changes that will lead to reduced nonpoint source pollution in the watershed.

### 1.2 Steering Committee

To begin work on the WMP, specific stakeholders were initially invited to join the steering committee and encouraged to become involved in the planning process. Once the process was underway, a general call for steering committee members was made to the public. A total of 19 people, from water resource professionals to landowners, participated in the first public/steering committee meeting held on February 25, 2013. Additional stakeholders were invited to become involved through education and outreach efforts.

Partnerships between water resource professionals and educators are essential to a successful WMP development. Therefore, personnel from the SWCDs, Purdue Cooperative Extension Service, Taylor University, Indiana State Department of Agriculture (ISDA), Upper Wabash River Basin Commission (UWRBC), IDEM, NRCS, and IDNR were invited to participate in the Steering Committee. Table 1 lists the steering committee members and their affiliation.

**Table 1 Steering Committee Members**

| Lower Salamonie Watershed Steering Committee | | | |
|---|---|---|---|
| Member | Affiliation | Member | Affiliation |
| Karen Kitterman | Blackford County SWCD | Susi Stephan | Wabash County SWCD |
| Joe Landrum | Huntington County SWCD/farmer | Nan Hammel | ISDA- Wabash |
| Ned Ruble | Huntington County SWCD/farmer | Joe Updike | NRCS- Wabash |
| Kyle Lund | Huntington County SWCD/farmer | Lynne Huffman | Wells County SWCD |
| Cassandra Vondran | NRCS- Huntington | Dave Lefforge | ISDA-Wells |
| Katie Frye | NRCS- Huntington | Mike Guebert | Taylor University Professor |
| Ed Farris | Huntington County Purdue Extension | Ben Blocker | Taylor University Student |
| Justin Harrington | DNR- Huntington | Mary Chapman | Taylor University Student |
| Craig Gutshell | Landowner-Huntington County | Jade Young | USACE-Louisville, KY |
| Charlie Enyeart | Wabash County SWCD | John Scheiber | USACE-Salamonie Lake |
| Rob Shellhamer | Wabash County SWCD | Joe Schmees | IDEM Representative |

## 1.3 Stakeholder Concerns List

At the initial public meeting, stakeholders were given the opportunity to write down resource concerns. Concerns are grouped and summarized in Table 2. As part of the LSR watershed management plan, each of these concerns will be investigated and addressed to the degree possible through this process.

**Table 2 Stakeholder Concerns**

| Stakeholder Concerns | |
|---|---|
| **Agricultural Concerns** | Lack of no-till farming practices |
| | Lack of cover crops seeded |
| | Pesticide concentrations |
| | Nutrient overloads |
| | Runoff |
| **Rural & Residential** | Failing septic systems |
| | Waste treatment systems maintenance |
| | E. coli |
| **Other** | Stream bank erosion |
| | Sediment/Silt levels |
| | Endangered species protection |
| | Fish health and habitat quality low |
| | Flashiness and Flooding |
| | Lack of Recreation on River |
| | Lack of public knowledge on area's water quality |
| | Fish Consumption |
| | Blue-Green Algae in Reservoir due to river |
| | Invasive plant species |

## 2.0 Watershed Inventory I

### 2.1 Geology/Topography

The Lower Salamonie River watershed falls within the Central Till Plain natural region as defined by Homoya et al (Appendix A). The region was formerly a forested plain of Wisconsinan till, with several glacial features, especially moraines. Region five, of which the Central Till Plain is a part, is divided into three sections: the Entrenched Valley, Tipton Till Plain, and Bluffton Till Plain. The LSR is located within the Bluffton Till Plain, which is characterized by the predominance of clayey Wisconsinan till on a relatively level till plain. This area was one of the last areas of Indiana to be covered by glacial ice. The most recent glacial period, the Wisconsin Age, formed the present landscape of the LSR watershed. The first two retreats of the Ontario and Erie Lobe of the Wisconsinan ice sheet deposited a distinct series of moraines, with the Union City Moraine marking the watersheds southern border (Homoya, 1985). Appendix B shows the arc-shaped ridges these Salamonie moraines formed across the area. The LSR watershed was scraped clear of most pre-Wisconsinan drift, with the Lagro drift sheet generally less than 50 feet thick. Erosion has removed the thin drift from the valleys so the Salamonie River flows on, or near, the bedrock (Fenelon, Bobay, Greeman, & others, 1994).

The LSR lies within the Upper Wabash River Basin, which is inside the Eastern Lake and Till Plains sections of the Central Lowland Province of the Interior Plains. The area is dominated by flat to undulating ground moraines and lake plains in front of recessional moraines. Narrow, shallow valley sand deposits are common along the larger streams in this area (U.S. Department of Agriculture, Natural Resources Conservation Service, 2006).

Both bedrock and unconsolidated aquifer systems are present in the LSR. The unconsolidated aquifers consist of buried sand and gravel deposits, and the bedrock aquifer is carbonate bedrock of Silurian age. Five unconsolidated aquifer systems exist within the watershed: Complex, Till Subsystem, Till, Outwash Subsystem, and Dissected Till and Residuum/Till Veneer (IDNR). The Silurian carbonate bedrock aquifer is seldom used because of the abundance of ground water in unconsolidated aquifers (Fenelon, Bobay, Greeman, & others, 1994).

### 2.2 Hydrology

The drainage area of the LSR is approximately half of the Salamonie watershed, totaling 196,426 acres. The river originates near the Indiana-Ohio border and flows to the northwest for about 60 miles before discharging into the Wabash River from the south bank at Lagro, IN. In 1966, a flood control reservoir was constructed on the lower portion of the Salamonie River, which forms Salamonie Lake.

The LSR watershed includes two 10-digit HUCs, 0512010203 (Black Creek-Salamonie River sub-watershed) and HUC 0512010204 (Salamonie River sub-watershed) (Figure 2). These sub-watersheds are further divided into twelve 12-digit HUCs (Table 3). Figure 3 along with Table 4 also detail these areas. The Salamonie River sub-watershed is the most northwest portion of the watershed and includes Salamonie Lake. Downstream of the lake, the Salamonie River meets up with the Wabash River in the town of Lagro. This sub-watershed includes 101,426 acres and 257 miles of streams and ditches. The Black Creek-Salamonie River sub-watershed makes up the southern portion of the LSR watershed, or middle course of the river. This sub-watershed consists of 95,026 acres and includes 227 miles of streams and ditches (Figure 4). Each of the 12-Digit HUC watersheds will be discussed in further detail under Watershed Inventory II.

**Table 3 LSR Watershed HUCs**

| **Lower Salamonie River Watershed HUCs** | | | |
|---|---|---|---|
| Mississippi River Basin | | | |
| **HUC** | **NAME** | **CODE** | **SUB-WATERSHED** |
| 2-digit HUC | Ohio Region | 05 | |
| 4-digit HUC | Wabash | 0512 | |
| 6-digit HUC | Upper Wabash | 051201 | |
| 8-digit HUC | Salamonie | 05120102 | |
| 10-digit HUC | Lower Salamonie River Watersheds | 0512010203 | Black Creek-Salamonie River |
| | | 0512010204 | Salamonie River |
| 12-digit HUC | Lower Salamonie River Sub-watersheds | 051201020301 | Scuffle Creek-Salamonie River |
| | | 051201020302 | Prairie Creek |
| | | 051201020303 | Shadle Drain-Salamonie River |
| | | 051201020304 | Baker Ditch- Black Creek |
| | | 051201020305 | Little Black Creek-Black Creek |
| | | 051201020306 | Owl Creek-Salamonie Rive |
| | | 051201020401 | Weasel Creek-Salamonie River |
| | | 051201020402 | Richland Creek |
| | | 051201020403 | Majenica Creek |
| | | 051201020404 | Rush Creek |
| | | 051201020405 | Salamonie Reservoir-Salamonie River |
| | | 051201020406 | Indian Creek-Salamonie River |

**Figure 2 Lower Salamonie River Watershed HUC 8 and HUC 10s**

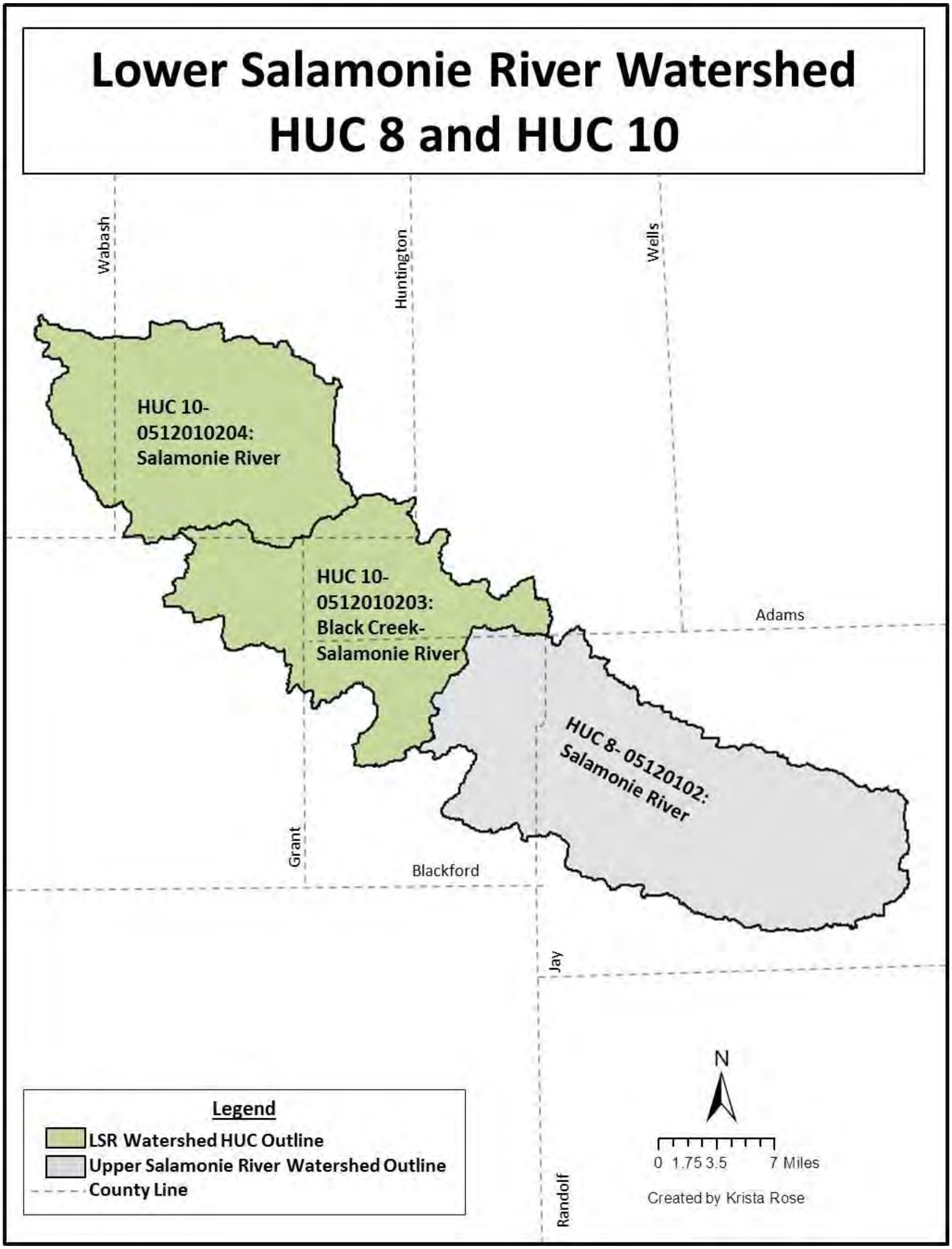
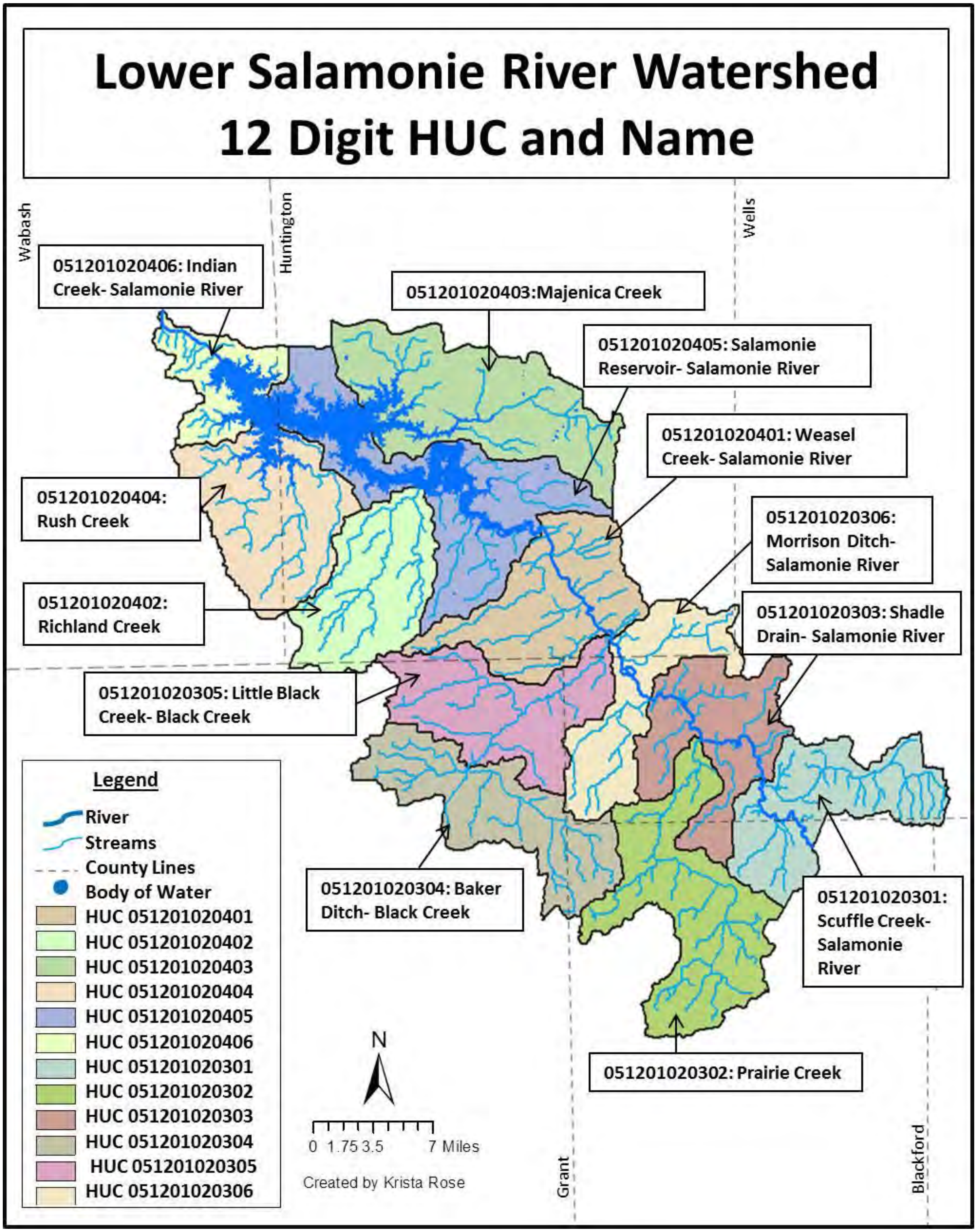


**Figure 3 LSR Watershed HUC 12 Map**



### 2.2.1 Wetlands, Streams and Legal Drains

Recently, people have come to realize that wetlands are vital to the balance of the environment. They may be described as in-between places that provide a transition between land and water. As precious ecological resources, wetlands host a variety of plants and animals adapted to living in these unique conditions. The highest diversity of plants and animals in Indiana, including several endangered species, can be found in wetlands. Wetlands also play a major role in flood storage and control, water quality, recreation, and controlling shoreline erosion. They can be compared to the ecological equivalent of giant kidneys in that they dilute, dissipate, and neutralize pollutants. Historically wetlands were thought of as wastelands. However, settlers soon discovered the productivity value of the hydric soils found within these areas and began to convert them into tillable land (Whitaker, et al., 2012).

When the first European settlers arrived in Indiana, almost one fourth of the state was covered with wetlands. About 85% of this original wetland acreage has been lost (Indiana Department of Environmental Management, 2008). While the drainage and clearing over the past 100 years has resulted in tremendous crop production, it has also decreased the benefits provided by wetland systems. Today, 2.92% (approximately 5,746 acres) of the LSR is covered in wetlands, with the majority in the northern part of the watershed (Figure 5). With the decrease in wetlands which act as a hydrologic sponge, and the increased drainage from human activity, the problem of flashiness and flooding is present in the Salamonie River. Table 4 outlines the sub-watershed acreage and miles of streams and wetlands within the LSR watershed.

Table 5 Lower Salamonie River Watershed Regulated Drain Mileage) outlines the mileage of regulated drains, both tiled and open (Regulated drain maps may be found in Appendix F). A regulated drain refers to an open drain, a tiled drain, or a combination of the two that is maintained by the county. An open drain is a natural or artificial channel that carries surplus water, whereas a tiled drain is a tiled channel that carries surplus water. This extensive use of drainage has made it possible to convert much of the acreage in the LSR to prime farmland for row crop agriculture. Available maps of county regulated drains are available upon request from the surveyor's office of each county. There are a total of 485 miles of streams and ditches in the watershed including many which are designated as legal drains.

**Table 4 LSR Watershed HUC 10 and HUC 12 Area Totals, Streams, and Wetlands**

| HUC 10 | HUC 10 Name | Acres | Sq. Miles | Stream Miles | Wetland Acres | Wetland % (HUC 10) | Wetland Acres (% LSR) |
|---|---|---|---|---|---|---|---|
| 0512010204 | Salamonie River | 101,468.00 | 158.48 | 257.45 | 4268 | 4.21 | 2.17 |
| 0512010203 | Black Creek-Salamonie River | 95,026.36 | 148.44 | 227.32 | 1478 | 1.56 | 0.75 |
| Lower Salamonie River Watershed Totals | | 196,494.36 | 306.92 | 484.77 | 5746 | n/a | 2.92 |
| **HUC 12** | **HUC 12 Name** | **Acres** | **Sq. Miles** | **Stream Miles** | **Wetland Acres** | **Wetland % (HUC 12)** | **Wetland Acres (% LSR)** |
| 051201020406 | Indian Creek-Salamonie River | 7,876 | 12.30 | 31.71 | 806 | 10.23 | 0.41 |
| 051201020405 | Salamonie Reservoir-Salamonie River | 23,258 | 36.33 | 61.65 | 2334 | 10.04 | 1.19 |
| 051201020404 | Rush Creek | 17,598 | 27.48 | 42.09 | 423 | 2.40 | 0.22 |
| 051201020403 | Majenica Creek | 22,245 | 34.74 | 43.45 | 257 | 1.16 | 0.13 |
| 051201020402 | Richland Creek | 14,148 | 22.10 | 32.76 | 191 | 1.35 | 0.10 |
| 051201020401 | Weasel Creek-Salamonie River | 16,343 | 25.53 | 45.78 | 257 | 1.57 | 0.13 |
| 051201020306 | Morrison Ditch-Salamonie River | 12,324 | 19.25 | 27.81 | 181 | 1.47 | 0.09 |
| 051201020305 | Little Black Creek-Black Creek | 15,961 | 24.93 | 32.42 | 192 | 1.20 | 0.10 |
| 051201020304 | Baker Ditch- Black Creek | 16,363 | 25.57 | 39.02 | 164 | 1.00 | 0.08 |
| 051201020303 | Shadle Drain-Salamonie River | 14,228 | 22.22 | 35.63 | 397 | 2.79 | 0.20 |
| 051201020302 | Prairie Creek | 20,682 | 32.31 | 46.19 | 318 | 1.54 | 0.16 |
| 051201020301 | Scuffle Creek-Salamonie River | 15,468 | 24.16 | 46.24 | 224 | 1.45 | 0.11 |

**Table 5 Lower Salamonie River Watershed Regulated Drain Mileage**

| County | Huntington | | | Wabash | | | Wells | | | Grant | | | Blackford | | | LSRW Reported Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Drain Type** | **Tile** | **Open** | **Total** | **Tile** | **Open** | **Total** | **Tile** | **Open** | **Total** | **Tile** | **Open** | **Total** | **Tile** | **Open** | **Total** | **Total**** |
| **Linear Miles** | 85.67 | 107.39 | **193.06** | 20.89 | 4.92 | **25.81** | 54.7 | 95.2 | **149.9** | * | * | * | * | * | **88.77** | **457.5** |

*Unable to Obtain County Data **Total does not include miles in Grant County

**Figure 4 Lower Salamonie River Watershed Rivers and Streams**

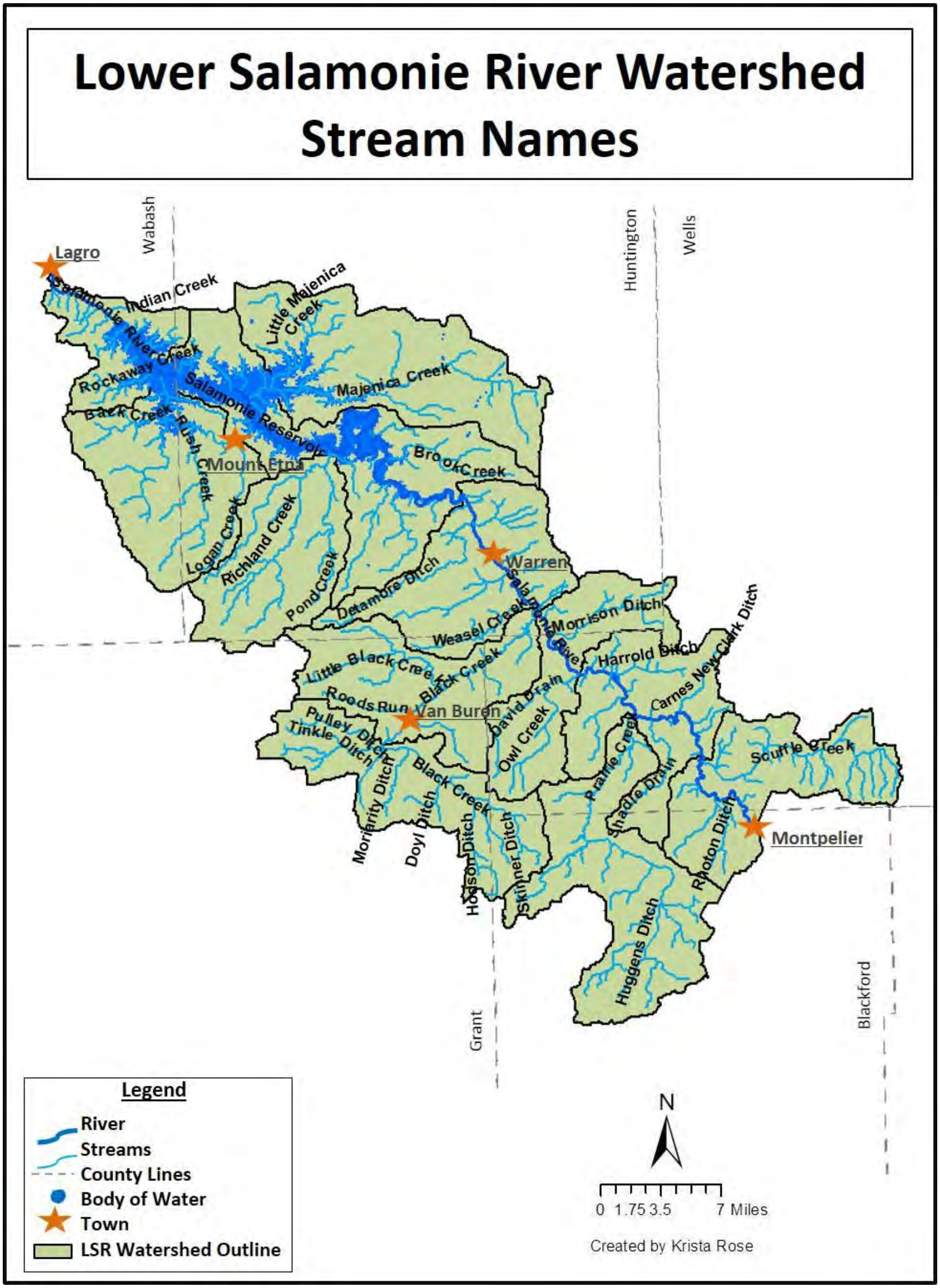
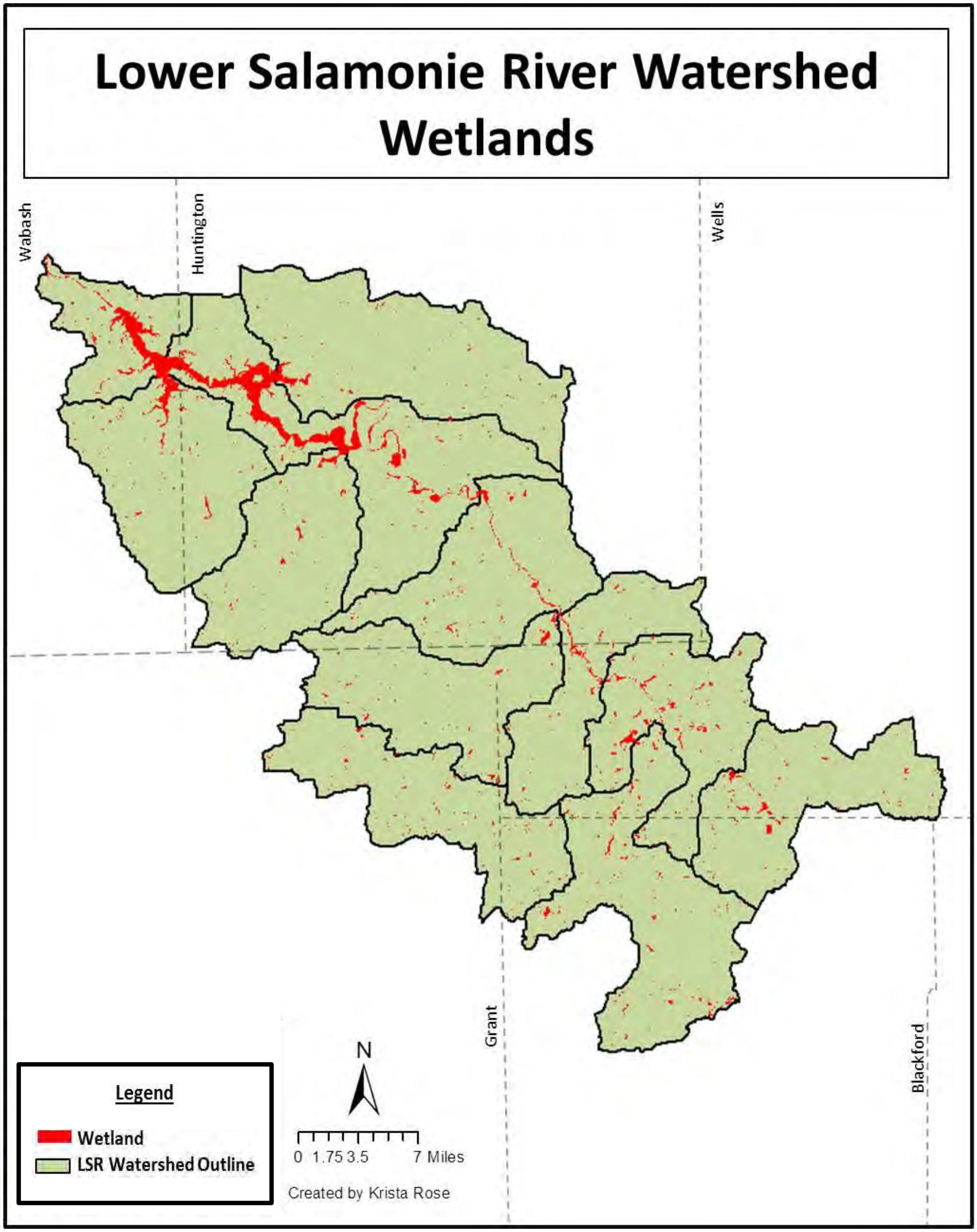


**Figure 5 Lower Salamonie River Watershed Wetlands**



### 2.2.2 Lakes and Dams

The Salamonie Reservoir was authorized under the Flood Control Act of 1958; its purpose was to reduce flood stages in the upper Wabash River Basin. The earthen and rock-fill dam was designed and built by the Louisville District of the U.S. Army Corps of Engineers in 1966. The Salamonie Reservoir operates in conjunction with Roush and Mississinewa Reservoirs, along with other flood-control reservoirs in southern Indiana, to reduce flood stages along the lower Wabash River and the Ohio River. The cities of Wabash, Peru, and Logansport, Indiana, benefit most directly from the Salamonie Reservoir.

The Salamonie Reservoir is managed through a cooperative effort between the USACE and IDNR. The dam has a height of 133 feet with a lake drainage area of 553 square miles. The lake has a surface area of 2860 acres and a maximum capacity of 263,600 acre-feet (Standford University, n.d.). When excessive rainfall is likely, such as in the fall and winter months, the lake is kept at a relatively low level. This allows surface water runoff to be stored in the lake until the swollen streams and rivers below the dam have receded and are able to handle the additional flow (U.S. Army Corps of Engineers , n.d.).

The lake's secondary purpose is for recreation; it provides 2,665 acres of water in the summer for water-related activities. Many of the watershed's residents take advantage of this property and associated state recreation areas for swimming, boating, and fishing. The Salamonie River State Forest and Kokiwanee Nature Preserve also operate around the reservoir, providing people with multiple outlets for recreation. Consisting of almost 14,000 acres, these properties offer a variety of recreational opportunities year round. (See Appendix C for a map of the lake and recreation areas provided by the IDNR and USACE.) Due to the heavy recreational use of the river and reservoir, fish health and habitat, as well as E.coli levels, are among stakeholder concerns.

Blue-green algae is an issue within the Salamonie Reservoir. Blooms have recently occurred two to three times per year. The known water-quality problems and algal blooms within the Salamonie Reservoir were the driving force for the development of a WMP. It was determined using USACE sampling data that excess nutrients were entering the reservoir via the Salamonie River. Therefore, water-quality must be improved in the Salamonie River to properly address water-quality problems in the reservoir.

### 2.2.3 Access Points

Nine boat ramps are available throughout the Salamonie Lake area, in addition to a marina boat ramp within the Lost Bridge West Recreational Area (see map, Appendix C).

## 2.3 Soils and Drainage

Five main soil orders are found in Indiana: Alfisols, Mollisols, Ultisols, Entisols, and Histosols. Alfisols and Mollisols dominate the watershed area. Alfisols develop under dry deciduous forests, and are characterized by some moisture retention. Mollisols develop under tall grass prairie, and have a thick A horizon due to deep penetrating root systems. They have good nutrient retention and are excellent for modern agricultural uses.

Fifty-three soil series represent the majority of soil types found throughout the state, and are grouped into associations of soil series that commonly occur together. Each soil association has a distinctive pattern of soils, relief, and drainage, as well as a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. The name is based on the major soil types within the association.  Soils making up one association can occur in another but in a different pattern. Five soil associations dominate the Central Till Plain region: Blount-Pewamo-Glynwood; Crosby-Treaty-Miami; Miami-Crosby-Treaty; Blount-Glynwood-Morley; and Fincastle-Brookston-Miami (Whitaker, et al., 2012). The widespread Miami soil is the state soil, due to its prized ability to grow corn. (See Figure 6 and Table 6 for the major soil associations found in the LSR watershed.) The two main associations in the watershed are Blount-Pewamo-Glynwood, which covers 43% of the LSR watershed, and Blount-Glynwood-Morley, which covers 24%. Generally, these two associations are equally present in both HUC 10 sub-watersheds.

According to the Salamonie Rapid Watershed Assessment, drainage class refers to the “frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil.” There are seven classes of natural soil drainage: excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained and very poorly drained (U.S. Department of Agriculture, Natural Resources Conservation Service, 2008). Over 50% of the watershed is classified as somewhat poorly drained (Figure 7, Table 7).

**Table 6 LSR Watershed General Soil Associations per HUC**

| Major Soil Associations per HUC | | | |
|---|---|---|---|
| **Association** | **HUC 0512010203** | **HUC 0512010204** | **Total LSR** |
| WATER | 0.00% | 21.74% | 9.80% |
| BLOUNT-GLYNWOOD-MORLEY (IN004) | 21.43% | 26.09% | 23.53% |
| BLOUNT-PEWAMO-GLYNWOOD (IN005) | 46.43% | 39.13% | 43.14% |
| MILLSDALE-NEWGLARUS-RANDOLPH (IN047) | 0.00% | 4.35% | 1.96% |
| SAWMILL-LAWSON-GENESEE (IN029) | 17.86% | 8.70% | 13.73% |
| HOYTVILLE-NAPPANEE-BLOUNT (IN032) | 3.57% | 0.00% | 1.96% |
| MILFORD-MARTINTON-DEL REY (IN053) | 10.71% | 0.00% | 5.88% |

**Table 7 LSR Watershed Drainage Classes per HUC**

| Drainage Class per HUC | | | |
|---|---|---|---|
| **Class** | **HUC 0512010203** | **HUC 0512010204** | **Total** |
| Excessively drained | 0.00% | 0.06% | 0.03% |
| Well drained | 2.90% | 7.11% | 4.94% |
| Moderately well drained | 31.95% | 29.70% | 30.86% |
| Somewhat poorly drained | 50.46% | 51.39% | 50.91% |
| Poorly drained | 7.55% | 10.64% | 9.05% |
| Very poorly drained | 7.13% | 1.11% | 4.21% |

**Figure 6 Lower Salamonie River Watershed General Soil Associations**

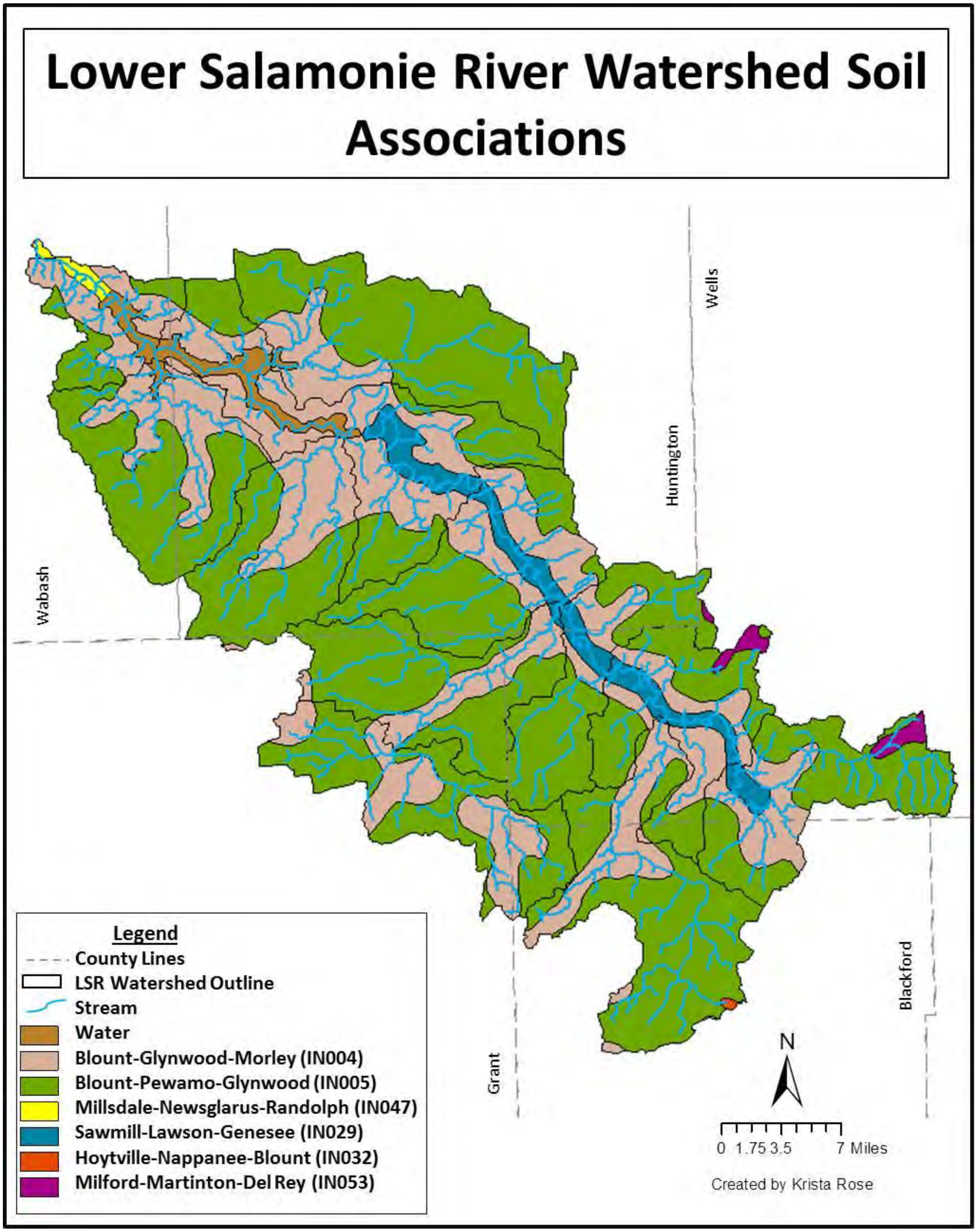
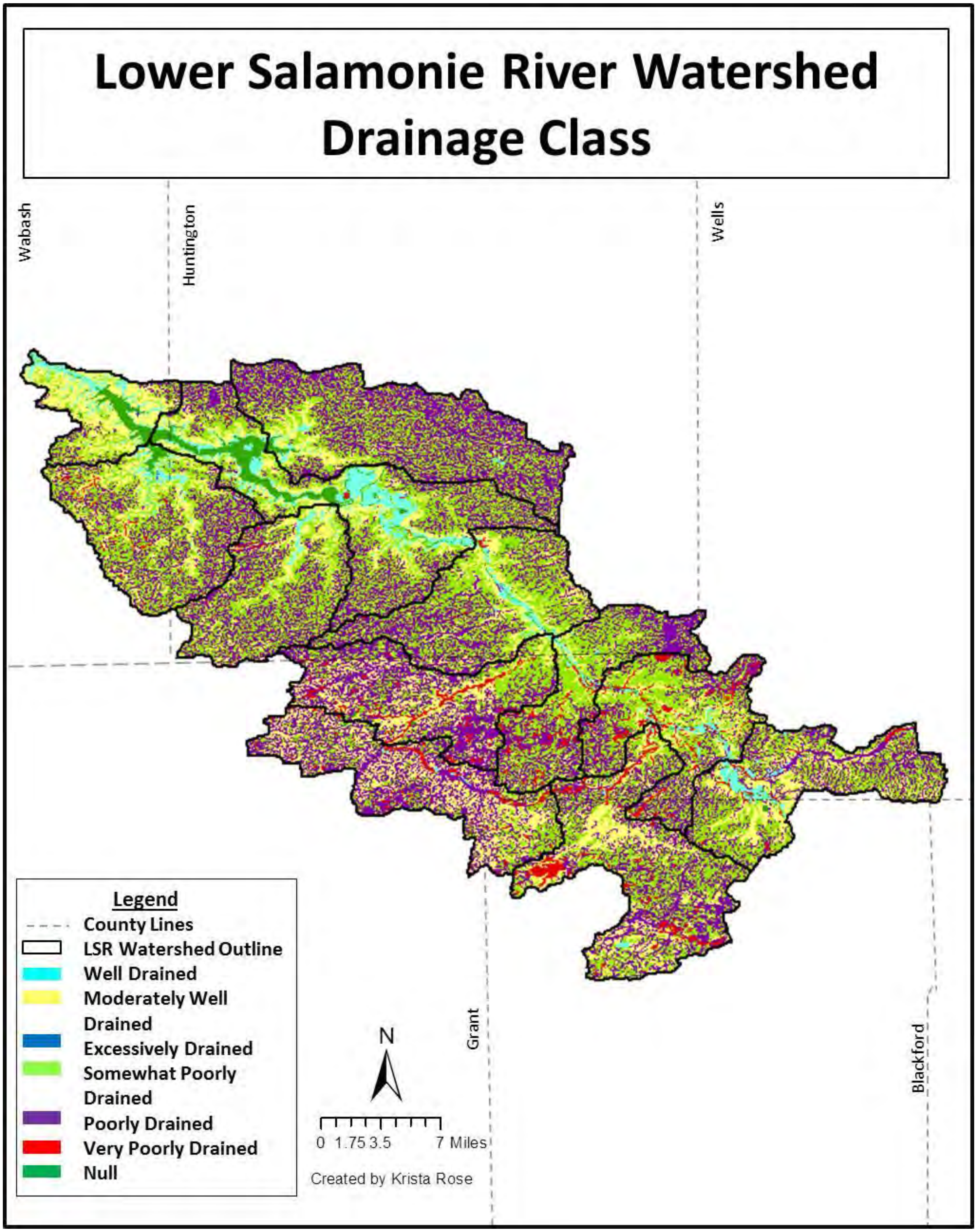


**Figure 7 Lower Salamonie River Watershed Drainage Class**



### 2.3.1 Hydric Soils

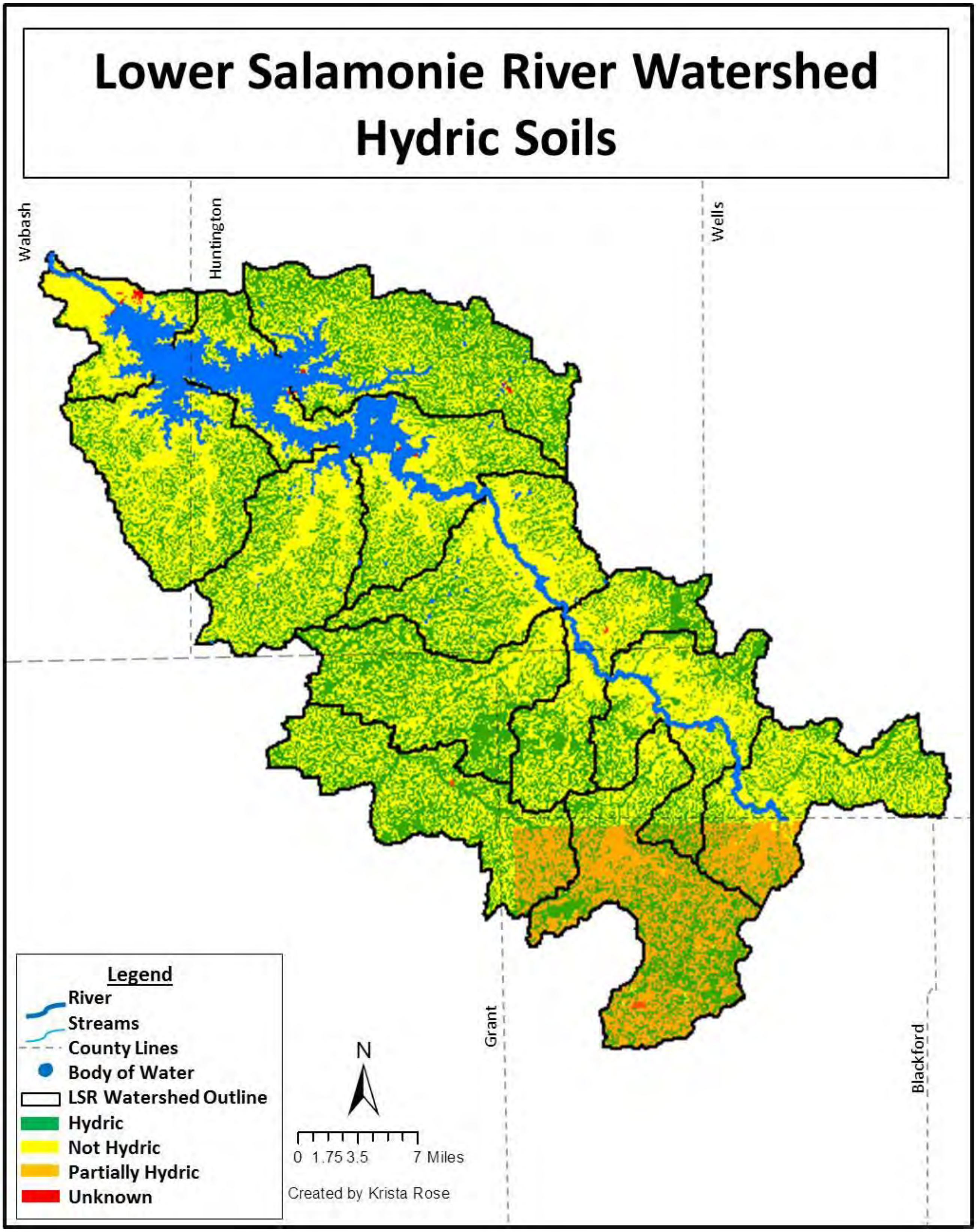
Hydric soils are defined by the National Technical Committee for Hydric Soils as soils that formed during the growing season under conditions of saturation, flooding, or ponding long enough to develop anaerobic conditions in the upper part. Saturation or inundation, along with microbial activity, causes oxygen depletion in the soil. Processes promoted by this anaerobiosis result in distinctive characteristics, such as the accumulation or loss of iron, manganese, sulfur, or carbon compounds. These characteristics persist in the soil during wet and dry periods (U.S. Department of Agriculture, Natural Resources Conservation Service, 2010). As mentioned earlier, hydric soils are found within wetlands, and are a criteria used to define and identify a wetland. Many of the hydric soils in the LSR watershed have been artificially drained over the years, yet they still retain their hydric soil capabilities, and are excellent candidates for wetland restoration. Approximately 13% of the LSR watershed is classified as total hydric soils, 6% are partially hydric soils, and 81% are not hydric soils (Table 8, Figure 8).

To convert these hydric soil areas to useable farmland, the area has been extensively ditched and tiled to drain the soil of excess water. Although this has resulted in much higher agricultural production, it does have negative impacts. Extensively changing the natural hydrology may lead to increased flows resulting in downstream flooding, bank destabilization, erosion and excess sedimentation in the stream. In addition, it allows for more pollutants such as nutrients and E. coli bacteria to be washed into area streams. This increased flow also prevents surface water from percolating through the soil and recharging aquifer systems. Finally, dredging and channelization of streams can result in the destruction of aquatic organisms and the habitats they rely on.

**Table 8 Lower Salamonie River Watershed Hydric Soils**

| Percent of Hydric Soils | | | |
|---|---|---|---|
| **Class** | **HUC 0512010203** | **HUC 0512010204** | **Total** |
| All Hydric | 14.56% | 11.63% | 13.14% |
| Partially Hydric | 10.99% | 0.00% | 5.65% |
| Not Hydric | 74.03% | 87.91% | 80.77% |
| Unknown | 0.42% | 0.46% | 0.44% |

**Figure 8 Lower Salamonie River Watershed Hydric Soils**



### 2.3.2 Highly Erodible Soil and Land

The soils that exist within a watershed and their ability to erode or sustain certain land use practices can greatly impact the water quality of the area. Soils with a high potential for erosion by water are called highly erodible lands (HEL). Defined by the Sodbuster Conservation Reserve and Conservation Compliance sections of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990, highly erodible soils (HES) are soils with an erodibility index of eight or greater, where the erodibility index (EI) is:

$$EI = \frac{R \times K \times LS}{T}$$

where:
K = the soil erodibility factor
T = Soil loss tolerance
R = Erosivity factor
S = Slope gradient
L = Slope length factor

Highly erodible soils (HES) are easily transported to waterways where they degrade water quality, interfere with recreational uses, impair aquatic habitat and health, and contribute to excess nutrients. Erosion rates lower than the rate of soil development are considered "tolerable". Soil scientists and soil conservationists determine if a soil, or soil map unit, is "highly erodible" due to sheet and rill erosion. This determination is made by using the Universal Soil Loss Equation. This equation relates soil characteristics, the effects of rainfall, and the length and steepness of slope to the soil's tolerable sheet and rill erosion rate.

A HES has a maximum potential for erosion that equals or exceeds eight times the tolerable erosion rate. This potential is calculated without considering crop management or conservation practices, which can significantly lower the actual erosion rate of a given field. To be considered HEL by the Farm Service Agency, a field or tract of land has to have at least one third of the parcel situated on HES, and must be used for agricultural production. Highly erodible lands in the LSR watershed are shown in Figure 9. In the LSR watershed approximately 12,680 acres, or 6.5% of the watershed, consists of highly erodible land. Fortunately, most of this land is located around the Salamonie Reservoir and is protected. For other areas it is important that land owners use appropriate BMPs to prevent soil loss and insure continued productivity.

A map showing the soil erosion classes within the watershed is found in Figure 10. According to the Soil Survey Manual, class 1 soils consist of soils that have lost some, but on average less than 25%, of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick. Class 2 soils have lost, on the average, 25 to 75% of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick. Class 3 soils have lost, on the average, 75% or more of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick. Class 4 soils have lost all of the original A and/or E horizons or the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick. Within the LSR Watershed, approximately 25% fall in Class 1, 42% of the soils fall in Class 2, and 33% fall in Class 3, as seen in Table 9. Soil loss results in lost production of agricultural lands and the need to amend the soil to obtain acceptable yields. It also results in increased sediment loads to streams and increased loading of particle bound pollutants.

**Table 9 LSR Watershed Soil Erosion Classes**

| Percent of Soils found in Each Soil Erosion Class | | | |
|---|---|---|---|
| **Class** | **HUC 0512010203** | **HUC 0512010204** | **Total** |
| Class 1 | 40.80% | 11.85% | 24.80% |
| Class 2 | 40.90% | 43.24% | 42.19% |
| Class 3 | 18.30% | 44.91% | 33.00% |
| Class 4 | 0.00% | 0.00% | 0.00% |

**Figure 9 Highly Erodible Land in the Lower Salamonie River Watershed**

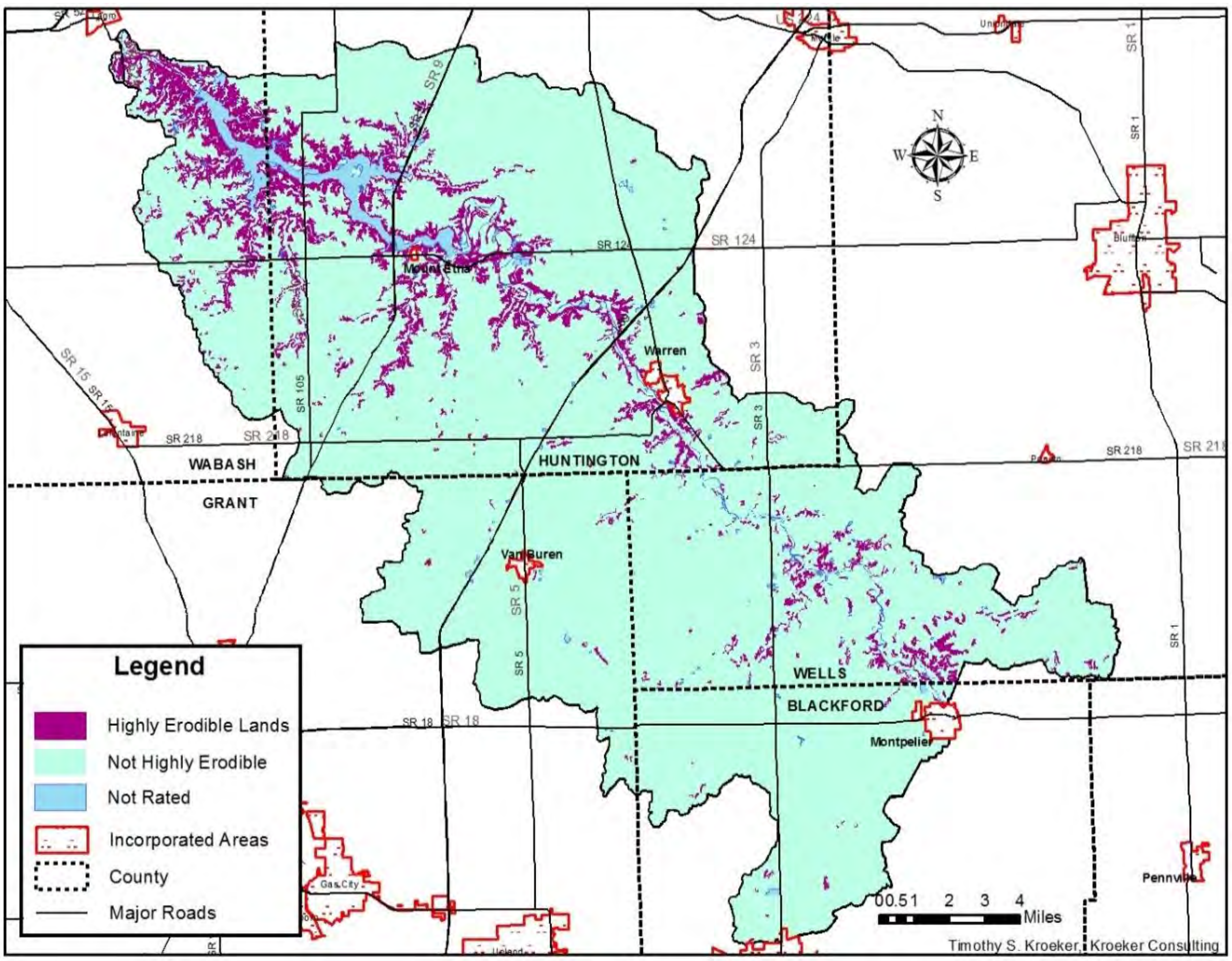
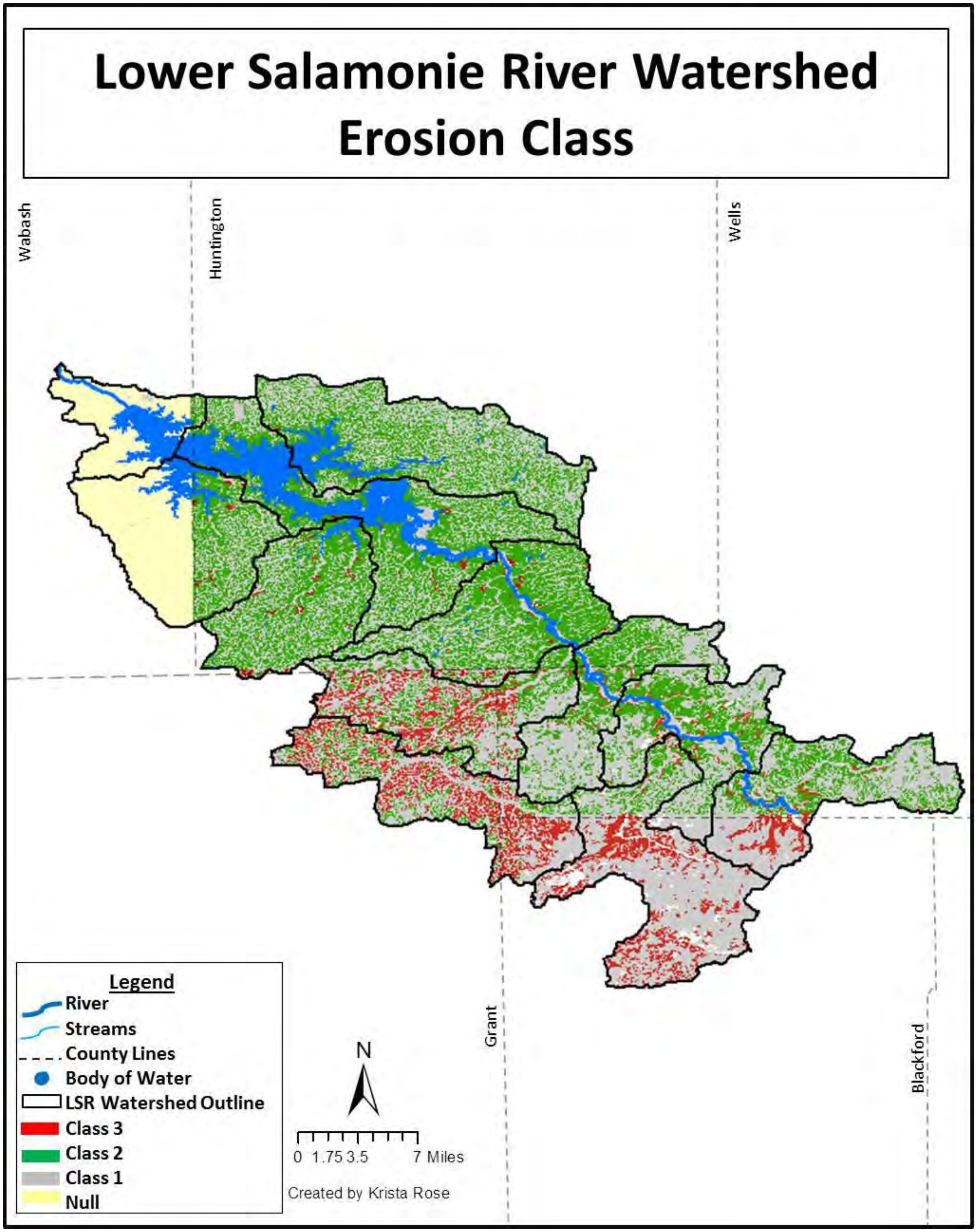


**Figure 10 Lower Salamonie River Watershed Soil Erosion Classes**



### 2.3.3 Wind Erodibility Group

Wind Erodibility Groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. When it comes to addressing sediment and nutrient loading and prioritizing best management practices in specific areas, wind erodibility within the watershed is an important factor. Soils are classified into one of eight groups. Soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible (Nelson, 2012). An overview of wind erodibility group properties and concerns is found in Table 10. (U.S. Department of Agriculture, Natural Resources and Conservation Service).

**Table 10 Wind Erodibility Group Properties and Concerns**

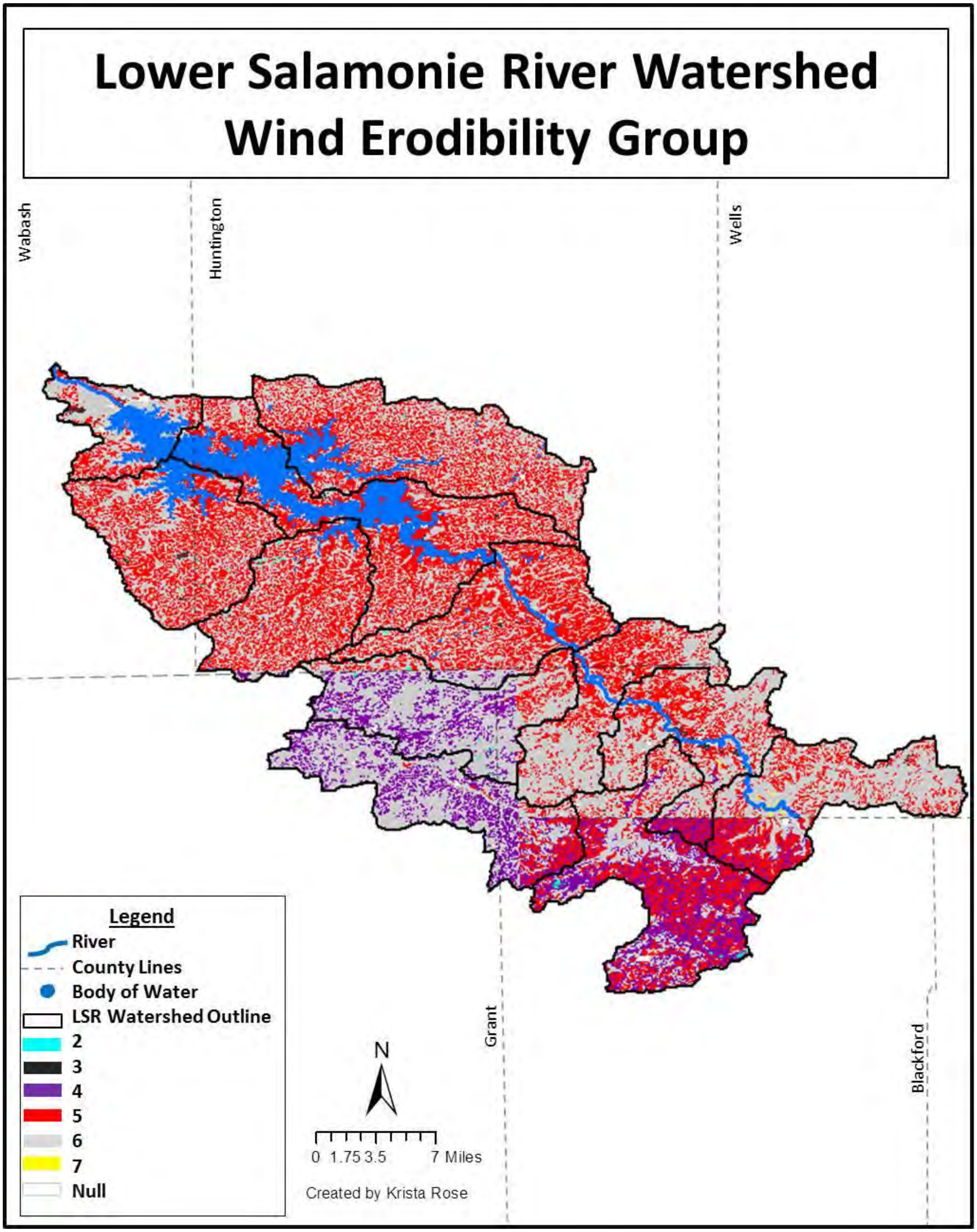
<table>
<tr><th>Groups</th><th>Properties of Soil Surface Layer</th><th>Production Concerns</th></tr>
<tr><td>1</td><td>Very fine sand, fine sand, sand or coarse sand</td><td>Most susceptible and generally not farmed</td></tr>
<tr><td>2</td><td>Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material</td><td rowspan="3">Crops can be grown if “intensive measures” are used, i.e. cover crops, conservation tillage</td></tr>
<tr><td>3</td><td>Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams</td></tr>
<tr><td>4L</td><td>Calcareous loams, silt loams, clay loams, and silty clay loam</td></tr>
<tr><td>4</td><td>Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35% clay</td><td rowspan="2">Crops can be grown if “measures to control wind erosion are used”</td></tr>
<tr><td>5</td><td>Noncalcareous loams and silt loams that are less than 20% clay and sandy clay loams, sandy clays, and hemic soil material</td></tr>
<tr><td>6</td><td>Noncalcareous loams and silt loams that are more than 20% clay and noncalcareous clay loams that are less than 35% clay</td><td rowspan="2">Crops can easily be grown with minimal soil loss</td></tr>
<tr><td>7</td><td>Silts, noncalcareous silty clay loams that are less than 35% clay, and fibric soil material</td></tr>
<tr><td>8</td><td>Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness</td><td>Generally not farmed, stony or gravelly</td></tr>
</table>

For planning purposes, wind erodibility groups 1 and 8 were not factored into mapping, since they are not farmed. Table 11 outlines the percent of each group per HUC 10, and Figure 11 maps out the wind erodibility groups found within the watershed. A more detailed discussion of the wind erodibility group in each sub-watershed occurs in the Watershed Inventory II section.

**Table 11 Wind Erodibility Group per HUC**

| Wind Erodibility Groups by HUCs | | | |
|---|---|---|---|
| **Groups** | **HUC 0512010203** | **HUC 0512010204** | **Total** |
| 1 | 0.00% | 0.00% | 0.00% |
| 2 | 0.28% | 0.49% | 0.38% |
| 3 | 0.89% | 0.95% | 0.92% |
| 4 | 14.14% | 0.65% | 7.60% |
| 5 | 26.68% | 58.91% | 42.31% |
| 6 | 57.73% | 39.00% | 48.64% |
| 7 | 0.28% | 0.00% | 0.14% |
| 8 | 0.00% | 0.00% | 0.00% |

**Figure 11 Lower Salamonie River Watershed Wind Erodibility Groups**



### 2.3.4 Septic System Suitability

More than one third of all Indiana homes utilize on-site wastewater disposal systems to treat household wastewater. The most common way to treat and dispose of wastewater in rural homes is through the use of septic systems. Most of these systems consist of a septic tank and a soil absorption field. These systems make use of the soil to remove contaminants from the wastewater before they reach our streams and drinking water aquifers. Soils effectively treat effluent through chemical, physical, and biological processes and act as a sort of natural filter to remove bacteria and viruses. A variety of soil properties can influence the effectiveness of septic systems and the soil's ability to function as a septic absorption field. Some soil conditions, such as a high water table, or horizons that have very high or very low permeability can allow bacterial or viral contamination of surface or ground water resources. However, septic systems can effectively treat wastewater for many years if they are: installed in suitable soils, designed for specific soil conditions, carefully constructed when soil is not too wet, and faithfully maintained.

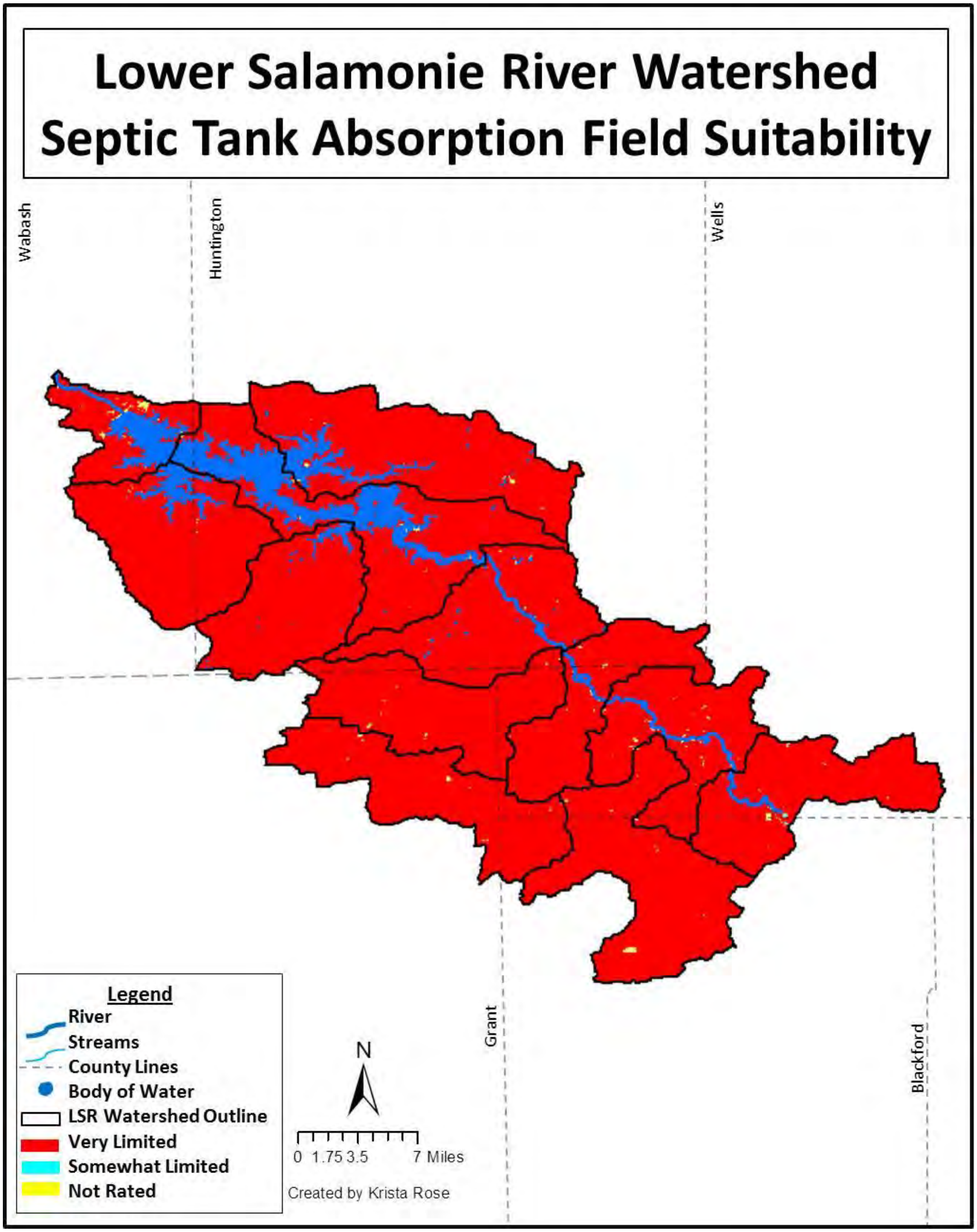
Not all soils are suitable for on-site wastewater disposal systems, and some soils are more suitable than others (Franzmeier, Steinhardt, & Lee, 2009). The NRCS and soil scientists rank each soil series in terms of its limitations for use as a septic tank absorption field. Rankings include: slightly limited, moderately limited, or severely limited. The ideal location for a soil absorption field is a large area that contains deep, well-drained soils. Unfortunately, such soils are hard to find in many areas of Indiana. Most Indiana soils in this region of the State have high water tables, shallow water-impermeable soil horizons, gravel layers, or compacted zones (Lee, Franzmeier, & Jones, 2004).

One of the major differences between owning a un-sewered versus a sewered home is that un-sewered wastewater treatment and disposal systems must be maintained by the homeowner. Yet, a large percentage of older homes built before wastewater system regulations were put into effect do not have any on-site wastewater disposal system, or the original system has failed over the years. For households with no system, sewage is directly discharged to the land surface, ditches, and streams. Failing and mismanaged septic systems can contribute to and/or directly impact many of our stakeholder's concerns. (Fish habitat, recreational water use, excess nutrients, and high Escherichia coli bacteria [E. coli] levels are all stated as watershed concerns.) Pollution from septic tank effluent can directly contribute to water quality impairment and eutrophication. Potential health concerns also exist for fishermen, boaters, and swimmers who come in contact with contaminated water.

Concerns were also expressed in regards to waste treatment in more populated areas in the watershed. Fortunately there are no large un-sewered communities in the LSR watershed. Montpelier, Warren, Van Buren and Mount Etna are all sewered communities. Each of these communities continues to work with IDEM to improve wastewater treatment.

As shown in Figure 12, nearly 99% of the LSR watershed is very limited in terms of suitability for septic tank absorption fields. Therefore, use of septic systems in these areas generally requires special designs, planning, and maintenance to minimize or overcome the soil limitations.

**Figure 12 Lower Salamonie River Watershed Septic Tank Absorption Field Ratings**



### 2.3.5 Tillage

The largest land use in the watershed is agriculture, and therefore it has the greatest potential to negatively or positively impact water quality. Although Table 2 lists only five stakeholder concerns under agriculture specifically, eight of the fourteen stakeholder concerns can be associated with agricultural land use: lack of no-till farming practices, lack of cover crops seeded, pesticide concentrations, flashiness and flooding of the river, runoff, too much sediment, excessive nutrients, and high E.coli levels. Tillage transects are county level windshield surveys that collect data on current crop use, tillage practices, and various soil-loss factors. Data from these surveys provide valuable information on trends in crop use and acceptance of conservation practices, such as conservation tillage and cover crops.

Common tillage types include no-till, strip-till, ridge-till, mulch-till, reduced-till, and conventional-till. According to the Indiana State Department of Agriculture (ISDA), no-till is any direct seeding system, including site preparation, with minimal soil disturbance (includes strip and ridge till). Mulch-till is any tillage system leaving 30%-75% residue cover after planting, excluding no-till. Reduced-till is any tillage system leaving 16%-30% residue cover after planting and conventional-till is any tillage system leaving less than 15% residue cover after planting (Indiana State Department of Agriculture, n.d.). No-till, ridge-till, strip-till, and mulch-till are all examples of conservation tillage. The purpose of conservation tillage is to reduce sheet and rill erosion, maintain or improve soil organic matter content, conserve soil moisture, increase available moisture, reduce plant damage, and provide habitat and cover for wildlife. The remaining crop residue helps reduce soil erosion and runoff volume, thus conservation tillage positively impacts water quality. The more acres under conservation tillage, the better protected the soil surface is from erosion which results in local water quality improvements.
Table 12 summarizes the 2013 ISDA Conservation Tillage Survey data for the counties found within the LSR watershed.
Table 13 summarizes the tillage data for 2011. Note: a general increase in conventional tillage for both corn and soybeans was observed from 2011 to 2013, which can negatively impact water quality.

**Table 12 Lower Salamonie River Watershed Tillage Practices 2013**

| 2013 | Total Acres | No Till | | Mulch Till | | Reduced Till | | Conventional Till | |
|---|---|---|---|---|---|---|---|---|---|
| County | | Percent | Acres | Percent | Acres | Percent | Acres | Percent | Acres |
| **Corn** | | | | | | | | | |
| **Blackford** | 25,000 | 6% | 2,000 | 16% | 5,500 | 19% | 6,500 | 59% | 20,100 |
| **Grant** | 74,000 | 8% | 5,800 | 2% | 1,500 | 0% | 0 | 90% | 65,700 |
| **Huntington** | 68,400 | 17% | 13,000 | 3% | 2,300 | 4% | 3,100 | 76% | 58,100 |
| **Wabash** | 75,200 | 16% | 13,800 | 2% | 1,700 | 5% | 4,300 | 77% | 66,600 |
| **Wells** | 74,600 | 2% | 1,700 | 4% | 3,400 | 2% | 1,700 | 91% | 77,600 |
| **Totals** | 317,200 | 10.2% | 36,300 | 4.1% | 14,400 | 4.4% | 15,600 | 81.3% | 288,100 |
| **Soybean** | | | | | | | | | |
| **Blackford** | 36,200 | 55% | 22,800 | 14% | 5,800 | 11% | 4,600 | 21% | 8,700 |
| **Grant** | 105,500 | 36% | 36,500 | 37% | 37,600 | 0% | 0 | 27% | 27,400 |
| **Huntington** | 85,900 | 46% | 36,100 | 22% | 17,200 | 6% | 4,700 | 25% | 19,600 |
| **Wabash** | 85,100 | 48% | 39,400 | 17% | 13,900 | 11% | 9,000 | 24% | 19,700 |
| **Wells** | 102,500 | 37% | 33,900 | 16% | 14,700 | 24% | 22,000 | 22% | 20,200 |
| **Totals** | 415,200 | 42.8% | 168,700 | 22.7% | 89,200 | 10.2% | 40,300 | 24.3% | 95,600 |

**Table 13 Lower Salamonie River Watershed Tillage Practices 2011**

| 2011 | Total | No Till | | Mulch Till | | Reduced Till | | Conventional Till | |
|---|---|---|---|---|---|---|---|---|---|
| County | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent | Acres |
| **Corn** | | | | | | | | | |
| **Blackford** | 25,100 | 28% | 7,000 | 13% | 3,300 | 16% | 4,000 | 43% | 10,800 |
| **Grant** | 74,000 | 7% | 5,200 | 2% | 1,500 | 0% | 0 | 91% | 67,300 |
| **Huntington** | 68,300 | 22% | 15,000 | 12% | 8,200 | 18% | 12,300 | 48% | 32,800 |
| **Wabash** | 74,500 | 15% | 11,300 | 9% | 6,800 | 6% | 4,500 | 69% | 51,900 |
| **Wells** | 74,600 | 4% | 3,000 | 10% | 7,500 | 22% | 16,400 | 64% | 47,700 |
| **Totals** | 316,500 | 13.1% | 41,500 | 8.6% | 27,300 | 11.8% | 37,200 | 66.5% | 210,500 |
| **Soybean** | | | | | | | | | |
| **Blackford** | 35,800 | 62% | 22,400 | 13% | 4,700 | 9% | 3,300 | 15% | 5,400 |
| **Grant** | 105,500 | 64% | 67,500 | 15% | 15,800 | 0% | 0 | 21% | 22,200 |
| **Huntington** | 85,800 | 56% | 48,100 | 19% | 16,300 | 14% | 12,000 | 11% | 9,400 |
| **Wabash** | 85,100 | 59% | 50,200 | 17% | 14,500 | 8% | 6,800 | 16% | 13,600 |
| **Wells** | 102,600 | 35% | 35,900 | 29% | 29,700 | 14% | 14,400 | 22% | 22,600 |
| **Totals** | 414,800 | 54.0% | 224,100 | 19.5% | 81,000 | 8.8% | 36,500 | 17.6% | 73,200 |

**Table 14 Lower Salamonie River Watershed No Till 2004-2013**

| Historic Tillage Transect for No-till Corn | | | | | |
|---|---|---|---|---|---|
| **No-Till Year** | **Blackford No till Corn (%)** | **Grant No till Corn (%)** | **Huntington No till Corn (%)** | **Wabash No till Corn (%)** | **Wells No till Corn (%)** |
| 2004 | 38% | 7% | 23% | 14% | 7% |
| 2007 | 49% | 10% | 33% | 17% | 12% |
| 2009 | 72% | N/A | 7% | 15% | 6% |
| 2011 | 28% | 7% | 22% | 15% | 4% |
| 2013 | 6% | 8% | 17% | 16% | 2% |
| **Summary Data** | **Blackford Corn** | **Grant Corn** | **Huntington Corn** | **Wabash Corn** | **Wells Corn** |
| Recorded High | 72% | 10% | 33% | 17% | 12% |
| 2013 | 6% | 8% | 17% | 16% | 2% |
| Loss (High to current) | 66% | 2% | 16% | 1% | 10% |
| **Historic Tillage Transect for No-till Soybeans** | | | | | |
| **No-Till Year** | **Blackford No till Soybeans (%)** | **Grant No till Soybeans (%)** | **Huntington No till Soybeans (%)** | **Wabash No till Soybeans (%)** | **Wells No till Soybeans (%)** |
| 2004 | 67% | 46% | 66% | 62% | 67% |
| 2007 | 82% | 53% | 85% | 67% | 75% |
| 2009 | 82% | N/A | 43% | 61% | 44% |
| 2011 | 62% | 64% | 56% | 59% | 35% |
| 2013 | 55% | 36% | 46% | 48% | 37% |
| **Summary Data** | **Blackford Soybeans** | **Grant Soybeans** | **Huntington Soybeans** | **Wabash Soybeans** | **Wells Soybeans** |
| Recorded High | 82% | 64% | 85% | 67% | 75% |
| 2013 | 55% | 36% | 46% | 48% | 37% |
| Loss (High to current) | 27% | 28% | 39% | 19% | 38% |

A summary of previous no till transects data for the counties within the watershed is seen in Table 14. Again, the downward trend in no-till acres is not positive for water quality protection.

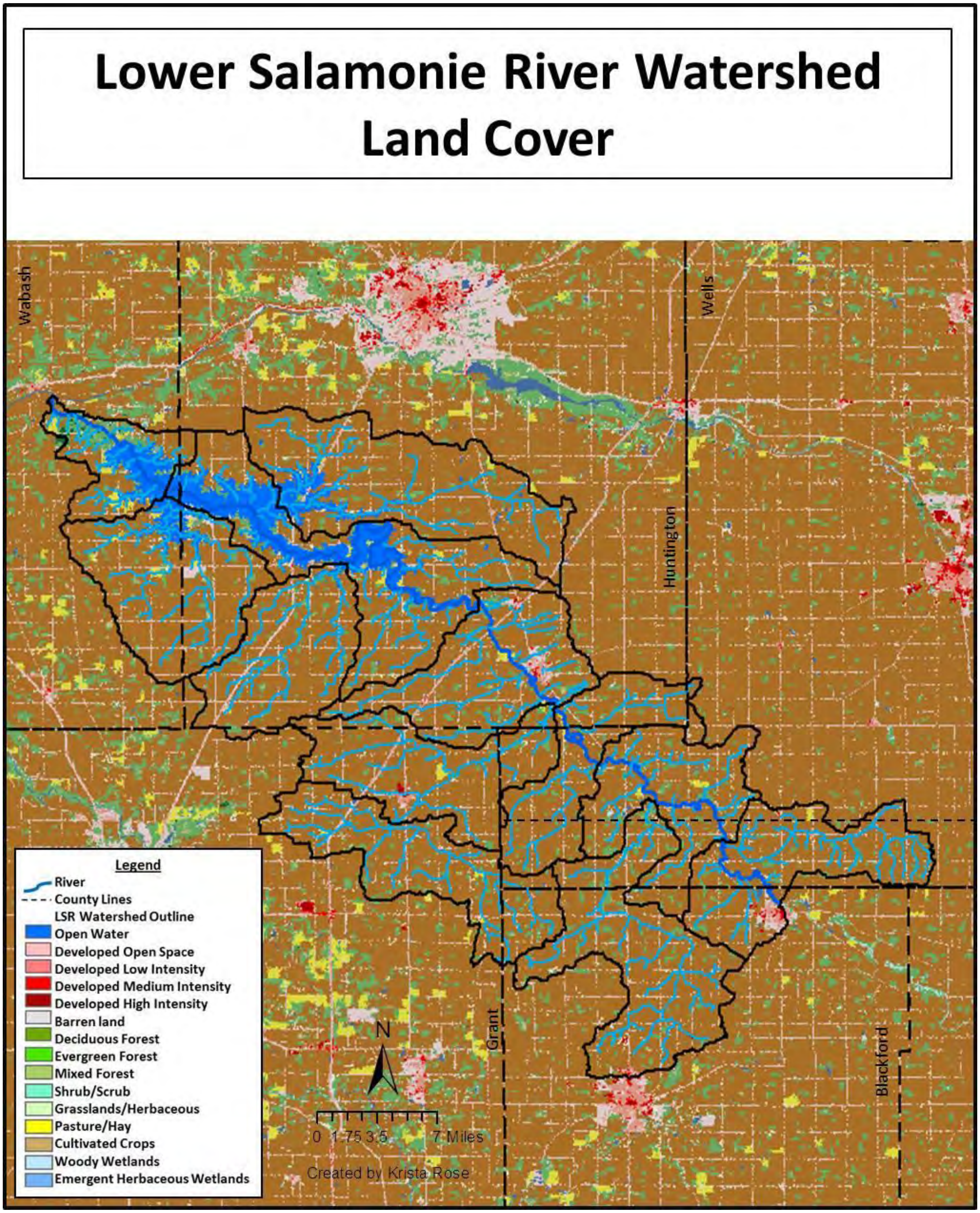
### 2.4.1 Land Use and Classification

Land use for the watershed is predominantly agricultural, covering 78% of the land surface (Figure 13). The main production is in corn and soybeans, with wheat, oats and other grains being grown on a smaller scale. There is also some hay production in the watershed (Whitaker, et al., 2012). Forested lands account for approximately 10%, urban or developed lands take up a little over 6%, and roughly 2.5% of the total watershed area is water or wetlands. Grasslands and pastures account for the remainder of the watershed, as seen in Table 15. The impact of agricultural practices on water quality is of concern to the stakeholders. Five concerns raised in public meetings stem directly from agriculture. Many non-point pollution sources are related to agriculture practices. Without proper management, nutrients, soil, agricultural chemicals, and manure applied to amend the soil can wash into rivers and streams.

**Table 15 Lower Salamonie River Watershed Land Use**

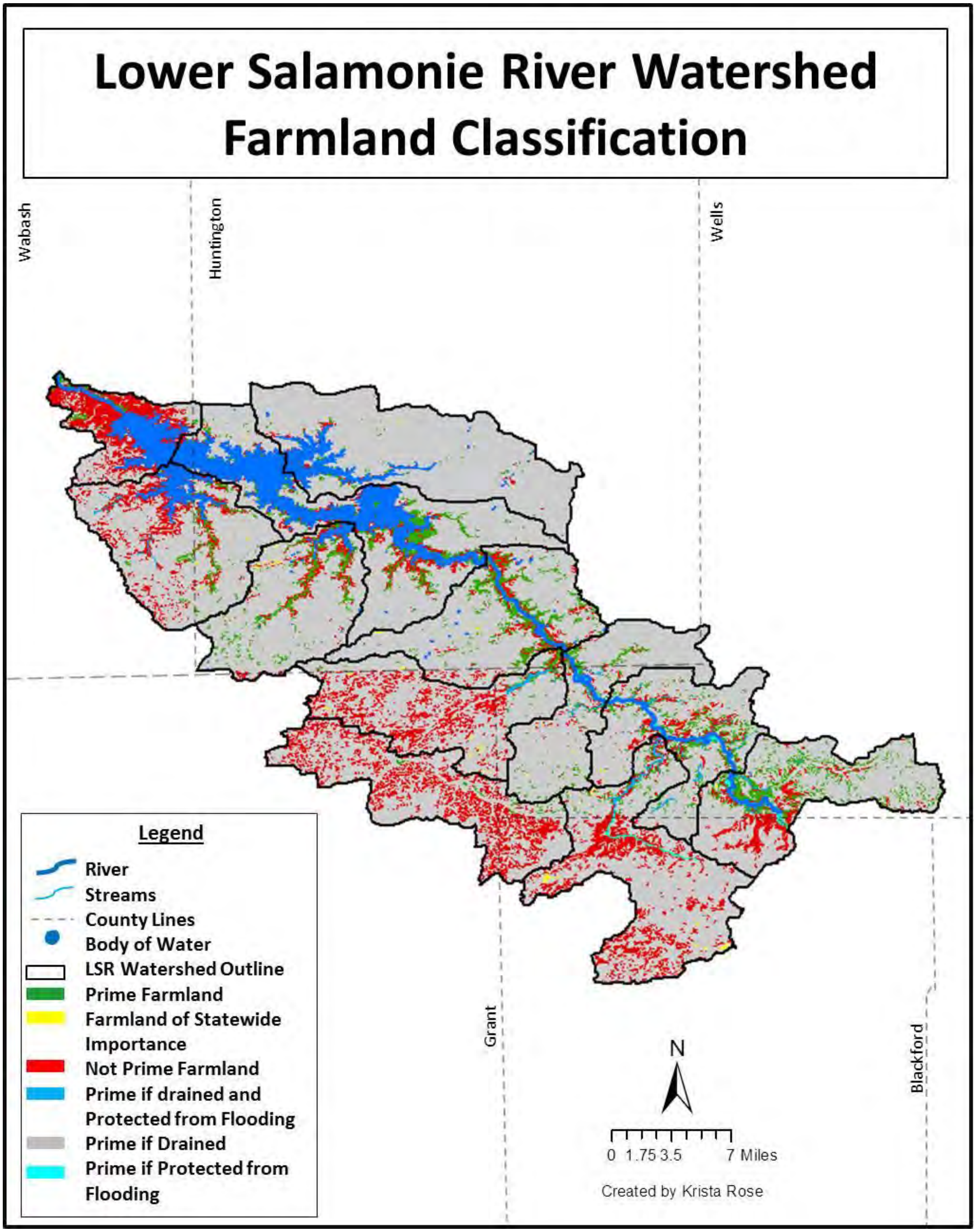
| Land Use | HUC 0512010204: Salamonie River Sub-watershed | HUC 0512010203: Black Creek-Salamonie River Sub-watershed | Total Lower Salamonie River Watershed | |
|---|---|---|---|---|
| | Acres | Acres | Acres | Percentage |
| Open Water | 3,367 | 250 | 3,618 | 1.84% |
| Developed, Open Space | 5,975 | 5,275 | 11,250 | 5.73% |
| Low Intensity Developed | 772 | 672 | 1,444 | 0.74% |
| Med Intensity Developed | 84 | 133 | 217 | 0.11% |
| High Intensity Developed | 17 | 90 | 107 | 0.05% |
| Barren/Pits/Quarries | 124 | 0 | 124 | 0.06% |
| Deciduous Forest | 12,781 | 6,719 | 19,500 | 9.93% |
| Evergreen Forest | 138 | 23 | 161 | 0.08% |
| Shrub/Scrub | 588 | 216 | 804 | 0.41% |
| Grassland/Herbaceous | 593 | 817 | 1,411 | 0.72% |
| Pasture/Hay | 1,356 | 490 | 1,845 | 0.94% |
| Cultivated Crops | 74,739 | 79,775 | 154,514 | 78.66% |
| Woody Wetlands | 123 | 361 | 485 | 0.25% |
| Emergent Herbaceous Wetlands | 768 | 177 | 945 | 0.48% |
| | | **Total Acreage** | **196,425** | **100%** |

**Figure 13 Lower Salamonie River Watershed Land Cover**




According to the 2008 Salamonie Rapid Watershed Assessment, the majority of the land within the Salamonie River Watershed is classified as prime farmland if drained, as seen in Figure 14. Farmland classification identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the Federal Register, Vol. 43, No 21, January 31, 1978.

**Figure 14 Lower Salamonie River Watershed Farm Land Classification**



Land capability classification indicates the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive land forming that would change slope, depth, or other characteristics of the soils, nor do they include possible, but unlikely, major reclamation projects. The class definitions are as follows: *Class I (1)* soils have slight limitations that restrict their use; *Class II (2)* soils have moderate limitations that reduce the choice of plants or require moderate conservation practices; *Class III (3)* soils have severe limitations that reduce the choice of plants, require special conservation practices, or both; *Class IV (4)* soils have very severe limitations that restrict the choice of plants, require very careful management, or both; *Class V (5)* soils have little or no potential for erosion but have other limitations that limit their use mainly to pasture, rangeland, forestland, or wildlife habitat; *Class VI (6)* soils have severe limitations that make them generally unsuited to cultivation and limit their use mainly to pasture, rangeland, forestland, or wildlife habitat; *Class VII (7)* soils have very severe limitations that make them unsuited to cultivation and restrict their use mainly to rangeland, forestland, or wildlife habitat; and *Class VIII (8)* soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use mainly to recreation, wildlife habitat, water supply, or esthetic purposes (USDA Agriculture Handbook No. 210). The majority of the land in the entire Salamonie River Watershed (71%) is classified as Class II (U.S. Department of Agriculture, Natural Resources Conservation Service, 2008), a characteristic that holds true for the Lower Salamonie River Watershed.

### Agricultural Statistics

A summary of the livestock and crop statistics by county, according to the last published Census of Agriculture in 2007, is outlined in Table 16 (U.S. Department of Agriculture, 2009). It is important to note that these statistics are for the entire county, and are not exclusive to the LSR watershed area.

**Table 16 Livestock and Crop Statistic Summary for LSR Watershed Counties, 2007**

| 2007 | | **Blackford County** | **Grant County** | **Huntington County** | **Wabash County** | **Wells County** |
|---|---|---|---|---|---|---|
| **Farms** | Number of Farms | 250 | 524 | 766 | 850 | 701 |
| | Land in Farms (acres) | 84,626 | 202,138 | 199,070 | 200,689 | 194,602 |
| | Average Size of Farm (acres) | 339 | 386 | 260 | 236 | 278 |
| **Crops (Acres)** | Corn for grain | 32,325 | 90,381 | 82,215 | 78,585 | 82,159 |
| | Soybeans for beans | 39,473 | 88,621 | 80,083 | 76,307 | 82,886 |
| | Wheat for grain, all | 1,941 | 4,100 | 6,105 | 8,769 | 8,553 |
| | Forage | 1,380 | 2,582 | 4,612 | 5,441 | 3,212 |
| | Corn for silage | 498 | (N/A) | 2,628 | 1,576 | (N/A) |

**Table 16 Cont. Livestock and Crop Statistic Summary for LSR Watershed Counties, 2007**

| 2007 | | Blackford County | Grant County | Huntington County | Wabash County | Wells County |
|---|---|---|---|---|---|---|
| **Livestock (Number)** | Layers | 810 | (D) | 172,515 | (N/A) | 924,421 |
| | Hogs and pigs | 24,256 | 17,239 | 50,971 | 139,298 | 45,828 |
| | Cattle and calves | 1,286 | 3,190 | 7,971 | 20,472 | 7,387 |
| | Goats, all | 299 | 416 | (N/A) | (N/A) | (N/A) |

(D): not disclosed (N/A): not listed

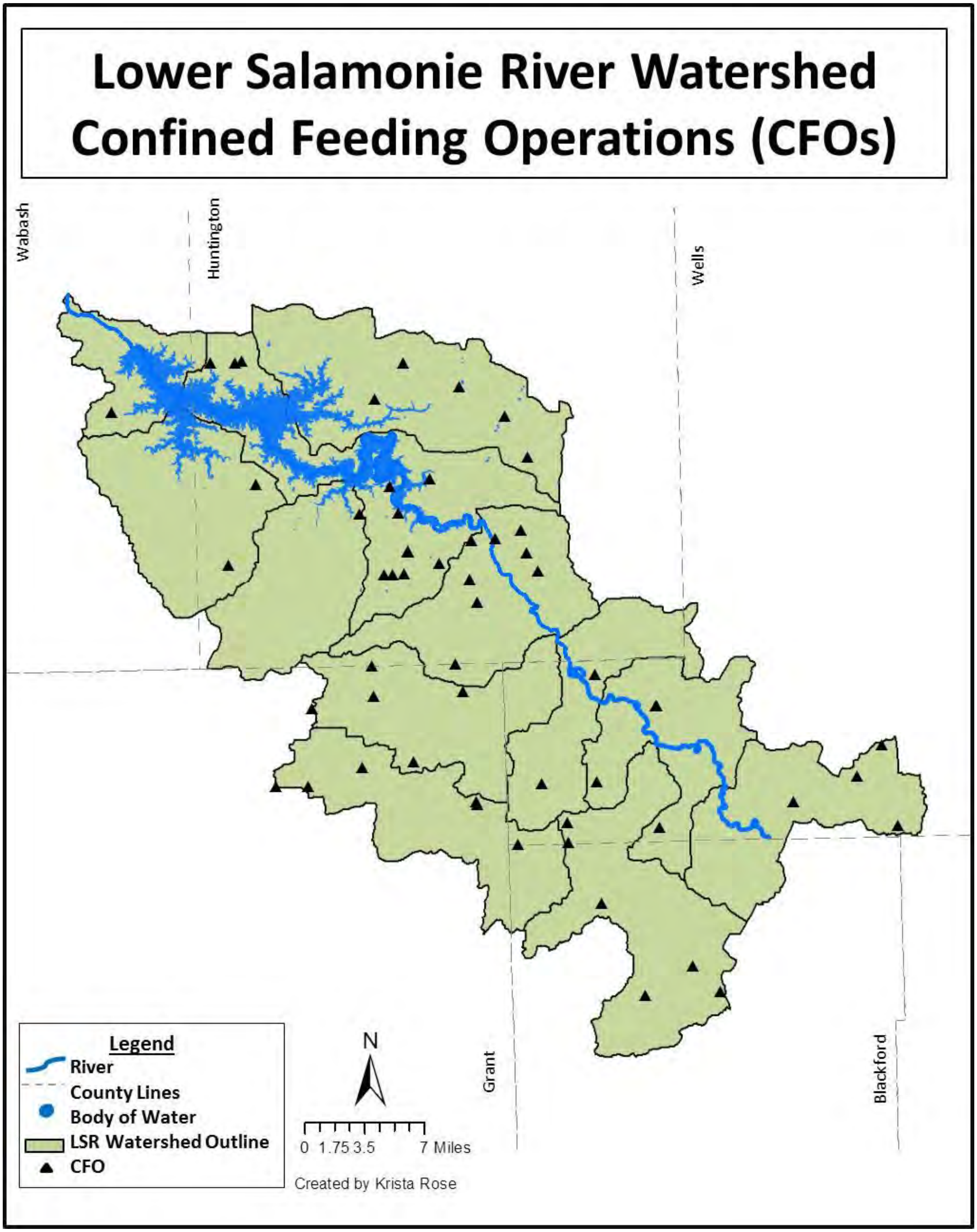
Some animals are raised in open lots or pastures, but most are reared in confined feeding operations. Confined feeding is the raising of animals for food, fur or recreation in lots, pens, ponds, sheds, or buildings, where they are confined, fed and maintained for at least 45 days during any year, and where there is no ground cover or vegetation present over at least half of the animals' confinement area. Indiana law defines a confined feeding operation (CFO) as any livestock operation engaged in the confined feeding of at least 300 cattle, 600 swine or sheep, or 30,000 fowl, such as chickens, ducks and other poultry. IDEM regulates these confined feeding operations, as well as smaller livestock operations which have violated water pollution rules or laws, under IC 13-18-10. A total of 56 CFOs are documented within the LSR watershed (Figure 15).

There are two different terms for CFOs, and the difference relates to the size of the operation. CFOs are described above, and CAFOs are CFOs that meet threshold numbers for larger operations. These threshold numbers are:

- 700 mature dairy cows
- 1,000 veal calves
- 1,000 cattle and other mature dairy cows
- 2500 swine above 55 lbs
- 10,000 swine below 55 lbs
- 500 horses
- 10,000 sheep or lambs
- 55,000 turkeys
- 30,000 – 125,000 laying hens or broilers depending on type of manure handling
- 5,000 – 30,000 ducks depending on type of manure handling

Many of IDEMs program requirements apply to CFOs of all sizes whereas some are reserved for the larger operations or CAFOs. All requirements are designed to minimize negative environmental impacts.

**Figure 15 Confined Feeding Operations in the Lower Salamonie River watershed**



### 2.4.2 Natural Communities

The LSR watershed falls within the Bluffton Till Plain natural region (Homoya et. al.). While most of the natural communities of this region are forested, minor areas of bog, prairie, fen, marsh, and lake communities exist. Composition of forest species include red maple *(Acer rubrum*), pin oak *(Quercus palustris*), bur oak *(Q. macrocarpa),* swamp white oak *(Q. bicolor)*, American elm *(Ulmus americana)*, green ash *(Fraxinus pennsylvanica),* and swamp cottonwood *(Populus heterophylla)*. A large number of northern wetland species occur in this area, e.g. cottongrass *(Eriophorum gracile),* northern St. John's-wort *(Hypericum boreale),* pitcher plant *(Sarracenia purpurea),* and sedges *(Carex alopecoidea, C. laricina,* and *C. limosa).* Two southern swamp species are known here as geographic restrictions: swamp St. John's-wort *(Triadenum tubulosum)* and log sedge *(Carex decomposita).* These two species, found within the Bluffton Till Plain Section of the northeast quadrant, are possibly found in only one other quadrant of the state (Homoya, 1985). Today, the upland soils support white oak, sugar maple, tulip poplar, northern red oak, wild black cherry, black walnut, white ash, American basswood, and slippery elm, while the wetter soils support red maple, pin oak, American elm, bur oak, and swamp white oak (Whitaker, et al., 2012). Invasive plant species are also present on the property and include such species as phragmites, reed canary grass, black locust, bush honey suckle, and buckthorn (Harrington, 2011).

According to the DNR, the Salamonie River State Forest was created as a demonstration riverside forest for the reclamation of eroded land. The forest was established in the mid-1930s when local people assisted the state in purchasing the hilly land and bluffs along the Salamonie River. Most of the land's topsoil was eroded away, making reclamation of the area a major challenge. To deal with this challenge, a 200-member Civilian Conservation Corps (CCC) camp was created. The CCC designed and planned the forest and recreation facilities, constructed the Hominy Ridge Lake, and opened a stone quarry. Several hundred acres of land were reforested, and many recreation facilities were built. Today, visitors to these properties enjoy activities such as camping, hiking, fishing and many other activities (Department of Natural Resources, n.d.).

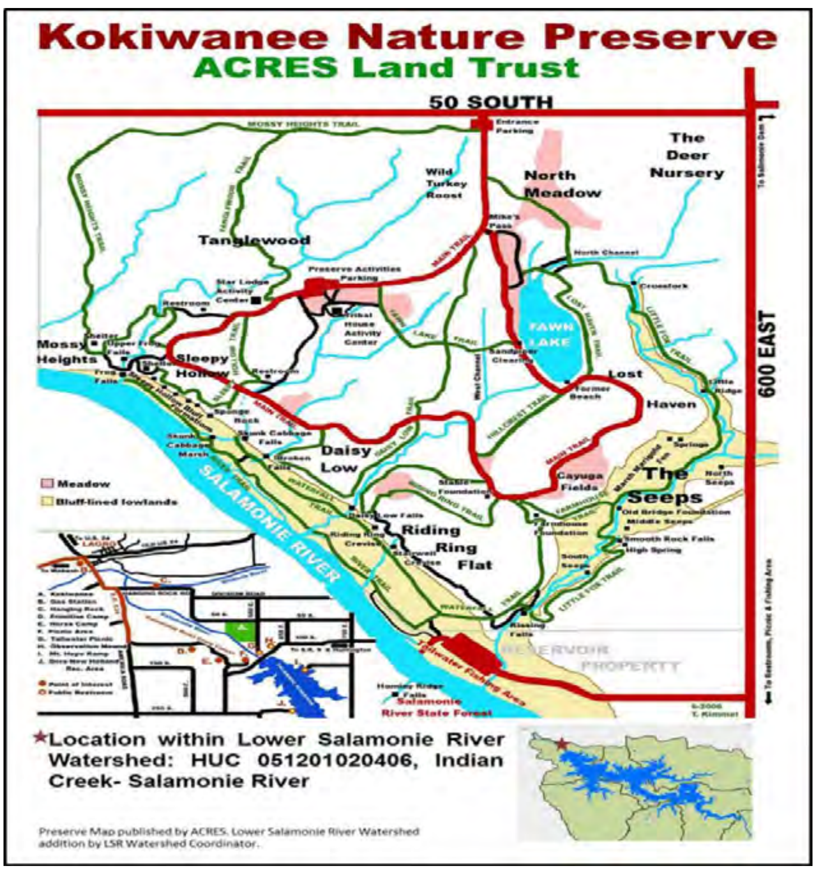
The Salamonie Reservoir and Salamonie River State Forest provide habitat for a diverse wildlife community. According to the DNR 5-year Strategic Plan (2011 – 2015), there are abundant populations of eastern wild turkey and white-tailed deer. Raccoon, red fox, coyote, skunk and opossum populations flourish and may require population control via trapping and hunting. According to the Strategic Plan, both beaver and river otter populations are abundant throughout the reservoir and river. In the spring and fall, water birds are common in the reservoir, and puddle ducks are common on the river itself as well as the 38 ponds and wetlands located across the reservoir property. Canada Geese and Mallards use the reservoir during migration from December to February, and many will persist as long as open water remains. Bald Eagles have been present since the 1990s, and populations are steadily increasing. In addition, Adult ospreys are regularly observed feeding along the reservoir and Hominy Ridge Lake during the summer.

Many reptile and amphibian species are found in the numerous wetlands, ponds, stream corridors, forests, and vernal pools across the reservoir property. Species observed include leopard frogs, tiger salamanders, red-backed salamanders, Jefferson salamanders, small-mouthed salamanders, bullfrogs, leopard frogs, snapping turtles, painted turtles, black rat snakes, and garter snakes.

Various wooded stream corridors and woodland edges across the property provide habitat for bat species, including the Indiana bat, a federally endangered species that has been documented on the property.

The watershed's single nature preserve is situated on the north side of the Salamonie River, across from the Salamonie River State Forest in Wabash County. The Kokiwanee Nature Preserve (Figure 16) encompasses 139.6 acres, and has been owned and managed by ACRES Land Trust since December of 2003. According to the Kokiwanee Nature Preserve Management Plan, the land is dominated by sugar maple; white, red, black, and chinquapin oak; shagbark and bitternut hickory; hackberry; white, blue, green, and black ash; walnut; and basswood. Several dozen rare or uncommon species are restricted to various bluff-side habitats within the preserve. Approximately 40 bird species, including Bald Eagles and many cliff-dwelling species, are frequently seen in Kokiwanee and Salamonie River State Forest which provide a large, contiguous block of interior forest habitat. Nine reptile and amphibian species are found within the preserve, including the timber rattlesnake, which is unusual for the region. The Management Plan describes the terrestrial communities seen at the preserve as bluff-top prairie-savannah, limestone ledge community, cliff-side shrub community, calcareous forest, mixed mesophytic forest, and small-stream floodplain forest. Wetlands are described as calcareous fen, seepage swamps, and hanging fens (Fleming, 2011). Along with this diverse array of desired species and habitats are sixty-five non-native plant species. Prime concerns include: Tree of Heaven, multiflora rose, autumn olive, Asian bush honeysuckle, crown vetch, garlic mustard, and periwinkle.

**Figure 16 Kokiwanee Nature Preserve Map**



## 2.5 Other Planning Efforts

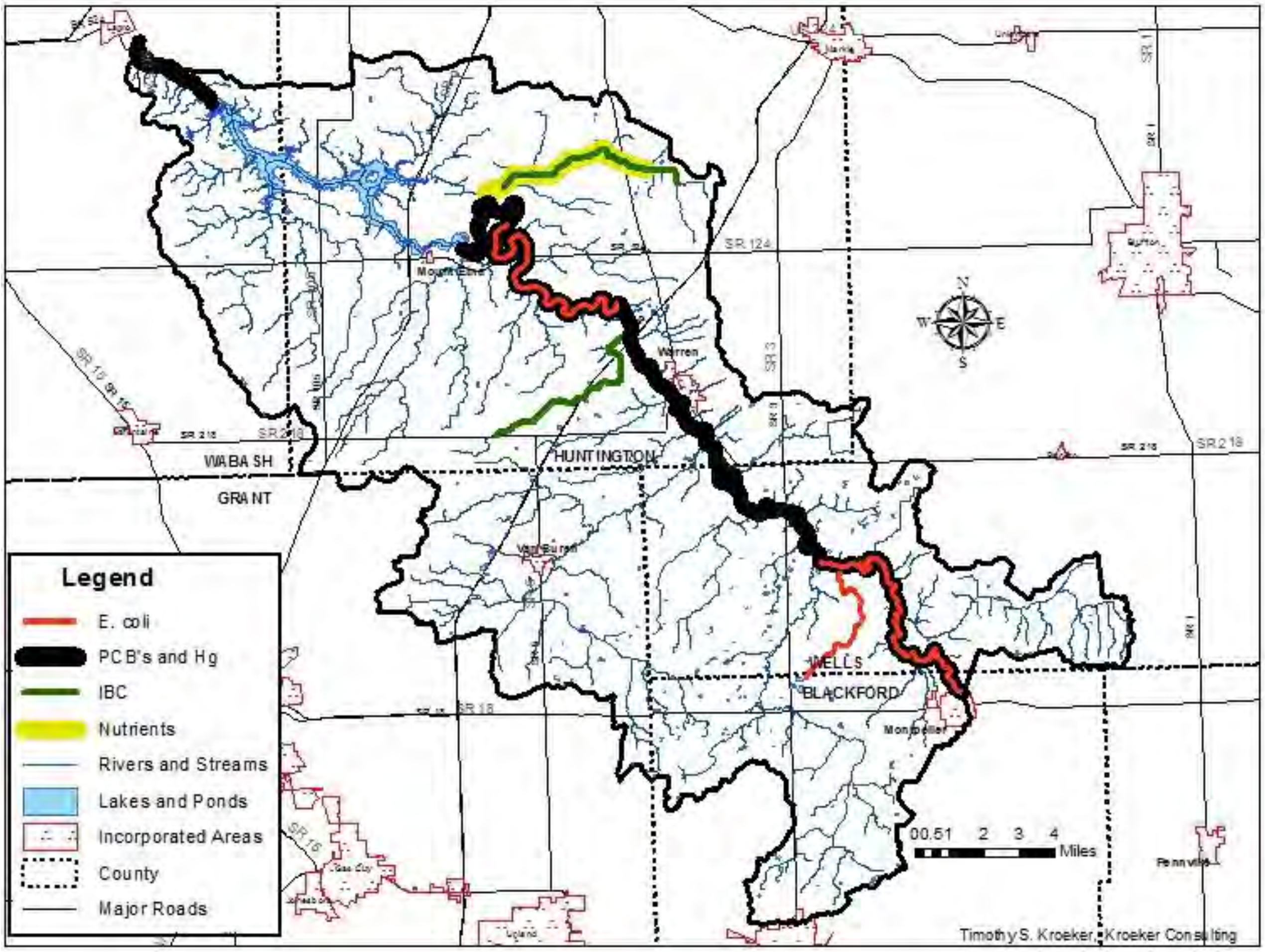
### 2.5.1 Federal Clean Water Act- Sections 305(b) and 303(d)

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify waters, based on assessment that do not or are not expected to meet applicable water quality standards. States must then rank these waters based on severity, and develop a Total Maximum Daily Load or TMDL for each waterbody listed. A TMDL is the total amount of a pollutant that can be assimilated by a body of water and still meet applicable water quality standards. Although there are several streams listed in the Lower Salamonie River watershed (Figure 17), there are presently no TMDLs developed for the Lower Salamonie. However, according to IDEM's long term TMDL Schedule, three listed waterbodies in the Lower Salamonie are scheduled for development between 2017 and 2021. The LSR watershed has 13 segments listed on the 2010 303(d) list. A total of 27 impairments are listed, which include E.coli, polychlorinated biphenyls (PCB), mercury, and impaired biotic communities (IBC) (Table 17).

**Table 17 Lower Salamonie River Watershed 303(d) List of Impaired Waters**

| HUC 10 | HUC 12 | Waterbody Segment ID | County | Waterbody Segment Name | Cause of Impairment | Miles | Unit |
|---|---|---|---|---|---|---|---|
| 512010203 | 51201020301 | INB0231_00 | Wells | Salamonie River-Rhoton Ditch | E.coli, PCBs, Total Mercury in Fish Tissue | 4.6 | Miles |
| | 51201020303 | INB0233_00 | Wells | Salamonie River | E.coli, PCBs, Total Mercury in Fish Tissue | 4 | Miles |
| | 51201020306 | INB0236_00 | Wells | Salamonie River-Custard Drain | PCBs, Total Mercury in Fish Tissue | 3.4 | Miles |
| 512010204 | 51201020405 | INB0242_T1002 | Huntington | Salamonie River-Lancaster | E.coli, PCBs, Total Mercury in Fish Tissue | 9.12 | Miles |
| | 51201020401 | INB0238_01 | Huntington | Salamonie River | PCBs, Total Mercury in Fish Tissue | 3.6 | Miles |
| | 51201020401 | INB0241_01 | Huntington | Salamonie River (Downstream of Detamore Ditch) | PCBs, Total Mercury in Fish Tissue | 4.4 | Miles |
| | 51201020401 | INB0241_02 | Huntington | Salamonie River (Downstream of Detamore Ditch) | PCBs, Total Mercury in Fish Tissue | 1.1 | Miles |
| | 51201020401 | INB0241_T1001 | Huntington | Detamore Ditch | Impaired Biotic Communities | 0.7 | Miles |
| | 51201020405 | INB0242_01 | Huntington | Salamonie River | PCBs, Total Mercury in Fish Tissue | 9.1 | Miles |
| | 51201020403 | INB0244_00 | Huntington | Majenica Creek-Headwaters | Impaired Biotic Communities, Nutrients | 6.05 | Miles |
| | 51201020406 | INB0248_00 | Wabash | Salamonie River (Below Dam) | PCBs, Total Mercury in Fish Tissue | 3.1 | Miles |
| | 51201020406 | INB02P1009_00 | Wabash | Hominy Ridge Lake | Total Mercury in Fish Tissue | 0.02 | Miles |
| | 51201020405 | INB02P1007_00 | Huntington | Salamonie Reservoir | PCBs, Total Mercury in Fish Tissue | 4.23 | Miles |

**Figure 17 Lower Salamonie River Watershed 303(d) Impaired Waters**




## 2.5.2 County Comprehensive Plans

County Comprehensive Plans are designed to encourage the most appropriate use of land, water, and other resources within the county consistent with the interests of the citizens. These plans set forth goals, objectives, policies, and implementation techniques that will guide development activity, and promote, preserve, and protect the health, safety, and general welfare of its citizens. From a watershed planning perspective, the plans provide a common language and vision, and a basic framework for future decision making.

<u>Huntington County Comprehensive Plan, 2005</u>

The Huntington County Comprehensive Plan lists several goals that are relevant to watershed planning as seen below.

- Environment: Promote an ecologically sound community through the protection and enhancement of environmental resources.

- Parks and Recreation: Develop, maintain, and promote recreational opportunities and/or facilities to meet the current and future needs of Huntington County and preserve greenspaces between towns by development of a county wide forest preserve system.

- Growth Management: Manage and direct growth and development in Huntington County by encouraging compact urban form within the corporate limits of each municipality, discouraging sprawl, and preserving the integrity of prime agricultural land while maintaining the highest "quality of life" for current and future residents.

Section one of the Huntington County Comprehensive Plan goes into great detail concerning the objectives, strategies, and timelines relevant to the environmental goal stated above. The objectives directly related to this plan are as follows:

- Protect the local groundwater supply.
- Protect the quality and quantity of water in Huntington County's streams, rivers, and reservoirs.
- Conserve natural areas such as forestland, wetlands and prairies.
- Protect and enhance the character of the natural environment present in Huntington County.
- Protect and enhance the streams and riverbanks throughout the county.
- Minimize conflicts between growth and the natural environment.
- Protect and preserve natural drainage areas and the 100-year floodplain.
- Reserve open space for future development of parks and recreation amenities, and to provide habitats for plants and animals.
- Reduce damage to life and property from flood and other natural hazards by situating them out of harm's way (500-year floodplain).

A copy of the Huntington County Comprehensive Plan can be found on the Huntington County website.

Wells County Comprehensive Plan, 2014

The newly developed comprehensive plan for Wells County lists strengths and weaknesses of the county as viewed by the government. Among the strengths are farming, parks, CFOs, wind farms, and biking and walking trails. However, CFOs are also listed among the weaknesses. The plan stresses the need to properly locate and regulate these entities to minimize any negative aspects of these operations and maximize their benefits. In addition, action points are discussed concerning the goals and aspirations for the future development of the county. Among the issues discussed are thoughts and concerns regarding CFOs, regulations for building in a floodplain, community sanitary sewer service, community recreation, and discouraged land uses (i.e. landfills, commercial scale wind turbines, etc.). A copy of the Wells County Comprehensive Plan can be found on the Wells County website. At present, no wind farms are located within the LSR watershed.

Wabash County Comprehensive Plan, 2012

The areas discussed within the Wabash County Comprehensive Plan include agriculture land use and livestock, environmental objectives and goals, and recreational objectives and goals. One objective is to preserve agricultural land and industry. Under this objective is the goal to “provide opportunities for county growth and development while preserving valuable Ag land, promoting community culture, and ensuring the environmental stability that will result in a diversely enhanced and healthier quality of life for the citizens of Wabash County.” The environmental objective states: “Balance the needs of community growth, human health, and other life forms while enhancing and protecting the county’s environment to the maximum possible level.” Under this objective are some of the following goals:

- Protect today’s environment and natural resources for our benefit and the benefit of future generations through strategic development practices.
- Work with Federal, State, and local environmental groups to meet regulations for sewage processing in all rural communities. Focus development where sanitary sewer and infrastructure exists.
- Protect underground aquifers from contamination that can result from inappropriate or improper development and/or use of land.
- Maintain the community floodways, floodplains and spillways as natural spaces primarily for flood and erosion control, water quality management, and groundwater recharge. Development must be managed carefully and well-buffered in these sensitive areas.
- Provide incentives for the agriculture community to incorporate best practices in all Ag and Ag related operations.
- Use zoning and ordinances to preserve natural wooded areas and wetlands to help minimize discord between growth and the natural environment.

Many of the goals, such as maintaining natural spaces for erosion control and water quality management, relate to watershed management and stakeholder concerns found in Table 2. A copy of the Wabash County Comprehensive Plan can be found on the Wabash County website.

Blackford County Comprehensive Plan, 2011

Among the goals and strategies discussed in the Blackford County Comprehensive Plan are the topics of land use and natural resources. Agricultural land, CAFOs, and wind farms are discussed, although no wind farms are currently located within the LSR watershed. The plan does address topics related to rivers and streams within the county in reference to floodplains and parks and recreation goals. Six priority actions were set forth by the plan regarding parks and recreation:

- Protect and Improve Current Assets
- Begin Planning for Park Improvements
- Greenway Projects
- Explore Establishment of County Parks
- Pursue Funding for Green-space Improvements
- The Salamonie River

The plan indicated that the county has no public access points on the Salamonie River, and the master plan should consider options for better utilizing this resource. Increasing the number of public access points along the Salamonie River would help increase recreational use of the river, one of the many concerns of stakeholders in the watershed.

Grant County Comprehensive Plan, 2011

The Grant County Comprehensive Plan covers environmental standards under Chapter 17, and General Development Standards, and animal feeding operations (AFO) under Chapter 27. The Environmental standards section discusses the filling of lands not included in a flood hazard area, the discharge of wastes into public waters, and overflows from drain fields. Development plans and standards for animal feeding operations are discussed in the AFO chapter. Lagoon and pit installation and monitoring wells are also covered. A copy of the Grant County Comprehensive Plan can be found on the Grant County website.

### 2.5.4 Other Planning Efforts

Various other documents and assessments that pertain to the LSR watershed are summarized below.

IDEM Watershed Restoration Action Strategy for the Salamonie River Watershed

The Watershed Restoration Action Strategy (WRAS) for the Salamonie River was published as a living document by IDEM in 2000. It is divided into two parts: *Characterization and Responsibilities,* and *Concerns and Recommendations*. The purpose of the WRAS for the Salamonie River Watershed was to provide a reference point and roadmap in assisting with water quality improvement. It includes stakeholder groups, a general watershed description, point and nonpoint sources of pollution, water quality monitoring programs, fish consumption advisories for the area, and other water quality related programs. The WRAS contains many stakeholder groups with a variety of missions, yet all exhibit an interest in the conservation of the Salamonie River Watershed. The WRAS and the Lower Salamonie River watershed project have many of the same stakeholders, such as NRCS, Hoosier Riverwatch, SWCDs, county health departments, county commissioners, county Purdue University Extension offices, and county surveyors.

The WRAS also discusses water quality concerns and recommended management strategies. The top concerns listed include stream bank erosion and stabilization, failing septic systems, straight pipe discharges, impairments listed on the 303(d) list, fish consumption advisories, and general nonpoint and point source pollution. Many of these concerns have been echoed in stakeholder comments during the development of the LSR watershed project.

Rapid Watershed Assessment for the Salamonie River

Rapid watershed assessments (RWA) developed by ISDA and NRCS provide general recommendations as to where conservation investments would best address the concerns of landowners, conservation districts, and other community organizations and stakeholders. The Salamonie River Watershed RWA, 2008, consists of geographically displayed data layers, along with a text and tabular report summarizing data and source information. RWAs pertain to 8 digit HUCs. They provide a watershed view of resource concerns that can be compared on a statewide scope. As such, information is general in nature and pertains to the entire Salamonie River Watershed. The goal is to assist watershed planners and local stakeholders in the development of a more detailed watershed management plan. Resource concerns identified by the RWA as being top priority include:

- impaired surface water quality due to excessive nutrients, sediments, and bacteria

- poor fish populations
- contaminated ground water quality due to soils with a high leaching index
- threatened and endangered species
- soil quality affected by soil and wind erosion (U.S. Department of Agriculture, Natural Resources Conservation Service, 2008).

<u>US Army Corps of Engineers Water Quality Assessments of the Salamonie Watershed</u>

An assessment on the Salamonie Watershed by Jade L. Young of the USACE included watershed sampling of the Salamonie Reservoir, Salamonie River, and sediment samples from the reservoir. The main reason for the research (as well as this WMP) was to find the causal factors behind the 2009 and 2012 harmful algae blooms in the Salamonie Reservoir. The 2012 algal bloom attracted media attention and public concern when two dogs were reported to have died after swimming in the reservoir. A 2009 reservoir study attributed these toxic algal blooms to increased nutrients in the water column. The source included land-use activities directly around the reservoir and to a much greater extent, the entire Salamonie River watershed. Since 2010, samplings for twelve different chemical parameters have been carried out on an average of 20 sites on the Salamonie River. These data provides a solid background to the existing water quality of the Salamonie River and its impact on the Salamonie Reservoir. A more detailed look at this USACE data will be discussed in Section 3.

<u>Rule 5</u>

Rule 5 is a regulation designed to reduced pollutants that are associated with construction or other land disturbing activities. These activities include such things as clearing, grading, excavation and other land disturbing activities that will result in the disturbance of one acre or more. Or if the area is less than an acre but is part of larger development where in total the land area disturbed will be over an acre, then Rule 5 still applies.
Each County has developed similar procedures to deal with Rule 5 requirements. . The applicant submits their construction plan to the county Soil and Water Conservation District. The office administrator reviews the plan and determines if the plan is adequate or deficient. The form is then returned to the submitter, and they send this on to IDEM along with a (NOI) Notice of Intent form. Depending on the county, there may or may not be a fee associated with this service. This review process helps insure that non-point source pollution from construction activities is adequately controlled in the LSR watershed.

Should a concern be brought to the attention of the SWCD, the SWCD will contact IDEM. A representative from IDEM visits the counties on a routine basis and on request. If there are any regulatory issues, IDEM deals with these problems. It is important that the role of the SWCD remain one of being a “friend” to landowners, and that the SWCD continue to assist them with problems when possible.

### 2.6 Endangered and Threatened Species

The Indiana Department of Natural Resources Natural Heritage Database indicates that there are several threatened, endangered or rare species, as well as high quality natural communities and natural areas documented within the Salamonie River watershed. The following definitions are used to list species:

- *Endangered*: Any species whose prospects for survival or recruitment within the state are in immediate jeopardy, and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government. Plants currently known to occur on five or fewer sites in the state are considered endangered.
- *Threatened*: Any species within Indiana likely to become endangered within the foreseeable future. This includes all species classified as threatened by the federal government. Plants currently known to occur on six to ten sites in the state are considered threatened.
- *Rare*: Plants and insects currently known to occur on 11 to 20 sites.

Thirty-four species listed as state endangered have been observed within the counties that make up the LSR watershed, and 10 species are listed as state threatened (Table 18).

**Table 18 State Endangered and Threatened Species within LSRW Counties**

| Species Name | Common Name | Counties |
|---|---|---|
| **State Endangered** | | |
| **Reptile** | | |
| Sistrurus catenatus catenatus | Eastern Massasauga | Wabash, Wells |
| Nerodia erythrogaster neglecta | Copperbelly Water Snake | Wells |
| Clonophis kirtlandii | Kirtland's Snake | Blackford, Grant, Wells |
| Emydoidea blandingii | Blanding's Turtle | Wabash |
| **Mollusk: Bivalvia (Mussels)** | | |
| Cyprogenia stegaria | Eastern Fanshell Pearlymussel | Wabash |
| Epioblasma torulosa rangiana | Northern Riffleshell | Grant, Huntington, Wabash, Wells |
| Pleurobema clava | Clubshell | Grant, Huntington, Wabash, Wells |
| Epioblasma triquetra | Snuffbox | Huntington, Wabash, Wells |
| Quadrula cylindrica cylindrica | Rabbitsfoot | Grant, Huntington, Wabash, Wells |
| **Mammal** | | |
| Myotis sodalis | Indiana Bat or Social Myotis | Blackford, Huntington, Wabash, Wells |
| **Bird** | | |
| Chlidonias niger | Black Tern | Wabash |
| Lanius ludovicianus | Loggerhead Shrike | Wabash |
| Circus cyaneus | Northern Harrier | Wabash |
| Cistothorus palustris | Marsh Wren | Huntington |
| Dendroica cerulea | Cerulean Warbler | Wabash |
| Ixobrychus exilis | Least Bittern | Huntington |
| Nycticorax nycticorax | Black-crowned Night-heron | Huntington |
| Rallus limicola | Virginia Rail | Grant, Huntington |
| Tyto alba | Barn Owl | Wabash |

**Table 18 Cont. State Endangered and Threatened Species within LSRW Counties**

| Species Name | Common Name | Counties |
|---|---|---|
| **State Endangered** | | |
| Ammodramus henslowii | Henslow's Sparrow | Grant |
| **Insect: Lepidoptera (Butterflies & Moths)** | | |
| Speyeria idalia | Regal Fritillary | Wabash |
| **Insect: Odonata (Dragonflies & Damselflies)** | | |
| Macromia wabashensis | Wabash River Cruiser | Wells |
| **Fish** | | |
| Moxostoma valenciennesi | Greater Redhorse | Huntington, Wabash |
| Clinostomus elongatus | Redside Dace | Wabash |
| **Vascular Plant** | | |
| Euphorbia obtusata | Bluntleaf Spurge | Wells |
| Fragaria vesca var. americana | Woodland Strawberry | Huntington, Wells |
| Plantago cordata | Heart-leaved Plantain | Wells |
| Schizachne purpurascens | Purple Oat | Wabash |
| Crataegus kelloggii | Kellogg Hawthorn | Wells |
| Armoracia aquatica | Lake Cress | Wells |
| Carex arctata | Black Sedge | Wells |
| Carex echinata | Little Prickly Sedge | Wells |
| Carex limosa | Mud Sedge | Wells |
| Viburnum opulus var. americanum | Highbush-cranberry | Wells |
| **State Threatened** | | |
| **Vascular Plant** | | |
| Carex flava | Yellow Sedge | Wabash |
| Coeloglossum viride var. virescens | Long-bract Green Orchis | Blackford, Huntington |
| Eriophorum gracile | Slender Cotton-grass | Wells |
| Erysimum capitatum | Prairie-rocket Wallflower | Wabash |
| Stenanthium gramineum | Eastern Featherbells | Grant |
| Xyris difformis | Carolina Yellow-eyed Grass | Wells |
| **Insect: Lepidoptera (Butterflies & Moths)** | | |
| Calephelis muticum | Swamp Metalmark | Wabash |
| Euphyes bimacula | Two-spotted Skipper | Wabash |
| Euphyes dukesi | Scarce Swamp Skipper | Wabash |
| Poanes viator viator | Big Broad-winged Skipper | Wabash |

In addition to the designation of state endangered, the Indiana Fish and Wildlife Service (FWS) use a designation of special concern. Any animal species requiring monitoring due to known/suspected limited abundance or distribution, or because of a recent change in legal status or required habitat, is classified as being of special concern. Three mollusk species found within the LSR watershed counties are listed as state species of special concern: Wavyrayed Lampmussel *(Lampsilis fasciola)*, Kidneyshell *(Ptychobranchus fasciolaris)*, and Purple Lilliput *(Toxolasma lividus)*. However, according to Brant Fisher, a nongame aquatic biologist with the DNR, these species are no longer found in the Salamonie River.

The Rayed Bean and Snuffbox are two state endangered mussels that are historically known to be found in the Salamonie River. The Rayed Bean is a small mussel, usually less than 1.5in (3.8cm) in length, while the Snuffbox is a small- to medium sized mussel, with males reaching up to 2.8in (7.0cm) in length and females reaching roughly 1.8in (4.5cm). Based on historical and current data, the Rayed Bean has declined significantly, and is now known to inhabit only 31 streams and 1 lake (down from 115) in 7 states and 1 Canadian province (Fish and Wildlife Service, Department of the Interior, 2012). According to Brant Fisher the Rayed Bean was historically known to be in the Salamonie River and Upper Wabash River. Currently, however, it is only found live (and reproducing) in the Tippecanoe River in Indiana.

Extant populations of the Snuffbox are known from 79 streams in 14 States and 1 Canadian province, including the Salamonie River (Fish and Wildlife Service, Department of the Interior, 2012). One reproducing population is found in a section of the Salamonie River upstream from the Salamonie Reservoir. This is likely the last reproducing population of Snuffbox left in the state of Indiana. According to Fisher, live individuals could still exist in the Tippecanoe River and Upper East Fork White River drainage area, but they are likely no longer reproducing. The current Snuffbox population was first discovered in 2004, and is now believed to be restricted to a section of less than 10 river miles of the Salamonie River. As of the beginning of 2014, the Wildlife Diversity Program has been using some of the female Snuffboxes from the Salamonie River population to raise juveniles in hopes of augmenting the Tippecanoe River population.

Habitat preferences for species on the state list vary. Warm water temperatures, high turbidity, and loss of habitat can all impact fish and mussel diversity. Deforestation or forest fragmentation has likely affected the Indiana bat species. However, according to the DNR Wildlife Specialist for the Salamonie Reservoir, data shows that the Indiana bat is living within the LSR watershed. This species requires large hunting areas; ideally areas of dense forest and small stream corridors with well-developed riparian forests. The loss of these habitats could result in the loss of roost and hunting habitat, thus eliminating the species. Other listed species, including the Eastern Massasauga, Kirtland's Snake, and several bird and vascular plant species rely on prairie habitat. Many species live on the border of forested and prairie habitats, hunting in one habitat and nesting in the other. The conversion of prairies and forests to agricultural and urban land uses could have resulted in the decline in these populations. Endangered species represent a stakeholder concern as identified in Table 2.

The DNR also lists 33 endangered, threatened, and rare (ETR) vascular plants and seven high quality natural communities that are found within the five counties that make up the LSR watershed (Table 19).

**Table 19 ETR Vascular Plants and High Quality Natural Communities of LSR Watershed**

| Vascular Plants | | | |
|---|---|---|---|
| Species Name | Common Name | STATE | Counties |
| Armoracia aquatica | Lake Cress | State Endangered | Wells |
| Carex arctata | Black Sedge | State Endangered | Wells |
| Carex echinata | Little Prickly Sedge | State Endangered | Wells |
| Carex limosa | Mud Sedge | State Endangered | Wells |
| Crataegus kelloggii | Kellogg Hawthorn | State Endangered | Wells |
| Euphorbia obtusata | Bluntleaf Spurge | State Endangered | Wells |
| Fragaria vesca var. americana | Woodland Strawberry | State Endangered | Huntington, Wells |
| Plantago cordata | Heart-leaved Plantain | State Endangered | Wells |
| Schizachne purpurascens | Purple Oat | State Endangered | Wabash |
| Viburnum opulus var. americanum | Highbush-cranberry | State Endangered | Wells |
| Arethusa bulbosa | Swamp-pink | State Extirpated | Wells |
| Platanthera orbiculata | Large Roundleaf Orchid | State Extirpated | Wells |
| Andromeda glaucophylla | Bog Rosemary | State Rare | Wells |
| Arenaria stricta | Michaux's Stitchwort | State Rare | Wabash |
| Carex lupuliformis | False Hop Sedge | State Rare | Wabash |
| Crataegus succulenta | Fleshy Hawthorn | State Rare | Grant |
| Cypripedium calceolus var. parviflorum | Small Yellow Lady's-slipper | State Rare | Wabash |
| Pinus strobus | Eastern White Pine | State Rare | Huntington |
| Platanthera psycodes | Small Purple-fringe Orchis | State Rare | Blackford |
| Poa alsodes | Grove Meadow Grass | State Rare | Wells |
| Poa wolfii | Wolf Bluegrass | State Rare | Grant |
| Viburnum molle | Softleaf Arrow-wood | State Rare | Huntington |
| Waldsteinia fragarioides | Barren Strawberry | State Rare | Wabash |
| Zigadenus elegans var. glaucus | White Camas | State Rare | Wabash |
| Carex flava | Yellow Sedge | State Threatened | Wabash |
| Coeloglossum viride var. virescens | Long-bract Green Orchis | State Threatened | Blackford, Huntington |
| Eriophorum gracile | Slender Cotton-grass | State Threatened | Wells |
| Erysimum capitatum | Prairie-rocket Wallflower | State Threatened | Wabash |
| Stenanthium gramineum | Eastern Featherbells | State Threatened | Grant |
| Xyris difformis | Carolina Yellow-eyed Grass | State Threatened | Wells |
| Cypripedium candidum | Small White Lady's-slipper | Watch List | Wabash |
| Juglans cinerea | Butternut | Watch List | Huntington |
| Panax quinquefolius | American Ginseng | Watch List | Wabash |

**Table 19 Cont. ETR Vascular Plants and High Quality Natural Communities of LSR Watershed**

| High Quality Natural Communities | | | |
|---|---|---|---|
| Species Name | Common Name | STATE | Counties |
| Forest - flatwoods central till plain | Central Till Plain Flatwoods | State Significant | Grant, Blackford, Huntington, Wabash, Wells |
| Forest - floodplain wet-mesic | Wet-mesic Floodplain Forest | State Significant | Blackford, Wabash, Wells |
| Forest - upland dry-mesic | Dry-mesic Upland Forest | State Significant | Wabash |
| Forest - upland mesic | Mesic Upland Forest | State Significant | Grant, Huntington, Wabash |
| Primary - cliff limestone | Limestone Cliff | State Significant | Wabash |
| Wetland - fen | Fen | State Significant | Wabash |
| Wetland - marsh | Marsh | State Significant | Blackford |
| **Other Significant Feature** | | | |
| Geomorphic - Nonglacial Erosional Feature - Water Fall and Cascade | Water Fall and Cascade | | Wabash |

## 2.7 Relationships

When watershed-wide data are examined, several relationships among watershed parameters become apparent. These relationships are discussed here in general, while specific sub-watershed related relationships are discussed in more detail in subsequent sections.

### 2.7.1 Soils, Topography and Land Forms

As mentioned, the LSR watershed lies within the Upper Wabash Valley, which is situated on mostly Silurian bedrock. In some parts of the LSR watershed, this bedrock is exposed as a result of the lowlands of the Valley being superimposed on a regional bedrock plateau. The Salamonie Gorge, which is located in the Indian Creek-Salamonie River sub-watershed, is deeply entrenched into the bedrock. The bedrock forms a series of sharp bluffs and cliffs along the river. The limestone beds tend to be more resistant to weathering than the siltstone and produce a series of ledges and waterfalls where they crop out. The steeper slopes adjacent to streams are characteristic of areas prone to soil loss, especially if they are farmed or lack vegetative cover year round. These would be a potential source of sediments and excess nutrients in the watershed. These areas would be good candidates for the installation of Best-Management Practices (BMPs) based on site conditions.

Most soils that occur in the watershed are generally classified as prime farmland. These areas can be a significant source of sediment and nutrients to rivers and streams if not managed properly. They can also be a source of nitrogen leaching when artificially drained. Conservation tillage and other best management practices are extremely important to minimize soil erosion.

### 2.7.2 Development and Population Centers

The largest population center inside the LSR watershed is the city of Montpelier. Therefore, urban BMPs will most likely be targeted for this area. Other urban impacts come from upstream and include the city of Portland. Portland is within the greater Salamonie River watershed, and is situated closer to the headwaters of the Salamonie River. It has a high population density and significant impervious surfaces which can be a source of urban non-point source pollution.

Other towns and communities in the area, especially unsewered areas, could be sources of urban non-point pollution. Failing septic systems also contribute E.coli and excess nutrients to the waterways. Given that the majority of the soils in the watershed are poorly suited for conventional septic systems, alternative wastewater treatment systems and regional sewer districts should be encouraged. Separation of combined sewer overflow (CSO) systems, the use of low impact developments and management practices, water conservation, and the use of storm water BMPs should also be encouraged.

### 2.7.3 High Quality Habitat, ETR Species, and Recreational Opportunities

A significant amount of publicly-owned land is located within the LSR watershed, especially in the northern part, including the Salamonie Reservoir property, Salamonie River State Forest, and nearby nature preserves. Since increasing recreational access to the river is a stakeholder concern, the variety of high quality habitats and ETR species in these areas creates a unique opportunity in the watershed. Publicly-owned land and non-profit conservation land that is not routinely visited by watershed stakeholders could provide a great opportunity to positively impact water quality. People care for and protect what they know and are connected to. Enhancement of these areas would allow stakeholders to view management options before developing/ them on their own property. As stakeholders' concern for these areas grows, willingness to protect ETR species and high-value natural communities, and their desire to positively impact water quality and the environment will increase the opportunity present in the watershed to improve water quality. Additionally, as many of these unique habitats are already protected through land trust and public ownership, the ability to positively impact ETR species is high within the watershed. Greater efforts need to be made to increase the number of access points along the main stem of the Salamonie River and appropriate tributaries in order to benefit recreation on the river.

## 3.0 Watershed Inventory II: 12-Digit HUC Drainages

### 3.1 Watershed Inventories

A desktop survey involves collecting and analyzing watershed field information through a variety of existing Geographic Information Systems (GIS) data and online mapping sources, data from a variety of agencies, and information in the literature. Information was collected through a array of online sources, such as IndianaMap, Local Decision Maker, county GIS websites, National Wetlands Inventory, and USGS Water Data for the Nation. The USGS website allows for real-time and historical water conditions at all USGS flow gauges. Two flow gauges exist on the Salamonie River within the LSR watershed: site 03324300 near Warren, IN, and site 03324500 at Dora, IN. However, the flow gauge at Dora only measures gage height, and not discharge. The flow gauge near Warren provides both discharge and gage height measurements. Websites such as IndianaMap were used to collect public GIS layers from government sources such as the National Hydrology Dataset from the USGS and U.S. EPA, section 303(d) impaired waters from IDEMs Office of Water Quality, and infrastructure data from the Indiana Department of Homeland Security, and Indiana Department of Transportation.

Specific layers were downloaded directly from IndianaMap and used in ESRI ArcMap Desktop 10 for mapping purposes. The EPA's Permit Compliance System online search was also utilized to obtain permit information and violations regarding National Pollution Discharge Elimination System (NPDES) permits for facilities that discharge industrial, municipal, or agricultural waste to the area's bodies of water. GIS data and layers were also used to estimate areas that would benefit from the implementation of conservation practices. Available reports from other planning efforts, such as the Rapid Watershed Assessment for the Salamonie River as discussed in Section 2.5, and tillage transect information from the NRCS and ISDA, as discussed in Section 2.4, were also reviewed to gather existing natural resource data. Reports such as these, along with GIS layers provided by NRCS and ISDA personnel, identify current land use, soils, wetlands, and tillage trends, which help identify areas where conservation practices may already exist.

### 3.1.1 Water Quality Targets

Water quality targets for each parameter have been selected based on applicable Indiana Administrative Code, Hoosier Riverwatch, and other standards accepted by IDEM. The Indiana Administrative Code designates all surface waters of the state for full body contact recreation uses. Targets outlined in Table 20 are used to assess the water quality for the LSR Watershed drainage area.

**Table 20 LSR Watershed Water Quality Targets**

| Water Quality Targets 2013 | | | |
|---|---|---|---|
| **Parameter** | **Target Level** | | **Source** |
| pH | min | 6 | Indiana Administrative Code |
| | max | 9 | Indiana Administrative Code |
| Temperature | January °C | 10.0 | Indiana Administrative Code |
| | February °C | 10.0 | Indiana Administrative Code |
| | March °C | 15.6 | Indiana Administrative Code |
| | April °C | 21.1 | Indiana Administrative Code |
| | May °C | 26.7 | Indiana Administrative Code |
| | June °C | 32.2 | Indiana Administrative Code |
| | July °C | 32.2 | Indiana Administrative Code |
| | August °C | 32.2 | Indiana Administrative Code |
| | September °C | 32.2 | Indiana Administrative Code |
| | October °C | 25.5 | Indiana Administrative Code |
| | November °C | 21.1 | Indiana Administrative Code |
| | December °C | 14.0 | Indiana Administrative Code |
| Dissolved Oxygen | min mg/l | 4 | Indiana Administrative Code |
| | max % | 100 | Indiana Administrative Code |
| E.coli | max | 235 | Safe bodily contact limit (Based on one-time sample) |

**Table 20 Cont.  LSR Watershed Water Quality Targets**

| | | | |
|---|---|---|---|
| Total Phosphorous | max mg/l | 0.08 | Ohio EPA recommendation for warm water aquatic habitats |
| Nitrate-Nitrogen | max mg/l | 1 | Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams in Ohio EPA Technical Bulletin MAS//1999-1-1 [PDF] (Ultimate goal for LSR watershed) |
| | max mg/l | 1.5 | Dividing line between mesotrophic and eutrophic streams (Dodds, W.K. et al., 1998, Table 1, pg. 1459, and in EPA-822-B-00-002 [PDF], p 27.) (Ultimate goal for the Salamonie River – mainstem) |
| | max mg/l | 10 | IDEM draft TMDL target based on drinking water targets (Short-term goal for LSR watershed) |
| Turbidity | max NTU<br>max TSS (mg/L) | 10.4<br>25 | US EPA recommendation<br>Concentrations above this value negatively impact fish populations (Waters, 1995) |
| Citizen Habitat Evaluation Index CQHEI | >100 High quality Stream | | Hoosier River Watch |
| | > 60 Generally Healthy | | Hoosier River Watch |
| Pollution Tolerance Index | >23 Excellent | | Hoosier River Watch |
| | 17-22 Good | | Hoosier River Watch |
| | 11-16 Fair | | Hoosier River Watch |
| | 10< Poor | | Hoosier River Watch |

### 3.1.2 Lower Salamonie River Watershed Water Quality Monitoring Program, 2013

A water quality monitoring program was initiated in the summer of 2013 for 13 sites within the LSR watershed. Monitoring was performed to gain an understanding of the existing water quality, and to identify potential problems and their sources.  Monitoring was completed using in-house equipment purchased for the program.  Monthly chemical and physical tests included: stream flow, dissolved oxygen, pH, temperature, nitrate and nitrite, total phosphorous, biochemical oxygen demand (BOD), and turbidity. Table 21 provides an overview of the sampling procedures. A total of nine sampling events take place in a year. Seven sampling events occur during the recreational period, April to October, and two more events during the non-recreational period from November to March. Monitoring will continue through 2016.

**Table 21 Water Monitoring Procedure Overview**

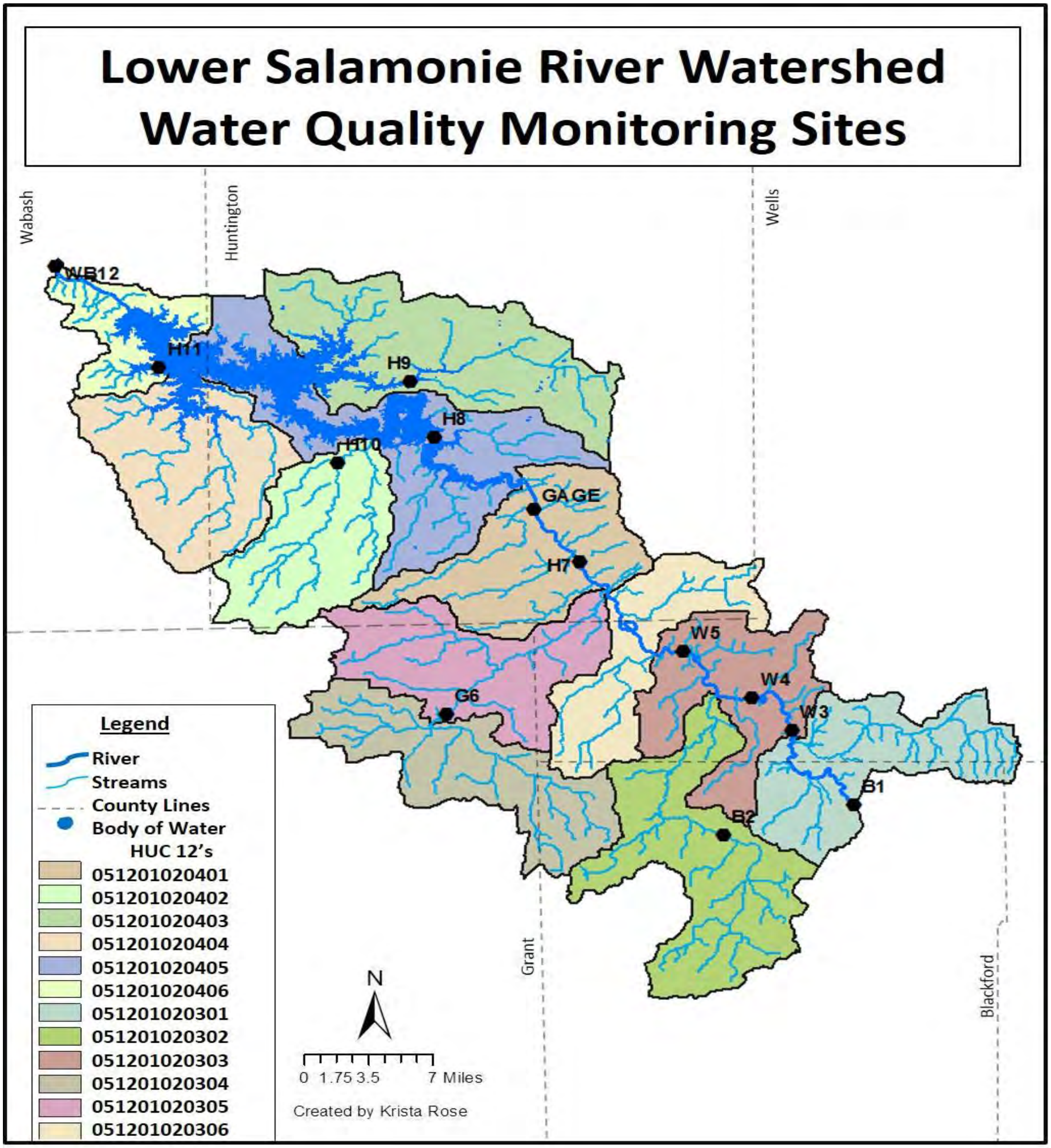
| Parameter | Sampling Method | Sample Container | Sample Volume | Holding Time | Sample Matrix | Sampling Frequency |
|---|---|---|---|---|---|---|
| BOD | ProODO | In field/ Lab | In field/Lab | 24 hours | Stream Water | June-Nov: Monthly<br><br>Dec-March: 2 time minimum |
| E. coli | Grab sample | Sterile Bottle | 5 mL | 24 hours | | |
| DO | ProODO | In field | In field | In field | | |
| pH | pHotoFlex | | | | | |
| Nitrate-nitrite nitrogen | pHotoFlex | | | | | |
| Total phosphorus | pHotoFlex | | | | | |
| Flow | HRW method | | | | | |
| Turbidity | Turbidity Tube | | | | | |
| Temperature | ProODO | | | | | |
| Macroinvertebrate | HRW method | | | | | |
| Habitat | HRW method | | | | | |

Yearly habitat and macroinvertebrate assessments were completed at each site where practical. Currently, 13 sites are sampled within the LSR watershed within Huntington, Wabash, Grant, Wells, and Blackford Counties, as seen in Figure 18. Location details for each sampling site are listed in Table 22. Results from June 2013 to August 2014 tests are discussed in the sub-watershed sections and summarized in Section 4 of this WMP.

**Table 22 LSR Watershed Sampling Location Details**

| LOWER SALAMONIE RIVER WATERSHED WATER QUALITY MONITORING SITES | | | | | | |
|---|---|---|---|---|---|---|
| **ID** | **LATITUDE** | **LONGITUDE** | **HUC 12** | **HUC 12 NAME** | **WATERBODY NAME** | **TOWN** |
| B1 | 40.559293 | -85.279222 | 051201020301 | SCUFFLE CREEK- SALAMONIE RIVER | SALAMONIE RIVER- EAST CREEK | Montpelier |
| B2 | 40.545279 | -85.351725 | 051201020302 | PRAIRIE CREEK | PRAIRIE CREEK | Montpelier |
| W3 | 40.596172 | -85.312435 | 051201020303 | SHADLE DRAIN- SALAMONIE RIVER | SALAMONIE RIVER-SCUFFLE CREEK | Montpelier |
| W4 | 40.612159 | -85.333983 | 051201020303 | SHADLE DRAIN- SALAMONIE RIVER | SALAMONIE RIVER- CARNES NEW CLARK DITCH | Warren |
| W5 | 40.635238 | -85.372123 | 051201020303 | SHADLE DRAIN- SALAMONIE RIVER | SALAMONIE RIVER-PRAIRIE CREEK | Warren |
| G6 | 40.606939 | -85.504873 | 051201020305 | LITTLE BLACK CREEK- BLACK CREEK | BLACK CREEK | Van Buren |
| H7 | 40.680905 | -85.428450 | 051201020401 | WEASEL CREEK- SALAMONIE RIVER | SALAMONIE RIVER- BLACK CREEK | Warren |
| GAGE | 40.712500 | -85.453611 | 051201020401 | WEASEL CREEK- SALAMONIE RIVER | SALAMONIE RIVER- DETAMORE DITCH | Warren |
| H8 | 40.741800 | -85.509827 | 051201020405 | SALAMONIE RESERVOIR- SALAMONIE RIVER | SALAMONIE RIVER- BROOK CREEK | Warren |
| H9 | 40.770565 | -85.521588 | 051201020403 | MAJENICA CREEK | MAJENICA CREEK | Huntington |
| H10 | 40.738752 | -85.544948 | 051201020402 | RICHLAND CREEK | RICHLAND CREEK | Huntington |
| H11 | 40.772807 | -85.621691 | 051201020406 | INDIAN CREEK- SALAMONIE RIVER | SALAMONIE RIVER- ROCKAWAY CREEK | Lagro |
| WB12* | 40.829592 | -85.718591 | 051201020406 | INDIAN CREEK- SALAMONIE RIVER | SALAMONIE RIVER- SALAMONIE DAM | Lagro |

**Figure 18 LSR Watershed Water Quality Monitoring Site Locations**



### 3.1.3 Historical Water Quality Data Used

Water quality for the LSR watershed has been evaluated by a number of agencies and is discussed below. Statewide assessments and listings include the integrated water monitoring assessment (305(b) Report), the impaired waterbodies assessment (303(d) List), fish consumption advisories, and USACE water quality and hazardous algal bloom data. Area specific information includes USACE data, SWCD data, IDEM monitoring, and various upper Wabash River Basin studies.

**Fish Consumption Advisories**

The Indiana State Department of Health (ISDH), Indiana DNR, IDEM, and Purdue University collaborate to produce the annual Indiana Fish Consumption Advisory. The Advisory is based on the statewide collection and analysis of fish samples for long-lasting contaminants found in fish tissue, such as PCBs, pesticides, and/or heavy metals (e.g., mercury). Samples were taken from fish that feed at all depths including predatory and bottom-feeding fish. Fish consumption advisories for the Salamonie River and Reservoir are listed below in Table 23. Recommended maximum fish consumption rates are listed by location, fish species and fish size. Sensitive populations include: pregnant or nursing women, women that will become pregnant, and children less than 6 years of age.

**Table 23 LSR Watershed County Fish Consumption Advisories (2010)**

| Location | Species | Fish Size | Contaminant | Maximum Amount for Adults to Eat | Maximum Amount for Adults to Eat-Sensitive Population |
|---|---|---|---|---|---|
| **Salamonie River** | Common Carp | all | Mercury (Hg), Polycholorinated Biphenyls (PCB) | 1 meal/week (8 ounces/week) | 1 meal/month (8 ounces/month) |
| Blackford/ Huntington/ Jay/ Wabash County | Freshwater Drum | up to 11 | | unrestricted | 1 meal/week (8 ounces/week) |
| | Golden Redhorse | up to 11 | | unrestricted | 1 meal/week (8 ounces/week) |
| | Rock Bass | up to 6 | | unrestricted | 1 meal/week (8 ounces/week) |
| | Spotted Sucker | up to 10 | | unrestricted | 1 meal/week (8 ounces/week) |
| | White Crappie | up to 8 | | unrestricted | 1 meal/week (8 ounces/week) |
| | White Sucker | up to 7 | | unrestricted | 1 meal/week (8 ounces/week) |
| **Salamonie Reservoir** | Bluegill | up to 7 | | unrestricted | 1 meal/week (8 ounces/week) |
| Wabash County | Common Carp | all | Hg | 1 meal/week (8 ounces/week) | 1 meal/month (8 ounces/month) |
| | Freshwater Drum | up to 11 | | unrestricted | 1 meal/week (8 ounces/week) |
| | White Crappie | all | | unrestricted | 1 meal/week (8 ounces/week) |

**US Army Corps of Engineers Water Quality Assessments of the Salamonie Watershed**

As mentioned under Section 2.5.4, an assessment on the Salamonie watershed was completed by Jade L. Young of the USACE. This study included watershed sampling of the Salamonie Reservoir, river, and sediment samples. These data provides a solid background for the existing water quality of the Salamonie River and its impact on the Salamonie Reservoir. Sampling for total alkalinity, chloride, ammonia, TKN, nitrate-nitrite nitrogen, total phosphorus, sulfate, total organic carbon, total solids, dissolved solids, suspended solids, and E.coli was completed at 20 sites. A summary of the data findings will be discussed in section 3.2.

A joint effort between the USACE-Louisville District for the Salamonie and the local SWCDs has been underway since 2010 to collect E. coli samples along the Salamonie River. These data contributes to the Water Quality Assessment Study of the Salamonie River and Reservoir as discussed in this report. E.coli tests from nine sampling locations in May of 2010 show an E.coli count higher than the standard maximum of 235 CFU/100mL. All but two sites show an E.coli count much higher than the maximum 235 CFU/100mL standard in April 2011. Figure 19 maps the river sampling site locations used by both USACE and the LSR watershed.

Due to recent toxic blue-green algae blooms within the Salamonie Reservoir the USACE has started conducting cyanobacteria monitoring for harmful algal blooms (HAB) in the reservoir. This issue was the impetus for the development of both the Upper and Lower Salamonie River watershed plans. The IDEM Office of Water Quality also conducts similar monitoring, and data is shared between the two agencies. Table 24 shows a summary of USACE data on the 2012 and 2013. Blank cells indicate that particular information was not provided. Table 25 outlines the classification and threshold criteria used by USACE concerning HABs, and Figure 20 shows USACE HAB sampling sites within the reservoir.

**Table 24 USACE HAB 2012-2013 Data**

| Salamonie HABs 2013 | | | | | | |
|---|---|---|---|---|---|---|
| **Date** | **Site** | **Total Cyanobacteria Cell Count** | **Dominant Genus** | **Dominant Genus Cell Count** | **Second Dominant Genus** | **Second Dominant Cell Count** |
| 5/9/2013 | 2SRR10000 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20001 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20030 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20031 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20029 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20028 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20027 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20026 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20025 | No cyanobacteria detected | | | | |
| 5/9/2013 | 2SRR20002 | No cyanobacteria detected | | | | |
| 7/31/2013 | 2SRR20001 | 110,400.0 | *Aphanocapsa sp.* | 76,250.0 | *Pseudanabaena sp.* | 19,850.0 |
| 7/31/2013 | 2SRR10000 | 6,500.0 | *Aphanocapsa sp.* | 6,500.0 | *n/a* | |
| 7/31/2013 | 2SRR20031 | 101,400.0 | *Aphanocapsa sp.* | 65,250.0 | *Pseudanabaena sp.* | 27,750.0 |

**Table 24 Cont.  USACE HAB 2012-2013 Data**

| Salamonie HABs 2013 | | | | | | |
|---|---|---|---|---|---|---|
| **Date** | **Site** | **Total Cyanobacteria Cell Count** | **Dominant Genus** | **Dominant Genus Cell Count** | **Second Dominant Genus** | **Second Dominant Cell Count** |
| 7/31/2013 | 2SRR20030 | 92,416.7 | *Aphanocapsa sp.* | 51,250.0 | *Pseudanabaena sp.* | 32,000.0 |
| 7/31/2013 | 2SRR20029 | 50,550.0 | *Aphanocapsa sp.* | 26,250.0 | *Pseudanabaena sp.* | 12,500.0 |
| 7/31/2013 | 2SRR20028 | 47,650.0 | *Aphanocapsa sp.* | 30,000.0 | *Microcystis sp.* | 7,500.0 |
| 7/31/2013 | 2SRR20027 | 98,566.7 | *Aphanocapsa sp.* | 53,750.0 | *Pseudanabaena sp.* | 30,350.0 |
| 7/31/2013 | 2SRR20026 | 107,300.0 | *Aphanocapsa sp.* | 35,250.0 | *Planktolyngbya sp.* | 25,600.0 |
| 7/31/2013 | 2SRR20025 | 68,216.7 | *Aphanocapsa sp.* | 35,500.0 | *Microcystis sp.* | 24,750.0 |
| 7/31/2013 | 2SRR20002 | 120,183.3 | *Pseudanabaena sp.* | 48,850.0 | *Aphanocapsa sp.* | 47,000.0 |
| 7/31/2013 | 2SRR20003 | 74,150.0 | *Aphanocapsa sp.* | 26,250.0 | *Pseudanabaena sp.* | 20,700.0 |
| 11/15/2013 | 2SRR10000 | No cyanobacteria observed | | | | |
| 11/15/2013 | 2SRR20001 | No cyanobacteria observed | | | | |
| 11/21/2013 | 2SRR10000 | 1,422.2 | *Merismopedia sp.* | 1,422.2 | | |
| 11/21/2013 | 2SRR20001 | 425.0 | *Pseudanabaena sp.* | 425.0 | | |

| Salamonie HABs 2012 | | | |
|---|---|---|---|
| Date | Cyanobacteria Count | Dominant Genus | Toxins |
| 6/26/2012 | >750k | *Microcystis* | 1.618 ppb microcystin |
| 7/12/2012 | >1 Million | *Aphanocapsa* | 2.91 ppb microcystin |
| | | *Merismopedia* | |
| 8/24/2012 | >100k | | 1.553 ppb microcystin |
| 8/31/2012 | >100k | | 0.302 ppb microcystin |
| 11/7/2012 | >42k | *Pseudanabaena* | Not assessed |
| | | *Aphanocapsa* | |
| 11/27/2012 | <10k | *Pseudanabaena* | Not assessed |

**Table 25 USACE HAB Classification**

| Cyanobacterial cell count | Health Risk | Classification |
|---|---|---|
| Exceed 20,000 cells/mL | **Low probability of adverse health effects.** | HAB ADVISORY |
| | *Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness.* | |
| Exceed 100,000 cells/mL | **Moderate probability of adverse health effects.** | HAB CAUTION |
| | *Potential for long-term illness with some cyanobacterial species.* | |
| | *Short-term adverse health outcomes, e.g., skin irritations, gastrointestinal illness.* | |

**Figure 19 LSRW and USACE Sampling Sites**

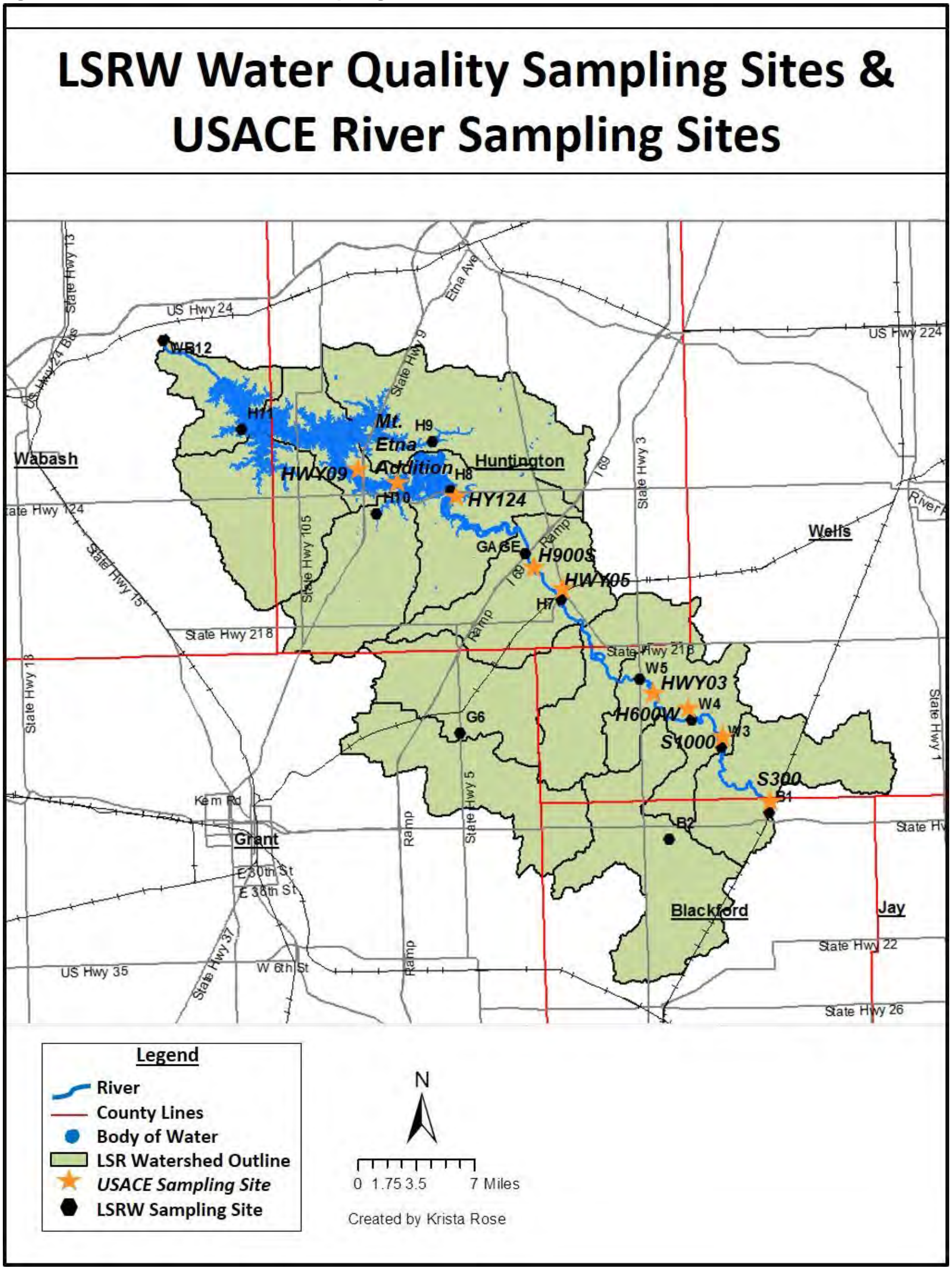
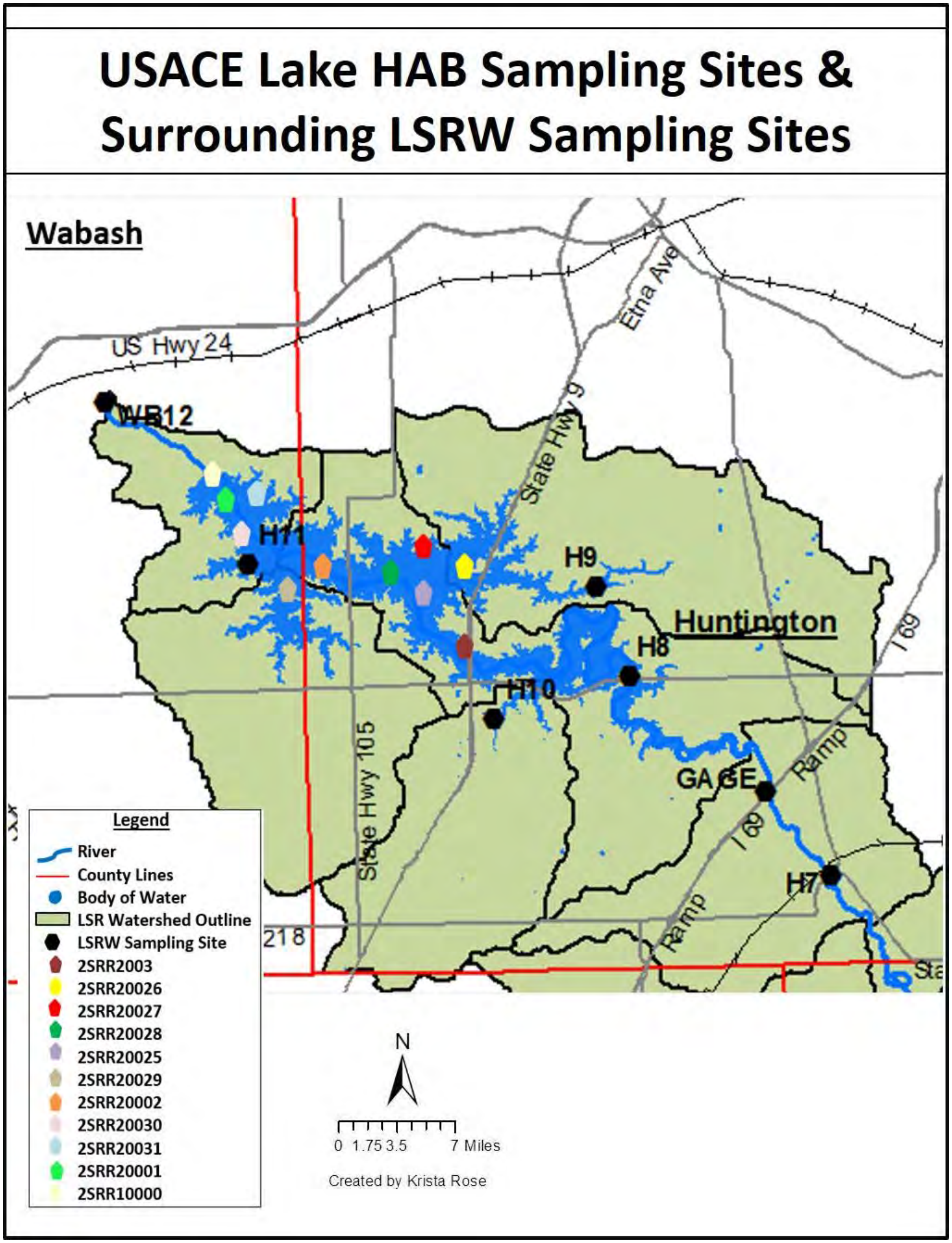


**Figure 20 USACE HAB Sampling Sites**



**Windshield Survey**

An extensive windshield survey was completed for the LSR watershed to gain a better understanding of the watershed, and to discover where improvements in land use practices could be made. All places where a road crossed a stream within the watershed were surveyed except for interstate highway bridges or other places that were potentially unsafe for volunteers to work. A total of 459 sites were evaluated. General observations were made concerning the stream, and current weather conditions were noted. Important items that were observed include: stream modifications, stream bank erosion, stream buffers present, including type of buffer and width, adjacent land use, presence or absence of conservation tillage, livestock with access to the stream, presence of confined feeding operations and hobby farms, the presence or absence of drain tiles and trash dumping, and other land perturbations such as construction sites or other modifications that could have an effect on water quality.

Each site was evaluated for 8 of the above listed parameters. They include, degree of stream bank erosion (slight, moderate, severe), buffer width (none, 0-30 feet, 30-100 feet, >100 feet), type of tillage (conventional vs conservation) and presence of cover crops, stream access for livestock, presence of confined feeding operations, presence of hobby farms, presence of drain tiles, and presence of trash. This data was assigned values where good conservation practices or environmentally healthy situations were given a low score and the opposite was true for degraded sites. Scores for all sites within a sub-watershed were summed and divided by the number of sites visited in that sub-watershed. These individual scores are shown in Table 26.

Scores for windshield survey sites were scored as follows:

| | |
|---|---|
| Stream Bank Erosion:<br>(General categories for visual length of stream) | Slight – 1 point<br>Moderate – 2 points<br>Severe – 3 points |
| Buffer Width: | None – 3 points<br>0-30 feet – 2 points<br>30-100 feet – 1 point<br>>100 feet – 0 points |
| Type of Tillage/cover crops: | Cover Crops – 0 points<br>Conservation Tillage – 1 point<br>Conventional Tillage – 2 points |
| Stream Access to livestock: | Yes – 1 point<br>No – 0 points |
| Confined Feeding Operations: | Yes – 1 point<br>No – 0 points |
| Hobby Farms: | Yes – 1 point<br>No – 0 points |
| Agricultural Drain Tiles: | Yes – 1 point<br>No – 0 points |
| Trash Present: | Yes – 1 point<br>No – 0 points |

Since all the sub-watersheds in the LSR watershed were degraded and in need of improvement, it was decided to divide the sub-watersheds into three tiers with an equal number of watersheds in each tier. Watersheds were then ranked as either Good, Fair, or Poor (Table 26). Scoring ranges for ratings are listed in Table 27. The data is somewhat normally distributed, but is skewed to the degraded side. It is important to note that from the observations made, all sub-watersheds are in need of improvement if water-quality goals are to be met. The ranking enables the steering committee to better prioritize where and how funds will be spent in the future to improve water quality in the Salamonie River and Salamonie Reservoir. The windshield survey will be discussed further in the report section dealing with critical areas.

**Table 26 Windshield Survey Degradation Rating**

| HUC 12 | HUC Name | Score | Rating |
|---|---|---|---|
| 051201020301 | Scuffle Creek - Salamonie River | 4.9082 | Poor |
| 051201020302 | Prairie Creek | 4.5610 | Fair |
| 051201020303 | Shadle Drain - Salamonie River | 3.5882 | Good |
| 051201020306 | Morrison Ditch - Salamonie River | 4.7727 | Fair |
| 051201020304 | Baker Ditch - Black Creek | 5.0833 | Poor |
| 051201020305 | Little Black Creek - Black Creek | 4.8403 | Poor |
| 051201020401 | Weasel Creek - Salamonie River | 3.8035 | Good |
| 051201020405 | Salamonie Reservoir - Salamonie River | 3.9418 | Good |
| 051201020402 | Richland Creek | 3.5833 | Good |
| 051201020403 | Majenica Creek | 4.9744 | Poor |
| 051201020404 | Rush Creek | 4.0526 | Fair |
| 051201020406 | Indian Creek - Salamonie River | 1.4783 | Good |

**Table 27 Windshield Rating Table**

| Score | Level | Rating |
|---|---|---|
| 4.8 – 5.1 | Tier 1 | Poor |
| 4 - 4.8 | Tier 2 | Fair |
| 1.4 - 4 | Tier 3 | Good |

## IDEM Monitoring

Through their fixed station water quality monitoring program, IDEM collects water quality samples once per month at 160 stream and river sample sites throughout the state. Two sample sites are located on the Salamonie River within the LSR Watershed. These include stations WSA040-005 and WSA040-001. Data for both sites from 2000 to 2013 are provided for alkalinity, arsenic, cadmium, chloride, chromium, COD, copper, cyanide, DO, hardness, iron, lead, mercury, nickel, ammonia, nitrate-nitrite, pH, total phosphorus, total suspended solids, total solids, total dissolved solids, sulfate, TBOD5, temperature, TKN, TOC, turbidity, and zinc. These sites correspond to LSR watershed sampling sites WB12 and H8 respectively (Figure 19). Sites from other IDEM projects include sites WSA030-008 and WSA030-0006, and WSA040-001 and WSA040-0016 which correspond to LSR watershed sites W4 and WB12.

These sites include parameters such as heavy metals, dissolved oxygen, ammonia, nitrate-nitrite, cyanide, solids, and sulfate, among others (Martin, 2013).

In addition, IDEM monitored four sites along the Salamonie River for macroinvertebrates. These include station sites WS040-008 and WSA040-0016 in Weasel Creek-Salamonie River sub-watershed, WSA040-0023 in Salamonie Reservoir-Salamonie River sub-watershed, and WSA-04-0004 in the Majenica Creek sub-watershed (Davis, 2013). Fish Community data was also gathered at WSA040-0016, WSA040-0023, and WSA-04-0004. Additional fish monitoring sites within the watershed include WSA-04-0012 and WSA-030-0005 (Sutton, 2013). These studies will be discussed later in the sub-watershed discussions.

Other studies completed by IDEM represent water bodies within the LSR watershed. Findings are summarized in Table 28 below.

**Table 28 IDEM Studies in the LSR Watershed and General Findings (From 1998 IDEM Upper Wabash Sampling)**

| Source | Station ID | Site Name | Site Location | HUC | Date | Comments |
|---|---|---|---|---|---|---|
| Nutrient, Habitat, and Basin-characteristics Data and Relations with Fish and Invertebrate Communities in Indiana Streams, 1998-2000. Prepared by IDEM and USGS | 44 | Majenica Creek | Near CR 200 W | 512010204 | Samples collected 3 times between May-Oct 1998-2000 | Especially high Nitrate and Total Nitrogen, but report did not identify violations. 55 QHEI score |
| Concentrations of E.coli in Streams in the Upper Wabash River in Indiana, June-September 1998. Prepared by IDEM and USGS | 9 | Salamonie River | Near SR124 near Lancaster | 512010204 | Samples collected from June-July 1998, 5 times in 30 day period | Exceeded the standard for the five-sample geometric mean |
| 1998 Upper Wabash River Basin Sampling Sites and Stream Standard Violations: Report for 305(b) Coordinator. Prepared by IDEM | 169-012 | Majenica Creek | Near CR 200 W | 512010204 | 7/9/1998 | Nitrate violation. From Probabilistic sampling program |
| | 169-064 | Salamonie River | Odd Fellows Cemetery | 512010203 | N/A | No violations. From Probabilistic sampling program |
| | 169-091 | Salamonie River | Near CR 600 E | 512010204 | N/A | No violations. From Probabilistic sampling program |
| | 38-01 | Salamonie River | Near SR 124 | 512010204 | 6/2-6/30/1998 | E.coli violation. From E.coli sampling program conducted by USGS |

**Table 28 Cont. IDEM Studies in the LSR Watershed and General Findings (From 1998 IDEM Upper Wabash Sampling)**

| Source | Station ID | Site Name | Site Location | HUC | Date | Comments |
|---|---|---|---|---|---|---|
| 1998 Upper Wabash River Basin Sampling Sites and Stream Standard Violations: Report for 305(b) Coordinator. Prepared by IDEM | S-25 | Salamonie River | Near SR 124 | 512010204 | 07/23/98; 06/17/98; 08/12/97 & 02/25/98 | Copper; Cyanide; and Lead violations. From Fixed station sampling program |
| | S-0 | Salamonie River | Near Division RD | 512010204 | 2/25/1998 | Lead. From Fixed station sampling program |

## NPDES Facilities

There are several facilities with National Pollution Discharge Elimination System (NPDES) permits within the watershed. The NPDES permit program is charged with controlling direct discharges to the waters of the state, and establishes limits on the amount of pollutants that may be discharged by each facility. There are three different types of permits: Municipal, Industrial, and Wet Weather. There were 12 facilities located within the watershed; however, as of 2013, three have been terminated (Table 29). A total of 21 outfalls are associated with the permitted facilities (Table 30). Three of these outfalls discharge directly into the Salamonie River, and all but five are located directly on a stream, creek, or river. An online search of the EPAs Permit Compliance System resulted in a total of 49 effluent violations. No violations are reported to have occurred within the last five years, with the last violation occurring in 2006.

**Table 29 Lower Salamonie River Watershed NPDES Facility Details**

| NPDES ID | Facility Name | Permit Status (IDEM) | Description | City | County | Affected Water Body | Facility Function | Permit Effective Date | 12 Digit HUC |
|---|---|---|---|---|---|---|---|---|---|
| IN0037583 | Southern Wells Community Schools | Effective | Mixed Ownership (public/private) | Poneto | Wells | Salamonie River via Scuffle Cr | Elementary and Secondary Schools | 1/1/2010 | 51201020301 |
| IN0020117 | Montpelier Municipal WWTP | Effective | Municipal or Water District | Montpelier | Blackford | Salamonie River | Sewerage Systems | 3/1/2006 | 51201020302 |
| IN004898 | Montpelier Public Water Supply | Terminated | Municipal or Water District | Montpelier | Blackford | Salamonie River | Water Supply | 1/1/1985 | 51201020302 |
| IN0020559 | Van Buren WWTP | Effective | Municipal or Water District | Van Buren | Grant | Salamonie River via Big Black Creek | Sewerage Systems | 3/1/2010 | 51201020305 |
| IN003891 | Van Buren Water Utility, Town of | Terminated | Municipal or Water District | Van Buren | Grant | Salamonie River via Black Cr- Roods Run | Water Supply | 2/1/1998 | 51201020305 |
| IN0057410 | National Oil and Gas Bulk Oil | Effective | Privately Owned Facility | Warren | Huntington | Salamonie River | Gasoline Service Stations | 7/1/2006 | 51201020401 |
| IN0024791 | Warren WWTP | Effective | Municipal or Water District | Warren | Huntington | Salamonie River | Sewerage Systems | 6/1/2010 | 51201020401 |
| IN0039446 | Salamonie Mobile Home Park | Effective | Mixed Ownership (public/private) | La Fontaine | Wabash | Wabash/Salamonie/ Rush Cr | Mobile Home Site Operators | 9/1/2006 | 51201020404 |
| IN0030449 | Lost Bridge West SRA | Effective | State Govt | Andrews | Huntington | Salamonie Reservoir | Sewerage Systems | 3/1/2006 | 51201020404 |
| IN0058963 | Mt Etna Municipal STP | Effective | Municipal or Water District | Huntington | Huntington | Salamonie River | Sewerage Systems | 2/1/2007 | 51201020405 |
| ING490106 | Speedway Sand and Gravel INC | Effective | Privately Owned Facility | Lancaster | Huntington | Sprowl Creek | Construction Sand And Gravel | 10/1/2006 | 51201020405 |
| IN0024244 | USDA USA COE SLMN LK BLW DM | Terminated | Federal Facility | Lagro | Wabash | Wabash River | Sewerage Systems | 3/1/1979 | 51201020406 |

**Table 30 LSR Watershed NPDES Pipe Location Details**

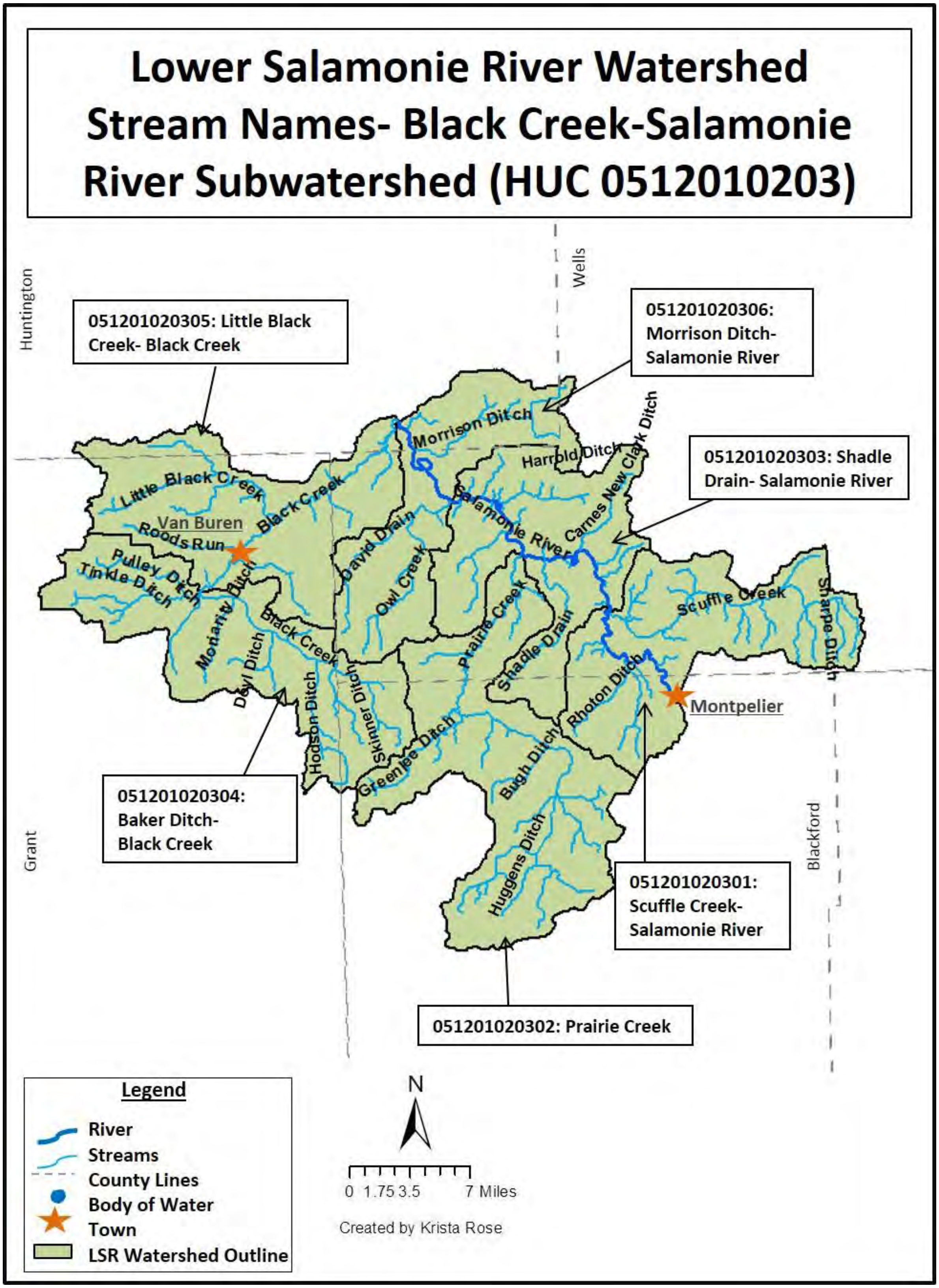
| Permit Name | Type of Permit | Affected body of Water | NOTES | County | 12 Digit HUC |
|---|---|---|---|---|---|
| SALAMONIE MOBILE HOME PARK | External Outfall | WABASH/SALAMONIE/RUSH CR/UNNMD T | UNNAMED TRIB TO RUSH CREEK.<br>NOT DIRECTLY ON TRIBUTARY BUT LEADS INTO RESERVOIR | Wabash | 51201020404 |
| BOZARTH RECREATIONAL RESORT | External Outfall | SALAMONIE RESERVOIR | IMMEDIATELY NEAR RESERVOIR | Wabash | 51201020404 |
| LOST BRIDGE WEST ST. REC. AREA | External Outfall | SALAMONIE RESERVOIR | IMMEDIATELY NEAR RESERVOIR | Huntington | 51201020405 |
| MOUNT HOPE STATE RECREAT. AREA | External Outfall | SALAMONIE RESERVOIR | IMMEDIATELY NEAR RESERVOIR | Wabash | 51201020406 |
| LOST BRIDGE EAST ST. REC. AREA | External Outfall | SALAMONIE RESERVOIR | CLASS I, EXTENDED AERATION, ETC. IMMEDIATELY NEAR RESERVOIR | Huntington | 51201020405 |
| LANCASTER ELEMENTARY SCHOOL | External Outfall | SALAMONIE RES VIA MAJENICA CR-DOLBY D | DOLBY DITCH. LEADS INTO RESERVOIR | Huntington | 51201020403 |
| SPEEDWAY SAND AND GRAVEL INC | External Outfall | SPROWL CREEK | LANCASTER PLANT. IMMEDIATELY NEAR RESERVOIR | Huntington | 51201020405 |
| MT. ETNA WWTP | External Outfall | SALAMONIE RIVER | MT. ETNA MUNICIPAL STP. IMMEDIATELY NEAR RESERVOIR | Huntington | 51201020402 |
| MOUNT ETNA STATE RECREAT. AREA | External Outfall | SALAMONIE RESERVOIR | CLASS I, EXTENDED AERATION, ETC. LEADS INTO RESERVOIR | Huntington | 51201020405 |
| WARREN WWTP | External Outfall | SALAMONIE RIVER | MAIN OUTFALL TO RIVER. DISCHARGES DIRECTLY INTO RIVER | Wells | 51201020401 |
| NATIONAL OIL & GAS, BULK OIL F | External Outfall | SALAMONIE RIVER | UNDERGROUND STORAGE TANK. IMMEDIATELY NEAR RIVER | Wells | 51201020401 |
| VAN BUREN WWTP | External Outfall | SALAMONIE R VIA BIG BLACK CREEK | MAIN OUTFALL- DISCHARGE TO BLACK CREEK. LEADS INTO RIVER | Grant | 51201020305 |
| VAN BUREN WATER WORKS | External Outfall | SALAMONIE R VIA BLACK CR-ROODS RUN | LEADS INTO RIVER | Grant | 51201020305 |
| WEAVER CONTRACT MANUFACTURING COMPANY | External Outfall | SALAMONIE R/ BLACK CR/ ROODS RUN CR | NON CONTACT COOLING WATER- TO ROODS CRK. LEADS INTO RIVER | Grant | 51201020305 |
| WEAVER POPCORN COMPANY | External Outfall | SALAMONIE R VIA BLACK CR -ROODS RUN | NON-CONTACT COOLING WATER. LEADS INTO RIVER | Grant | 51201020305 |
| SOUTHERN WELLS COMMUNITY SCHOOLS | External Outfall | SALAMONIE R VIA SCUFFLE CR VIA D | MAIN OUTFALL-TO SCUFFLE CREEK. NOT DIRECTLY ON TRIBUTARY BUT LEADS INTO RIVER | Wells | 51201020301 |
| MONTPELIER MUNICIPAL STP | External Outfall | SALAMONIE RIVER | MUNICIPAL STP. DISCHARGES DIRECTLY INTO RIVER | Blackford | 51201020301 |
| MONTPELIER MUNICIPAL STP | External Outfall | SALAMONIE RIVER | CSO- OVERFLOW AT HIGHWAY 303. DISCHARGES DIRECTLY INTO RIVER | Blackford | 51201020301 |
| GRIPCO FASTENER DIVISION | External Outfall | MONTPELIER STP (SALAMONIE R. BASIN) | IN TOWN, NOT IMMEDIATELY NEAR RIVER | Blackford | 51201020301 |
| BRC RUBBER GROUP, INC. | External Outfall | SALAMONIE R VIA CHAPMAN DITCH | IN TOWN, NOT IMMEDIATELY NEAR RIVER | Blackford | 51201020301 |
| EMHART TEKNOLOGIES - A BLACK AND DECKER CO | External Outfall | SALAMONIE R VIA HAWKINS DITCH | MAIN OUTFALL- NON-CONTACT COOLING WATER. IN TOWN, NOT IMMEDIATELY NEAR RIVER | Blackford | 51201020301 |

## 3.2 Sub-watershed Discussion

The LSR watershed consists of two 10-digit HUCs that are further subdivided into twelve 12-digit HUCs. To begin teasing out possible differences in this highly agricultural watershed, sample data was analyzed and desktop and windshield survey data was evaluated. This data and information was examined on a 10-digit HUC level; differences in the 12-digit HUCs were discussed as they became evident. Discussions of the two 10-digit HUCS are presented below beginning with the Black Creek-Salamonie River sub-watershed (Figure 21).

### 3.2.1 HUC 0512010203, Black Creek-Salamonie River

**Figure 21 Black Creek- Salamonie River Sub-watersheds**



### *Landuse*

The Black Creek-Salamonie River sub-watershed (HUC 0512010203) is the upstream portion of the watershed, and consists of six 12-digit HUCS (Table 31, Figure 21). Sub-watershed areas range from 12,324 (Morrison Ditch) to 20,682 (Prairie Creek) acres and together contain over 227 miles of rivers and streams. The primary land use in the Black Creek-Salamonie River sub-watershed is agricultural comprising 80,265 acres out of 95,026, or 84% of the total land area (Figure 22, Table 32). The next highest land use is forest with 6,742 acres or only 7% of the watershed. Because of the highly agricultural nature of the watershed, most development in the basin is low intensity consisting of single family homes and farmsteads. These homes rely heavily on septic systems for waste treatment. Because soils in the watershed are not very suitable for septic systems (Figure 12), it is important that proper maintenance and care for these systems is provided. It is also important that failing septic systems and straight pipes are addressed as soon as practical and are replaced with proper functioning systems.

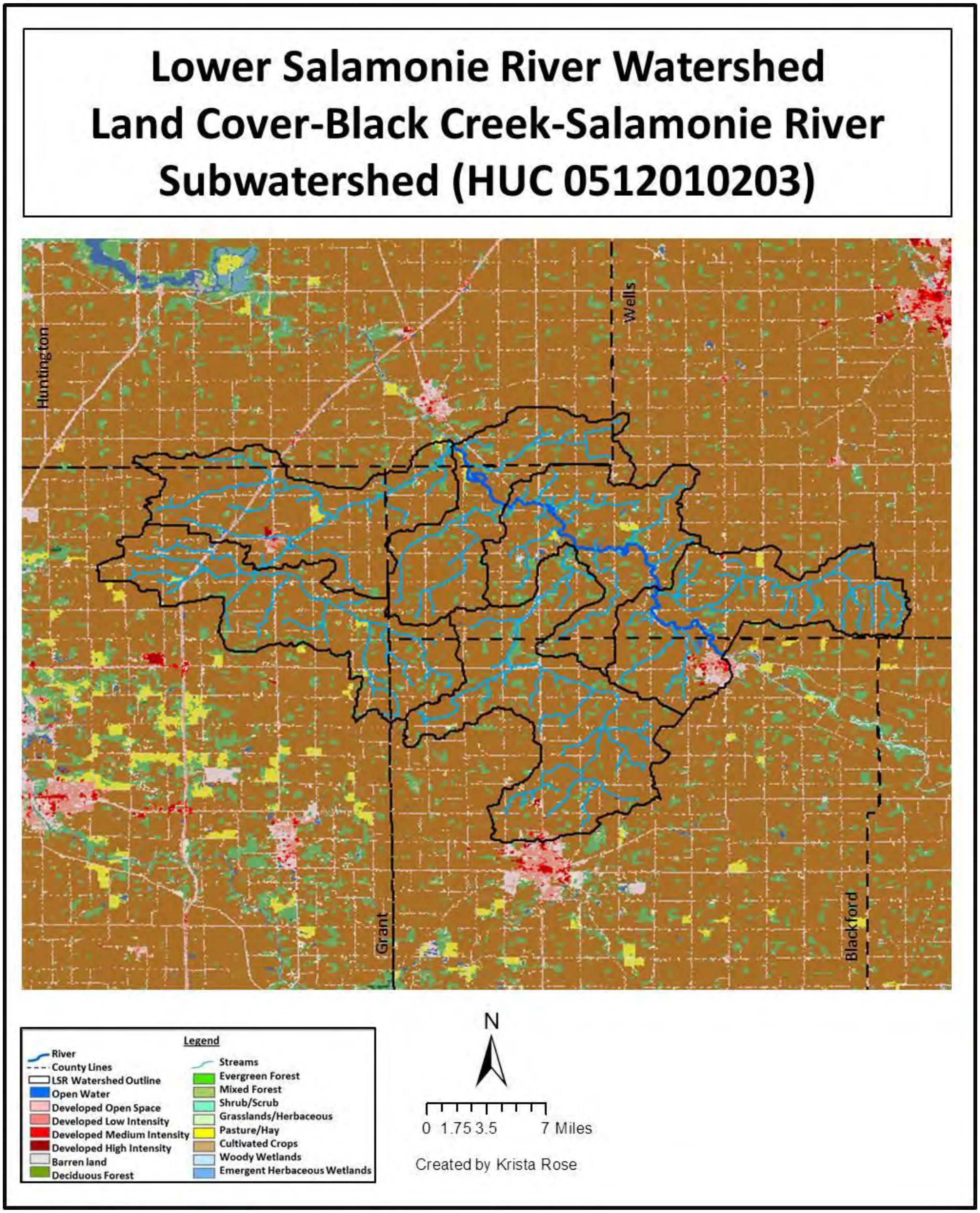
**Table 31 Black Creek-Salamonie River Sub-watershed General Data**

| HUC 10 | HUC 10 Name | Acres | Sq. Miles | HUC 10 Stream Miles |
|---|---|---|---|---|
| 512010203 | Black Creek- Salamonie River | 95,026 | 148.44 | 227.3 |
| **HUC 12** | **HUC 12 Name** | **Acres** | **Sq. Miles** | **HUC 12 Stream Miles** |
| 51201020306 | Morrison Ditch-Salamonie River | 12324 | 19.25 | 27.8 |
| 51201020305 | Little Black Creek- Black Creek | 15961 | 24.93 | 32.4 |
| 51201020304 | Baker Ditch- Black Creek | 16363 | 25.57 | 39.0 |
| 51201020303 | Shadle Drain- Salamonie River | 14228 | 22.22 | 35.6 |
| 51201020302 | Prairie Creek | 20682 | 32.31 | 46.2 |
| 51201020301 | Scuffle Creek- Salamonie River | 15468 | 24.16 | 46.2 |

**Table 32 Landuse in the Black Creek-Salamonie River Watershed (HUC 0512010203)**

| Land Use | Acres |
|---|---|
| Cultivated Crops | 79,775 |
| Pasture/Hay | 490 |
| Forest | 6,742 |
| Developed, Open Space | 5,275 |
| Low Intensity Developed | 672 |
| Med Intensity Developed | 133 |
| High Intensity Developed | 90 |
| Grassland/Herbaceous/Shrub/Scrub | 1033 |
| Wetlands | 538 |
| Open Water | 250 |
| Misc. Landuse | 28 |
| Total Acreage | 95,026 |

**Figure 22  Land use in the Black Creek-Salamonie River Watershed**



Although most of the land area is agricultural, two sub-watersheds in the Black Creek-Salamonie River watershed contain urban centers. The city of Montpelier lies mostly within the Scuffle Creek-Salamonie River sub-watershed, and is located at the southeast most edge of the LSR watershed. Montpelier is home to Fireman's Park, which is situated on the bank of the Salamonie River on the north end of town. This provides citizen access to the river and a chance to interact with the resource in a variety of ways, including fishing. The town of Van Buren lies within the Little Black Creek-Black Creek sub-watershed in the western portion of the Black Creek-Salamonie River sub-watershed. Weaver popcorn is an important industry in Van Buren, and its flagship brand, Pop Weaver microwave popcorn, is still produced there. Both of these areas would benefit from urban BMPs to protect local and downstream water resources.

### *National Pollutant Discharge Elimination System (NPDES) Permitted Facilities and Pipes*

Of the six sub-watersheds in the Black Creek-Salamonie River watershed, only two of them contain NPDES permitted facilities and pipes. These are associated with the two main urban areas in the watershed, Montpelier and Van Buren, and are in the Scuffle Creek-Salamonie River and Little Black Creek-Black Creek sub-watersheds (Figure 23, Table 33). There are two active facility permits, one in each sub-watershed and ten permitted pipes, four in the Little Black Creek-Black Creek sub-watershed and six in the Scuffle Creek-Salamonie River sub-watershed. There were a few reported NPDES violations in 2005 and 2006 (Table 34). There are presently two CSOs in the watershed associated with the city of Montpelier. They are both located on the north side of town, one at highway 103, and the other at the old water plant (Figure 23). CSOs are a source of excess nutrients as well as E. coli and other unwanted pollutants and should ultimately be eliminated. As stated in the Blackford County Comprehensive Plan, Montpelier is working to implement a combined sewer overflow Long Term Control Plan. The goal is to eventually eliminate these CSOs.

**Table 33 NPDES Facilities and Pipes**

| NPDES Permitted Facilities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NPDES ID** | **Facility Name** | **Permit Status (IDEM)** | **Description** | **City** | **County** | **Affected Water Body** | **Facility Function** | **Permit Effective Date** | **12 Digit HUC** |
| IN0020559 | Van Buren WWTP | Effective | Municipal or Water District | Van Buren | Grant | Salamonie River via Big Black Creek | Sewerage Systems | 3/1/2010 | 51201020305 Little Black Creek-Black Creek |
| IN003891 | Van Buren Water Utility | Terminated | Municipal or Water District | Van Buren | Grant | Salamonie River via Black Cr-Roods Run | Water Supply | 2/1/1998 | 51201020305 Little Black Creek-Black Creek |
| IN0020117 | Montpelier Municipal WWTP | Effective | Municipal or Water District | Montpelier | Blackford | Salamonie River | Sewerage Systems | 3/1/2006 | 51201020302 Scuffle Creek-Salamonie River |
| IN004898 | Montpelier Public Water Supply | Terminated | Municipal or Water District | Montpelier | Blackford | Salamonie River | Water Supply | 1/1/1985 | 51201020302 Scuffle Creek-Salamonie River |

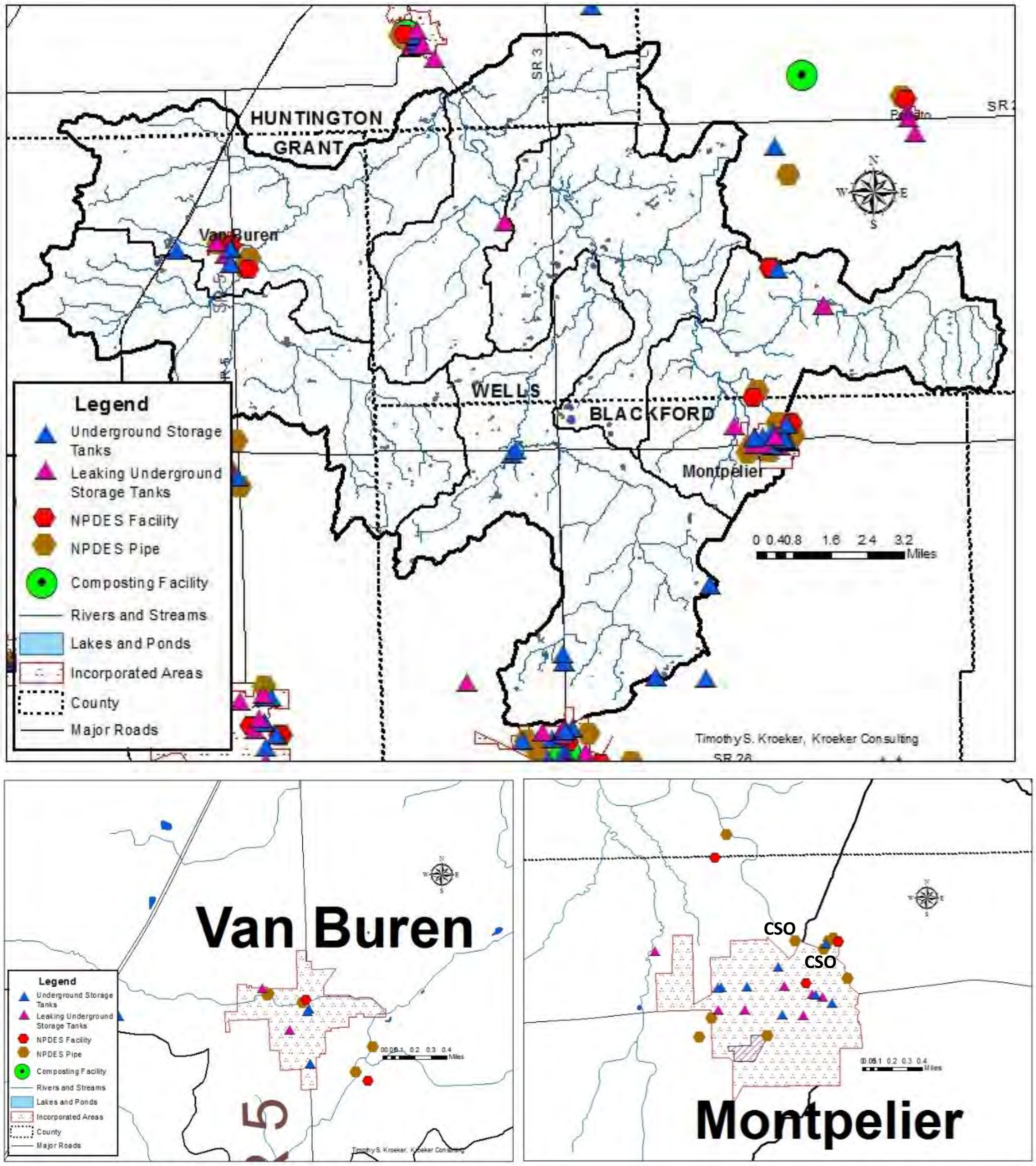
**Table 33 (Cont.) NPDES Facilities and Pipes**

| NPDES Pipe Locations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NPDES ID | Permit Name | Description | Type of Permit | Latitude | Longitude | Affected body of Water | County | 12 Digit HUC |
| IN0020559 | Van Buren WWTP | Main Outfall Discharge to Black Creek | External Outfall | 40.611750 | -85.499400 | SALAMONIE R VIA BIG BLACK CREEK | Grant | 51201020305 Little Black Creek-Black Creek |
| IN0003891 | Van Buren Waterworks | N/A | External Outfall | 40.618140 | -85.505500 | SALAMONIE R VIA BLACK CR-ROODS RUN | Grant | 51201020305 Little Black Creek-Black Creek |
| ING250097 | Weaver Contract Manufacturing Company | Non-Contact Cooling Water to Roods Cr. | External Outfall | 40.618890 | -85.509700 | SALAMONIE R/ BLACK CR/ ROODS RUN CR | Grant | 51201020305 Little Black Creek-Black Creek |
| ING250018 | Weaver Popcorn Company | Non-Contact Cooling Water | External Outfall | 40.619030 | -85.509600 | SALAMONIE R VIA BLACK CR -ROODS RUN | Grant | 51201020305 Little Black Creek-Black Creek |
| IN0037583 | Southern Wells Community Schools | Main Outfall to Scuffle Creek | External Outfall | 40.608222 | -85.280889 | SALAMONIE R VIA SCUFFLE CR VIA D | Wells | 51201020302 Scuffle Creek-Salamonie River |
| IN0020117 | Montpelier Municipal STP | Municipal STP | External Outfall | 40.569389 | -85.287972 | SALAMONIE RIVER | Blackford | 51201020302 Scuffle Creek-Salamonie River |
| IN0020117 | Montpelier Municipal STP | CSO Overflow at Highway 303 | External Outfall | 40.559056 | -85.279556 | SALAMONIE RIVER | Blackford | 51201020302 Scuffle Creek-Salamonie River |
| INP000004 | Gripco Fastener Division | N/A | External Outfall | 40.550000 | -85.283333 | MONTPELIER STP (SALAMONIE R. BASIN) | Blackford | 51201020302 Scuffle Creek-Salamonie River |
| IN0003344 | BRC Rubber Group Inc. | N/A | External Outfall | 40.551806 | -85.290306 | SALAMONIE R VIA CHAPMAN DITCH | Blackford | 51201020302 Scuffle Creek-Salamonie River |
| ING250056 | Emhart Teknologies – A Black and Decker Company | Main Outfall Non-Contact Cooling Water | External Outfall | 40.550000 | -85.291917 | SALAMONIE R VIA HAWKINS DITCH | Blackford | 51201020302 Scuffle Creek-Salamonie River |

**Table 34 NPDES Effluent Violations**

| NPDES | Effluent Violation Code for Parameter Measurement | MONITORING PERIOD END DATE | Parameter Code | COUNTY | 12 DIGIT HUC | TYPE |
|---|---|---|---|---|---|---|
| IN0020559 | NUMERIC VIOLATION | 1/31/2006 | NITROGEN AMMONIA TOTAL (AS N) | GRANT | 51201020305 Little Black Creek-Black Creek | FACILITY |
| IN0020559 | NUMERIC VIOLATION | 1/31/2006 | BOD CARBONACEOUS 05 DAY 20C | GRANT | 51201020305 Little Black Creek-Black Creek | FACILITY |
| IN0020559 | NUMERIC VIOLATION | 2/28/2006 | NITROGEN AMMONIA TOTAL (AS N) | GRANT | 51201020305 Little Black Creek-Black Creek | FACILITY |
| IN0020559 | NUMERIC VIOLATION | 4/30/2006 | N/A | GRANT | 51201020305 Little Black Creek-Black Creek | FACILITY |
| IN0020559 | NUMERIC VIOLATION | 3/31/2006 | NITROGEN AMMONIA TOTAL (AS N) | GRANT | 51201020305 Little Black Creek-Black Creek | FACILITY |
| ING250097 | NUMERIC VIOLATION | 10/31/2005 | PH | GRANT | 51201020305 Little Black Creek-Black Creek | OUTFALL |
| ING250097 | NUMERIC VIOLATION | 8/31/2005 | TEMPERATURE WATER DEG. FAHRENHEIT | GRANT | 51201020305 Little Black Creek-Black Creek | OUTFALL |
| ING250056 | NUMERIC VIOLATION | 1/31/2005 | TEMPERATURE WATER DEG. FAHRENHEIT | Blackford | 51201020301 Scuffle Creek-Salamonie River | OUTFALL |

**Figure 23  NPDES Facilities and Pipes and Other Potential Sources**




### *Leaking Underground Storage Tanks*

Figure 23 also shows the locations of underground storage tanks, and more importantly, those that are leaking and pose an environmental threat. Any underground storage tank (UST) containing petroleum or hazardous substances greater than 110 gallons and operated on or after January 1, 1974, with the exception of USTs used for on-site heating such as home heating oil USTs are regulated. It there is a spill, or the UST has been found to be leaking, then this leaking underground storage tank (LUST) must be investigated and possibly require a cleanup. These LUSTs can contaminate groundwater and at times enter surface water bodies and cause problems there. IDEM regulates these and has a program to guide remediation when necessary.

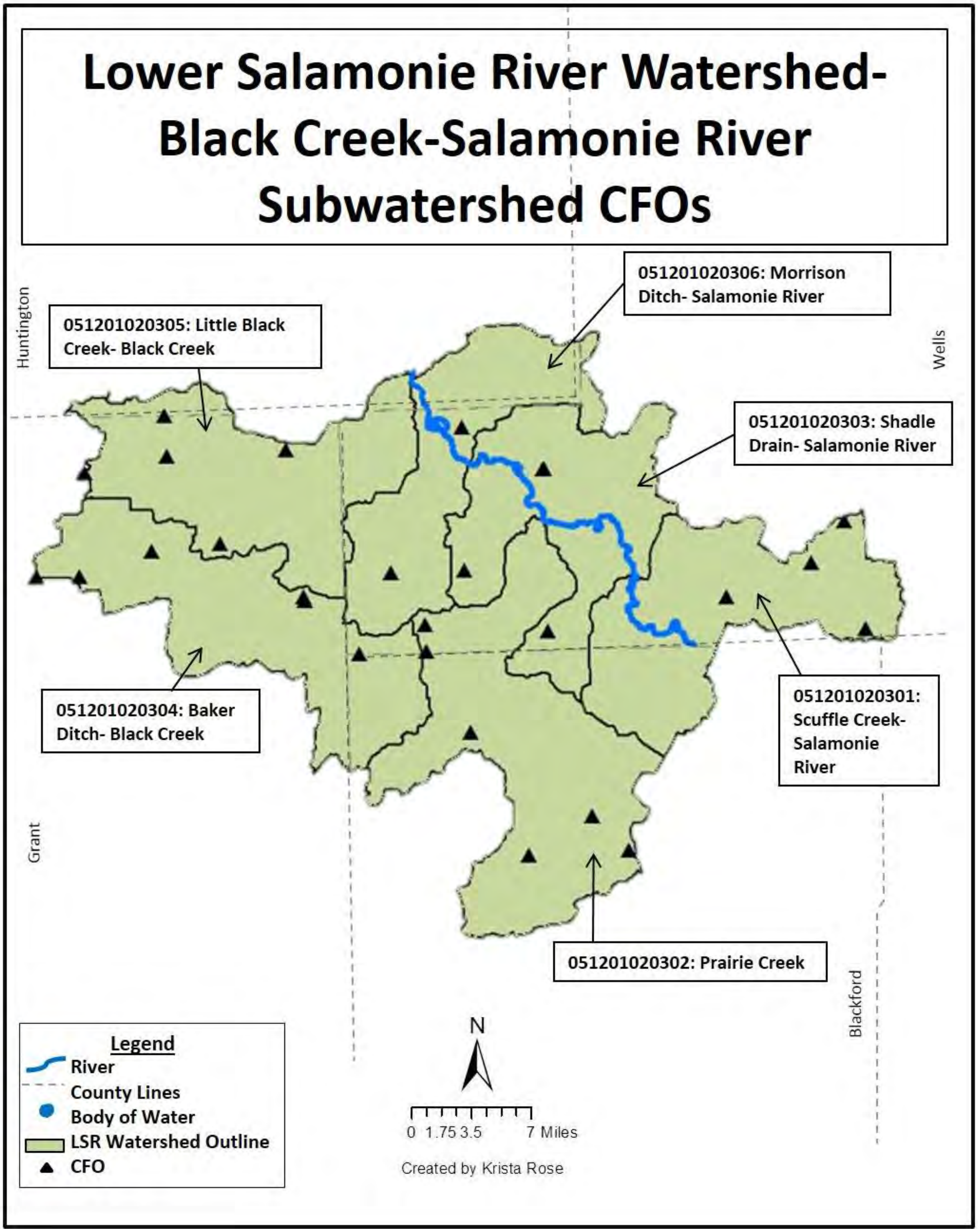
### *Confined Feeding Operations*

A total of 27 confined feeding operations (CFOs) are documented within the Black Creek-Salamonie River sub-watershed (Table 35, Figure 24). These are spread throughout the watershed ranging from two sites within the Morrison Ditch-Salamonie River sub-watershed to six sites in both the Baker Ditch-Black Creek and Prairie Creek sub-watersheds. CFOs are a benefit to the community and can be environmentally practical if appropriate protocols are followed, and proper measures are used for waste storage and disposal. At present there are no compliance issues in the watershed. The most common way to dispose of waste is via land application to augment nutrients in the soil. It is important that manure is not over-applied and the soils over-saturated with nutrients. When this happens, excess nutrients can run off the land surface and through tile drains into nearby waterways, causing problems not only for local waters, but downstream areas as well. Nutrient loading to streams is a stakeholder concern in the LSR watershed, so this issue needs to be kept in mind as more CFOs begin to locate in the area.

**Table 35 CFOs (Black Creek- Salamonie River Sub-watershed)**

| Confined Feeding Operations (CFOs) | |
|---|---|
| **10 Digit HUC** | **Number of Facilities** |
| 512010203 Black Creek-Salamonie River | 27 |
| **12 Digit HUC** | **Number of Facilities** |
| 51201020306 Morrison Ditch-Salamonie River | 2 |
| 51201020305 Little Black Creek-Black Creek | 5 |
| 51201020304 Baker Ditch-Black Creek | 6 |
| 51201020303 Shadle Drain-Salamonie River | 4 |
| 51201020302 Prairie Creek | 6 |
| 51201020301 Scuffle Creek-Salamonie River | 4 |

**Figure 24 CFOs in the Black Creek- Salamonie River Sub-watershed**



### *Water Quality in the Black Creek-Salamonie River Sub-watershed*

#### 303(d) Listed Streams

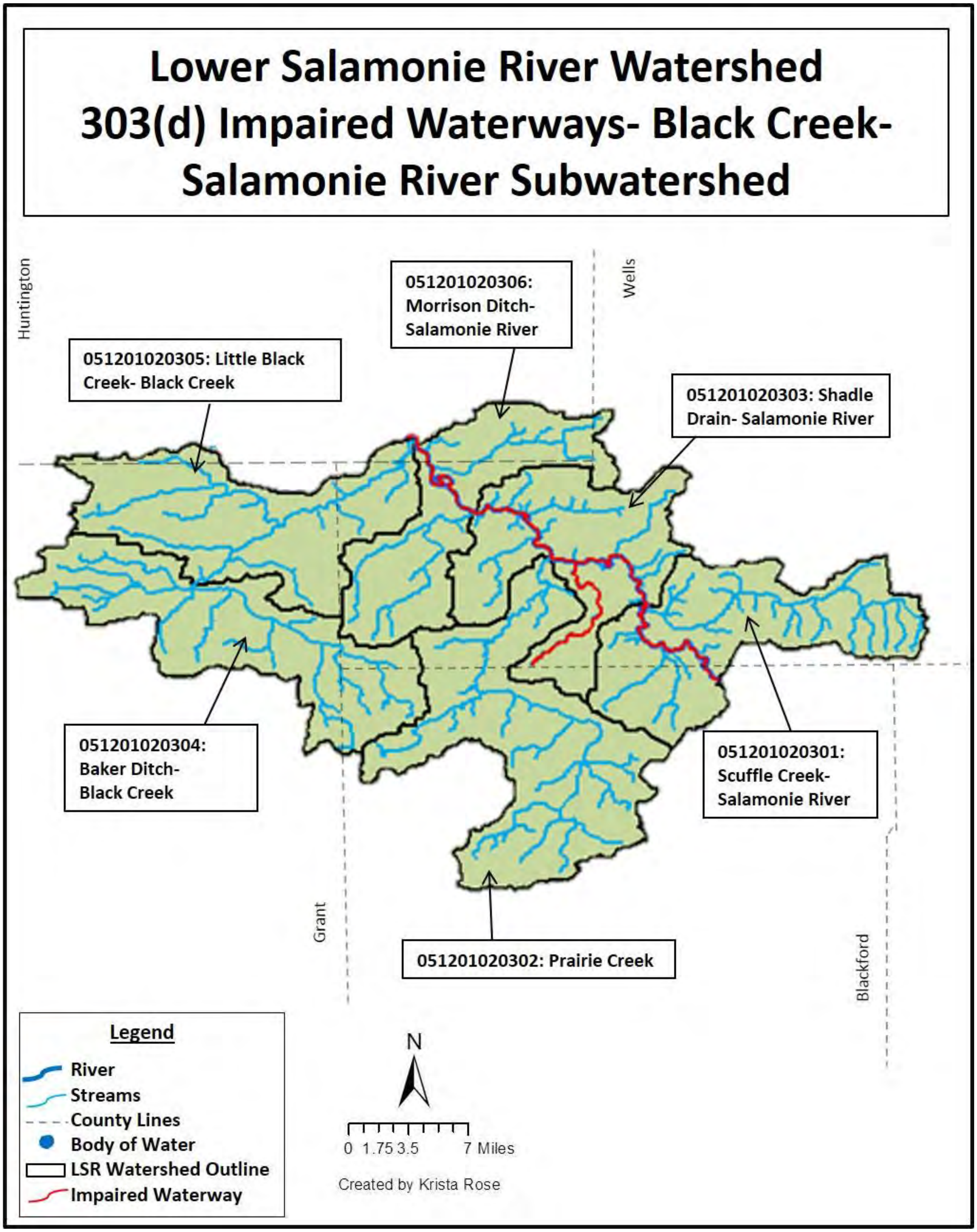
Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify waters, based on assessments, which do not or are not expected to meet applicable water quality standards. These impaired streams are then placed on what is known as a 303(d) list of impaired waterbodies. IDEM analyzed available data and came up with the following impaired waters in the Black Creek-Salamonie River sub-watershed (Table 36, Figure 25). It is important to note that even though a stream is not listed for a particular pollutant, it does not mean that the stream is not impaired. Impaired streams are often a function of where sampling has been done in the past. Therefore, a stream might not be listed as impaired only because it has not yet been sampled. That is why it is important to analyze water quality to the extent practical, and to continue to find and address water quality issues throughout the watershed.

The impairments for PCBs and Mercury in fish tissue will not be addressed in this watershed management plan. They are legacy pollutants and need to be addressed on a regional level. However, E. coli is also listed as an impairment and is of concern to stakeholders in the watershed. This impairment is well within the scope of this project. A total of 12 stream miles in the Black Creek-Salamonie River sub-watershed are impaired for E. coli (Table 36).

**Table 36 303(d) Listed Streams in the Black Creek-Salamonie River Sub-watershed**

| HUC 10 | HUC 12 | Waterbody Segment ID | County | Waterbody Segment Name | Cause of Impairment | Miles |
|---|---|---|---|---|---|---|
| 512010203 Black Creek-Salamonie River | 51201020306 Morrison Ditch-Salamonie River | INB0236_00 | Wells | Salamonie River-Custard Drain | PCBs, Total Mercury in Fish Tissue | 3.4 |
| 512010203 Black Creek-Salamonie River | 51201020303 Shadle Drain-Salamonie River | INB0233_00 | Wells | Salamonie River | E.coli, PCBs, Total Mercury in Fish Tissue | 4 |
| 512010203 Black Creek-Salamonie River | 51201020301 Scuffle Creek-Salamonie River | INB0231_00 | Wells | Salamonie River-Rhoton Ditch | E.coli, PCBs, Total Mercury in Fish Tissue | 4.6 |

**Figure 25 303(d) Listed Streams for Black Creek- Salamonie River Sub-watershed**



## Black Creek Sub-Watershed Biological Sampling and Habitat Analysis data

As part of the requirements for the development of the Lower Salamonie River Watershed Management Plan, a sampling protocol was developed. Part of this protocol was to sample macro-invertebrates once a year to investigate water quality. Because macro-invertebrates spend a year or more of their time in the aquatic environment, the number, diversity, and type of organisms found in the river or stream can provide a good understanding of the overall quality of the resource. However, macro-invertebrates also require specific substrates or habitats in order to survive, therefore it is important that these habitats are present. A poor macro-invertebrate community does not necessarily mean that the water quality is poor unless the proper habitat is available. A lack of habitat can be due to stream alterations, modified hydrology, and other man-made causes. Trying to preserve the natural system is also important in the improvement of overall stream health.

Macro-invertebrate sampling was completed in 2013 and 2014, and the results are shown below (Table 37). In addition, Tables 38 and 39 provides a range of values that define the habitat and biological rating for each particular sample site. The 2013 PTI, or Pollution Tolerance Index for the macro-invertebrates appears to closely follow the Citizens Habitat Evaluation Index (CQHEI) or seems slightly better. The one exception is W3, which although the CQHEI is Fair, it has a PTI Rating of Excellent.

For 2014, volunteers in the Black Creek sub-watershed used the Ohio EPA QHEI for habitat analysis, which is a more accurate assessment. Again, PTI scores were similar to the QHEI values. However, one site stands out as potentially impaired. Site B1 had a QHEI rating of Excellent but a PTI rating of Fair. Upon closer inspection of the sample site a straight pipe was discovered. This may be the cause of the problem, and if so, the samples taken at this site may only reflect the quality of the immediate area and not the entire tributary.

**Table 37 Black Creek- Salamonie River Sub-watershed Macroinvertebrate & Habitat Assessment Ratings**

| Site | 12 Digit HUC | 2013 CQHEI Score | 2013 CQHEI Rating | 2013 PTI Score | 2013 PTI Rating | 2014 QHEI Score | 2014 QHEI Rating | 2014 PTI Score | 2014 PTI Rating |
|---|---|---|---|---|---|---|---|---|---|
| B1 | 51201020301 | 79 | **Good** | 19 | Good | 72* | Excellent* | 16 | Fair |
| B2 | 51201020302 | 51 | Fair | 17 | Good | 35* | Poor* | 13 | Fair |
| W3 | 51201020303 | 57 | Fair | 23 | Excellent | 68* | Good* | 27 | Excellent |
| W4 | 51201020303 | 69 | **Good** | 18 | Good | 61* | Good* | 16 | Fair |
| W5 | 51201020303 | 59 | Fair | 16 | Fair | 53* | Fair* | 5 | Poor |
| G6 | 51201020304 | 61.5 | **Good** | 23 | Excellent | 44* | Fair* | 19 | Good |

*Volunteers used Ohio EPA QHEI in place of CQHEI

**Table 38 CQHEI and PTI Scores and Ratings**

| Citizen Habitat Evaluation Index (CQHEI) | | Pollution Tolerance Index (PTI) | |
|---|---|---|---|
| Score | Rating | Score | Rating |
| >100 | Excellent | ≤ 10 | Poor |
| > 60 | Good | 11 - 16 | Fair |
| > 51 | Fair | 17 - 22 | Good |
| < 51 | Poor | >23 | Excellent |

**Table 39 General narrative ranges assigned to Ohio EPA QHEI**

| Headwaters | | Larger Waters | |
|---|---|---|---|
| **Score** | **Rating** | **Score** | **Rating** |
| >70 | Excellent | >75 | Excellent |
| 55 - 69 | Good | 60 - 74 | Good |
| 43 - 54 | Fair | 45 - 59 | Fair |
| 30 - 42 | Poor | 30 - 44 | Poor |
| <30 | Very Poor | <30 | Very Poor |

## IDEM Biological and Habitat Data

IDEM sampled fish at one site on the Salamonie River in the Black Creek sub-watershed in August of 1998 (Table 40). Because fish live for several years, looking at the health of the present population and the community structure can speak to the overall health of the aquatic system. Along with the fish sampling effort, an examination of the habitat was made to help determine if any negative impact on the fish population was due to lack of habitat or another stressor such as pollutants or turbidity in the water. Although the habitat score was considered Good, the Index of Biotic Integrity for fish indicated a Fair rating (Table 41). Therefore, fish populations are being impacted by some pollutant. As indicated below in the water quality analysis of the Black Creek sub-watershed, many of the water quality parameters studied are above recommended limits and may be causing damage to the aquatic community.

**Table 40 IDEM Fish Community and QHEI Data for Black Creek Sub-watershed**

| Station Name | 12-Digit HUC | Waterbody Name | IBI Score | IBI Rating | QHEI Score | QHEI Rating |
|---|---|---|---|---|---|---|
| WSA030-0005 | 051201020301 | Salamonie River | 44 | Fair | 72 | Good |

**Table 41 Index of Biotic Integrity Scores, Ratings and Attributes**

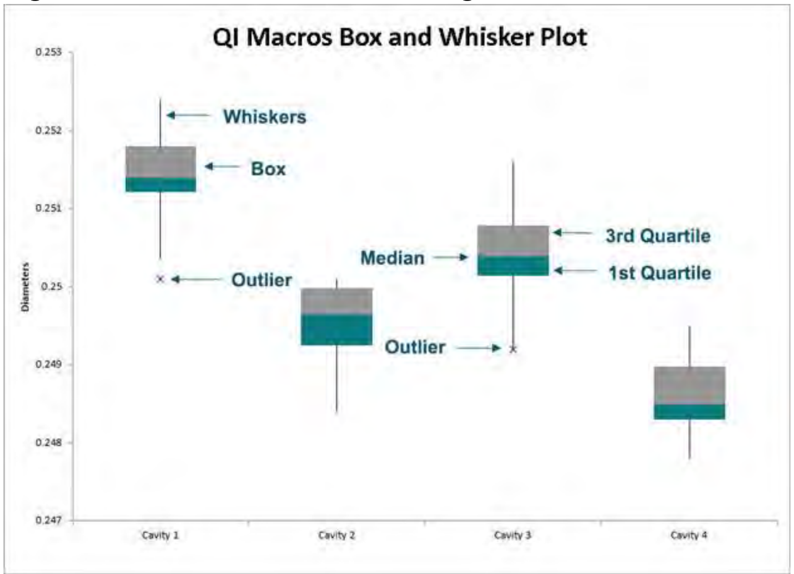
| Total IBI Score | Integrity Class | Attributes |
|---|---|---|
| 53 - 60 | Excellent | Comparable to “least impacted” conditions, exceptional assemblage of species. |
| 45 - 52 | Good | Decreased species richness (intolerant species in particular), sensitive species present. |
| 35 - 44 | Fair | Intolerant 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. |

**Lower Salamonie River Watershed Chemical Sampling and Analysis Black Creek Sub-watershed**

Chemical sampling was also completed as part of the development of the Lower Salamonie River Watershed Management Plan. Sampling was executed on a monthly basis during the recreational season (April – October), and twice during the winter months. Data from June 2013 to August 2014 were used for the sub-watershed analysis.

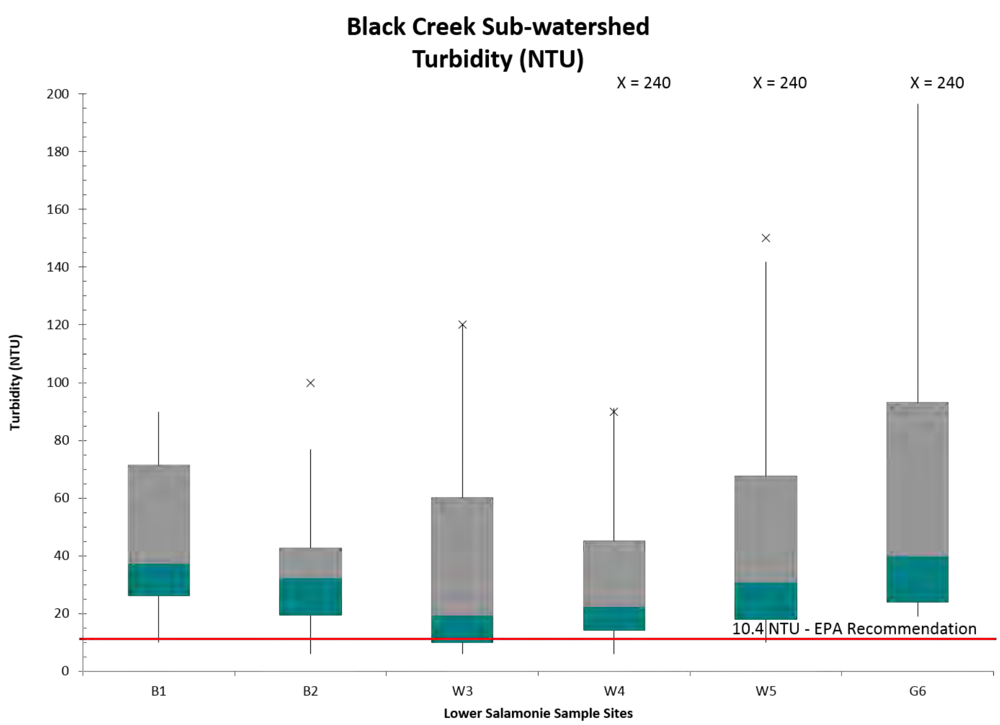
Because of the variable nature of the chemistries of river and stream systems, a helpful way to view the data is using box and whisker plots. This enables the viewing of all the data at a glance, and median values, data variability, and outliers are immediately evident. Figure 26 shows a basic box and whisker plot. The box contains half the data points. The color change indicates the median value, and the extent of the box ranges from the $1^{st}$ quartile of the data to the $3^{rd}$ quartile. The whiskers show the data range of the two quartiles furthest from the median, minus any outliers. Outliers are values that statistically don’t make immediate sense. They are data extremes that may not truly reflect the reality of the system. These value should be investigated to determine if they are sampling, analysis, or data entry errors or are true events. In rivers and streams, chemistry data that are often shown as outliers may be due to extreme events such as flooding. For example, turbidity in a particular stream may range from 10 to 20 NTU, but may jump to 120 NTU when a storm event causes the stream to flood its banks and soil and other particles from streets and farmland wash into the stream.

**Figure 26  Box and Whisker Plot Diagram**




Turbidity, Phosphorus, Nitrate, and E. coli were sampled throughout the Black Creek sub-watershed as part of the development of the LSR watershed management plan.  Box and Whisker plots are shown below in figures 27 – 30 for these parameters.

**Fiqure 27  Turbidity Values in the Black Creek Sub-watershed**

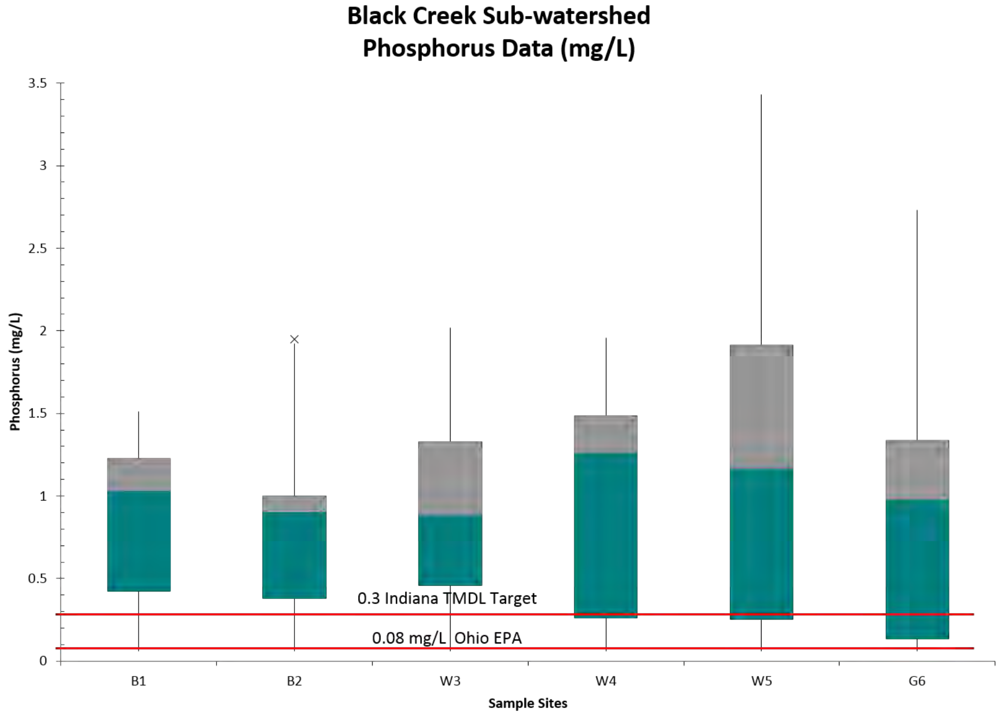


Turbidity values were high for all sites sampled in the Black Creek sub-watershed. The U.S. Environmental Protection Agency recommends a turbidity value of 10.4 NTU (Nephelometric Turbidity Unit) for the Eastern Corn Belt Plains of which the Lower Salamonie River Watershed is a part. Figure 27 indicates that almost all measurements were above this recommendation despite the flow regime. Turbidity values are expected to rise during high flows when water washes sediment and other particles into the stream from adjacent land and stream banks are eroded. However, turbidity values remained high even when streams were at low flow. It will be important to strive for proper conservation practices to keep soil and other pollutants from washing into area streams. It will also be important to find ways to restore a more natural hydrology so that stream banks are stabilized and extreme flows don't cause serious in-stream and bank erosion.

Turbidity data collected by IDEM also show this same problem (Appendix D). The U. S. Army Core of Engineers also collected data in the Black Creek Sub-watershed as part of their effort to address toxic blue green algae growth in the Salamonie Reservoir. Instead of Turbidity they measured actual Total Suspended Solids in the water column (Appendix D). Median values were above the average median value or 19mg/L for the Eastern Corn Belt Region ranging from around 24 to 27 mg/L. Values above 25 mg/L have been found to negatively affect aquatic life, so it is important to find ways to minimize stream turbidity.

Excess nutrients in the water column are the driving factor for the toxic blue-green algae blooms in the Salamonie Reservoir. To control these pollutants, the nutrient content of upstream rivers and streams must be controlled. The limiting nutrient for growth in most aquatic systems in Indiana is phosphorus. Therefore, the main priority is to address this particular pollutant. Figure 28 shows phosphorus data collected from June 2013 to August 2014 in the Black Creek sub-watershed. There are several different target values for phosphorus that are used in Indiana. IDEMs Total Maximum Daily Load (TMDL) program has set a target of 0.3mg/L for Indiana streams. However, the Ohio EPA has found that phosphorus levels above 0.08 mg/L have a negative effect on river and stream biological systems. This is the ultimate target level for phosphorus chosen for the LSR watershed. In addition, for streams and rivers that flow into lakes or reservoirs, the recommended target level for phosphorus is 0.03mg/L, the level that can cause nuisance algae blooms in lakes and reservoirs. The TMDL target for phosphorus of 0.3 mg/L is included on the graphs so measured values can be compared to this state standard. As is evident by the data in Figure 28, almost all the data collected exceeded these recommendations. Phosphorus samples were also collected by IDEM and the USACE (Appendix D). These data also indicated a need to address the phosphorus levels in the Black Creek sub-watershed.

## Figure 28  Phosphorus Values in the Black Creek Sub-watershed




## Figure 29  Nitrate Values in the Black Creek Sub-watershed

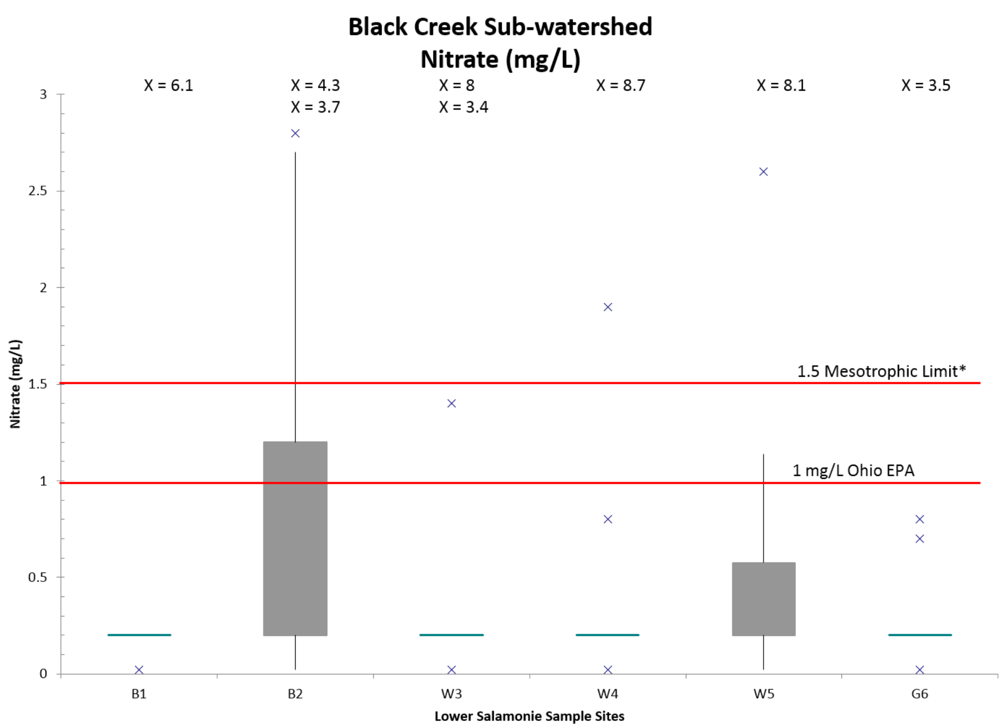
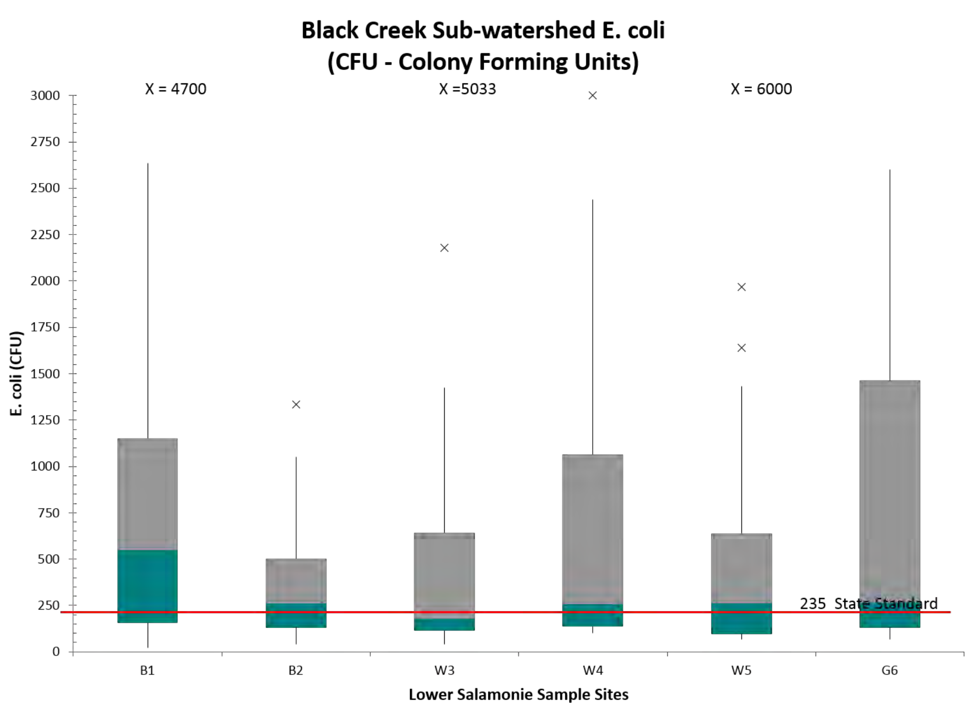


Figure 29 displays Nitrate values for the Black Creek sub-watershed. Although not as important as phosphorus when looking at the issues faced by the Salamonie Reservoir, Nitrogen, the limiting nutrient for marine systems has been found to be the main driver for the dead zone in the Gulf of Mexico. Water from the Salamonie River eventually flows into the Gulf of Mexico so it is important to address this nutrient due to downstream impacts. In addition, although not as crucial as phosphorus, nitrate levels in the Black Creek sub-watershed are often above recommended levels for the local aquatic systems and appear to be tied to application of nitrogen as fertilizer and nitrogen leaching from the soil through the increasing number of drainage tiles used throughout the watershed. Conservation practices tied to soil sampling may help address this issue. Data from IDEM and USACE also confirm issues with nitrate and data can be seen in Appendix D.

Figure 30 shows E. coli data from the Black Creek sub-watershed. The State standard for E. coli is a one-time sample of 235 CFU (Colony Forming Units)/100ml, or a geometric mean of five equally spaced samples over a 30 day period of less than 125 CFU/100ml. The data below consists of monthly grab samples from 6/20/13 to 8/18/14. For all sites except W3, the median value was over the state standard of 235 CFU/100ml. High E. coli values indicated fecal contamination and thus the potential that other pathogens could be present in the water and could cause human illness. This fecal material could be from human and/or animal sources. Human sources are typically from failing septic systems, combined sewer overflows and poorly functioning wastewater treatment plants. Animal sources include wildlife, waterfowl, pets, and livestock. Manure applied to agricultural fields for fertilizer is a common source of E. coli.

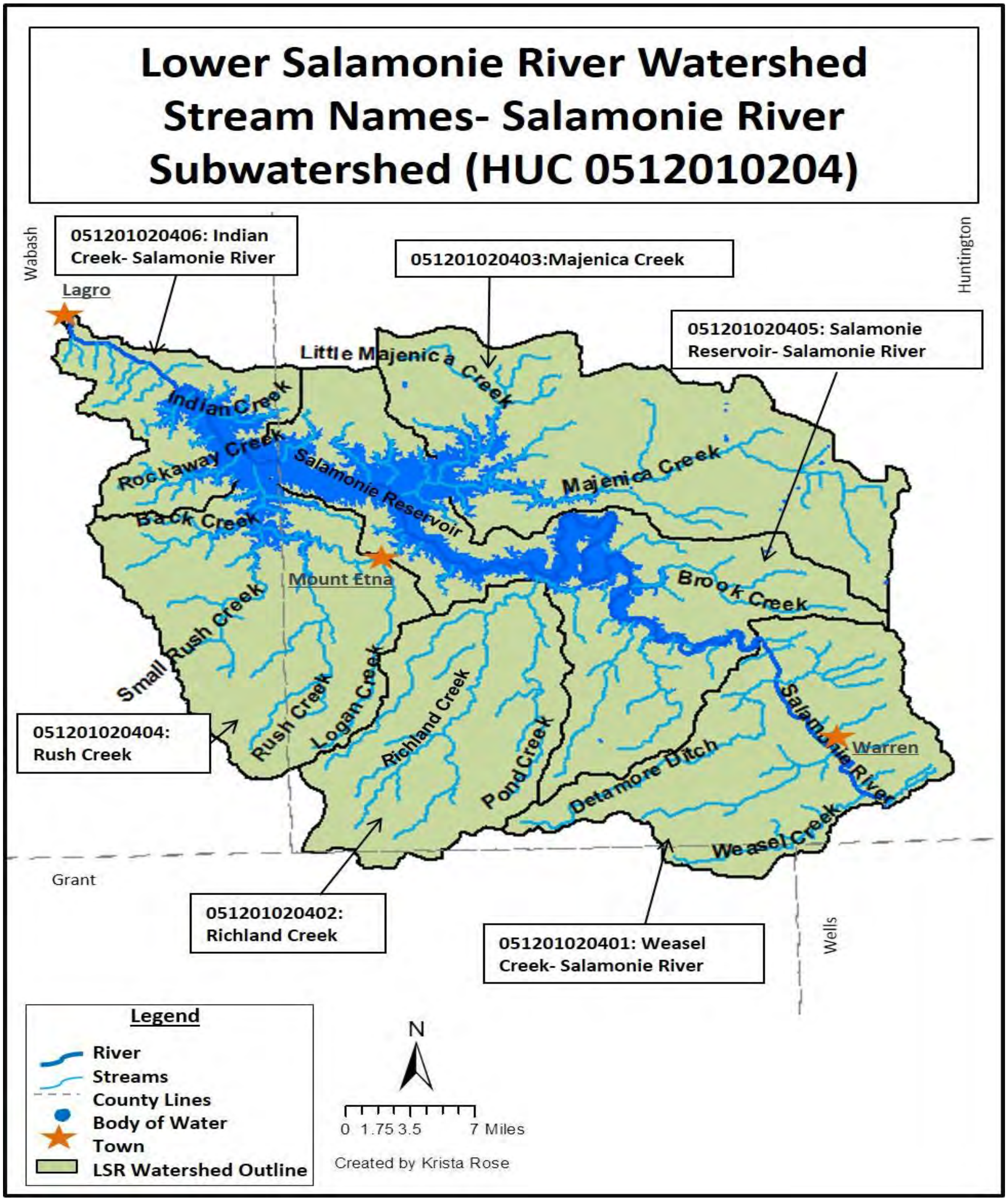
**Figure 30 E. coli Values in the Black Creek Sub-watershed**



Other parameters including temperature, pH, and dissolved oxygen were evaluated at each of the sample sites. All results for these parameters to date have met Indiana water quality standards (IAC 2-1-6).

### 3.2.2 HUC 0512010204 Salamonie River Sub-watershed

**Figure 31 Salamonie River Sub-watershed Streams**



### *Landuse*

The Salamonie River sub-watershed (HUC 0512010204) is the downstream portion of the watershed, and consists of six 12-digit HUCS (Table 42, Figure 31). Sub-watersheds range from 7,876 (Indian Creek) to 23,258 (Salamonie Reservoir) acres and together contain over 257 miles of rivers and streams. As in the Black Creek-Salamonie sub-watershed, the primary landuse is agriculture, including 76,095 acres or 75% of the total land area (Table 43, Figure 32). The next highest landuse is forest consisting of almost 13,000 acres or nearly 13% of the watershed. Much of this forested area is public land associated with the Salamonie River Reservoir. The reservoir itself is a major feature of the landscape, and, as mentioned, the impetus behind the development of the Lower Salamonie River Watershed Management Plan. At summer pool it has approximately 2,670 acres of open water.

**Table 42 Salamonie River Sub-watershed Acreage, Streams, and Wetlands**

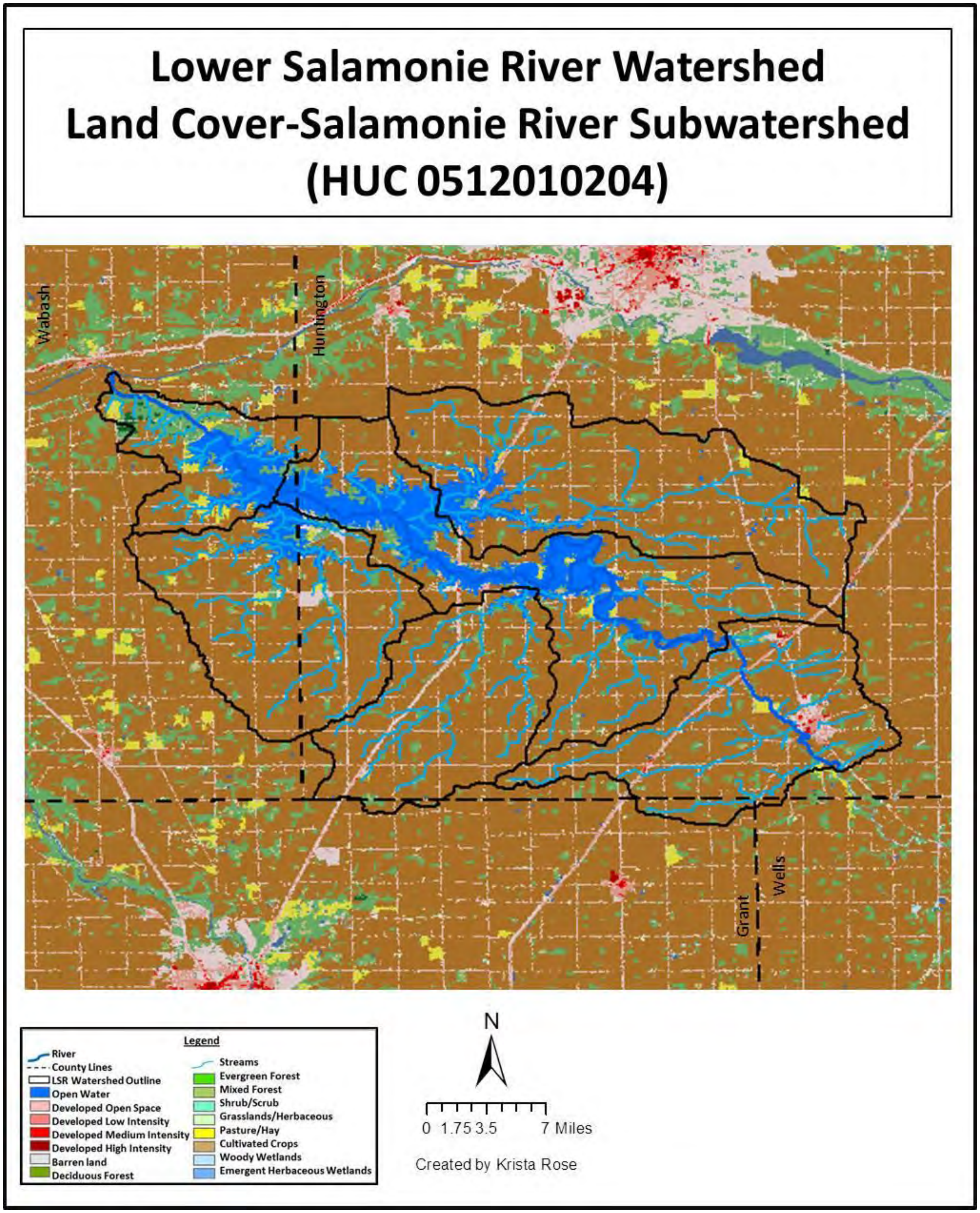
| HUC 10 | HUC 10 Name | Acres | Sq. Miles | HUC 10 Stream Miles |
|---|---|---|---|---|
| 512010204 | Salamonie River | 101,468 | 158.5 | 257.5 |
| **HUC 12** | **HUC 12 Name** | **Acres** | **Sq. Miles** | **HUC 12 Stream Miles** |
| 51201020406 | Indian Creek-Salamonie River | 7876 | 12.3 | 31.7 |
| 51201020405 | Salamonie Reservoir-Salamonie River | 23258 | 36.3 | 61.7 |
| 51201020404 | Rush Creek | 17598 | 27.5 | 42.1 |
| 51201020403 | Majenica Creek | 22245 | 34.7 | 43.5 |
| 51201020402 | Richland Creek | 14148 | 22.1 | 32.8 |
| 51201020401 | Weasel Creek-Salamonie River | 16343 | 25.5 | 45.8 |

**Table 43 Landuse in the Salamonie River Watershed (HUC 0512010204)**

| Land Use | Acres |
|---|---|
| Cultivated Crops | 74,739 |
| Pasture/Hay | 1,356 |
| Forest | 12,919 |
| Developed, Open Space | 5,975 |
| Low Intensity Developed | 772 |
| Med Intensity Developed | 84 |
| High Intensity Developed | 17 |
| Open Water | 3,367 |
| Grassland/Herbaceous/Scrub/Shrub | 1181 |
| Wetlands | 891 |
| Barren/Pits/Quarries | 124 |
| Total Acreage | 101,425 |

The Salamonie Reservoir is a part of a DNR property that includes 12,486 acres. It provides a host of recreational opportunities including: swimming, fishing, boating, hunting, hiking and other interpretive, cultural, and recreational programs. A map of the property can be found in Appendix C.

**Figure 32 Salamonie River Sub-watershed Land Cover**



### *National Pollutant Discharge Elimination System (NPDES) Permitted Facilities and Pipes*

Of the six sub-watersheds in the Salamonie River sub-watershed, three of them contain permitted facilities or pipes (Tables 44, Figure 33). Two facilities are located in Warren and discharge into the Weasel Creek sub-watershed. Facilities in Andrews, Huntington, and Lancaster, discharge into the Salamonie Reservoir sub-watershed. One facility is located in Largo in the Indian Creek sub-watershed, however the discharge pipe is located on the Wabash River and thus has no effect on the Salamonie. There have been a number of violations in the past (Table 45). Although most of these have been related to pH and BOD, it should be noted that Warren (Weasel Creek sub-watershed) has had violations for phosphorus, a parameter of concern in the Salamonie.

**Table 44 NPDES Facilities and Pipes**

| NPDES Permitted Facilities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NPDES ID** | **Facility Name** | **Permit Status (IDEM)** | **Description** | **City** | **County** | **Affected Water Body** | **Facility Function** | **Permit Effective Date** | **12 Digit HUC** |
| IN0057410 | National Oil and Gas Bulk Oil | Effective | Privately Owned Facility | Warren | Huntington | Salamonie River | Gasoline Service Stations | 7/1/2006 | 051201020401 Weasel Creek-Salamonie River |
| IN0024791 | Warren WWTP | Effective | Municipal or Water District | Warren | Huntington | Salamonie River | Sewerage Systems | 6/1/2010 | 051201020401 Weasel Creek-Salamonie River |
| IN0039446 | Salamonie Mobile Home Park | Effective | Mixed Ownership (public/private) | La Fontaine | Wabash | Rush Creek | Mobile Home Site Operators | 9/1/2006 | 51201020404 Rush Creek |
| IN0030449 | Lost Bridge West SRA | Effective | State Govt | Andrews | Huntington | Salamonie Reservoir | Sewerage Systems | 3/1/2006 | 51201020404 Rush Creek |
| IN0058963 | Mt Etna Municipal STP | Effective | Municipal or Water District | Huntington | Huntington | Salamonie River | Sewerage Systems | 2/1/2007 | 051201020405 Salamonie Reservoir-Salamonie River |
| ING490106 | Speedway Sand and Gravel INC | Effective | Privately Owned Facility | Lancaster | Huntington | Sprowl Creek | Construction Sand And Gravel | 10/1/2006 | 051201020405 Salamonie Reservoir-Salamonie River |
| IN0024244 | USDUSDA USA COE SLMN LK BLW DM | Terminated | Federal Facility | Lagro | Wabash | Wabash River | Sewerage Systems | 3/1/1979 | 051201020406 Indian Creek-Salamonie River |

**Table 44 (Cont.) NPDES Facilities and Pipes**

| NPDES Pipe Locations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NPDES ID** | **Permit Name** | **Descriptio n** | **Type of Permit** | **Latitude** | **Longitude** | **Affected body of Water** | **NOTES** | **County** | **12 Digit HUC** |
| IN0024791 | Warren WWTP | Main Outfall - To Salamonie River | External Outfall | 40.68392 | -85.4326 | Salamonie River | DISCHAR GES DIRECTL Y INTO RIVER | Wells | 0512010204 01 Weasel Creek-Salamonie River |
| IN0057410 | National Oil and Gas Bulk Oil Facility | Undergroun d Storage Tank | External Outfall | 40.68044 | -85.4284 | Salamonie River | Immediate ly Near Reservoir | Wells | 0512010204 01 Weasel Creek-Salamonie River |
| IN0058963 | Mt. Etna WWTP | Mt. Etna Municipal STP | External Outfall | 40.73886 | -85.5454 | Salamonie River | Immediate ly Near Reservoir | Huntingto n | 0512010204 02 Richland Creek |
| IN0058963 | Mt. Etna WWTP | Mt. Etna Municipal STP | External Outfall | 40.73886 | -85.5454 | Salamonie River | Immediate ly Near Reservoir | Huntingto n | 0512010204 03 Majenica Creek |
| IN0039446 | Salamnie Mobile Home Park | Unnamed Trib. To Rush Creek | External Outfall | 40.73792 | -85.6422 | Unnamed Trib. of Rush Creek | Leads into Reservoir | Wabash | 5120102040 4 Rush Creek |
| IN0041637 | Bozarth Recreatio nal Resort | Salalmonie Reservoir | External Outfall | 40.76789 | -85.6526 | Salamonie Reservoir | Immediate ly Near Reservoir | Wabash | 5120102040 4 Rush Creek |
| IN0030449 | Lost Bridge West St. Rec. Area | N/A | External Outfall | 40.77097 | -85.6374 | Salamonie Reservoir | Immediate ly Near Reservoir | Huntingto n | 0512010204 05 Salamonie Reservoir-Salamonie River |
| IN0024198 | Lost Bridge West St. Rec. Area | Class I Extended Aeration | External Outfall | 40.77000 | -85.5914 | Salamonie Reservoir | Immediate ly Near Reservoir | Huntingto n | 0512010204 05 Salamonie Reservoir-Salamonie River |
| ING490106 | Speedway Sand and Gravel Inc | Lancaster Plant | External Outfall | 40.73853 | -85.503 | Sprowl Creek | Immediate ly Near Reservoir | Huntingto n | 0512010204 05 Salamonie Reservoir-Salamonie River |
| IN0024287 | Mount Etna State Rec. Area | Class I Extended Aeration | External Outfall | 40.74972 | -85.58 | Salamonie Reservoir | Leads into Reservoir | Huntingto n | 0512010204 05 Salamonie Reservoir-Salamonie River |
| IN0030457 | Mount Hope State Rec. Area | N/A | External Outfall | 40.80417 | -85.6672 | Salamonie Reservoir | Immediate ly Near Reservoir | Wabash | 0512010204 06 Indian Creek-Salamonie River |

**Table 45 NPDES Effluent Violations**

| NPDES | Effluent Violation Code for Parameter Measurement | MONITORING PERIOD END DATE | Parameter Code | COUNTY | 12 DIGIT HUC | TYPE |
|---|---|---|---|---|---|---|
| IN0024791 | Numeric Violation | 6/30/2005 | Phosphourus Total Percent Removal | Huntington | 051201020401 Weasel Creek | Facility |
| IN0024791 | Numeric Violation | 4/30/2006 | Phosphourus Total Percent Removal | Huntington | 051201020401 Weasel Creek | Facility |
| IN0057410 | Numeric Violation | 8/31/1999 | pH | Huntington | 051201020401 Weasel Creek | Facility |
| IN0031721 | Discharge Monitoring Report (State) Overdue | 7/31/2005 | Nitrogen Ammonia Total (As N) | Huntington | 051201020403 Majenica Creek | Outfall |
| IN0031721 | Discharge Monitoring Report (State) Overdue | 7/31/2005 | N/A | Huntington | 051201020403 Majenica Creek | Outfall |
| IN0031721 | Discharge Monitoring Report (State) Overdue | 7/31/2005 | BOD Carbonaceous 5-Day, 20C | Huntington | 051201020403 Majenica Creek | Outfall |
| IN0031721 | Discharge Monitoring Report (State) Overdue | 7/31/2005 | N/A | Huntington | 051201020403 Majenica Creek | Outfall |
| IN0058963 | Numeric Violation | 6/30/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 9/30/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 10/31/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2003 | BOD Carbonaceous 5-Day, 20C | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 9/30/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 7/31/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 11/30/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |

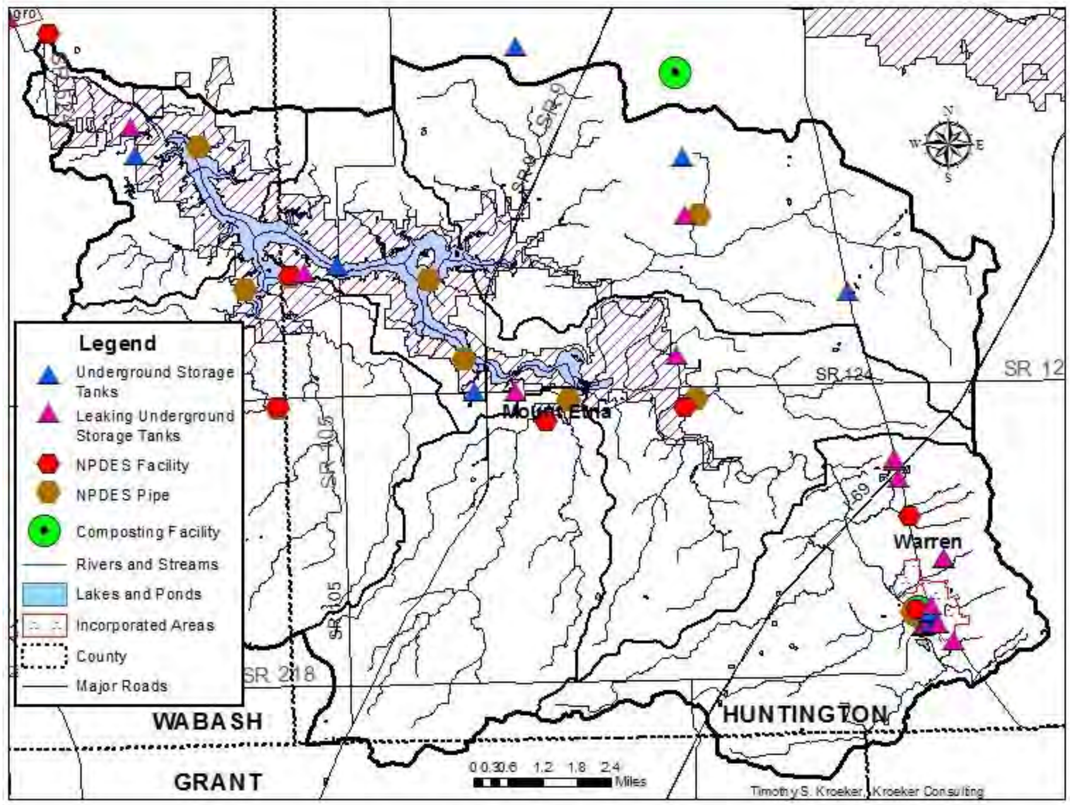
**Table 45 Cont. NPDES Effluent Violations**

| NPDES | Effluent Violation Code for Parameter Measurement | MONITORING PERIOD END DATE | Parameter Code | COUNTY | 12 DIGIT HUC | TYPE |
|---|---|---|---|---|---|---|
| IN0058963 | Numeric Violation | 7/31/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 11/30/2004 | BOD Carbonaceous 5-Day, 20C | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 8/31/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 8/31/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 10/31/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2003 | BOD CARBONACEOUS 05 DAY 20C | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 8/31/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 12/31/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |

Table 45 Cont.  NPDES Effluent Violations

| NPDES | Effluent Violation Code for Parameter Measurement | MONITORING PERIOD END DATE | Parameter Code | COUNTY | 12 DIGIT HUC | TYPE |
|---|---|---|---|---|---|---|
| IN0058963 | Numeric Violation | 6/30/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 11/30/2003 | TSS | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 6/30/2003 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 6/30/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 7/31/2004 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 9/30/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2004 | BOD Carbonaceous 5-Day, 20C | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 7/31/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 10/31/2002 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2005 | pH | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 4/30/2003 | TSS | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |
| IN0058963 | Numeric Violation | 5/31/2002 | BOD Carbonaceous 5-Day, 20C | Huntington | 051201020405 Salamonie Reservoir - Salamonie River | Facility |

**Figure 33  NPDES Permitted Facilities and Pipes and Other Potential Sources**




### *Confined Feeding Operations*

A total of 29 confined feeding operations are found throughout the Salamonie River sub-watershed (Table 46, Figure 34). These are distributed throughout the watershed and range from one facility each in both the Indian Creek and Richland Creek sub-watersheds to 12 specific sites in the Salamonie Reservoir sub-watershed. As mentioned, it is important to properly manage and maintain these facilities to insure that excess nutrients don't find their way into local waterways and ultimately into the Salamonie Reservoir. At present there are no compliance issues with CFOs in the watershed.

**Table 46 CFOs (Salamonie River Sub-watershed)**

| Confined Feeding Operations (CFOs) | |
|---|---|
| **10 Digit HUC** | **Number of Facilities** |
| 0512010204 Salamonie River | 29 |
| **12 Digit HUC** | **Number of Facilities** |
| 051201020401 Weasel Creek-Salamonie River | 8 |
| 051201020402 Richland Creek | 1 |
| 51201020405 Salamonie Reservoir-Salamonie River | 12 |
| 51201020403 Majenica Creek | 5 |
| 51201020404 Rush Creek | 2 |
| 51201020406 Indian Creek-Salamonie River | 1 |

**Figure 34 Salamonie River Sub-watershed CFOs**

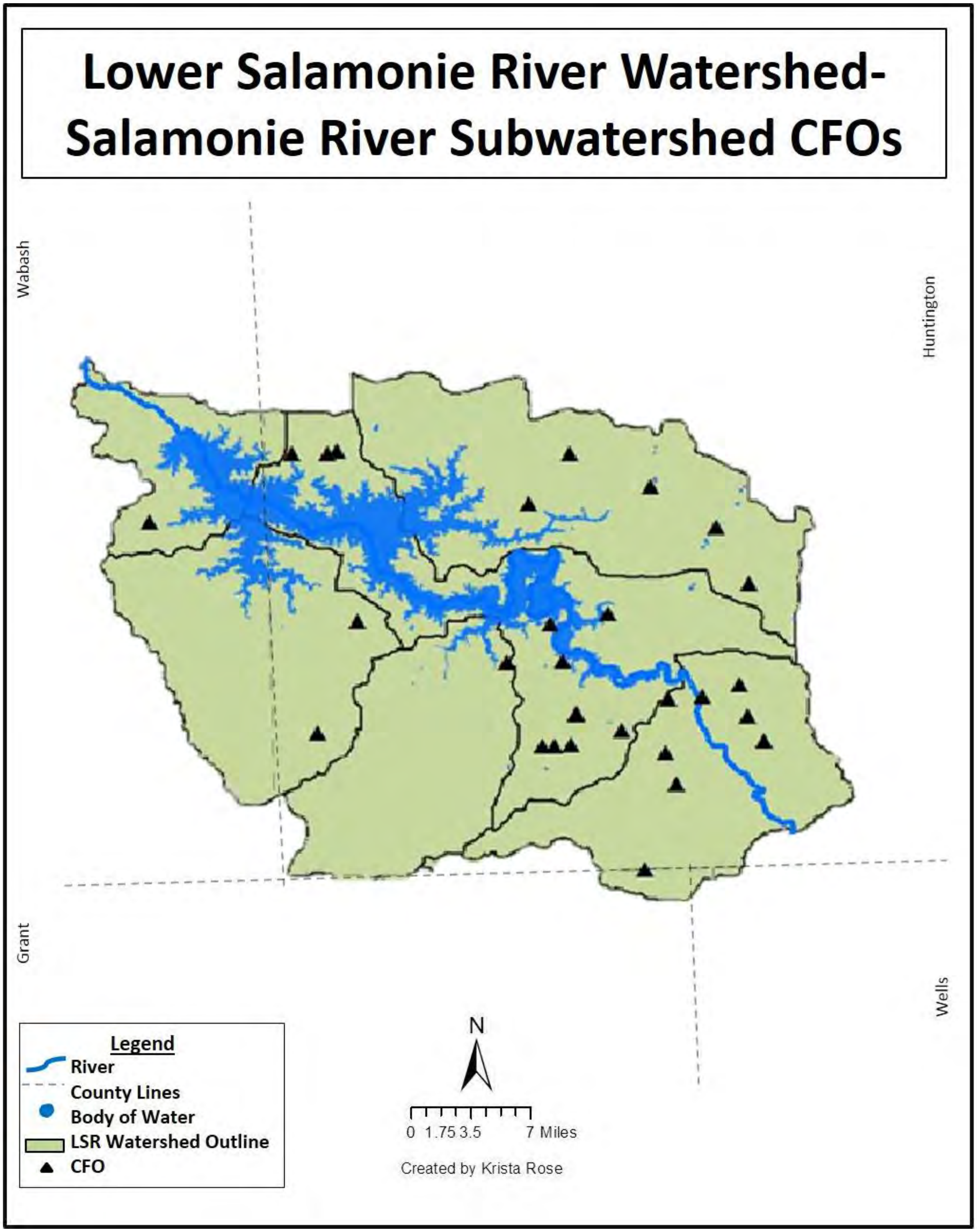
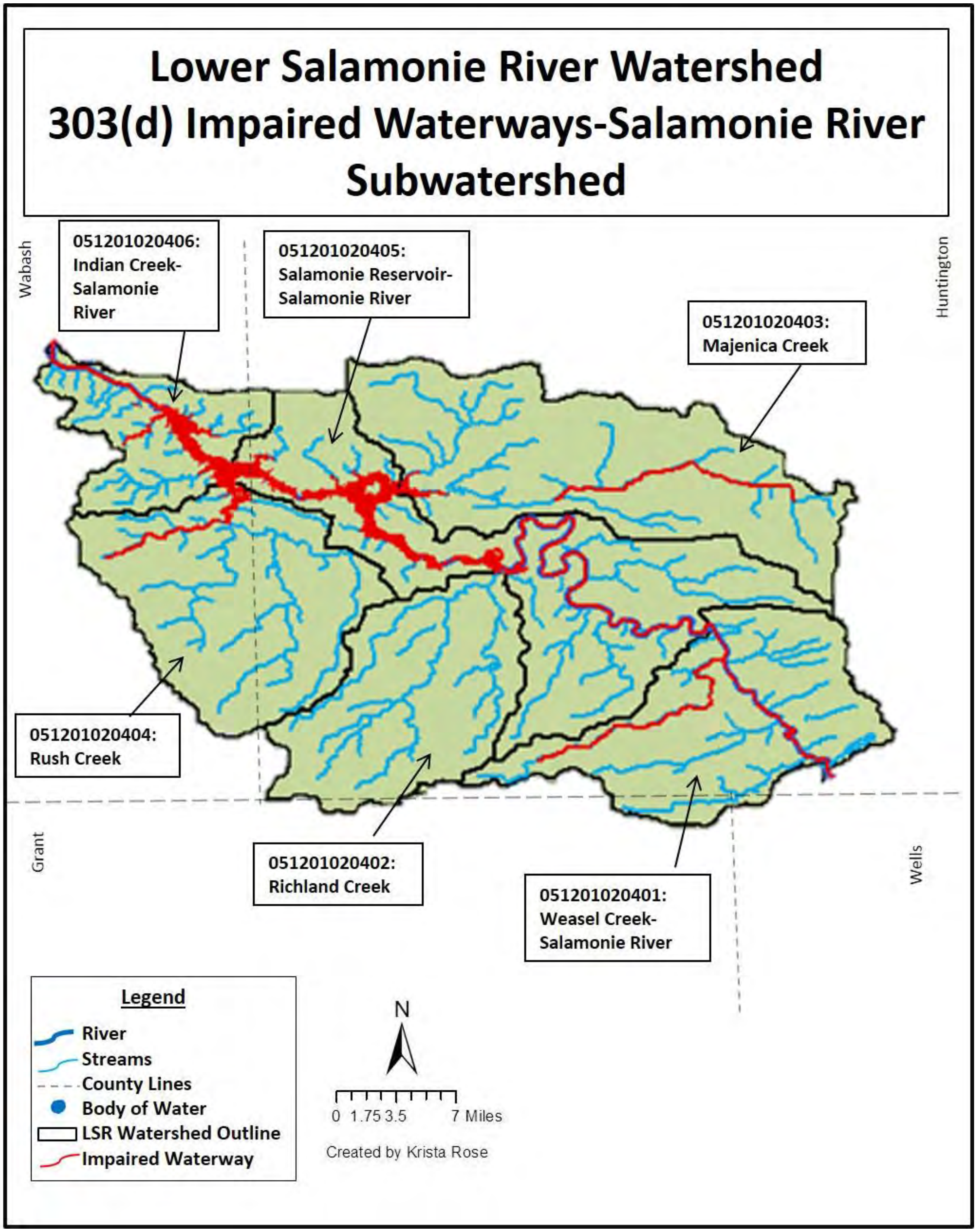


Table 47 and Figure 35 indicate impaired waters in the Salamonie River sub-watershed. Impairments include E. coli, Impaired Biotic Communities, Nutrients, and PCBs and Mercury in fish tissue. As previously stated, PCBs and Mercury are legacy pollutants that are beyond the scope of this report. However, E. coli, nutrients, and Impaired Biotic Communities need to be addressed. Approximately 9.12 stream miles are listed for E. coli, 6.75 miles for Impaired Biotic Communities, and 6.05 miles are listed for Nutrients on IDEM's 303 (d) list for the Salamonie River sub-watershed.

**Table 47 303(d) Listed Streams in the Salamonie River Sub-watershed**

| HUC 10 | HUC 12 | Waterbody Segment ID | County | Waterbody Segment Name | Cause of Impairment | Miles |
|---|---|---|---|---|---|---|
| 0512010204 Salamonie River sub-watershed | 051201020401 Weasel Creek | INB0238_01 | Huntington | Salamonie River | PCBs, Total Mercury in Fish Tissue | 3.6 |
| 0512010204 Salamonie River sub-watershed | 051201020401 Weasel Creek | INB0241_01 | Huntington | Salamonie River (Downstream of Detamore Ditch) | PCBs, Total Mercury in Fish Tissue | 4.4 |
| 0512010204 Salamonie River sub-watershed | 051201020401 Weasel Creek | INB0241_02 | Huntington | Salamonie River (Downstream of Detamore Ditch) | PCBs, Total Mercury in Fish Tissue | 1.1 |
| 0512010204 Salamonie River sub-watershed | 051201020401 Weasel Creek | INB0241_T1001 | Huntington | Detamore Ditch | Impaired Biotic Communities | 0.7 |
| 0512010204 Salamonie River sub-watershed | 051201020403 Majenica Creek | INB0244_00 | Huntington | Majenica Creek-Headwaters | Impaired Biotic Communities, Nutrients | 6.05 |
| 0512010204 Salamonie River sub-watershed | 051201020405 Salamonie Reservoir - Salamonie River | INB0242_T1002 | Huntington | Salamonie River-Lancaster | E.coli, PCBs, Total Mercury in Fish Tissue | 9.12 |
| 0512010204 Salamonie River sub-watershed | 051201020405 Salamonie Reservoir - Salamonie River | INB0242_01 | Huntington | Salamonie River | PCBs, Total Mercury in Fish Tissue | 9.1 |
| 0512010204 Salamonie River sub-watershed | 051201020405 Salamonie Reservoir - Salamonie River | INB02P1007_00 | Huntington | Salamonie Reservoir | PCBs, Total Mercury in Fish Tissue | 4.23 |
| 0512010204 Salamonie River sub-watershed | 051201020406 Indian Creek | INB0248_00 | Wabash | Salamonie River (Below Dam) | PCBs, Total Mercury in Fish Tissue | 3.1 |
| 0512010204 Salamonie River sub-watershed | 051201020406 Indian Creek | INB02P1009_00 | Wabash | Hominy Ridge Lake | Total Mercury in Fish Tissue | 0.02 |

**Figure 35 Salamonie River Sub-watershed 303(d) listed streams**



***Salamonie River Sub-Watershed Biological Sampling and Habitat Analysis data***

Table 48 summarizes the habitat and biological data for the Salamonie River Sub-Watershed for 2013 and 2014. Explanations for values are found in Table 49. For 2013, PTI ratings are similar to CQHEI ratings with PTI ratings being slightly higher then would be predicted from available habitat. Two specific sites stand out for 2013. Site H7 has a CQHEI score of Fair, but an Excellent PTI rating. This difference may be due to volunteer error, as these ratings match more closely in 2014, or the aquatic organisms were able to take advantage of the limited habitat. Site H11 has the opposite situation with a Good CQHEI rating and a rating of Poor for PTI. However, in 2014 these scores are more closely aligned with each other. In 2014 there was a noticeable decrease in scores for Site H8. The reason for this is unknown so it warrants closer inspection in the spring of 2015 when habitat and macro-invertebrates will be evaluated again. In 2014 the CQHEI and PTI ratings are more in line with each other, however, the smaller tributaries appear to have poorer PTI ratings in relation to habitat than the main stem of the Salamonie River.

**Table 48 Salamonie River Sub-watershed Macroinvertebrate & Habitat Assessment Ratings**

| Site | 12 Digit HUC | 2013 CQHEI Score | 2013 CQHEI Rating | 2013 PTI Score | 2013 PTI Rating | 2014 CQHEI Score | 2014 CQHEI Rating | 2014 PTI Score | 2014 PTI Rating |
|---|---|---|---|---|---|---|---|---|---|
| H7 | 51201020401 | 55 | Fair | 24 | Excellent | 65 | Good | 28 | Excellent |
| GAGE | 51201020401 | 69 | Good | 17 | Good | 51 | Fair | 26 | Excellent |
| H8 | 51201020405 | 83 | Good | 26 | Excellent | 57 | Fair | 7 | Poor |
| H9 | 51201020403 | 52 | Fair | 18 | Good | 45 | Poor | 15 | Fair |
| H10 | 51201020402 | 63 | Good | 22 | Good | 65 | Good | 14 | Fair |
| H11 | 51201020406 | 68 | Good | 4 | Poor | 67 | Good | 16 | Fair |
| WB12 | 51201020406 | 62 | Good | 20 | Good | ** | ** | ** | ** |

**Fall Drawdown, Site was too treacherous to sample.

**Table 49 CQHEI and PTI Scores and Ratings**

| Citizen Habitat Evaluation Index (CQHEI) | | Pollution Tolerance Index (PTI) | |
|---|---|---|---|
| Score | Rating | Score | Rating |
| >100 | Excellent | ≤ 10 | Poor |
| > 60 | Good | 11 - 16 | Fair |
| > 51 | Fair | 17 - 22 | Good |
| < 51 | Poor | >23 | Excellent |

Tables 50 and 51 show macro-invertebrate and fish data for streams in the Salamonie River sub-watershed. Both macro-invertebrates and fish sampling indicate that Detamore Ditch is impaired and listed on Indiana's 303(d) list of impaired waterbodies. In addition, fish sampling in Majenica Creek and Majenica Ditch indicated these waterbodies had a poor rating for fish community data, and were also on the 303(d) list. Majenica Creek and Ditch are located in a Tier 1 priority critical area, so it is expected that BMPs installed in this area will help improve the biological integrity of these streams.

**Table 50 IDEM Macroinvertebrate and Habitat Data Summary Salamonie River Sub-watershed**

| Site | Date | 12 Digit HUC | Stream Name | QHEI Score | QHEI Rating | mIBI Score | Sample Method | Impairment Status |
|---|---|---|---|---|---|---|---|---|
| WSA040-0016 | 02-Jul-03 | 051201020401 | Detamore Ditch | 59 | **Good** | 1.2 | Kick | Imparied |
| WSA040-0008 | 18-Aug-03 | 051201020401 | Salamonie River | 69 | Good | 5.4 | Kick | Supporting |
| WSA040-0023 | 21-Jul-08 | 051201020405 | Salamonie River | 69 | Good | 44 | MHAB | Supporting |
| WSA-04-0004 | 25-Jul-11 | 051201020403 | Majenica Creek | 40 | **Poor** | 38 | MHAB | Supporting |

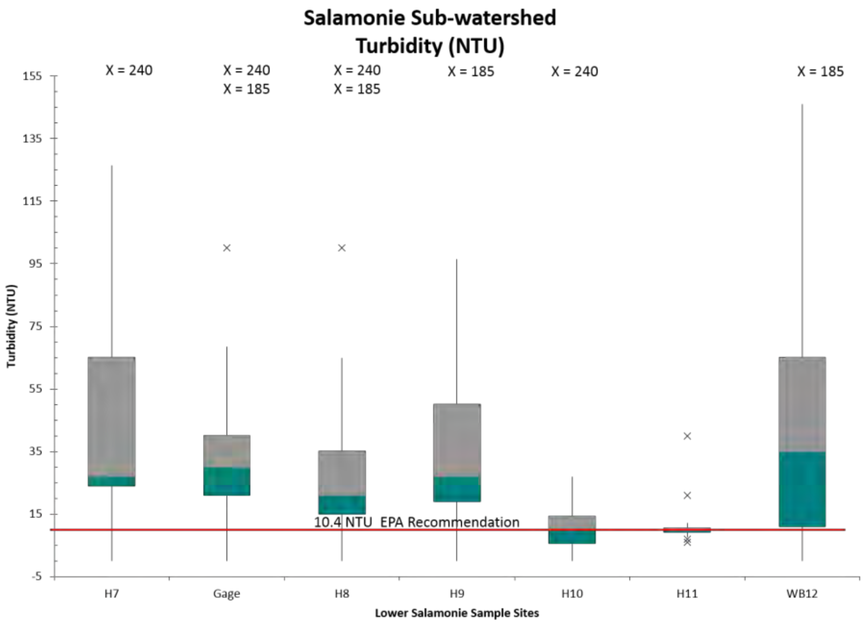
**Table 51 IDEM Fish Community and QHEI Data for Salamonie Rive Sub-watershed**

| Station Name | 12-Digit HUC | Waterbody Name | IBI Score | IBI Rating | QHEI Score | QHEI Rating |
|---|---|---|---|---|---|---|
| WSA040-0016 | 051201020401 | Detamore Ditch | 24 | Poor | 59 | Good |
| WSA040-0023 | 051201020405 | Salamonie River | 44 | Fair | 80 | Excellent |
| WSA-04-0004 | 051201020403 | Majenica Creek | 30 | Poor | 58 | Good |
| WSA040-0012 | 051201020403 | Majenica Ditch | 32 | Poor | 55 | Good |

### *Lower Salamonie River Watershed Chemical Sampling*

Turbidity, Phosphorus, Nitrate, and E. coli were sampled throughout the Salamonie River sub-watershed as part of the development of the LSR watershed management plan. Box and Whisker plots are shown below in figures 36-39 for these parameters.

**Figure 36  Salamonie Sub-watershed Turbidity**




Turbidity values (Figure 36) were high for all sites sampled in the Salamonie River sub-watershed except for at site H10 (Richland Creek sub-watershed) and site H11 (Indian Creek sub-watershed). Both of these sites are relatively small tributaries, especially H11 which runs so shallow over bedrock it can be difficult to obtain a sample. Site H9 in the Majenica Creek sub-watershed is also located on a smaller tributary to the north of the reservoir but is well above the recommendations of the US EPA regarding turbidity. The other sites are on the Salamonie River and are all above recommended values.

**Figure 37  Salamonie Sub-watershed Phosphorus**

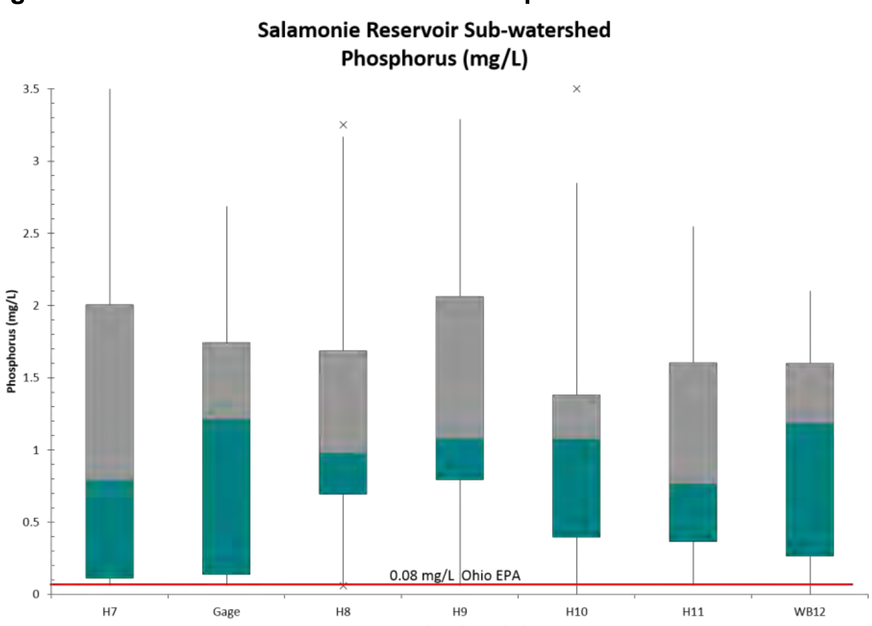
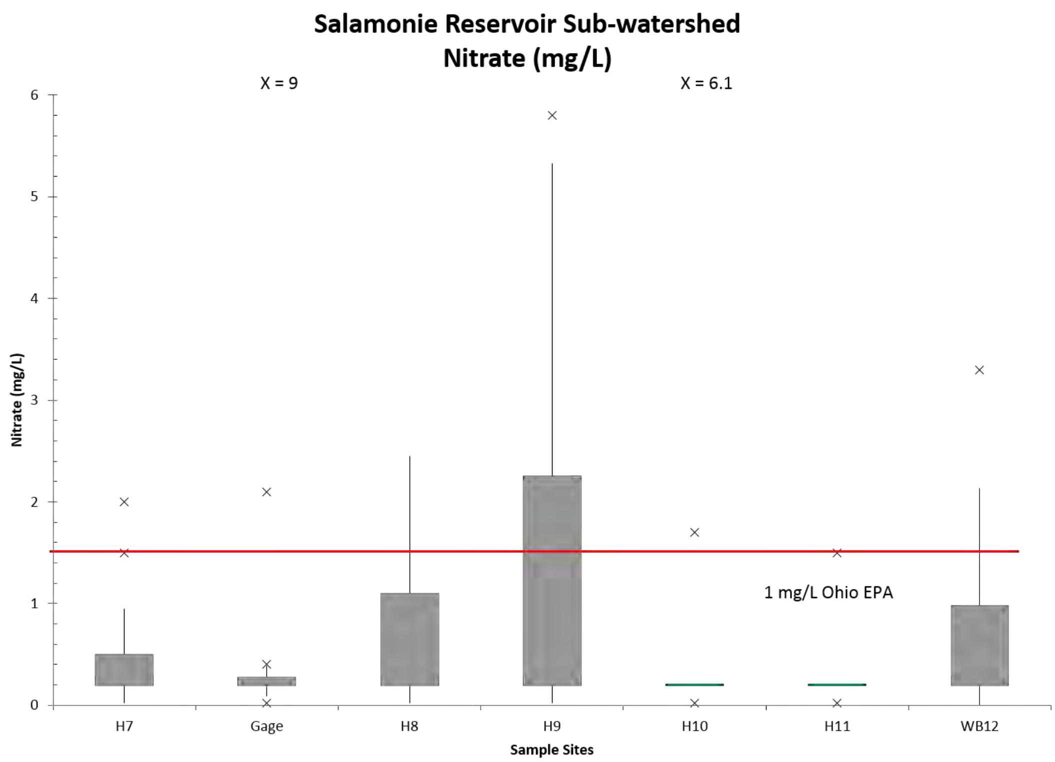


Figure 37 indicates that almost all samples were well above the recommended phosphorus levels for rivers and streams which can lead to algae blooms in downstream lakes and reservoirs. Samples collected by IDEM and USACE also indicated high levels of phosphorus throughout the watershed (Appendix D). Samples from IDEM trend lower than those collected by USACE and the LSR watershed. The reason for this may be due to further implementation of Clean Air Act regulations, which have resulted in less acid rain causing higher pH levels in the soil. Higher soil pH makes phosphorus more available and more likely to leach out of soils into area waterways. IDEM results show samples taken over many years, so statistical results will include data before present Clean Air Act regulations. However, USACE data also trends below that of the LSR watershed. It is unlikely that phosphorus release from soils due to pH would change that rapidly in the LSR watershed. Other possibilities for this difference between USACE and LSR watershed may include testing methodology differences. However, the overall result indicates a need for phosphorus reduction in LSR watershed's rivers and streams.

**Figure 38 Salamonie Sub-watershed Nitrate**




Nitrate levels in the Salamonie River sub-watershed were less of a problem than phosphorus levels (Figure 38). Most samples were below recommendations, but could become a problem during storm events, especially in the spring after nitrogen fertilizer applications to row crops. These problems are widespread and can best be solved through wise management of farm acreage.

**Figure 39  Salamonie Sub-watershed E. coli**

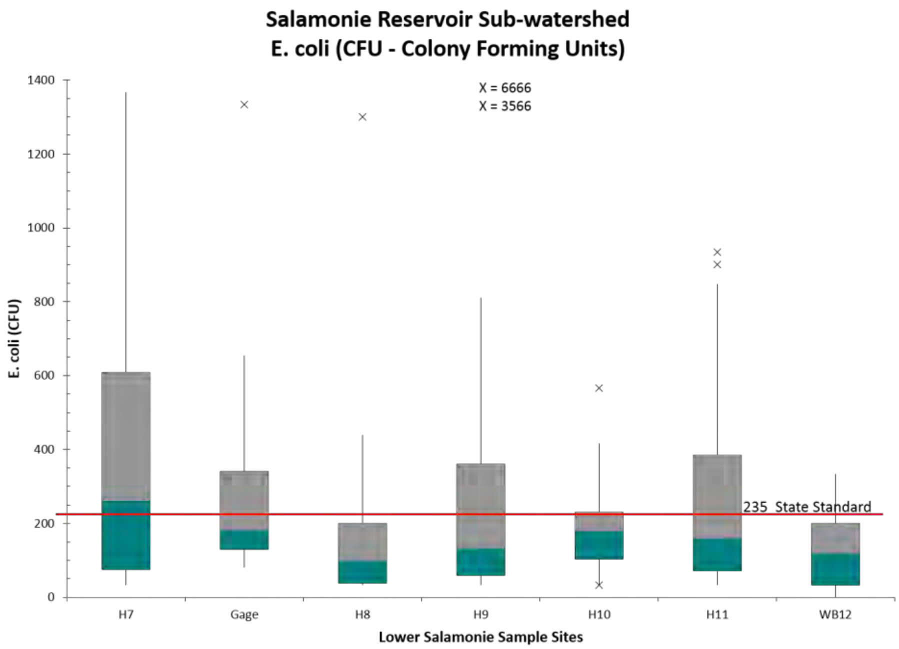



Figure 39 shows E. coli data from the Salamonie River sub-watershed.   Values were better than for the Black Creek sub-watershed with only one site, H7, having a median value over the State standard of 235 CFU/100ml.  This seems to indicate that E. coli contamination is less of a concern for sites around the reservoir.  However, work still remains to be done to avoid any violations of E. coli standards.

Other parameters including temperature, pH, and dissolved oxygen were evaluated at each of the sample sites.  All results met Indiana water quality standards with the exception of two measurements at site H9 on Majenica Creek (Figure 18).  During the first year of sampling during July and August of 2013, measurements of 3.53mg/L and 2.12mg/L respectively were found for dissolved oxygen.  These measurements are below the 4mg/L one time sample value indicated by Indiana's water quality standards (IAC 2-1-6).  No further violations have been found to date.

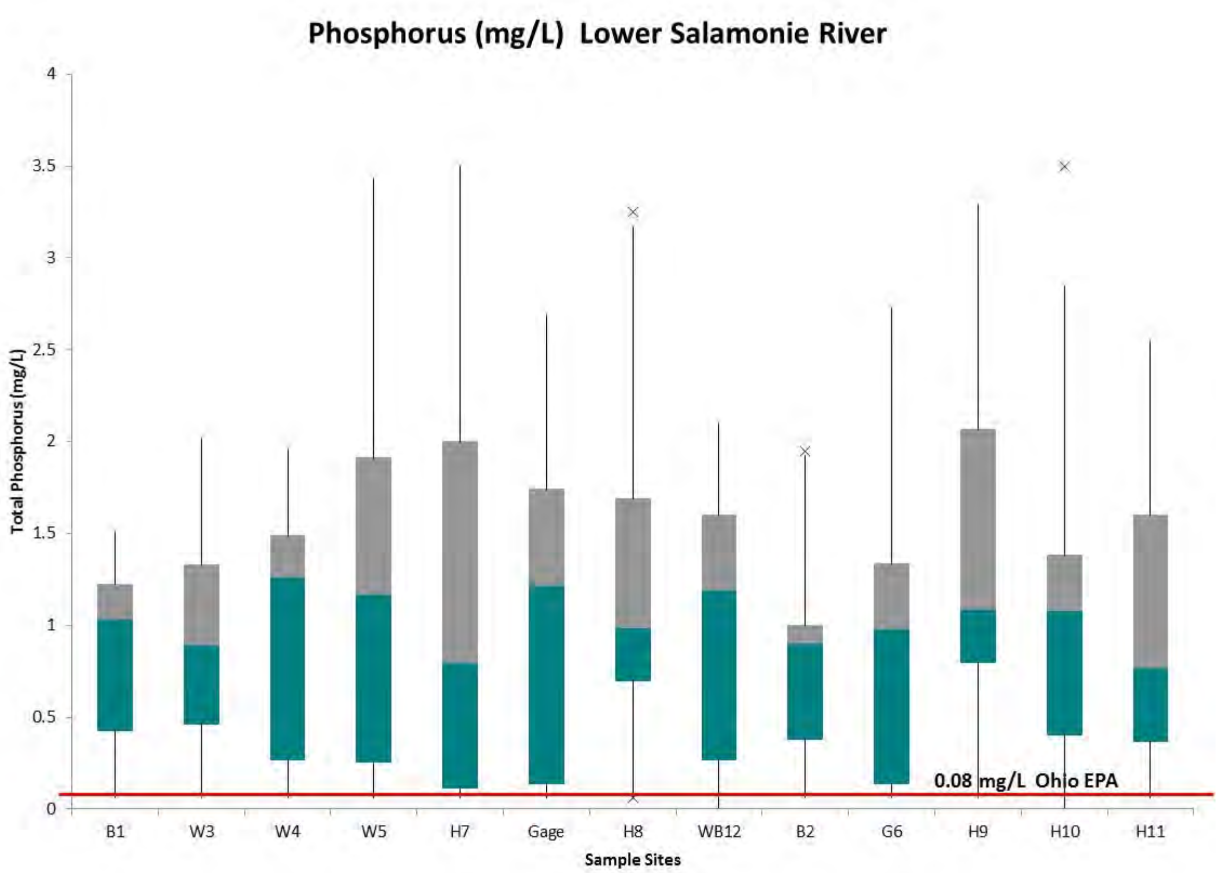
## 4.0 Watershed Inventory III

## 4.1 Watershed Inventory Summary

### Nutrients

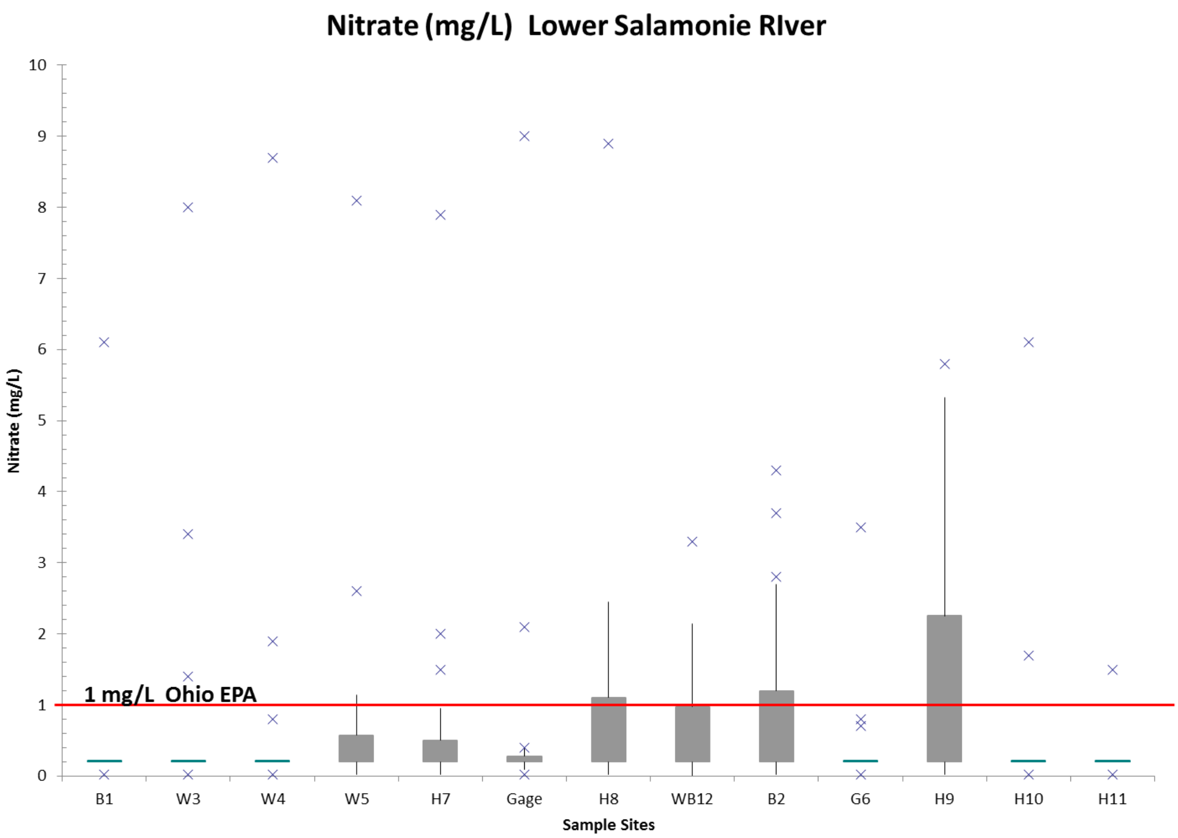
Excess nutrients are a major problems in the LSR watershed and is a stakeholder concern. Majenica Creek sub-watershed, HUC 051201020403, is listed on IDEM's 2012 303(d) list as impaired due to nutrients. Although it is the only sub-watershed listed under this impairment designation, LSR water quality monitoring shows consistently high values of total phosphorous that exceed the target level of 0.08mg/L (Figure 40). They also exceed the 0.3mg/L that IDEM uses to determine the necessity of a TMDL. Values indicate that all areas of the watershed are in need of measures to reduce phosphorus loading to rivers and streams.

**Figure 40 Phosphorus Levels in the Lower Salamonie River Watershed**



Nitrate levels were not as much as a problem as phosphorus in the LSR watershed, but still often exceeded recommended values (Figure 41). Values changed radically, which may be due to run-off events in association with nitrogen fertilizer application, and increased tile drainage which has been found to be high in nitrogen because of the ability of nitrogen to leach from soils. Better farm practices and the use of drainage management may help solve this issue.

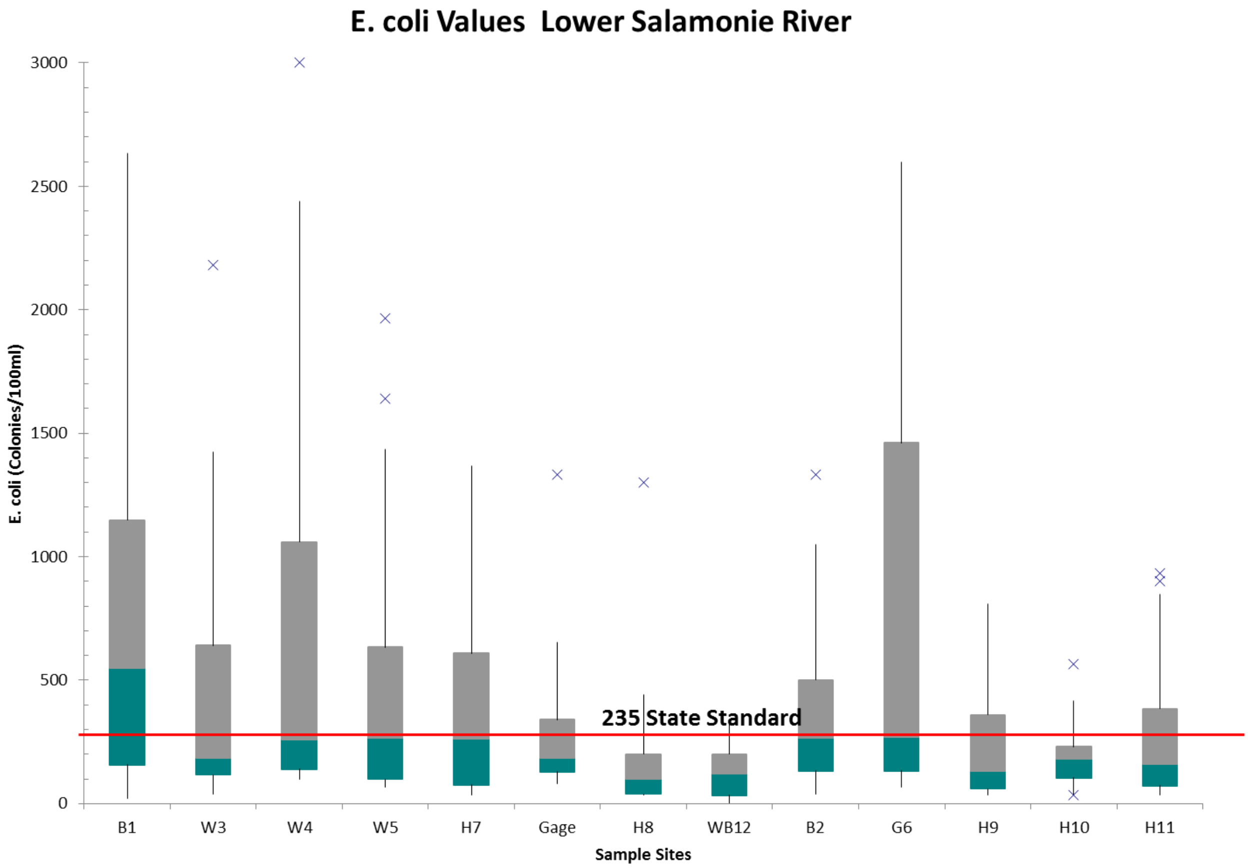
**Figure 41 Nitrate Values in the Lower Salamonie River Watershed**




## E.coli

E.coli is another important water quality parameter in the LSR watershed. High levels of E.coli are included on the stakeholders list of concerns. The 2010 303(d) list identifies E.coli impairments in three sub-watersheds: Scuffle Creek, Shadle Drain, and Salamonie Reservoir. Water quality monitoring indicates that E.coli is often above state standards for safe full contact recreation (Figure 42). Although the problem is wide spread, it appears to be more of an issue in the upstream Black Creek sub-watershed as opposed to the Salamonie River watershed to the west.

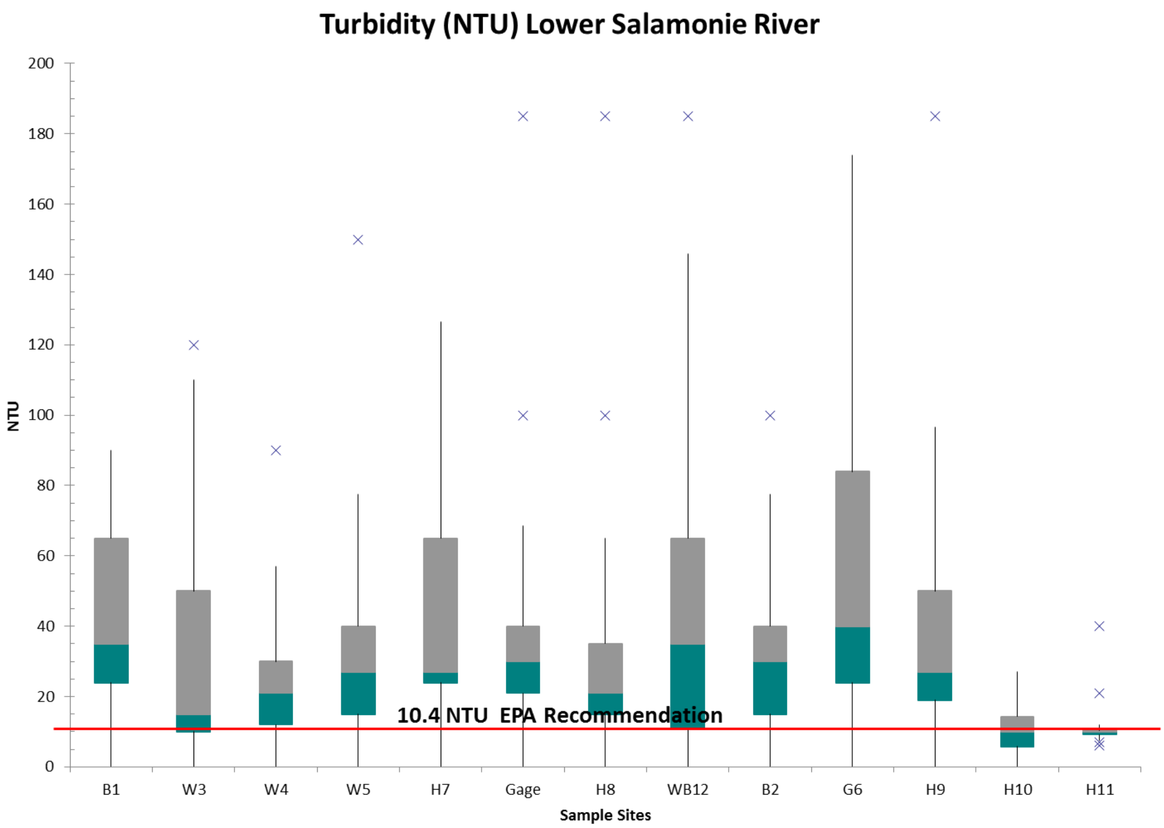
**Figure 42  E. coli Values in the Lower Salamonie River Watershed**




## Turbidity

Turbidity measurements are often used as a surrogate for total suspended solids measurements.  Turbidity values exceed recommendations for the majority of samples taken in the LSR watershed (Figure 43).  This problem is widespread and is only less of an issue on a couple small tributaries to the Salamonie Reservoir (Sites H10 and H11).  Maintaining a low turbidity is important for the health of the aquatic ecosystem.  In addition, soil particles can transport phosphorus downstream resulting in toxic algae blooms when this nutrient becomes bio-available.  It will be important to reduce loading of suspended solids in all areas of the watershed.

**Figure 43  Turbidity Values in the Lower Salamonie River Watershed**




## Biology and Habitat

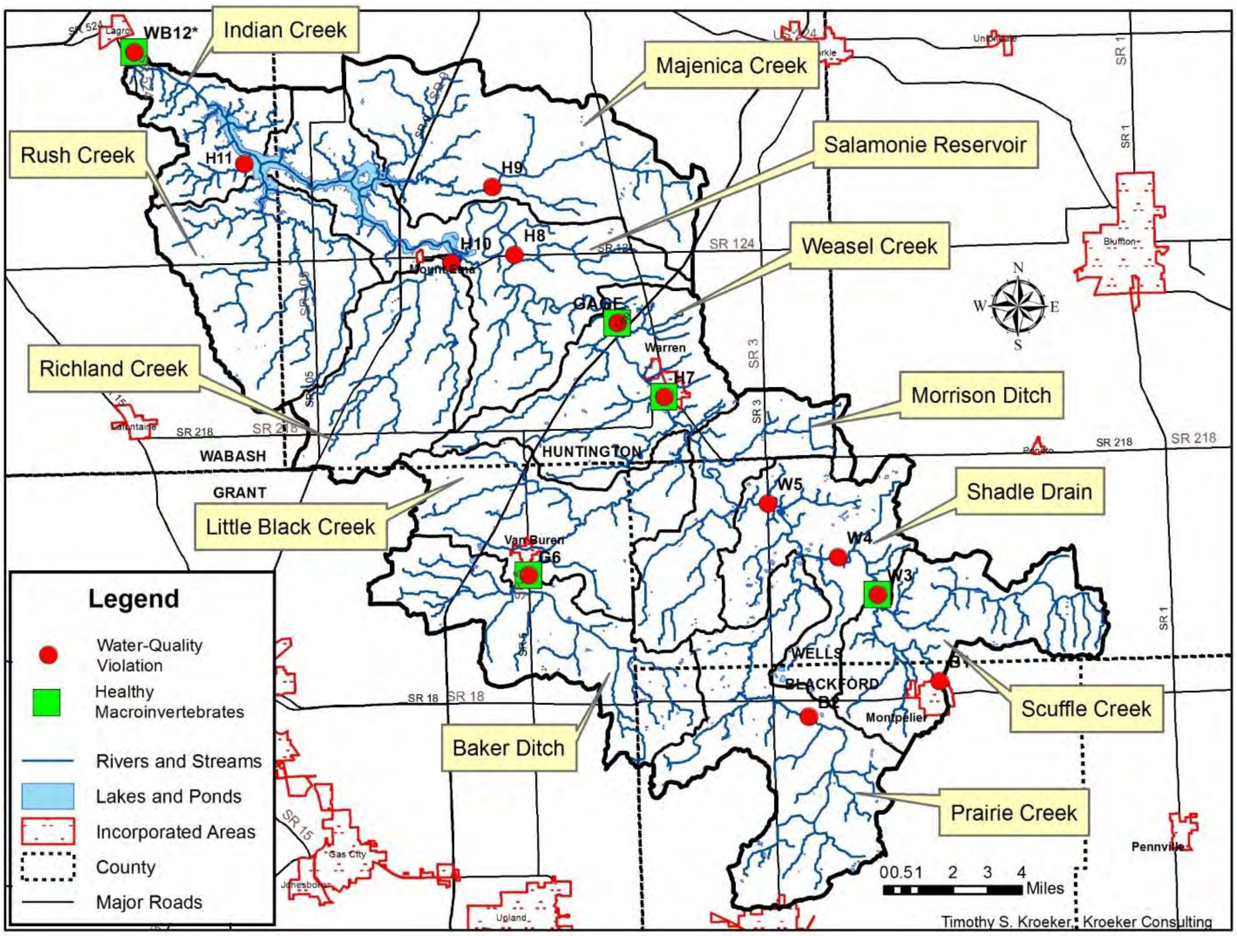
The Lower Salamonie River watershed group looked at habitat and macroinvertebrates in 2013 and 2014. In 2013 for habitat, five sites ranked as Fair and eight sites were considered Good. Overall the macroinvertebrate community ranked higher than would be predicted by habitat with seven sites ranking as Good, 4 sites considered Excellent, one site considered Fair, and only one site ranking as Poor. In 2014 the distribution was different. For habitat, one site was considered Excellent, five sites were Good, four sites were Fair, and two sites were considered Poor. The macroinvertebrate data did not mirror the habitat value. Some sites did better than predicted by habitat, and several ranked worse. Three sites were considered Excellent, one site Good, six sites were considered Fair, and two sites ranked as Poor. The differences between the two years could be the result of water quality changes, or due to methodology, seasonal differences, sampler error, or the fact that volunteer macroinvertebrate data only identifies aquatic insects down to the family level which may result in misleading rankings. Professional sampling may need to be performed to get a better picture of the stream biology at these sites.

IDEM collected fish community and habitat data at five sites. Although the habitat indicated the sites were Good to Excellent, the fish community ranked Fair to Poor. This would indicate that problems with water quality were to blame for the impaired fish communities. It is expected that BMPs installed throughout the watershed will help address these water quality issues.

## Hydrology

The hydrology throughout the LSR watershed has been highly modified and much of the farmland is being drained to improve agricultural production. Volunteers performing the windshield survey reported that many streams had been ditched and/or straightened to speed flow off farm fields. In addition, 44% of all sites visited had fields with tile drains present. These stream modifications have resulted in a system that is very flashy in nature which can lead to stream bank erosion and downstream flooding. A summary figure of water quality and biological monitoring is shown below in figure 44.

**Figure 44 Summary of Monitoring Results**



## 4.2 Analysis of Stakeholder Concerns

Following the characterization and inventory of the LSR watershed, stakeholder concerns were analyzed. As part of this analysis, each concern was evaluated to determine if there were data to support it, what evidence was currently available, could the concern be quantified, and was the concern within the scope of this project (Table 52). These grading variables helped the steering committee decide what to focus on, and how to prioritize the concerns that were gathered during the initial stages of this watershed planning effort. Most concerns are supported by data and inside the scope of the project. Please note, however that fish consumption advisories are due to legacy pollutants, and will be addressed through educational efforts only.

**Table 52 Analysis of Stakeholder Concerns**

| Concern | Supported by Data | Evidence | Quantifiable | Outside Scope | Group Focus On |
|---|---|---|---|---|---|
| Lack of no-till farming practices | Yes | Tillage Transect, Windshield Survey, WQ monitoring | Yes | No | Yes |
| Lack of cover crops seeded | Yes | Tillage Transect, Windshield Survey, WQ monitoring | Yes | No | Yes |
| Pesticide concentrations | No | | No | Yes | No |
| Nutrient overloads | Yes | WQ monitoring | Yes | No | Yes |
| Runoff | Yes | Watershed Inventory, WQ monitoring | Yes | No | Yes |
| Failing septic systems | Yes | County Health Departments | Yes | No | Yes |
| Waste treatment systems maintenance | yes | WQ monitoring | Yes | No | Yes |
| E. coli | Yes | WQ monitoring | Yes | No | Yes |
| Stream bank erosion | Yes | Watershed Inventory, WQ monitoring | Yes | No | Yes |
| Sediment/Silt levels | Yes | WQ monitoring | Yes | No | Yes |
| Endangered species protection | Yes | DNR and FWS Endangered Species List | Yes | No | Yes |
| Fish health and habitat quality low | Yes | Habitat monitoring | Yes | No | Yes |
| Flashiness and Flooding | Yes | USGS Gage, Observed Flows | Yes | No | Yes |
| Lack of Recreation on River | Yes (undocumented) | Conversations with the public | No | No | Yes |
| Lack of public knowledge on area's water quality | Yes (undocumented) | Conversations with the public | No | No | Yes |
| Fish Consumption | Yes | DNR Fish Advisory List | Yes | No | Yes |
| Blue-green algae blooms in Salamonie Reservoir | Yes | WQ Monitoring – IDEM, USACE | Yes | No | Yes |
| Invasive plant species | Yes | Windshield Survey, Inventory | Yes | No | Yes |

## 5.0 Identifying Problems and Causes

Initial stakeholder concerns were grouped under four problem statements (Table 53). Within these four problem statements, potential causes were then documented based on historic and current water quality data (Table 54).

**Table 53 LSRW Concerns and Problems**

| Concern | Problem |
|---|---|
| Sediment/Silt levels | Water of the Salamonie River and streams are very cloudy and turbid. |
| Stream bank erosion | |
| Lack of no-till, cover crops | |
| Flashiness and Flooding | |
| Runoff | |
| Sediment/Silt levels | The Salamonie River and its tributaries are listed on IDEM's 303(d) list for E.coli, nutrients, IBC, and fish impairments. |
| Nutrient overloads | |
| E. coli | |
| Runoff | |
| Failing septic systems | |
| Waste treatment systems maintenance | |
| Lack of cover crops seeded | |
| Lack of no-till farming practices | |
| Pesticide concentrations | |
| Fish health and habitat quality low | |
| **Concern** | **Problem** |
| Stream bank erosion | Widespread recreational use on the Salamonie River is prevented. |
| Lack of Recreation on River | |
| E. coli | |
| Lack of public knowledge on area's water quality | |
| Fish Consumption Warning | |
| Fish health and habitat quality low | |
| Endangered species protection | The desirable native fish, mussel and plant populations in and around the Salamonie River and surrounding waterways are suspected to be in decline. |

**Table 54 LSRW Problems and Potential Causes**

| Problem | Potential Causes |
|---|---|
| Waters of the Salamonie River and streams are very cloudy and turbid. | Turbidity exceed target values set by state water quality standards. |
| | Livestock access disturb bottom sediments |
| | Lack of no-till, cover crops |
| | Streambank erosion and slope failures input high levels of sediment |
| The Salamonie River and its tributaries are listed on IDEM's 303(d) list for E.coli, nutrients, IBC, and fish impairments. | Nutrient concentrations exceed target values set by this project |
| | E.coli levels exceed target levels |
| | Fish Community diversity is low |
| | Lack of Buffer strips along waterways |
| | Lack of and decline of use of conservation tillage practices |
| | Nothing actively growing during non-cash crop season to prevent nutrient loss (e.g. cover crops) |
| Widespread recreational use on the Salamonie River is prevented. | Lack of public access points on the River |
| | Perceived poor water quality |
| | Harmful Algal Blooms |
| | E.coli levels exceed target levels |
| | Perceived poor fishing |
| The desirable native fish, mussel and plant populations in and around the Salamonie River and surrounding waterways are suspected to be in decline. | Nutrient concentrations exceed target values set by this project (water looks "dirty") |
| | Poor habitat/water quality limits the biotic community which is food source for fish |
| | Perceived poor fishing |
| | Competing land uses resulting in loss of riparian/diverse fish habitat |

## 5.1 Potential Sources of Water Quality Impairments

Concerns were identified by the steering committee and used to identify specific problems in the watershed. Once problems were identified, they were further subdivided into potential causes, and possible sources of those problems (Table 55). Both recent and historic data were evaluated to aid in the development of specific root causes and sources. Many of these sources may be more evident in one sub-watershed as compared to another, which will help define critical areas of concern within the watershed.

**Table 55 Stakeholder Concerns and Related Problems and Sources**

| Stakeholder Concern | Problem | Potential Causes | Potential Sources |
|---|---|---|---|
| E coli Contamination | Surface waters throughout the watershed do not meet full body contact recreational use requirements due to E. Coli contamination. Specific waters of the Lower Salamonie are listed for E. coli on IDEMs 303(d) list. | E. coli exceeds target levels | 56 Combined Feeding Operations located in the watershed |
| Waste Treatment System Maintenance | | | Approximately 99% of the land in the watershed is unsuitable for septic systems. Indiana State Department of Health indicates that 25 Percent of septic systems in the state are failing or have failed due to poor maintenance, system age, or unsuitable placement. Many environmental professionals think this number may be much higher. |
| Lack of Knowledge Concerning Area Water Quality | | | 21 NPDES Outfalls are located in the watershed, 13 of which have the potential to discharge E. coli |
| Failing Septic Systems | | | Montpelier has a CSO that discharges into the river |
| | | | Suspected direct discharges into waterbodies from older septic systems |
| Lack of Recreation on the River | | | Manure application in the watershed due to the high number of confined feeding operations |
| | | | Livestock access to streams Of 459 survey sites, 14 sites had stream access for livestock. Eight of the 14 sites are located in the Weasel Creek and Salamonie Reservoir sub-watersheds. |
| Stream Bank Erosion | Surface waters throughout the Lower Salamonie River watershed appear muddy, turbid. | Turbidity exceed desired levels | Stream-bank erosion |
| | | | Lack of cover crops and other conservation practices |
| Sediment/Silt Levels | | Stream-bank erosion and slope failures input high levels of sediment | Floodplains are grazed, hayed or cultivated Of 459 sites surveyed, 401 have land adjacent to streams in either row crop or pasture land. The majority of these have no buffer or inadequate buffers to replace floodplain functions. |

**Table 55 Cont. Stakeholder Concerns and Related Problems and Sources**

| Stakeholder Concern | Problem | Potential Causes | Potential Sources |
|---|---|---|---|
| Nutrient overloads | Surface waters throughout the Lower Salamonie River watershed appear muddy, turbid. | | Conventional Tillage is common in the watershed. Of the 459 sites surveyed, 389 sites have cropland and of these, 49% include areas of conventional tillage. Watersheds where conventional tillage is high include, Rush Creek, Baker Ditch, Scuffle Creek, and Morrison Ditch. |
| Flashiness and Flooding | | | 12,680 acres or 6.5 percent of the watershed contains highly erodible soils |
| | | | |
| Run-0ff | | | Livestock access to streams Of 459 survey sites, 14 sites had stream access for livestock. Eight of the 14 sites are located in the Weasel Creek and Salamonie Reservoir sub-watersheds. |
| Lack of Knowledge Concerning Area Water Quality | | | Approximately 6% of land use is urban and consists of highly impervious surfaces which can lead to sediment laden runoff |
| Lack of Conservation Tillage and Cover Crops | | | Hydrology is highly modified contributing to unstable stream-banks and increased runoff. The majority of streams throughout the watershed have been ditched, straightened, and modified in other ways as is evident by the miles of regulated drains found in the watershed (see Table 5). |
| Fish Health and low habitat quality | The desirable native fish, mussels and plant population in and around the Salamonie River and it's tributaries are suspected to be in decline | Nutrient concentrations exceed target values set by this project | Floodplain habitat destruction due to drainage policy and the cropping and pasturing found in 401 of the 459 sites surveyed |
| Invasive plant species | | | Hydrologic modification due to drainage practices and legal drain maintenance as evident by the miles of regulated drains found in the watershed (see Table 5) which also effects habitat |
| Lack of Recreation on the River - such as fishing | | | Fish consumption advisories |

**Table 55 Cont.  Stakeholder Concerns and Related Problems and Sources**

| Stakeholder Concern | Problem | Potential Causes | Potential Sources |
|---|---|---|---|
| Endangered Species Protection | The desirable native fish, mussels and plant population in and around the Salamonie River and it's tributaries are suspected to be in decline | Poor habitat/water quality limits the biotic community that is part of the food chain for desired fish species | Excess nutrient, sediment, and other pollutants enter the river system due to lack proper conservation practices effecting habitat and species survival.  49% of all sites surveyed still have land under conventional tillage, although a few of these have incorporated filter strips. |
| | | | Stream-bank erosion and slope failures input high levels of sediment  219 or 48% of all sites surveyed showed signs of stream-bank erosion.  Sites were spread throughout the LSR watershed. |
| | | | Sediment laden runoff from land smothers aquatic habitats |
| | | | Lack of catchable size fish in river |
| Lack of Public knowledge on areas water quality | | Perceived poor fishing | Competing land uses resulting in loss of riparian/diverse fish habitat |
| Sediment/Silt Levels | The Salamonie River is listed on IDEM's 303(d) list for Nutrients and Impaired Biotic Communities | Nutrient concentrations exceed target values set by project | Montpelier has a CSO that discharges into the river |
| Nutrient Overloads | | Streams are listed as having Impaired Biotic | 12,680 acres or 6.5 percent of the watershed contains highly erodible soils |
| Runoff | | Lack of Buffer Strips along the River | 21 NPDES Outfalls are located in the watershed |
| Failing Septic Systems | | | Floodplains are grazed, hayed or cultivated resulting in a lack of buffer between land practices and aquatic systems  Of 459 sites surveyed, 401 have land adjacent to streams in either row crop or pasture land. The majority of these have no buffer or inadequate buffers to replace floodplain functions. |
| Waste treatment system maintenance | | Lack of cover crops and other conservation | Over 112 miles of legal drains |
| Lack of cover crops seeded | | | Approximately 6% of land use is urban and consists of highly impervious surfaces which can lead to sediment and pollutant laden runoff |

**Table 55 Cont. Stakeholder Concerns and Related Problems and Sources**

| Stakeholder Concern | Problem | Potential Causes | Potential Sources |
|---|---|---|---|
| Lack of no-till farming practices | | | Lack of cover crops and other conservation practices Of the 389 survey sites with cropland, only 19 sites had cover crops. 13 of these 19 sites were in Weasel Creek, Scuffle Creek, and Prairie Creek sub-watersheds. In addition, 191 survey sites had land still in conventional tillage. |
| Pesticide concentrations | | Stream are listed as having excess nutrients | |
| Fish Health and habitat quality is low | | | Livestock access to streams Of 459 survey sites, 14 sites had stream access for livestock. Eight of the 14 sites are located in the Weasel Creek and Salamonie Reservoir sub-watersheds. |
| | | | Conventional Tillage is common in the watershed Of the 459 sites surveyed, 389 sites have cropland and of these, 49% include areas of conventional tillage. Watersheds where conventional tillage is high include, Rush Creek, Baker Ditch, Scuffle Creek, and Morrison Ditch. |
| Stream Bank Erosion | Widespread recreational use on the Salamonie River is prevented | Nutrient concentrations exceed target values set by project | Competing land uses resulting in loss of riparian/diverse fish habitat |
| Lack of Recreation on the River | | | Perceived water quality problems |
| E. coli | | | Poor fish populations based on conversations with anglers and other stakeholders. Fish populations and sizes have declined significantly over the past 20 years. |
| Lack of public knowledge on areas water quality | | Poor habitat quality limits the biotic community which is a source of food | Fish consumption advisories |
| Fish Consumption Warnings | | | Aesthetic problems of turbid, waters algae blooms and foam and scum |

**Table 55 Cont. Stakeholder Concerns and Related Problems and Sources**

| Stakeholder Concern | Problem | Potential Causes | Potential Sources |
|---|---|---|---|
| Fish Health and Habitat Low | Widespread recreational use on the Salamonie River is prevented | Perceived poor fishing | Flashiness of system. Because of high degree of agricultural drainage, very high flows and very low flows are possible because there is so little retention of water in the watershed. Approximately 84% of land in the Salamonie River watershed is being drained to improve agricultural productivity (Sui, 2007). |

## 6.0 Calculation of Current Loads and Designation of Critical Areas

The LSR watershed was subdivided into 12-digit Hydrologic Unit Code areas to facilitate the identification of priority or critical areas. These are areas that have been classified as top priority areas for the limited funds available to address the concerns raised in this report. For this task, generalized modeling was performed using the web-based Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL) developed by Purdue University and Kangwon National University.

The STEPL model is designed to compute annual runoff, sediment load, nutrient loads, and the 5-day biological oxygen demand. It estimates the non-point source loading of these parameters, and also allows the user to model a variety of BMPs that might be used to address these non-point issues.

General inputs required for the program include individual land uses for each sub-watershed, soil types and characteristics, and climate data (specifically precipitation data) from the closest weather station available. There are also some optional data types that may be entered to improve the models accuracy. For the Lower Salamonie we looked at two of these alternative inputs. The first was number of septic systems and estimated failure rates, and the second was livestock located in the watershed.

Because the model is generalized, certain assumptions were made in order to input this additional data. The model assumes that for each septic system there are 2.34 users. To arrive at the number of users in each sub-watershed, the population for the county in which the sub-watershed was located was determine via US census data. The population of cities and towns within the county were subtracted out under the assumption that this population group had access to a centralized waste water treatment system. The remaining population was then considered to be evenly distributed throughout the county. The percentage of land area in the county within the sub-watershed was calculated, and this percentage of the rural population of the county was considered to be within the sub-watershed. This number was then divided by the model estimate of 2.34 users per septic system, and the calculated number of septic systems was input to the model. According to the Indiana Department of Health, the estimated number of septic systems that have failed or are failing is approximately 25%. This was the failure rate that was input for the Lower Salamonie River Watershed. However, this is most likely a conservative estimate since 99% of the soils in the watershed are considered very limited in their ability to adequately treat waste water.

Livestock numbers were also input into the model. To get a general estimate of livestock numbers, data from the 2007 Census of Agriculture developed by the Unites States Department of Agriculture were used to determine numbers of livestock, by species, at the county level. These numbers were once again considered to be evenly distributed throughout the county containing the sub-watershed, and the percentage of the county in the sub-watershed was used to determine final values. In the event a sub-watershed was located in more than one county, final numbers were determined looking at the percent of the watershed in each county and that county's overall livestock numbers. Once these numbers were input, the model was run with the following results (Tables 56 & 57).

**Table 56 Total Loading Calculations for Sub-watershed by STEPL**

| Watershed | N Load (lb/yr) | P Load (lb/yr) | BOD Load (lb/yr) | Sediment Load by Watersheds (t/yr) |
|---|---|---|---|---|
| Majencia Creek | 87453 | 16746 | 207055 | 2886.41 |
| Indian Creek | 21249 | 4084 | 56108 | 559.31 |
| Salamonie Reservoir | 76440 | 14395 | 192153 | 2291.20 |
| Rush Creek | 66928 | 12844 | 161911 | 2141.54 |
| Weasel Creek | 65882 | 12410 | 165205 | 2096.66 |
| Richland Creek | 56237 | 10779 | 134702 | 1856.64 |
| Little Black Creek | 66171 | 12834 | 161344 | 2129.20 |
| Morrison Ditch | 48680 | 9323 | 114496 | 1612.67 |
| Shadle Drain | 54123 | 10369 | 128571 | 1770.71 |
| Scuffle Creek | 61678 | 11620 | 149069 | 2027.92 |
| Prairie Creek | 80209 | 15109 | 188609 | 2695.37 |
| Baker Ditch | 66949 | 13015 | 161401 | 2159.23 |
| Lower Salamonie River Total | 751999 | 143528 | 1820623 | 24226.86 |

**Table 57 Total Loading Calculation from STEPL by Landuse**

| Sources | Total N Load by Land Uses (lb/yr) | N Loading Percentage | Total P Load by Land Uses (lb/yr) | P Loading Percentage | Total BOD Load by Land Uses (lb/yr) | BOD Loading Percentage | Total Sediment Load by Land Uses (t/yr) | Sediment Loading Percentage |
|---|---|---|---|---|---|---|---|---|
| Urban | 74722 | 9.94 | 11534 | 8.04 | 289839.23 | 15.92 | 1716 | 7.08 |
| Cropland | 605283 | 80.49 | 111794 | 77.89 | 1266760.07 | 69.58 | 22322.8 | 92.14 |
| Pastureland | 27104 | 3.6 | 2176 | 1.52 | 87510.56 | 4.81 | 144.37 | 0.6 |
| Forest | 4242 | 0.56 | 2105 | 1.47 | 10534.38 | 0.58 | 43.7 | 0.18 |
| Septic | 40648 | 5.41 | 15920 | 11.09 | 165978.69 | 9.12 | 0 | 0 |
| Total | 751998.598 | 100 | 143528.48 | 100 | 1820622.93 | 100 | 24226.86 | 100 |

## E. coli Loading

E. coli values will be addressed as percentage of samples over target levels as opposed to loading numbers. Percentages addressed in the goals include 1) 5 year goal: Less than 60% of samples exceed state standards (235 colony forming units (cfu)), 2) 10 year goal: Less than 75% of samples exceed the state standard, 3) 30 year goal: only statistical outliers exceed state standard. At present six sites still exceed the 5 year goal: they include sites B1, B2, W4, W5, G6, and H7. Ten of 13 sites exceed the 10 year goal at present. The three sites that meet this goal are sites H8 (200cfu), WB12 (200cfu) and H10 (230cfu). The other sites have third quartile values ranging from 340cfu to 1460cfu.

## Nitrogen Loading

The STEPL model for watershed loading yielded anticipated yearly loads for nitrogen. Although nitrogen is of concern, the limiting nutrient in the aquatic systems of the Lower Salamonie River is phosphorus. Phosphorus will be the most important nutrient for load reductions in the watershed. The STEPL model calculates the total load of nitrogen from the watershed. It does not give the specific speciation, or what percentage of nitrogen is in each form. Therefore it is not possible to compare the STEPL loads to the forms of nitrogen being sampled by the LSR watershed group. Therefore it was decided that load reduction targets for nitrogen would consist of standard percentages based on the 5 year, 10 year, and 30 year targets. The percentages chosen were 10%, 15% and 20% for the respective target dates. Actual reductions in pounds per year of nitrogen are shown in Table 58. For nitrate sampling, the ultimate goal for the LSR watershed would be to meet the 1mg/L set by Ohio EPA for warm water aquatic systems.

**Table 58 Load Reductions for Nitrogen**

| Watershed | N Load lbs/year | N Load 10% reduction | N Load 15% reduction | N Load 20% reduction |
|---|---|---|---|---|
| Majencia Cr. | 87453 | 78708 | 74335 | 69963 |
| Indian Cr. | 21249 | 19124 | 18061 | 16999 |
| Salamonie Res. | 76440 | 68796 | 64974 | 61152 |
| Rush Cr. | 66928 | 60235 | 56889 | 53542 |
| Weasel Cr. | 65882 | 59294 | 56000 | 52706 |
| Richland Cr. | 56237 | 50613 | 47801 | 44989 |
| Little Black Cr. | 66171 | 59554 | 56246 | 52937 |
| Morrison D. | 48680 | 43812 | 41378 | 38944 |
| Shadle Drain | 54123 | 48711 | 46005 | 43299 |
| Scuffle Cr. | 61678 | 55510 | 52426 | 49343 |
| Prairie Cr. | 80209 | 72188 | 68178 | 64167 |
| Baker D. | 66949 | 60254 | 56906 | 53559 |

## Phosphorus Loading

STEPL was also used to calculate anticipated phosphorus loads for the 12 sub-watersheds. These values are shown below (Table 59), along with the target values for phosphorus. The ultimate target value is based on Ohio EPA's warm water recommendations for phosphorus. This value is 0.08mg/L. To obtain loading values, the annual flow from each sub-watershed was calculated and multiplied by this standard of 0.08mg/L. The result is shown below in pounds per year (Table 59). The reduction required is high, ranging from a 53% to 70% reduction. This will be the target for the 30 year goal. It is understood that this target is very aggressive, and will need to be re-evaluated as implementation of the plan proceeds. The five and ten year goals are 10% and 20% respectively.

**Table 59 Load Reductions for Phosphorus**

| Watershed | P Load (lb/yr) | Phosphorus 10% reduction | Phosphorus 20% reduction | Phosphorus lbs/year @0.08mg/L Target Value | Target Value % Reduction |
|---|---|---|---|---|---|
| Majencia Cr. | 16746 | 15072 | 13397 | 5406 | 67.7 |
| Indian Cr. | 4084 | 3676 | 3267 | 1914 | 53.1 |
| Salamonie Res. | 14395 | 12956 | 11516 | 5652 | 60.7 |
| Rush Cr. | 12844 | 11560 | 10276 | 4276 | 66.7 |
| Weasel Cr. | 12410 | 11169 | 9928 | 3972 | 68.0 |
| Richland Cr. | 10779 | 9701 | 8623 | 3438 | 68.1 |
| Little Black Cr. | 12834 | 11550 | 10267 | 3878 | 69.8 |
| Morrison D. | 9323 | 8390 | 7458 | 2995 | 67.9 |
| Shadle Drain | 10369 | 9332 | 8295 | 3458 | 66.7 |
| Scuffle Cr. | 11620 | 10458 | 9296 | 3759 | 67.6 |
| Prairie Cr. | 15109 | 13598 | 12087 | 5027 | 66.7 |
| Baker D. | 13015 | 11714 | 10412 | 3978 | 69.4 |

## Sediment Loading

Anticipated loading for sediment for each sub-watershed was calculated using STEPL. The result for sediment load in tons per year is shown in Table 60). Sediment is a key factor affecting biological communities, and also transports phosphorus, which can be bound to sediment particles. For these reasons, sediment needs to be reduced. TSS (Total Suspended Solids) is one method by which suspended sediment is measured. However, TSS can also contain algae and other organic material, so it is often an over estimate of the sediment in the water column. However, for this study we will use it as a surrogate for sediment concentrations.

It has been found that a TSS concentration between 25 and 80mg/L can reduce fish populations. Higher concentrations have an even greater negative effect on aquatic organisms. A target of 40mg/L was chosen based on New Jerseys warm water recommendations for aquatic life. This target is also aggressive requiring load reductions from 14 to 55%. Therefore, this goal will be set at 30 years and will need to be re-evaluated as implementation proceeds. The five and ten year goals are 10% and 20% respectively (Table 60).

**Table 60 Load Reductions for Sediment**

| Watershed | Sediment Load (t/yr) | TSS at 10% reduction | TSS at 20% reduction | TSS at 40mg/L in Tons per year Target Level | Target Value % Reduction |
|---|---|---|---|---|---|
| Majencia Cr. | 2886.41 | 2597.77 | 2309.13 | 1351.48 | 53.2 |
| Indian Cr. | 559.31 | 503.38 | 447.45 | 478.44 | 14.5 |
| Salamonie Res. | 2291.20 | 2062.08 | 1832.96 | 1413.01 | 38.3 |
| Rush Cr. | 2141.54 | 1927.39 | 1713.24 | 1069.11 | 50.1 |
| Weasel Cr. | 2096.66 | 1886.99 | 1677.33 | 992.94 | 52.6 |
| Richland Cr. | 1856.64 | 1670.98 | 1485.31 | 859.51 | 53.7 |
| Little Black Cr. | 2129.20 | 1916.28 | 1703.36 | 969.43 | 54.5 |
| Morrison D. | 1612.67 | 1451.40 | 1290.14 | 748.73 | 53.6 |
| Shadle Drain | 1770.71 | 1593.64 | 1416.57 | 864.50 | 51.2 |
| Scuffle Cr. | 2027.92 | 1825.13 | 1622.34 | 939.81 | 53.7 |
| Prairie Cr. | 2695.37 | 2425.83 | 2156.29 | 1256.65 | 53.4 |
| Baker D. | 2159.23 | 1943.31 | 1727.39 | 994.52 | 53.9 |

## 6.1 Water Quality Goals and Indicators

Water quality impairments have been indicated for several different parameters. These include E. coli, Nutrients (both phosphorus and nitrogen), Sediment, and Impaired Biotic Communities. In addition, the steering committee and other stakeholders have indicated that the recreational and aesthetic use of the water resource has been compromised. STEPL modeling was conducted to look at loading of phosphorus, nitrogen, and sediment at the sub-watershed level. Sampling took place over the past year to determine the overall health of the resource and where efforts need to be focused. In addition, data from other sources, such as IDEM and USACE, have been evaluated to determine the extent of the problem. Goals have been developed to address each of these impairments based on present conditions and desired outcomes.

The steering committee has determined that a variety of BMPs will need to be implemented to address each of the impairments. Because of the variety of sources and situations in the watershed, various BMPs will be needed to address site-specific impairments. However, since the watershed is predominantly row crop agriculture and has a large number of confined feeding operations, a general suite of well-known BMPs can be implemented to achieve the needed reductions in pollutant loads. Many of the BMPs suggested are already in use throughout the watershed, so successful implementation can be shown to landowners who are leery of making changes. Education and outreach will be a vital part of the implementation plan as we strive to meet the following goals.

### 6.1.1 Bacteria and Pathogens

Bacteria and harmful pathogens are of concern throughout the state and are the cause of impairments within the LSR watershed. The steering committee would like to reduce E. coli concentrations at all sites to 235 cfu/100ml or below within 30 years. The goal will be achieved in stages over this 30 year time frame.

1) 5 year goal: less than 60% of all samples exceed target (six sites exceed this standard)
2) 10 year goal: less than 75% of all samples exceed target (10 sites exceed this standard ranging from 340cfu to1460cfu)
3) 30 year goal: only statistical outliers exceed target (all sites have 4$^{th}$ quartile values ranging from 333cfu to 2633cfu)

Indicators of Progress:

Sampling will show a continuing decline in E. coli counts
Calculated load reductions for Best Management Practices installed
Number of livestock restricted from stream access
Improvement of agricultural waste management practices: number of practices implemented
Improvements in septic system maintenance and care as a result of workshops and disseminated information
CSO separation by communities in the Salamonie River watershed, or other urban waste management strategies (Montpelier and upstream Portand are already working to solve these issues.)

### 6.1.2 Nutrients (Phosphorus and Nitrogen)

High nutrient concentrations have been documented in the LSR watershed. The steering committee would like to reduce phosphorus loading up to 70% and nitrogen loading up to 20%. Current loading for nitrogen and phosphorus are 751,999 lbs/yr and 143.528 lbs/yr respectively.

5 Year Goal: 10% reduction in Nitrogen (75,200lbs/yr), 10% reduction in Phosphorus (14,353 lbs/yr)
10 Year Goal: 15% reduction in Nitrogen (112,800 lbs/yr), 20% reduction in Phosphorus (28,705 lbs/yr)
30 Year Goal: 20% reduction in Nitrogen (150,400 lbs/yr), 53-70% reduction in Phosphorus (76,070 – 100,470 lbs/yr)

Indicators of Progress:

Number of BMPs implemented, and calculated load reductions for each
Number of farmers implementing conservation tillage and acreage involved
Number of Farmers using cover crops and acreage involved
Number of nutrient management plans completed
Linear feet of 2-stage ditches installed
Number of livestock stream access sites eliminated
Steady or positive trends in nutrient concentrations after 5 or 10 years, noticeable downward trend in nutrient concentrations after 30 years. (Response of water quality measurements to BMPs in the watershed can be slow, so it is anticipated that a major statistical change may take up to 30 years.)
Number of attendees to workshops and other educational events
(Any BMPs installed will be modeled to determine their overall load reduction.)

### 6.1.3 Sediment (Total Suspended Solids)

Total Suspended Solids (TSS) such as sediment, organic matter, and other floating debris have been shown to be problematic throughout the watershed. Sediment smothers habitat, transports excess nutrients, and makes the stream aesthetically unappealing. The steering committee would like to see average sediment reduced by up to 55% in the next 30 years. Current loading for sediment is 24,227 tons/yr. A 55% reduction would be equivalent to 13,325 tons/yr. Turbidity values are often used as a surrogate for TSS and will be tracked to help document success.

5 Year Goal: Reduce sediment by 10% (2,423 Tons/yr)
10 Year Goal: Reduce sediment by 20% (4,845 Tons/yr)
30 Year Goal: Reduce sediment up to 55% (13,325 Tons/yr)

Indicators of Progress:

Steady or downward trend in documented TSS or Turbidity values in five to ten years, statistically significant downward trend in TSS or Turbidity values after 30 years
Number of BMPs implemented, and calculated load reductions for each.
Number of farmers implementing conservation tillage and acreage involved
Number of Farmers using cover crops and acreage involved
Linear feet of 2-stage ditches installed

Improvement in stream mIBI scores
Number of attendees to workshops and other educational event
(Any BMPs installed will be modeled to determine their overall load reduction.)

### 6.1.4 Impaired Biotic Communities

Portions of the Lower Salamonie watershed have Impaired Biotic Communities. The steering committee would like to improve habitat and educate stakeholders on the importance of protecting natural areas and restoring habitat in rivers and riparian areas. It is also desired that all rivers and streams meet aquatic life designations. At present, the biological community at many sites do not score as high as expected when the habitat is considered. (See Biology and Habitat section.) After 5 to 10 years the Steering Committee would like to see mIBI and PTI scores in line with QHEI scores.

5 Year Goal: Improved mIBI Scores
10 Year Goal: mIBI scores in line with QHEI scores
30 Year Goal: Many locations across the Lower Salamonie River Watershed have impaired biological communities and habitats. The Steering Committee would like to increase stakeholder awareness regarding the importance of restoring and protecting natural land uses within floodplain and riparian areas. All waterways which are currently listed on the 303(d) Impaired Waters List will be restored to their aquatic life use designation by 2045. In addition, the Steering Committee would like to see a statistical rise in QHEI and mIBI scores across the watershed. In addition, it is expected that fish community sampling by IDEM in the future will show improved IBI scores.

Indicators of Progress:
Increased quality of aquatic and riparian habitat in the form of statistically higher QHEI scores
Positive trends in mIBI scores
Improved fish survey scores in future IDEM samplings
Acres of restored wetland systems
Reduced nutrient and sediment concentrations meeting the goals set forth above
Increase in linear feet of stream buffer
Linear feet of installed 2-stage ditches

### 6.1.5 Recreational Use

It has been noted that little recreational use is made of the Lower Salamonie River. The steering committee would like to increase the recreational use of streams and riparian areas in the watershed by encouraging use of the resource and increasing access to the river and its associated tributaries.

30 Year Goal: Create new access points to rivers and streams
Increase walking/riding trails along waterways
Educate stakeholders on the value of the Salamonie River and Reservoir
Improve riparian areas, aquatic habitats, and the fishery
Help organize river clean-ups

Indicators of Progress:

- Increased number of access sites (Three sites in 5 to 10 years)
- Linear miles of trails along the waterways: (Trail from Huntington to Markle in 5 to 10 years)
- Decrease in number of E. coli violations
- Improved clarity of the water
- Stakeholder interest in improving the river
- Decrease in number of harmful blue-green algal blooms

## 7.0 Critical and Priority Area Selection

To effectively address water quality issues within the LSR watershed, it is important to document where the most critical areas are located so that limited funds can be spent where they will have the greatest impact. This can be difficult in a watershed where one land use dominates most of the landscape, as is the case in the LSR watershed. Approximately 80% of the watershed is devoted to agriculture, so this landuse will be the primary focus of implementation efforts. To begin to understand where to focus these funds, several methods were utilized. First an extensive look was taken at existing water quality data that was available. Data was obtained from IDEM (which included USGS data) and the USACE. Second, a water quality monitoring program was begun looking at chemical, physical, and biological quality in the watershed. Third, modeling was completed utilizing the STEPL model to evaluate where nutrient and sediment problems may be arising in the watershed, and finally, an extensive windshield survey was completed to determine where localized sources of pollution were located.

## 7.1 Windshield Survey Critical Area Evaluation

As previously mentioned, an extensive windshield survey resulting in 459 evaluated sites was completed in the LSR watershed. Several categories of data collected where used to determine the overall quality of the site, and the areas potential contribution to water quality problems (Table 61). For each of the categories evaluated a scoring system was devised to compare information from site to site. Site scores for each sub-watershed where summed and then divided by the number of sites in the watershed. This resulted in a unique number for each sub-watershed. The higher the number, the more degraded the sub-watershed was according to the parameters studied. From these scores, the sub-watersheds were divided into three categories: Tier 1, Tier 2, and Tier 3. Tier 1 are the sub-watersheds of greatest concern, and Tier 3 are sub-watersheds of least concern. The score ranges are shown in Table 27. Although all sub-watersheds are in need of improvement, this ranking system helps guide the prioritization of limited funds and technical assistance.

**Table 61 Windshield Survey Category Scores and Ratings**

| Stream Name | Steam Bank Erosion | Buffer Width | Conserva-tion Tillage | Livestock Access | CFO | Hobby Farms | Drain Tiles | Trash | Total Score | Score per site | Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Majencia Cr. | 39 | 66 | 41 | 0 | 3 | 13 | 21 | 11 | 194 | 4.9744 | Tier 1 |
| Indian Cr. | 11 | 8 | 4 | 1 | 0 | 1 | 2 | 7 | 34 | 1.4783 | Tier 3 |
| Salamonie Res. | 46 | 39 | 32.5 | 12 | 7 | 13 | 12 | 8 | 169.5 | 3.9419 | Tier 3 |
| Rush Cr. | 18 | 67 | 44 | 6 | 0 | 0 | 19 | 0 | 154 | 4.0526 | Tier 2 |
| Weasel Cr. | 61 | 68 | 40 | 12 | 3 | 9 | 18 | 2 | 213 | 3.8036 | Tier 3 |
| Richland Cr. | 24.5 | 46.5 | 38 | 0 | 2 | 2 | 16 | 0 | 129 | 3.5833 | Tier 3 |
| Little Black Cr. | 39 | 67.25 | 36 | 0 | 1 | 6 | 24 | 1 | 174.25 | 4.8403 | Tier 1 |
| Morrison D. | 13 | 46 | 33 | 0 | 4 | 1 | 7 | 1 | 105 | 4.7727 | Tier 2 |
| Shadle Drain | 24 | 24 | 50 | 3 | 6 | 2 | 13 | 0 | 122 | 3.5882 | Tier 3 |
| Scuffle Cr. | 30 | 98 | 69.5 | 6 | 5 | 5 | 26 | 1 | 240.5 | 4.9082 | Tier 1 |
| Prairie Cr. | 24 | 80 | 46 | 3 | 4 | 4 | 26 | 0 | 187 | 4.5610 | Tier 2 |
| Baker D. | 15 | 98 | 70.5 | 0 | 4 | 5 | 20 | 1 | 213.5 | 5.0833 | Tier 1 |

### 7.2 STEPL Critical Area Evaluation

STEPL watershed modeling was performed on each of the 12 sub-watersheds to determine the loading of three parameters of concern (phosphorus, nitrogen, and sediments) to area streams. The total loads were calculated for each sub-watershed, and then divided by the number of acres in the watershed to determine relative contribution per acre of each of the parameters of concern. These values were also used to rank the sub-watersheds into three tiers as was done for the windshield survey. These rankings are shown below in tables 62 - 64. Ranges for each parameter of concern were developed to assign tier ratings. These ranges are indicated in Table 65. Value ranges were determined by grouping similar scores together and attempting to keep a relatively equal number of sub-watersheds in each tier. More weight was put on the former qualification than the latter.

**Table 62 Nitrogen Loads and Ranking by Sub-watershed**

| Watershed | Acres | N Load lbs/year | N Load per Acre (lbs/year) | Critical Area Tier |
|---|---|---|---|---|
| Majencia Cr. | 22237 | 87453 | 3.932781258 | 2 |
| Indian Cr. | 7872 | 21249 | 2.699278771 | 3 |
| Salamonie Res. | 23249 | 76440 | 3.287874258 | 3 |
| Rush Cr. | 17591 | 66928 | 3.80467901 | 3 |
| Weasel Cr. | 16337 | 65882 | 4.032683796 | 1 |
| Richland Cr. | 14142 | 56237 | 3.976561115 | 1 |
| Little Black Cr. | 15951 | 66171 | 4.148421849 | 1 |
| Morrison D. | 12319 | 48680 | 3.951592793 | 2 |

Table 62 Cont.  Nitrogen Loads and Ranking by Sub-watershed

| Watershed | Acres | N Load lbs/year | N Load per Acre (lbs/year) | Critical Area Tier |
|---|---|---|---|---|
| Shadle Drain | 14224 | 54123 | 3.805073719 | 2 |
| | | | | |
| Scuffle Cr. | 15463 | 61678 | 3.988761083 | 1 |
| Prairie Cr. | 20676 | 80209 | 3.879322011 | 2 |
| Baker D. | 16364 | 66949 | 4.091465324 | 1 |

Table 63  Phosphorus Loads and Ranking by Sub-watershed

| Watershed | Acres | P Load (lb/yr) | P Load per Acre (lbs/year) | Critical Area Tier |
|---|---|---|---|---|
| Majencia Cr. | 22237 | 16746 | 0.753074965 | 2 |
| Indian Cr. | 7872 | 4084 | 0.518793276 | 3 |
| Salamonie Res. | 23249 | 14395 | 0.61917307 | 3 |
| Rush Cr. | 17591 | 12844 | 0.730173666 | 2 |
| Weasel Cr. | 16337 | 12410 | 0.759612409 | 2 |
| Richland Cr. | 14142 | 10779 | 0.762186459 | 1 |
| Little Black Cr. | 15951 | 12834 | 0.804578708 | 1 |
| Morrison D. | 12319 | 9323 | 0.756768168 | 2 |
| Shadle Drain | 14224 | 10369 | 0.728996585 | 2 |
| Scuffle Cr. | 15463 | 11620 | 0.751475399 | 3 |
| Prairie Cr. | 20676 | 15109 | 0.730753284 | 3 |
| Baker D. | 16364 | 13015 | 0.795411037 | 1 |

Table 64  Sediment Loads and Ranking by Sub-watershed

| Watershed | Acres | Sediment Load (t/yr) | TSS Load per acre (tons/year) | Critical Area Tier |
|---|---|---|---|---|
| Majencia Cr. | 22237 | 2886.41 | 0.129802317 | 2 |
| Indian Cr. | 7872 | 559.31 | 0.071050248 | 3 |
| Salamonie Res. | 23249 | 2291.20 | 0.098550373 | 3 |
| Rush Cr. | 17591 | 2141.54 | 0.121740878 | 3 |
| Weasel Cr. | 16337 | 2096.66 | 0.128338017 | 2 |
| Richland Cr. | 14142 | 1856.64 | 0.131285792 | 1 |
| Little Black Cr. | 15951 | 2129.20 | 0.133483628 | 1 |
| Morrison D. | 12319 | 1612.67 | 0.130909263 | 2 |
| Shadle Drain | 14224 | 1770.71 | 0.124487413 | 3 |

**Table 64 Cont. Sediment Loads and Ranking by Sub-watershed**

| Watershed | Acres | Sediment Load (t/yr) | TSS Load per acre (tons/year) | Critical Area Tier |
|---|---|---|---|---|
| Scuffle Cr. | 15463 | 2027.92 | 0.131146601 | 1 |
| Prairie Cr. | 20676 | 2695.37 | 0.130362085 | 2 |
| Baker D. | 16364 | 2159.23 | 0.131958376 | 1 |

**Table 65 Value Ranges for Each Critical Area Tier**

| Parameter | Total Range of Values | Tier 1 Range | Tier 2 Range | Tier 3 Range |
|---|---|---|---|---|
| **Nitrogen** | 2.7 - 4.15 | 3.95 - 4.15 | 3.81 - 3.95 | 2.7 - 3.81 |
| **Phosphorus** | 0.52 - 0.80 | 0.76 - 0.80 | 0.73 - 0.76 | 0.52 - 0.73 |
| **TSS** | 0.07 - 0.133 | 0.131 - 0.133 | 0.125 - 0.131 | 0.07 - 0.125 |

## 7.3 Final Critical Area Determination

Critical Areas were determined using both the windshield survey and modeling. Windshield surveys were prioritized first in the development of the critical areas because they involve actual documentation of parameters that have been scientifically shown to cause water quality degradation. Modeling we prioritized second because, although it is an estimate, it looks at the entire sub-watershed area and takes into account soil types and properties, such as erodibility and hydric qualities, land use, septic system use, and other regional properties that can be applied to the entire watershed.

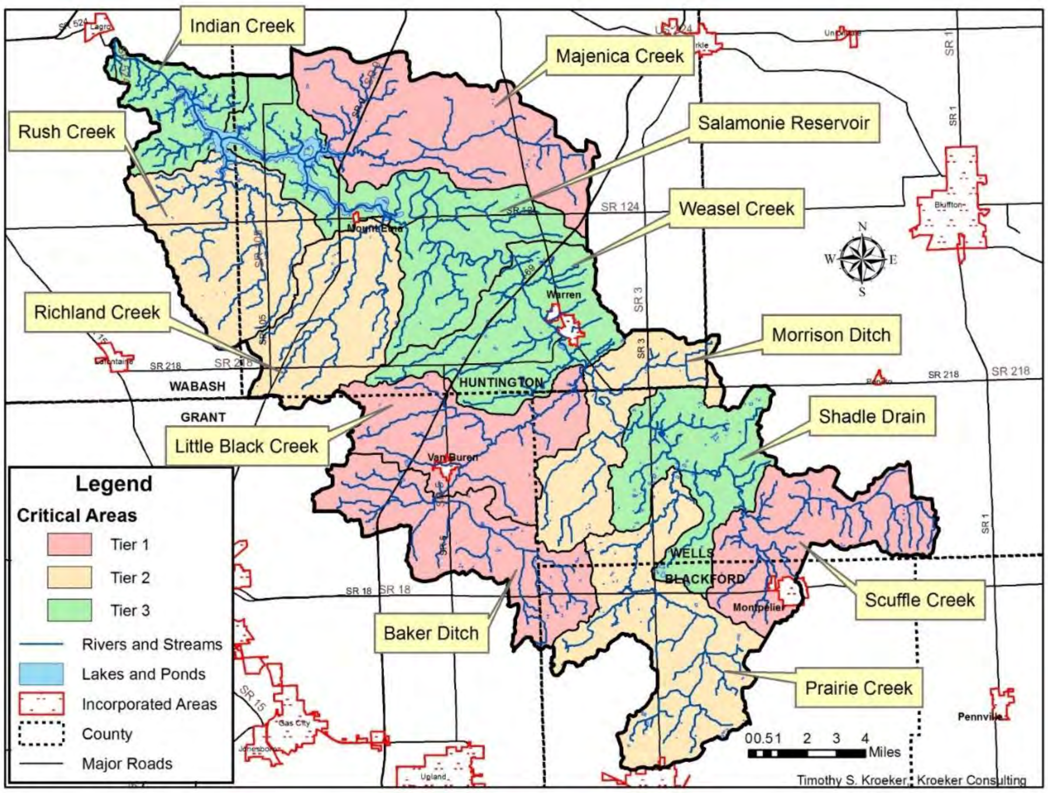
In addition, water quality data, both chemical and biological, were evaluated to determine if the data generally supported or didn't support the critical area designations. Chemical water quality data, unless it exists in sufficient quantity for a proper evaluation, although valuable can be transient, and site specific. There for it was used only to add support to the critical area assignments. The biological data collected for the project was part of a volunteer effort, and since it could not be professionally verified, was used in a supportive role. Table 66 shows each sub-watershed, the tier designations for the windshield survey and three key parameters, and whether or not the chemical and biological data tended to support the tier designation, or there was some question. Where differences arise may indicate where further investigation needs to take place to determine if the data is indicative of a localized problem or indeed represents the overall quality of the sub-watershed. The designated critical areas are shown in Figure 45.

In summary, critical areas were evaluated and designated as either Tier 1, Tier 2, or Tier 3 watersheds depending on the severity of the problems. Tier 1 watersheds are believed to be the most degraded and are thus a high priority for implementation whereas Tier 3 watersheds are considered to be in the best condition, and are a lower priority. Tier 2 watersheds are intermediate. However, it should be understood that watersheds in all three tiers may benefit from best management practices to improve water quality and protect and enhance existing natural resources.

**Table 66 Critical Area Tier Designations Support**

| Watershed | Windshield Survey Tier | Nitrogen Tier | Phosphorus Tier | Sediment Tier | Final Designated Tier | Supported by Chemical Data | Supported by Biological Data |
|---|---|---|---|---|---|---|---|
| Majencia Cr. | 1 | 2 | 2 | 2 | 1 | Yes | Yes |
| Indian Cr. | 3 | 3 | 3 | 3 | 3 | Yes | Yes |
| Salamonie Res. | 3 | 3 | 3 | 3 | 3 | Yes | Partially |
| Rush Cr. | 2 | 3 | 2 | 3 | 2 | No Data | No Data |
| Weasel Cr. | 3 | 1 | 2 | 2 | 3 | Partially | Yes |
| Richland Cr. | 2 | 1 | 1 | 1 | 2 | Yes | Yes |
| Little Black Cr. | 1 | 1 | 1 | 1 | 1 | Partially | Partially |
| Morrison D. | 2 | 2 | 2 | 2 | 2 | Yes | Yes |
| Shadle Drain | 3 | 2 | 2 | 3 | 3 | Partially | Partially |
| Scuffle Cr. | 1 | 1 | 3 | 1 | 1 | Partially | Partially |
| Prairie Cr. | 2 | 2 | 3 | 2 | 2 | Yes | Yes |
| Baker D. | 1 | 1 | 1 | 1 | 1 | Partially | Partially |

**Figure 45 Critical Areas in the Lower Salamonie River Watershed**




Within Tier 1 and Tier 2 sub-watersheds, landowners will be eligible to apply for cost-share funds. Prioritization for funds will be determined by ranking each cost-share application using Table 67.

**Table 67: Lower Salamonie River Watershed Cost-Share Program Ranking Sheet**

| Written Conservation Plan Required | Yes | No | Maximum Possible Points | Actual Points |
|---|---|---|---|---|
| **Watershed Criteria** | | | | |
| **Tier 1 Sub-watershed*** (Majenica Creek, Little Black Creek, Baker Ditch, Scuffle Creek) | | | 20 | |
| **Tier 2 Sub-watershed*** (Rush Creek, Richland Creek, Morrison Ditch, Prairie Creek) | | | 10 | |
| **Tier 3 Sub-watershed** (Indian Creek, Salamonie Reservoir, Weasel Creek, Shadle Drain) | STOP HERE, NOT ELIGIBLE FOR COST SHARE | | | |
| Project Name and Location Information: | | | | |
| * Please circle associated sub-watershed and provide location information. | | | | |
| **BMP Ranking Criteria** | | | | |
| Priority Ranking 1 | | | 60 | |
| Priority Ranking 2 | | | 40 | |
| Priority Ranking 3 | | | 20 | |
| Priority Ranking 4 | | | 10 | |
| Priority Ranking 5 | | | 5 | |
| **Location and Project Elements** | | | | |
| Project Area: | Yes | No | Maximum Possible Points | Actual Points |
| Less than 500 feet from waterbody | | | 40 | |
| 500 to 1000 feet from waterbody | | | 20 | |
| Greater than 1000 feet from waterbody | | | 10 | |
| | | | | |
| Highly Erodible Soils: | | | | |
| Slopes 5% - 10% | | | 20 | |
| Slopes greater than 10% | | | 40 | |
| | | | | |
| Not Highly Erodible, but serious erosion present | | | 20 | |
| **Cropland** | | | | |
| Does the project convert cropland to permanent hay land, pasture, woodland, or wildlife habitat? | | | | |
| Slopes less than 5% | | | 10 | |
| Slopes 5% - 10% | | | 20 | |
| Slopes greater than 10% | | | 40 | |
| | | | | |
| Does the project propose a conservation tillage system that leaves greater than 30% residue? | | | | |
| Slopes less than 5% | | | 10 | |
| Slopes 5% - 10% | | | 20 | |
| Slopes greater than 10% | | | 40 | |

**Table 67 Cont. Lower Salamonie River Watershed Cost-Share Program Ranking Sheet**

| | | | | |
|---|---|---|---|---|
| **Cropland Continued** | | | | |
| Does the project include using winter cover crops? | | | | |
| Slopes less than 5% | | | 10 | |
| Slopes 5% - 10% | | | 20 | |
| Slopes greater than 10% | | | 40 | |
| Does the project establish grass filter strips or herbaceous riparian buffers along streams on your farm? | | | | |
| 30 foot width | | | 20 | |
| 90 foot width | | | 40 | |
| **Livestock** | | | | |
| Does the project restrict livestock access to waterbodies? | | | | |
| Perennial or Intermittent Streams | | | 40 | |
| Other Waterbodies | | | 20 | |
| Does the project address a pasture with inadequate ground cover to project against erosion? | | | 20 | |
| Does the project include renovation and maintenance of the pasture as a managed grazing system? | | | 40 | |
| **Feasibility and Economics** | | | | |
| There are no other conservation programs that are available for the proposed project. | | | 20 | |
| Necessary permits are in place if needed. | | | 10 | |
| **Habitat** | | | | |
| Will the project provide new wildlife habitat | | | 40 | |
| Will the project protect existing wildlife habitat | | | 40 | |
| **Water Quality Impact Criteria** | | | | |
| Will the project address: | | | | |
| Sediment (Erosion) | | | 50 | |
| Nutrients | | | 50 | |
| E. coli | | | 50 | |
| | **TOTAL POINTS** | | | |

## 8.0 Best Management Practices

## 8.1 Best Management Practices for Watershed Protection and Restoration

Steering Committee members identified a generalized list of Best Management Practices which were most likely to be adopted in the LSR watershed (Tables 68 – 71). It is anticipated that these practices will result in the Salamonie River watershed meeting the water quality goals outlined in this report. There are many other practices that could be used to address these issues, and these may or may not come into play as changes and improvements in technology and land management strategies develop and implementation proceeds. The list is heavily focused on practices for agricultural-based land use since this is the greatest landuse in the watershed. Many of these practices may also be used in urban and suburban areas. As implementation proceeds, more practices may be added to the list as they become effective and practical for use in this watershed.

**Table 68 BMPs for Phosphorus and Nitrogen Load Reductions**

| Sub-watershed and Critical Area Tier | Water Quality Impairment | Implementation Strategy | Estimated Cost | Estimated Load Reduction |
|---|---|---|---|---|
| Majenica Creek (Tier 1) | Nitrogen and Phosphorus | Conservation Tillage - No-till, strip-till, Mulch-till (Equipment Modifications) | Dependent on existing equipment and type of modification | (Nitrogen – 15%, Phosphorus – 30%, Sediment – 70%) |
| Little Black Creek (Tier 1) | | Nutrient Management Plan Development | Approximately $2,200 - $9.500/Nutrient Management Plan | (Nitrogen – 7%, Phosphorus – 5%) |
| Scuffle Creek (Tier 1) | | Cover Crops | $56 per acre | (Nitrogen – 43%, Phosphorus – 32%, Sediment – 15%) |
| Baker Ditch (Tier 1) | | Conservation Cover and Buffers (Filter Strips, Grassed Waterways, Bioswales, Riparian Plantings) | $452/acre for Seedlings and Plantings, $4,345/acre for Installed Waterways and Swales | (Nitrogen – 54%, Phosphorus – 58%, Sediment – 58%) |
| Rush Creek (Tier 2) | | Other Equipment Modifications (Variable Rate Controllers) | Dependent on existing equipment and type of modification | (Nitrogen – 7%, Phosphorus – 5%) |
| Richland Creek (Tier 2) | | Livestock Exclusion Fencing, Livestock Access Points or Watering Options, Heavy Use area Protections (Feedlot Blankets) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type | Unknown |
| | | Pasture Management (Seeding Establishment), Rotational Grazing (Fenced Areas) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type, Seeding - $273.00/acre | Unknown |
| Morrison Ditch (Tier 2) | | Water and Sediment Control Basins (WASCOBs) | $2,884/structure | (Nitrogen – 20%, Phosphorus – 20%, Sediment – 60%) |
| | | Septic System Maintenance and Upgrades (Education through Brochures, Workshops, and other Outreach Activities) | | (Nitrogen – 50%) (Higher Loadings of Nitrogen and Phosphorus if eliminating straight pipe.) |
| Prairie Creek (Tier 2) | | Stream Bank Stabilization, 2-stage Ditch | $11.50/foot of 2-Stage Ditch, $1.50/foot of Fencing | Unknown |
| | | Stormwater Infiltration and Detention (Rain Gardens, Rain Barrels, Tile Drain Flow Management) | $3,790/structure, $30 - $70/Rain Barrel | (Stormwater Infiltration and Detention - Nitrogen – 85%, Phosphorus – 85%, Sediment – 90%) Tile Drain Mangement (Nitrogen - 30%, Phosphorus - 30%, TSS - 30%) |

Livestock reductions are unknown and depend on the type and number of animals and the acreage involved.

## Table 69 BMPs for TSS Load Reductions

| Sub-watershed and Critical Area Tier | Water Quality Impairment | Implementation Strategy | Estimated Cost | Suggested Practices and Estimated Load Reduction |
|---|---|---|---|---|
| Majenica Creek (Tier 1) | Total Suspended Solids | Conservation Tillage - No-till, strip-till, Mulch-till (Equipment Modifications) | Dependent on existing equipment and type of modification | (Nitrogen – 15%, Phosphorus – 30%, Sediment – 70%) |
| Little Black Creek (Tier 1) | | Cover Crops | $56 per acre | (Nitrogen – 43%, Phosphorus – 32%, Sediment – 15%) |
| Scuffle Creek (Tier 1) | | Conservation Cover and Buffers (Filter Strips, Grassed Waterways, Bioswales, Riparian Plantings) | $452/acre for Seedlings and Plantings, $4,345/acre for Installed Waterways and Swales | (Nitrogen – 54%, Phosphorus – 58%, Sediment – 58%) |
| Baker Ditch (Tier 1) | | Livestock Exclusion Fencing, Livestock Access Points or Watering Options, Heavy Use area Protections (Feedlot Blankets) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type | Unknown |
| Rush Creek (Tier 2) | | Pasture Management (Seeding Establishment), Rotational Grazing (Fenced Areas) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type, Seeding - $273.00/acre | Unknown |
| Richland Creek (Tier 2) | | Water and Sediment Control Basins (WASCOBs) | $2,884/structure | (Nitrogen – 20%, Phosphorus – 20%, Sediment – 60%) |
| Morrison Ditch (Tier 2) | | Stream Bank Stabilization, 2-stage Ditch | $11.50/foot of 2-Stage Ditch, $1.50/foot of Fencing | Unknown |
| Prairie Creek (Tier 2) | | Stormwater Infiltration and Detention (Rain Gardens, Rain Barrels, Tile Drain Flow Management) | $3,790/structure, $30 - $70/Rain Barrel | (Stormwater Infiltration and Detention - Nitrogen – 85%, Phosphorus – 85%, Sediment – 90%) Tile Drain Mangement (Nitrogen - 30%, Phosphorus - 30%, TSS - 30%) |

Livestock reductions are unknown and depend on the type and number of animals and the acreage involved.
2-stage Ditch structures are new and actual reductions are presently being researched

## Table 70 BMPs for Bacterial and Pathogen Load Reductions

| Sub-watershed and Critical Area Tier | Water Quality Impairment | Implementation Strategy | Estimated Cost | Suggested Practices and Estimated Load Reduction |
|---|---|---|---|---|
| Majenica Creek (Tier 1) | Bacteria and Pathogens | Nutrient Management Plan Development | Approximately $2,200 - $9.500/Nutrient Management Plan | (Nitrogen – 7%, Phosphorus – 5%) |
| Little Black Creek (Tier 1) | | Conservation Cover and Buffers (Filter Strips, Grassed Waterways, Bioswales, Riparian Plantings) | $452/acre for Seedlings and Plantings, $4,345/acre for Installed Waterways and Swales | (Nitrogen – 54%, Phosphorus – 58%, Sediment – 58%) |
| Scuffle Creek (Tier 1) | | Livestock Exclusion Fencing, Livestock Access Points or Watering Options, Heavy Use area Protections (Feedlot Blankets) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type | Unknown |
| Baker Ditch (Tier 1) | | Pasture Management (Seeding Establishment), Rotational Grazing (Fenced Areas) | $1.50/foot Fencing, Cost of watering options dependent on | Unknown |
| Rush Creek (Tier 2) | | | | |
| Richland Creek (Tier 2) | | Water and Sediment Control Basins (WASCOBs) | $2,884/structure | (Nitrogen – 20%, Phosphorus – 20%, Sediment – 60%) |
| Morrison Ditch (Tier 2) | | | | |
| Prairie Creek (Tier 2) | | Septic System Maintenance and Upgrades (Education through Brochures, Workshops, and other Outreach Activities) | | (Nitrogen – 50%) (Higher Loadings of Nitrogen and Phosphorus if eliminating straight pipe.) |

Livestock reductions are unknown and depend on the type and number of animals and the acreage involved.

**Table 71  BMPs for Habitat and Biological Impairments**

| Sub-watershed and Critical Area Tier | Water Quality Impairment | Implementation Strategy | Estimated Cost | Suggested Practices and Estimated Load Reduction |
|---|---|---|---|---|
| Majenica Creek (Tier 1) | | Conservation Tillage - No-till, strip-till, Mulch-till (Equipment Modifications) | Dependent on existing equipment and type of modification | (Nitrogen – 15%, Phosphorus – 30%, Sediment – 70%) |
| Little Black Creek (Tier 1) | | Nutrient Management Plan Development | Approximately $2,200 - $9.500/Nutrient Management Plan | (Nitrogen – 7%, Phosphorus – 5%) |
| Scuffle Creek (Tier 1) | | Cover Crops | $56 per acre | (Nitrogen – 43%, Phosphorus – 32%, Sediment – 15%) |
| Baker Ditch (Tier 1) | | Conservation Cover and Buffers (Filter Strips, Grassed Waterways, Bioswales, Riparian Plantings) | $452/acre for Seedlings and Plantings, $4,345/acre for Installed Waterways and Swales | (Nitrogen – 54%, Phosphorus – 58%, Sediment – 58%) |
| Rush Creek (Tier 2) | Habitat and Aquatic Biology | Livestock Exclusion Fencing, Livestock Access Points or Watering Options, Heavy Use area Protections (Feedlot Blankets) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type | Unknown |
| Richland Creek (Tier 2) | | Pasture Management (Seeding Establishment), Rotational Grazing (Fenced Areas) | $1.50/foot Fencing, Cost of watering options dependent on type, Heavy Use protection costs dependent on type, Seeding - $273.00/acre | Unknown |
| Morrison Ditch (Tier 2) | | Water and Sediment Control Basins (WASCOBs) | $2,884/structure | (Nitrogen – 20%, Phosphorus – 20%, Sediment – 60%) |
| | | Stream Bank Stabilization, 2-stage Ditch | $11.50/foot of 2-Stage Ditch, $1.50/foot of Fencing | Unknown |
| Prairie Creek (Tier 2) | | Stormwater Infiltration and Detention (Rain Gardens, Rain Barrels, Tile Drain Flow Management) | $3,790/structure, $30 - $70/Rain Barrel | (Stormwater Infiltration and Detention - Nitrogen – 85%, Phosphorus – 85%, Sediment – 90%) Tile Drain Mangement (Nitrogen - 30%, Phosphorus - 30%, TSS - 30%) |

Livestock reductions are unknown and depend on the type and number of animals and the acreage involved.
2-stage Ditch structures are new and actual reductions are presently being researched

## 8.2 Outreach and Education for Watershed Protection and Restoration

Education and outreach plays a crucial role in the implantation of any watershed management plan. Various outreach strategies have been developed to help address issues in critical areas in the watershed. Table 72 shows desired outcomes and recommended strategies for achieving those outcomes in the Lower Salamonie River watershed.

**Table 72  Desired Outcomes for Outreach and Education in the LSR Watershed**

| Outcomes | Strategies |
|---|---|
| Increase general knowledge of rural BMPs | Septic System Maintenance Workshops, Cover Crop Field Days, Booths and Displays at Community Events, Educational Materials on the Internet and in Brochures |
| Increase adoption of BMPs within critical areas | Cost-Share Monies through the LSR Watershed, ISDA Clean Water Indiana, and the LARE Program, Technical Assistance Provided by NRCS and ISDA, Conservation Tillage Workshops, Cover Crop Field Days |
| Increase capacity to fund BMPs within critical areas | Cost-Share, Technical Assistance, Seek alternative funding sources such as The Nature Conservancy for 2-stage Ditches, or Possible County or Private Funding for Specific Projects |

**Table 72 Cont. Desired Outcomes for Outreach and Education in the LSR Watershed**

| Outcomes | Strategies |
|---|---|
| Increase awareness of watershed efforts, cost share programs, and benefits of BMPs | Media outreach (Website, Social Media, Newspaper), Signage, Newsletter, Community Events |
| Highlight the recreational opportunities associated with the Salamonie River watershed and Salamonie Reservoir | Recreational Field Days, Media, Newsletter, Community Events |

## 8.3 Action Register and Schedule

The steering committee has compiled an Action Register to help guide implementation efforts in the LSR watershed. The register identifies specific strategies and lists: anticipated load reductions, the target audience, milestones, estimated costs, potential partners, and where funding might be sought. Partners will be valuable as funds and technical support specialties are leveraged to improve the acceptance and implementation of BMPs. Each partner agency listed has the capacity to offer both technical assistance and needed support. The Action Register can be found in Appendix E.

As mentioned, the action register lists anticipated load reductions for several of the BMPs that will be marketed in the watershed. The US EPA's Region 5 Model was used to estimate load reductions for several of these BMPs including: cover crops, conservation tillage, filter strips, water and sediment control basins, prescribed grazing and pasture management, and stream bank stabilization. If implementation goals are met within the first 5 years, these modeled practices alone will result in a reduction of 6,599 tons/year of sediment, 11,105 lbs/year of phosphorus, and 22,148 lbs/year of nitrogen. This will meet the five-year goal for sediment and a major portion of the five-year nutrient goals. It is anticipated that the rest of the reductions needed for nutrients within the first five years will be met by practices that are not covered in the Region 5 Model such as nutrient management plans, and through work completed by other conservation partners such as NRCS and ISDA.

The action register table for nutrients lists goals for the first five years. These goals will be the same for the following five years. At the end of this 10 year period, the 30 year goals outlined in the plan will be re-evaluated and adjusted if necessary to reflect insight gained during implementation.

# 9.0 Future Activities & Project Tracking

## 9.1 Tracking Effectiveness

Indicators have been identified for each of the goals outlined by the steering committee and will be monitored to evaluate the level of success during implementation. Water quality data will also be collected. Temperature, dissolved oxygen, pH, total phosphorus, nitrate, nitrite, turbidity, and

E.coli will be sampled once a month during the recreational season (April – October) and twice during the winter months and compared to water quality criteria outlined in the plan. Sampling will continue as long as funding is available. Habitat and biological sampling will also take place once a year at each of the 13 sampling sites if conditions allow. In addition, modeling will be completed to estimate load reductions for each of the best management practices knowingly installed in the watershed during the grant period.

Total load reductions for each parameter of concern will be tabulated at the end of each year and compared to goals outlined in the Watershed Management Plan to track progress. In addition, attendance will be recorded at specific events related to the project. Additional funding will be sought to continue implementation and tracking of progress toward established goals. Efforts to continue this record keeping beyond the grant will be pursued by project partners as staff time is available. The steering committee is also presently working on a social indicator study with Taylor University. The data from this study will be used to help guide implementation of BMPs in the LSR watershed, and to document attitudes and the level of acceptance of different BMPs being marketed.

### 9.2 Future Plans

It is anticipated that the Huntington County SWCD will remain the project leader for implementation of the Lower Salamonie River watershed project. However, continued participation and support from partner organizations is key. It is vital that the county SWCD's (Grant, Blackford, Wells, Wabash and Huntington) and local and regional NRCS staff continue to be involved in the process. It is also important that stakeholders be kept informed on what is happening with the project, and that they continue to support efforts to improve the watershed. It is also recommended that the steering committee work with and support Blackford and Jay counties as they complete and begin implementation of the Upper Salamonie River watershed management plan. Work completed by the USACE indicated that excess nutrients from the Upper Salamonie were impacting the health of the Lower Salamonie and ultimately the Salamonie Reservoir.

The LSR watershed management plan is a living document and may need to be updated in the future. The plan may need to be revised if there are changes in local land use or regulations, or if changes in attitudes, awareness, and behavior result in a need to adjust goals or strategies. Meetings will be held quarterly to keep stakeholders appraised of progress and to discuss any issues as they arise. The watershed management plan will be revisited at a minimum every 5 years as resources allow to determine if any changes need to be made or if specific goals need to be altered. In addition, if new information comes to light or additional BMPs become eligible for funding, special meetings will be held to address these issues and incorporate them into the plan if it is determined they will benefit the watershed.

Every effort to continue water quality monitoring will be made, and future testing results might also warrant changes to the plan. A 319 implementation grant is currently being pursued to continue to fund implementation when present funding ends in January of 2017. Additional possibilities for funding such as Clean Water Indiana, and LARE will be investigated starting in 2015. The plan may also need to be altered if it will work better with other local and regional planning efforts. Finally, it is anticipated that the specific partnerships established during the planning phase of the project will be carried through the implementation phase, and the outcome will be a successful implementation resulting in improved water quality, greater soil health, and a higher quality of life.

## 10.0 Bibliography


City of Huntington. (2012). *City of Huntington Indiana Comprehensive Plan.* Retrieved from http://www.huntington.in.us/egov/docs/1358282065_72845.pdf

Davis, T. E. (2013, May 3). [Personal Communication]. *Located at: Indiana Department of Environmental Management (IDEM)*. Indianapolis, Indiana: Assesment Information Management System (AIMS) Database.

Department of Natural Resources. (n.d.). *Salamonie River State Forest*. Retrieved 2013, from In.gov: http://www.in.gov/dnr/forestry/4814.htm

Fenelon, J. M., Bobay, K. E., Greeman, T. K., & others. (1994). *Hydrogeologic Atlas of Aquifers in Indiana.* Indianapolis: U.S. Geological Survey.

Fish and Wildlife Service, Department of the Interior. (2012, February 14). Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Rayed Bean and Snuffbox Mussels Throughout their Ranges. *Federal Register, Vol.77*(No.30). Retrieved 2013

Fisher, B. (2014, January 13). Snuffbox Population. (K. Rose, Interviewer)

Fleming, T. (2011). *Preserve Management Plan for Kokiwanee Nature Preserve.* Huntertown: ACRES Land Trust.

Franzmeier, D., Steinhardt, G., & Lee, B. (2009). *Indiana Soils Evaluation and Conservation Manual.* West Lafayette: Purdue University Cooperative Extension Service, Purdue University Agronomy.

Grant County Government. (2011). *Grant County Comprehensive Plan.* Retrieved from http://areaplan.grantcounty27.us/cgi.exe?CALL_PROGRAM=REPORTS

Harrington, J. (2011). *Wildlife Management Program 5-Year Strategic Plan for Salamonie Reservoir 2011-2015.* Andrews: Department of Natural Resources.

Homoya, M. B. (1985). *The Natural Regions of Indiana.* Indianapolis: Indiana Department of Natural Resources.

Huntington County Government. (2005). *Huntington County Indiana Comprehensive Plan.* Retrieved 2013, from http://www.huntington.in.us/egov/docs/1245348446_312133.pdf

Indiana Department of Environmental Management. (2008). *Getting Your Feet Wet in Indiana's Wetlands.* Indianapolis : Office of Water Quality.

Indiana State Department of Agriculture. (n.d.). *Conservation Tillage Program*. Retrieved 2013, from IN.gov: http://www.in.gov/isda/2383.htm

Lee, B., Franzmeier, D., & Jones, D. (2004). *Indiana Soils and Septic Systems.* West Lafayette: Purdue University Cooperative Extension Service, Purdue University Department of Agronomy HENV-7-W. Retrieved from http://www.extension.purdue.edu/extmedia/henv/henv-7-w.pdf

Martin, C. (2013, May 2). [Personal Communication]. *Located at: Indiana Department of Environmental Management (IDEM)*. Indianapolis, Indiana: Assessement Information Management System (AIMS) Database.

Nelson, R. (2012, January 5). Indiana State Soil Scientist. (D. Perkins, Interviewer)

Soil Survey Staff, Natural Resources Conservation Service, USDA. (n.d.). *Soil Survey Geographic (SSURGO) Database for .*

Standford University. (n.d.). *Dam Directory*. Retrieved 2013, from National Performance of Dams Program: http://ce-npdp-serv2.stanford.edu/npdphome/damdir.htm

Strategic Development Group, Inc.'s . (2011). *Blackford County Indiana Comprehensive Plan.* Blackford County Government. Retrieved from http://strategicdevelopment.me/wp-content/uploads/2012/08/blackford_co_cp_112211.pdf

Sutton, S. (2013, May 3). [Personal Communication]. *Located at: Indiana Department of Environmental Management (IDEM)*. Indianapolis, Indiana: Assessment Information Management System (AIMS) Database.

U.S. Army Corps of Engineers . (n.d.). *Salamonie Lake*. Retrieved 2013, from Louisville District: http://www.lrl.usace.army.mil/Missions/CivilWorks/Recreation/Lakes/SalamonieLake.aspx

U.S. Department of Agriculture. (2006). *Land Capability Classification .* Retrieved 2013, from Index to USDA Agriculture Handbooks AH210: http://www.nal.usda.gov/ref/USDApubs/aghandbk.htm

U.S. Department of Agriculture. (2009). *United States Summary and State Data 2007 Volume 1.* Retrieved 2013, from USDA Census of Agriculture: http://www.agcensus.usda.gov/Publications/2007/Full_Report/usv1.pdf

U.S. Department of Agriculture, Natural Resources and Conservation Service. (n.d.). *Determinations and Delineations of Hydric Soils.* Retrieved 2013, from Technical Soil Services Handbook Part 618: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053400

U.S. Department of Agriculture, Natural Resources Conservation Service. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* U.S. Department of Agriculture Handbook 296.

U.S. Department of Agriculture, Natural Resources Conservation Service. (2008). *Salamonie Rapid Watershed Assessment.* USDA.

U.S. Department of Agriculture, Natural Resources Conservation Service. (2010). *Field Indicators of Hydric Soils in the United States.* Version 7.0 LM Vasilas, GW Hurt, CV Noble (eds): USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

U.S. Department of Agriculture, Soil Survey Division Staff. (1993). Soil Survey Manual. *Soil Conservation Service, U.S. Dept. of Agriculture Handbook 18*, Ch. 3: Examination and Description of Soils.

U.S. Geological Survey. (2005). *Estimated Use of Water in the United States*. Retrieved 2013, from Water Use in the United States: http://water.usgs.gov/watuse/

Wabash County Government. (2012). *Wabash County Indiana Comprehensive Plan .* Retrieved from http://areaplan.wabash.in.datapitstop.us/DATA/REPORTS/FLD00002/00003729.PDF

Wells County Government. (2014). *Wells County Indiana Comprehensive Plan.* Retrieved from http://www.wellscounty.org/documents/COMPREHENSIVEPLANREVISIONGUIDE10_18_2013.pdf

Whitaker, J. O., Amlaner, C. J., Jackson, M. T., Parker, G. R., Scott, P. E., & Editors. (2012). *Habitats and Ecological Communities of Indiana Presettlement to Present.* Bloomington and Indianapolis: Indiana University Press.

**Appendix A:** Indiana Natural Regions

Indiana Natural Regions

LAKE MICHIGAN NATURAL REGION

NORTHWESTERN MORAINAL NATURAL REGION
LAKE MICHIGAN BORDER SECTION
VALPARAISO MORAINE SECTION
CHICAGO LAKE PLAIN SECTION

GRAND PRAIRIE NATURAL REGION
GRAND PRAIRIE SECTION
KANKAKEE SAND SECTION
KANKAKEE MARSH SECTION

NORTHERN LAKES NATURAL REGION

CENTRAL TILL PLAIN NATURAL REGION
TIPTON TILL PLAIN SECTION
ENTRENCHED VALLEY SECTION
BLUFFTON TILL PLAIN SECTION

BLACK SWAMP NATURAL REGION

SOUTHWESTERN LOWLANDS NATURAL REGION
PLAINVILLE SAND SECTION
DRIFTLESS SECTION
GLACIATED SECTION

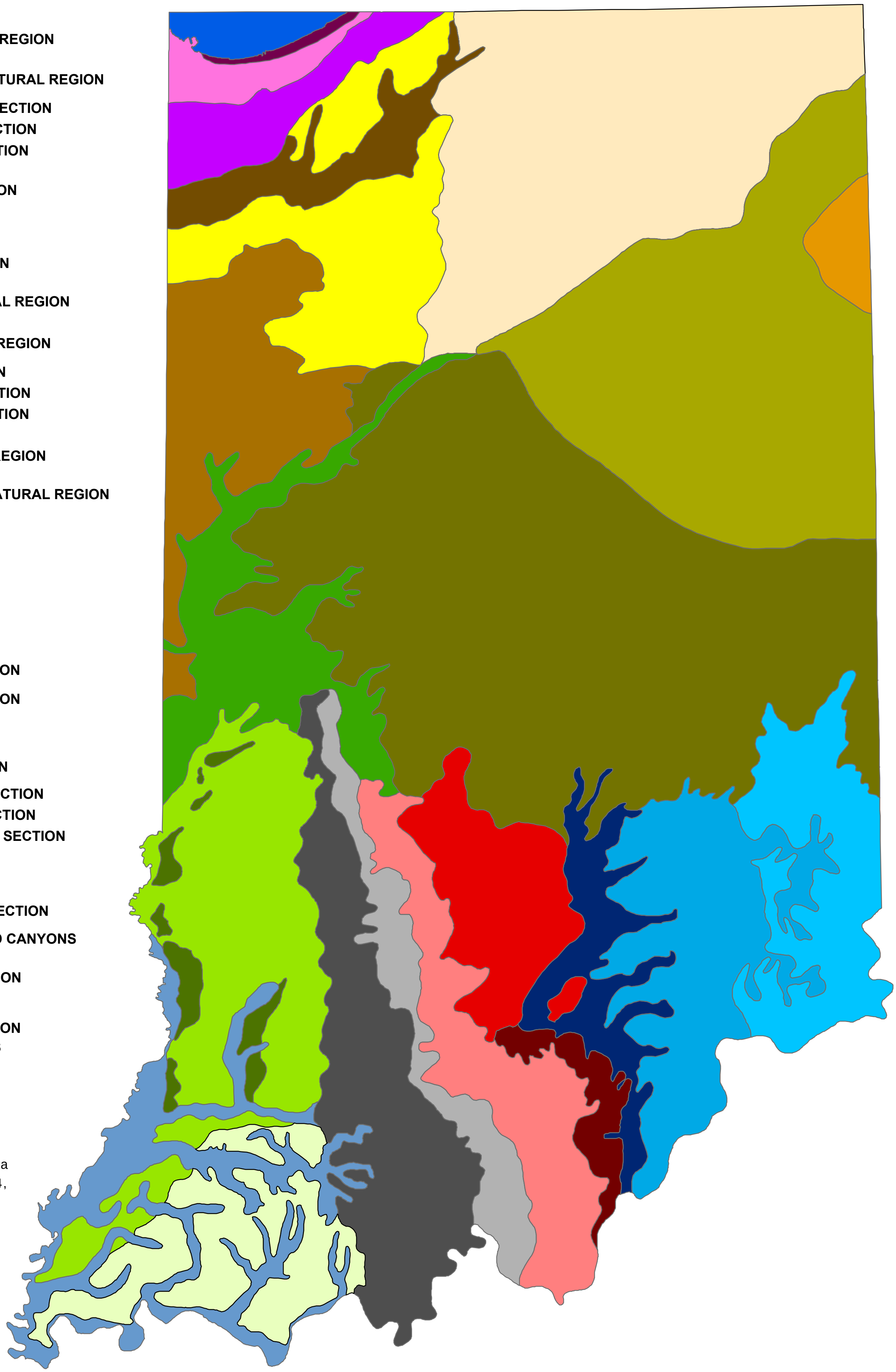
SOUTHERN BOTTOMLANDS NATURAL REGION

SHAWNEE HILLS NATURAL REGION
CRAWFORD UPLAND SECTION
ESCARPMENT SECTION

HIGHLAND RIM NATURAL REGION
MITCHELL KARST PLAIN SECTION
BROWN COUNTY HILLS SECTION
KNOBSTONE ESCARPMENT SECTION

BLUEGRASS NATURAL REGION
SCOTTSBURG LOWLAND SECTION
MUSCATATUCK FLATS AND CANYONS SECTION
SWITZERLAND HILLS SECTION

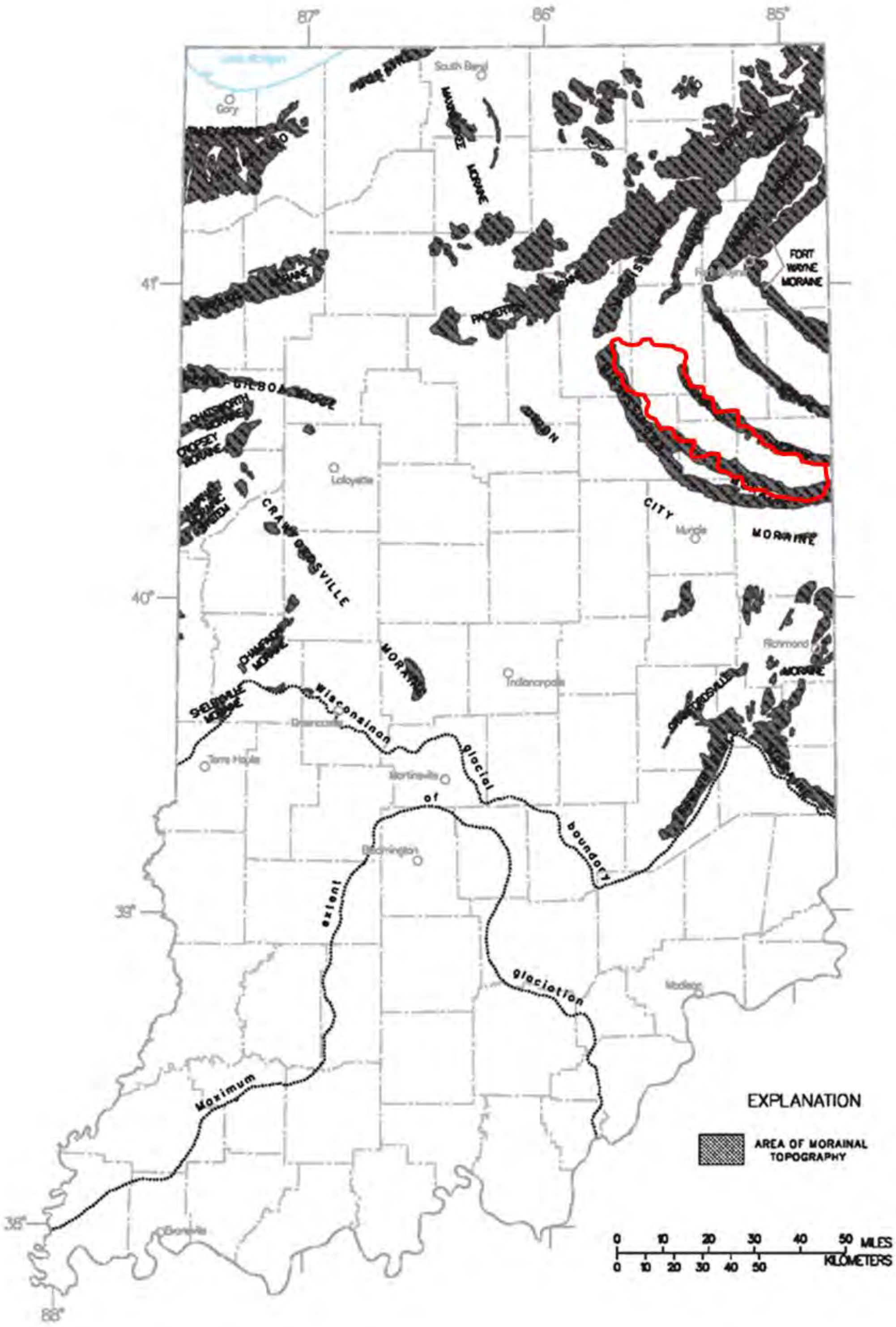
BIG RIVERS NATURAL REGION
OHIO AND WABASH RIVERS



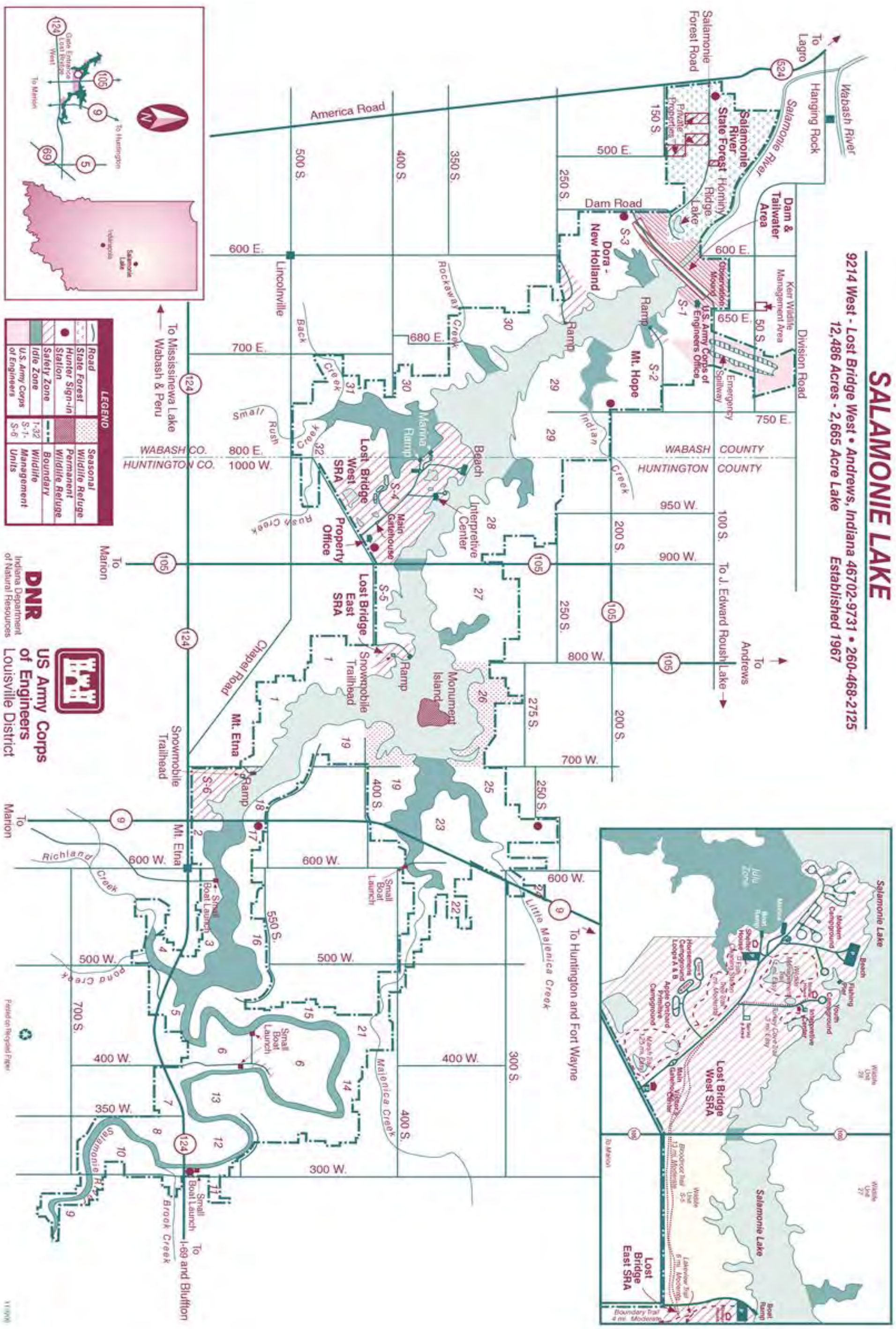
Michael A. Homoya

1985. Proceedings of the Indiana Academy of Science, Volume 94, Plate 1.

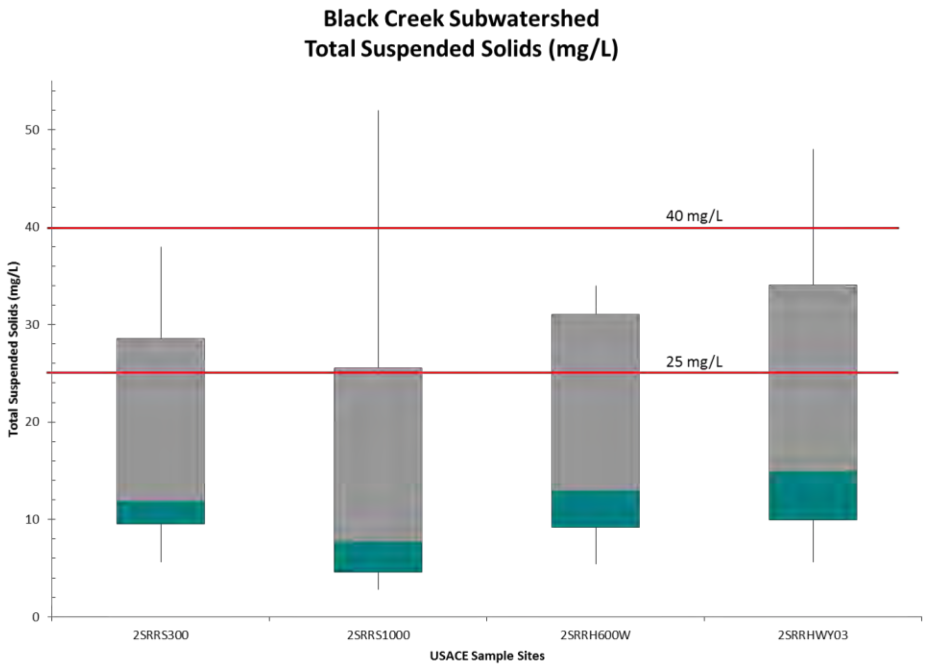
**Appendix B: Principal Moraines and Extent of Glaciation**
(Red Outline Depicts the Lower Salamonie River Watershed)

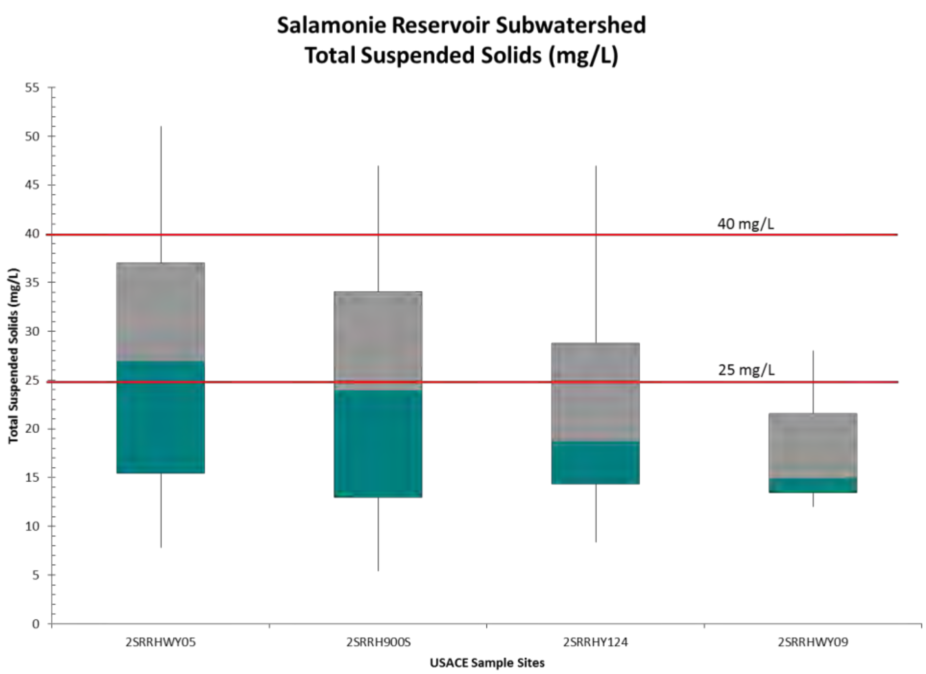


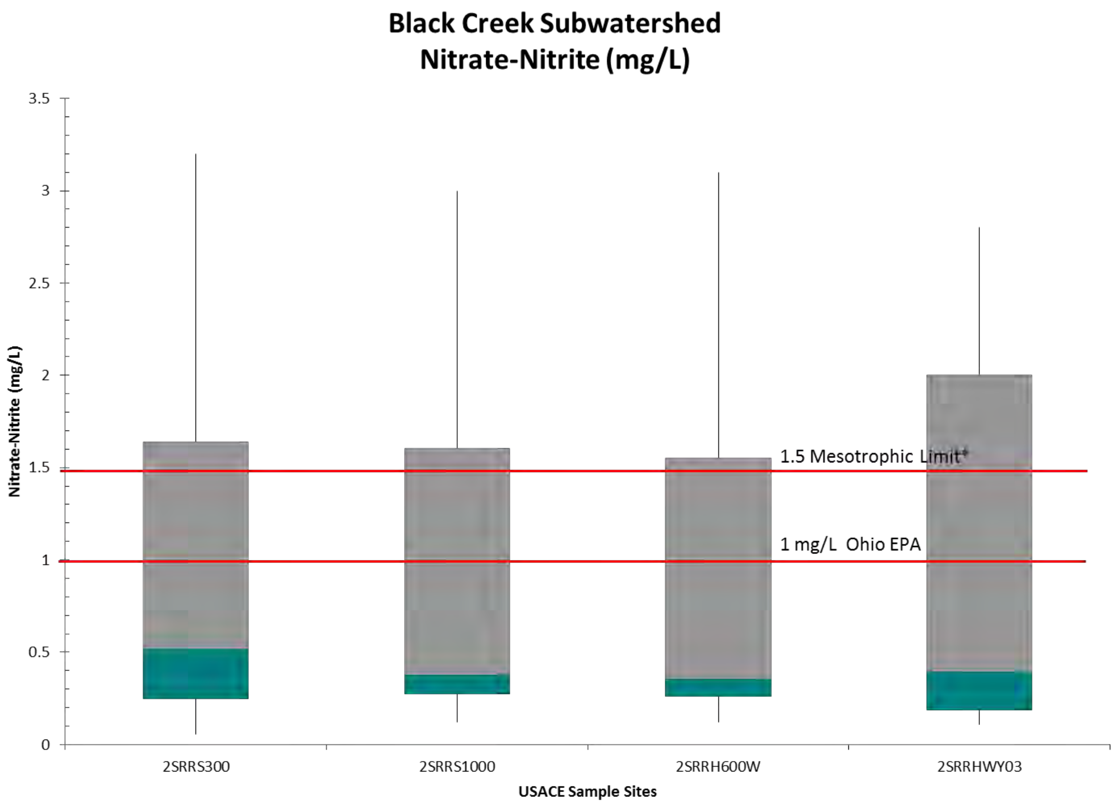
## Appendix C:  Salamonie Reservoir Map



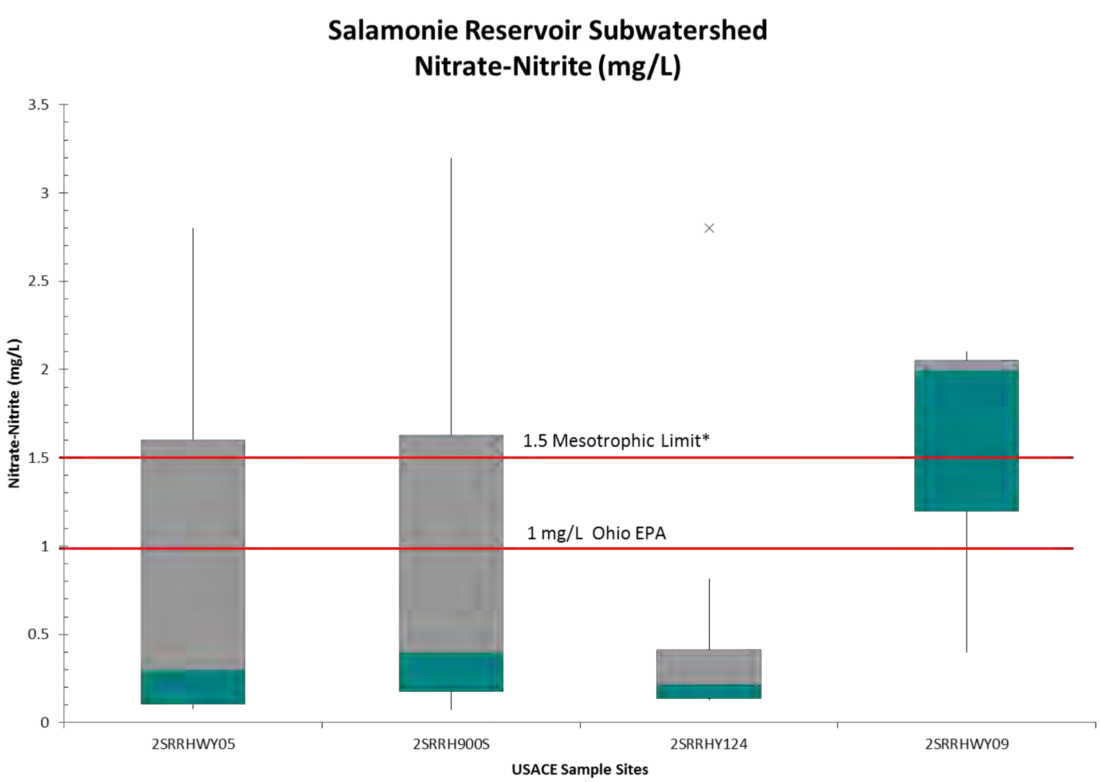
# Appendix D:  IDEM and USACE Chemical Data



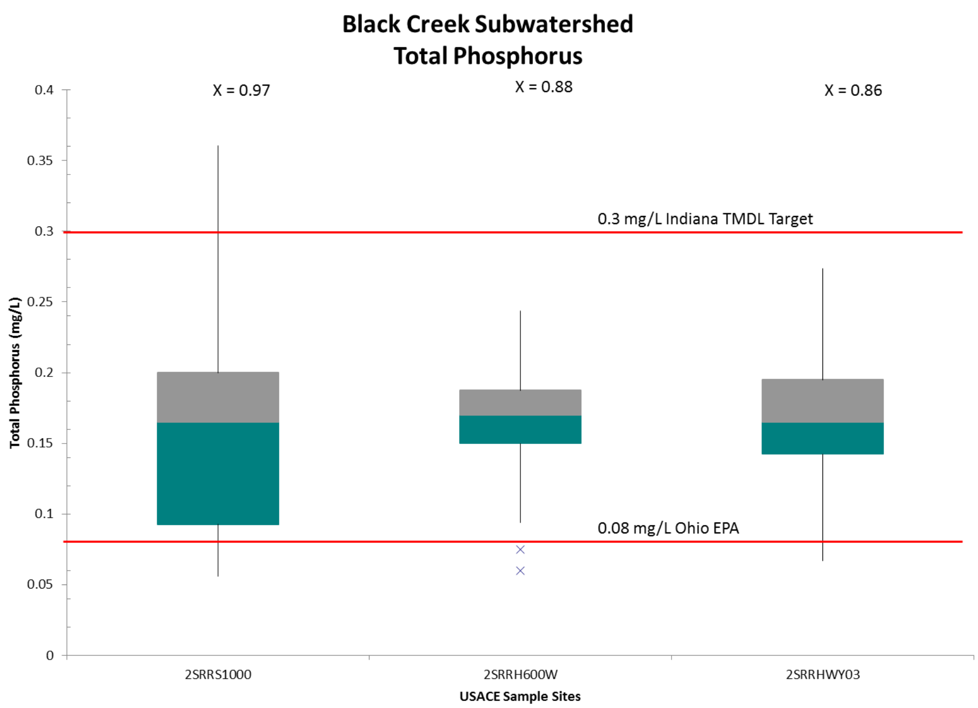



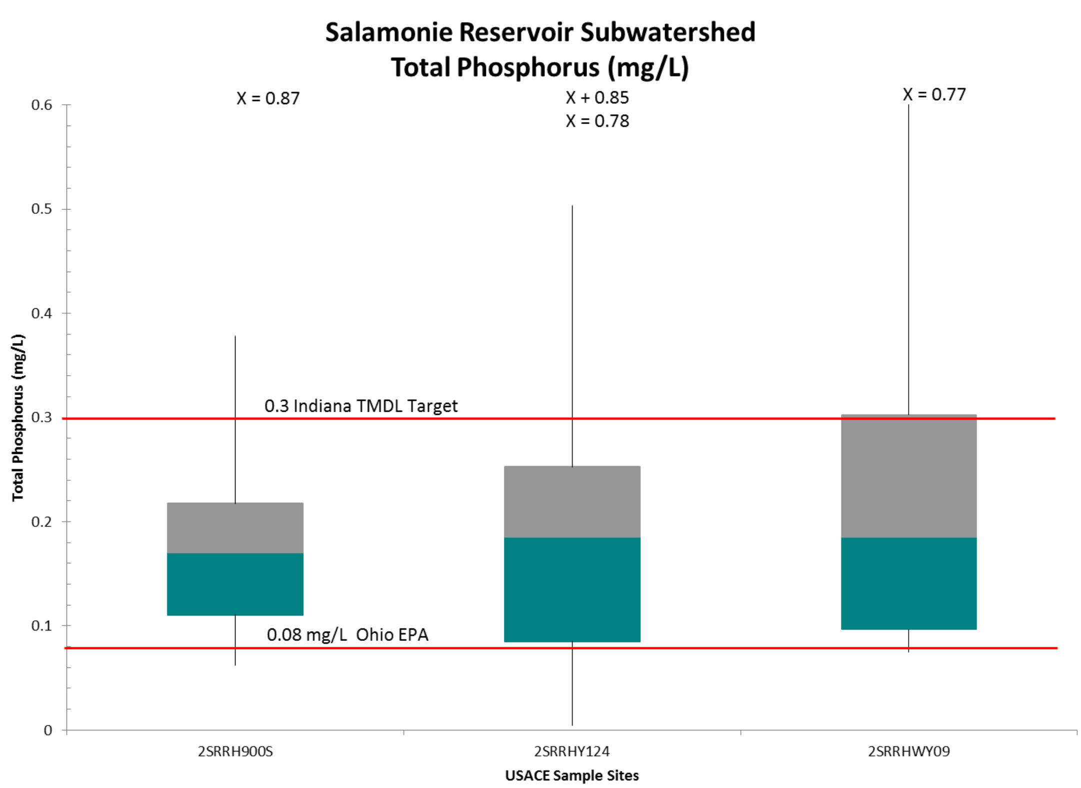


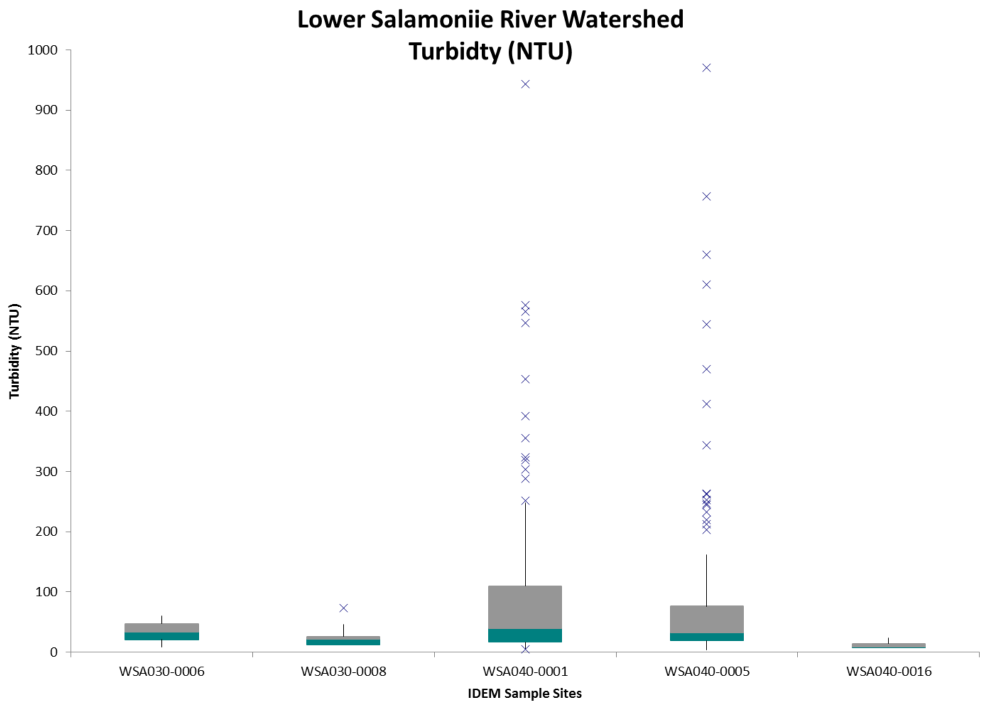
Black Creek Subwatershed
Nitrate-Nitrite (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Nitrate-Nitrite (mg/L)
1.5 Mesotrophic Limit*
1 mg/L Ohio EPA
2SRRS300
2SRRS1000
2SRRH600W
2SRRHWY03
USACE Sample Sites

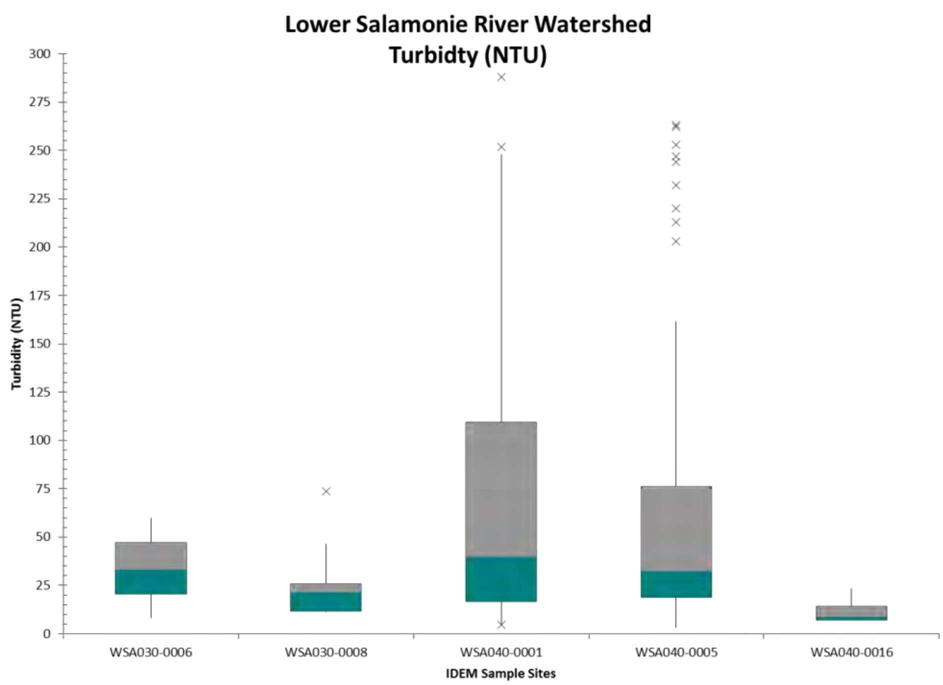



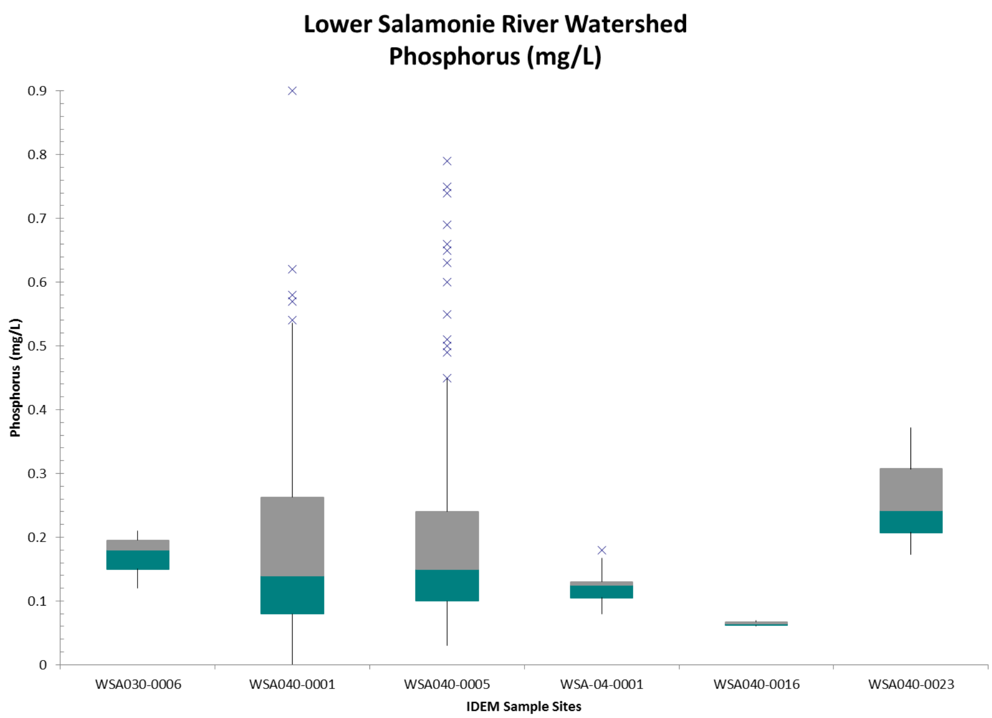
Salamonie Reservoir Subwatershed
Nitrate-Nitrite (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Nitrate-Nitrite (mg/L)
1.5 Mesotrophic Limit*
1 mg/L Ohio EPA
2SRRHWY05
2SRRH900S
2SRRHY124
2SRRHWY09
USACE Sample Sites

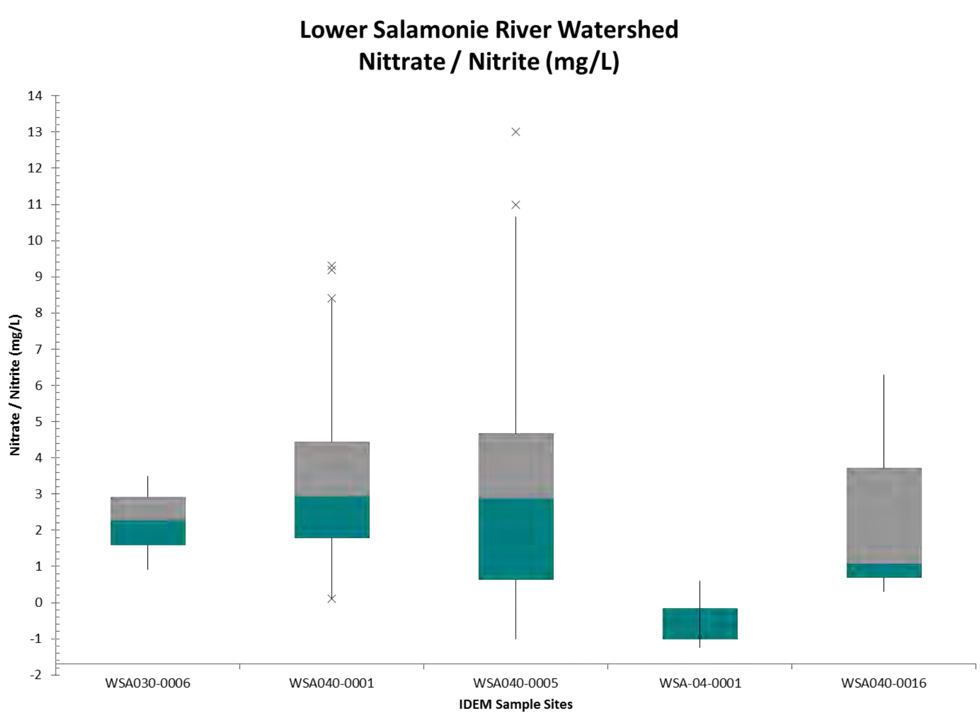

Black Creek Subwatershed
Total Phosphorus
X = 0.97
X = 0.88
X = 0.86
0.3 mg/L Indiana TMDL Target
0.08 mg/L Ohio EPA
Total Phosphorus (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2SRRS1000
2SRRH600W
2SRRHWY03
USACE Sample Sites


Salamonie Reservoir Subwatershed
Total Phosphorus (mg/L)
X = 0.87
X + 0.85
X = 0.78
X = 0.77
0.3 Indiana TMDL Target
0.08 mg/L Ohio EPA
Total Phosphorus (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
2SRRH900S
2SRRHY124
2SRRHWY09
USACE Sample Sites


Lower Salamoniie River Watershed
Turbidty (NTU)
Turbidity (NTU)
1000
900
800
700
600
500
400
300
200
100
0
WSA030-0006
WSA030-0008
WSA040-0001
WSA040-0005
WSA040-0016
IDEM Sample Sites


Lower Salamonie River Watershed
Turbidty (NTU)
Turbidity (NTU)
300
275
250
225
200
175
150
125
100
75
50
25
0
WSA030-0006
WSA030-0008
WSA040-0001
WSA040-0005
WSA040-0016
IDEM Sample Sites


Lower Salamonie River Watershed
Phosphorus (mg/L)
Phosphorus (mg/L)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
WSA030-0006
WSA040-0001
WSA040-0005
WSA-04-0001
WSA040-0016
WSA040-0023
IDEM Sample Sites


Lower Salamonie River Watershed
Nittrate / Nitrite (mg/L)
Nitrate / Nitrite (mg/L)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
WSA030-0006
WSA040-0001
WSA040-0005
WSA-04-0001
WSA040-0016
IDEM Sample Sites

## Appendix E:  Action Register

| Action Register and Schedule | | | | | |
|---|---|---|---|---|---|
| 30-Year Bacteria and Pathogen Goal - Reduce measured E. coli levels to below State standard | | | | | |
| **Objectives** | **Target Audience** | **Milestones** | **Estimated Costs** | **Potential Partners/Technical Assistance** | **Potential Funding Sources** |
| Educate Landowners on septic system operation and maintenance | Rural Homeowners and unincorporated areas without public sewage treatment plants | Hold Septic System Workshop in Spring of 2015 | $500 | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, Local Health Departments | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | Create Septic System Informational Brochure | $500 | | |
| | | Create Septic System Informational Refrigerator Magnet to pass out at events | $500 | | |
| | | Encorage proper upkeep and maintence of septic system as well as promote awareness of the water-quality impacts of failing systems | $4000 10% coordinator salary | | |
| Complete Nutrient Management Plans on 8,000 acres of cropland | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | Annually implement 1,600 acres of Nutrient Management Plans (2015 - 2020) | $21,200 | | |
| | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| Exclude livestock access to streams in 4 locations, provide alternative water source. | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | Prevent cattle access to streams at 1 location per | $5,000 | | |
| | | Provide alternate watering source where needed | | | |
| | | stabilize impacted stream banks through stream bank stabilization program | $50,000 | | |
| | | Identify alternative funding sources for practices | $4000 10% coordinator salary | | |
| Install 5 miles of conservation cover and buffers along streams | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| | | Complete 1 mile of conservation cover or buffers | $1,800 | | |
| Install 10 water and sediment control basin (WASCOBs) | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| | | Install 2 WASCOBs per year (2015-2020) | | | |
| Increase awareness of Agricultural BMPs | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | Promote Soil Health | $4000 10% coordinator salary | | |
| Increase prescribed grazing and pasture management by 100 acres | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |

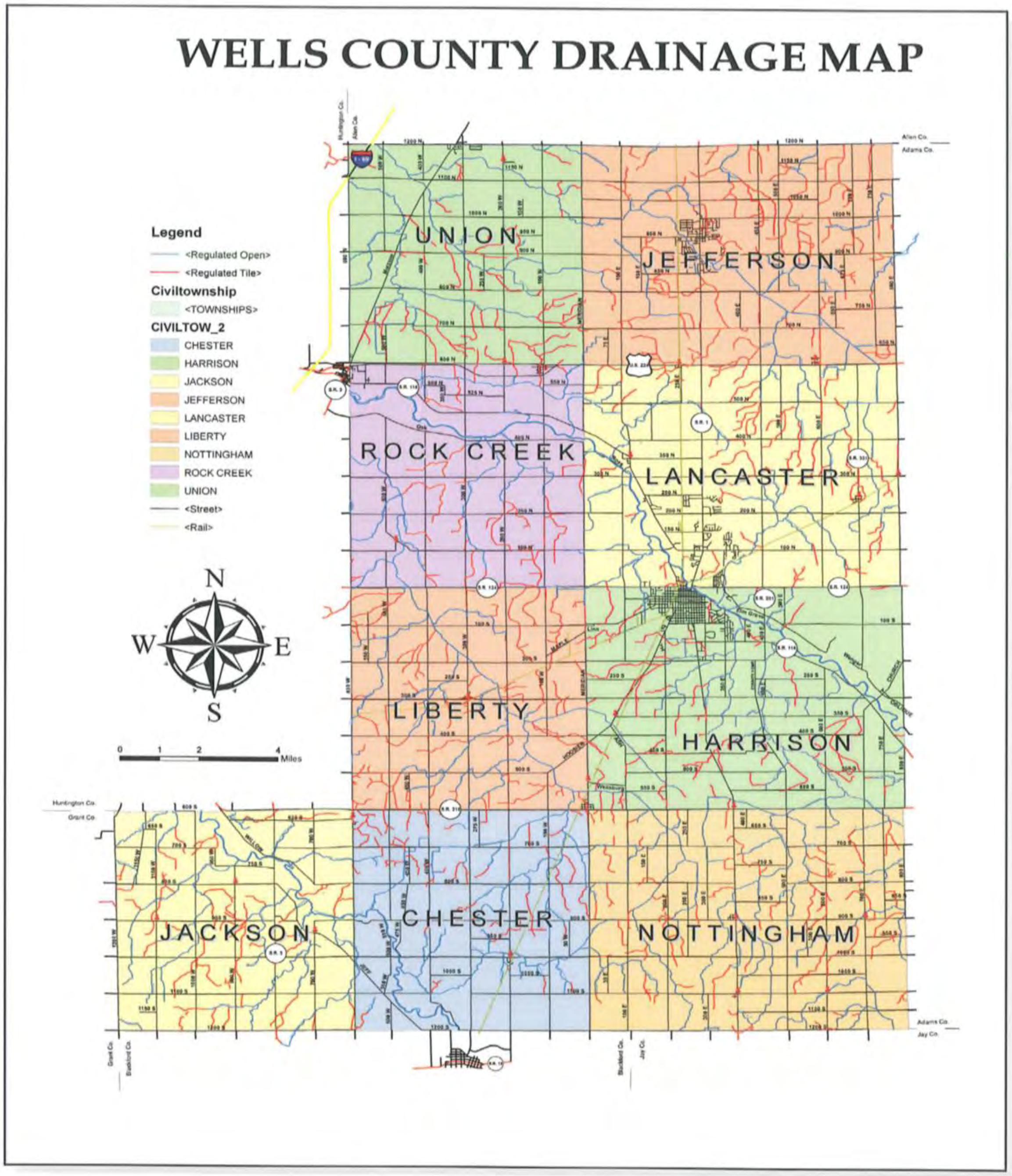
Action Register and Schedule

5-Year Nutrient, Sediment, and Environmental Goals. (These goals will be repeated for the following 5 years unless it is determined by the steering committee that they should be changed.)

| Objectives | Anticipated Load Reductions* | Target Audience | Milestones | Estimated Costs | Potential Partners/Technical Assistance | Potential Funding Sources |
|---|---|---|---|---|---|---|
| Plant 2,500 acres of cover crops | Sediment - 1547 t/year, Phosphorus - 2713 lbs/year, Nitrogen - 5412 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| | | | Maintain demonstration plot for cover crops | $1,250 | | |
| | | | Implemant 500 acres of new cover crop acreage per year (2015 - 2020) | $28,000 see example | | |
| | | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | | Promote Soil Health | $4000 10% coordinator salary | | |
| Complete Nutrient Management Plans on 8,000 acres of cropland | Unknown | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | | Annually implement 1,600 acres of Nutrient Management Plans (2015 - 2020) | $21,200 | | |
| | | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| Exclude livestock access to streams in 4 locations, provide alternative water source. | Unknown | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | | Prevent cattle access to streams at 1 location per year (2015-2019) | $5,000 | | |
| | | | Provide alternate watering source where needed | | | |
| | | | stabilize impacted stream banks through stream bank stabilization program | $50,000 | | |
| | | | Identify alternative funding sources for practices | $4000 10% coordinator salary | | |
| Increase conservation tillage in the watershed by 7,500 acres | Sediment - 3539 t/year, Phosphorus - 6228 lbs/year, Nitrogen 12423 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | | Promote Soil Health | $4000 10% coordinator salary | | |
| | | | Provide funds for equipment modifications | $10,000 | | |
| Install 5 miles of conservation cover and buffers along streams | Sediment - 925 t/year, Phosphorus - 1519 lbs/year, Nitrogen 3024 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| | | | Complete 1 mile of conservation cover or buffers per year | $1,800 | | |
| Install 10 water and sediment control basin (WASCOBs) | Sediment - 189 t/year, Phosphorus - 189 lbs/year, Nitrogen 378 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| | | | Identify alternate funding sources to increase participation | $4000 10% coordinator salary | | |
| | | | Install 2 WASCOBs per year (2015-2020) | | | |
| Increase awareness of septic system problems and solutions | Unknown | Rural Homeowners and unincorporated areas without | Hold 1 workshop on rural/residntial septic operation and maintenance | $500 | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, Local Government | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | | Create Septic System Informational Brochure | $500 | | |
| | | | Create Septic System Informational Refrigerator Magnet to pass out at events | $500 | | |
| Increase awareness of Agricultural BMPs | Unknown | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | | Promote Soil Health | $4000 10% coordinator salary | | |
| Increase prescribed grazing and pasture management by 100 acres | Sediment - 93 t/year, Phosphorus - 150 lbs/year, Nitrogen 612 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| Complete 1000 feet of streambank stabilization | Sediment - 306 t/year, Phosphorus - 306 lbs/year, Nitrogen 612 lbs/year | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | | Install 1000 feet of streambank stabilization | $50,000 | | |
| Install a demonstration rain garden in a prominent urban setting | Unknown | Residential landowners and local governments | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, Local Government, Volunteers | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | | Install one rain garden | $3,000 | | |
| | | | Develop marketing materials | $500 | | |
| Increase awareness of cost share programs | Unknown | Agricultural Producers | Establish Cost Share Program Spring/Summer of 2015 | $20,000 50% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants |
| | | | Targeted mailing and personal visits with prospective landowners | $4000 10% coordinator salary | | |
| Work with County Surveyors and landowners on environmentally sound alternatives to standard ditch maintenance practices | Unknown | Agricultural Producers and Land Owners | Promote the use of two stage ditches, especially where ditch maintenance is needed frequently | $4000 10% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants |
| | | | Promote the use of drainage management | $4000 10% coordinator salary | | |
| | | | Work with County Surveyors to adopt more environmentally sound drainage practices | $1,000 | | |
| Promote Wetlands for water storage and water-quality | Unknown | Agricultural Producers and Land Owners | Promote WRP cost share program to enhance water storage and | $4,000 10% coordinator salary | NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts | IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants |
| | | | Promote wetland restoration | $4,000 10% coordinator salary | | |
| | | | Identify alternative funding sources for practices | $4,000 10% coordinator salary | | |

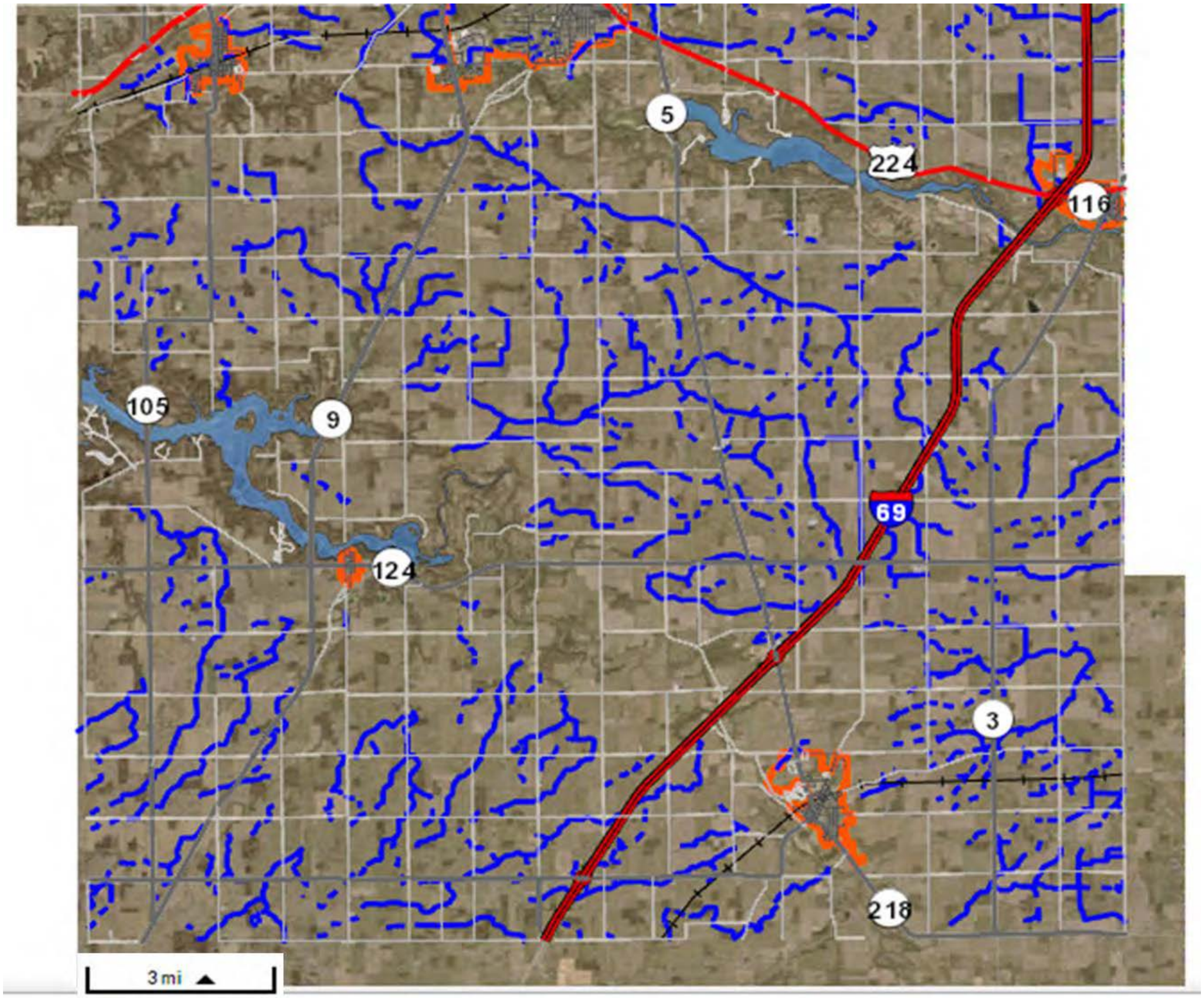
*Numbers based on US EPA Region 5 Model.

**Appendix F: County Drainage Maps**

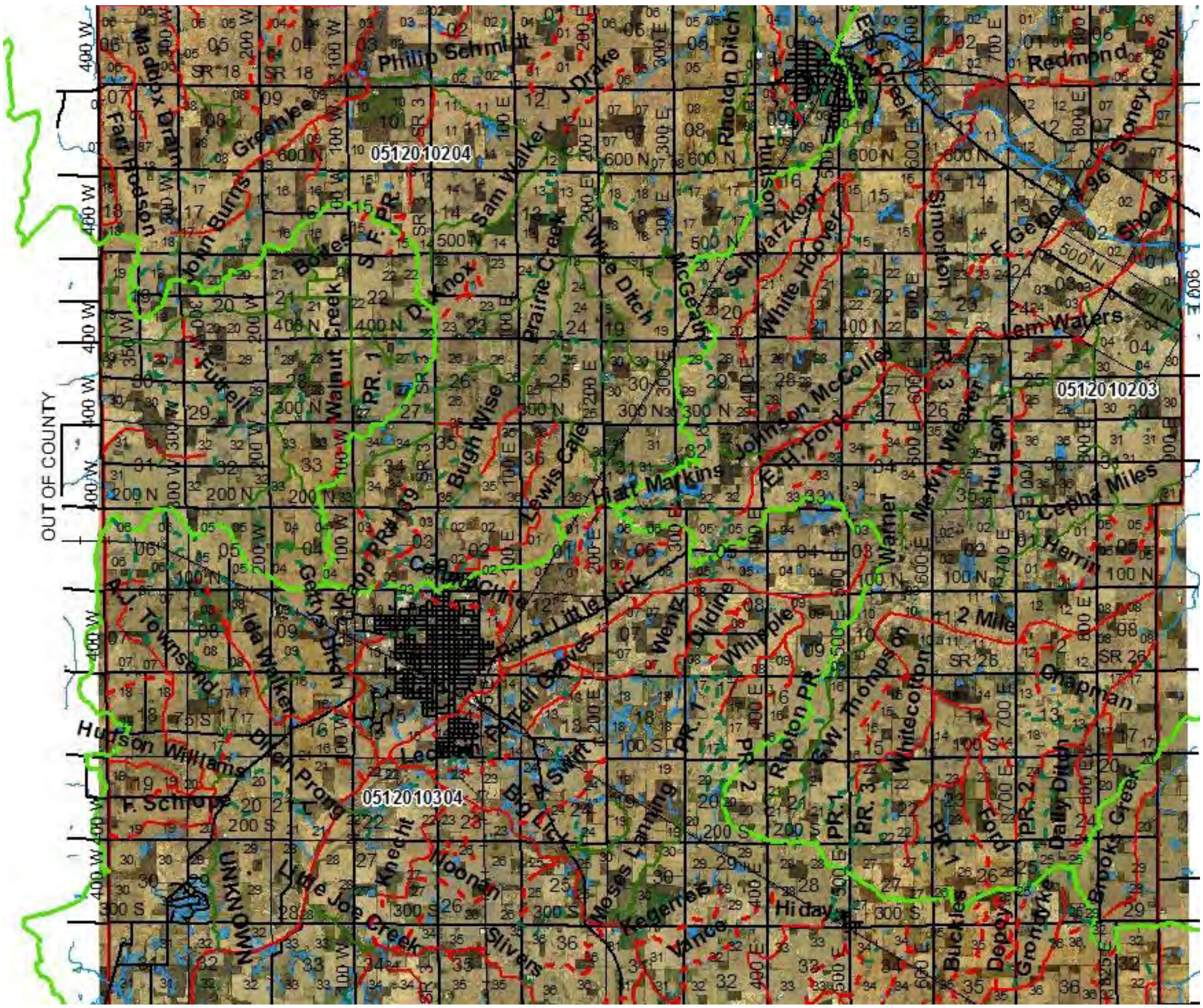


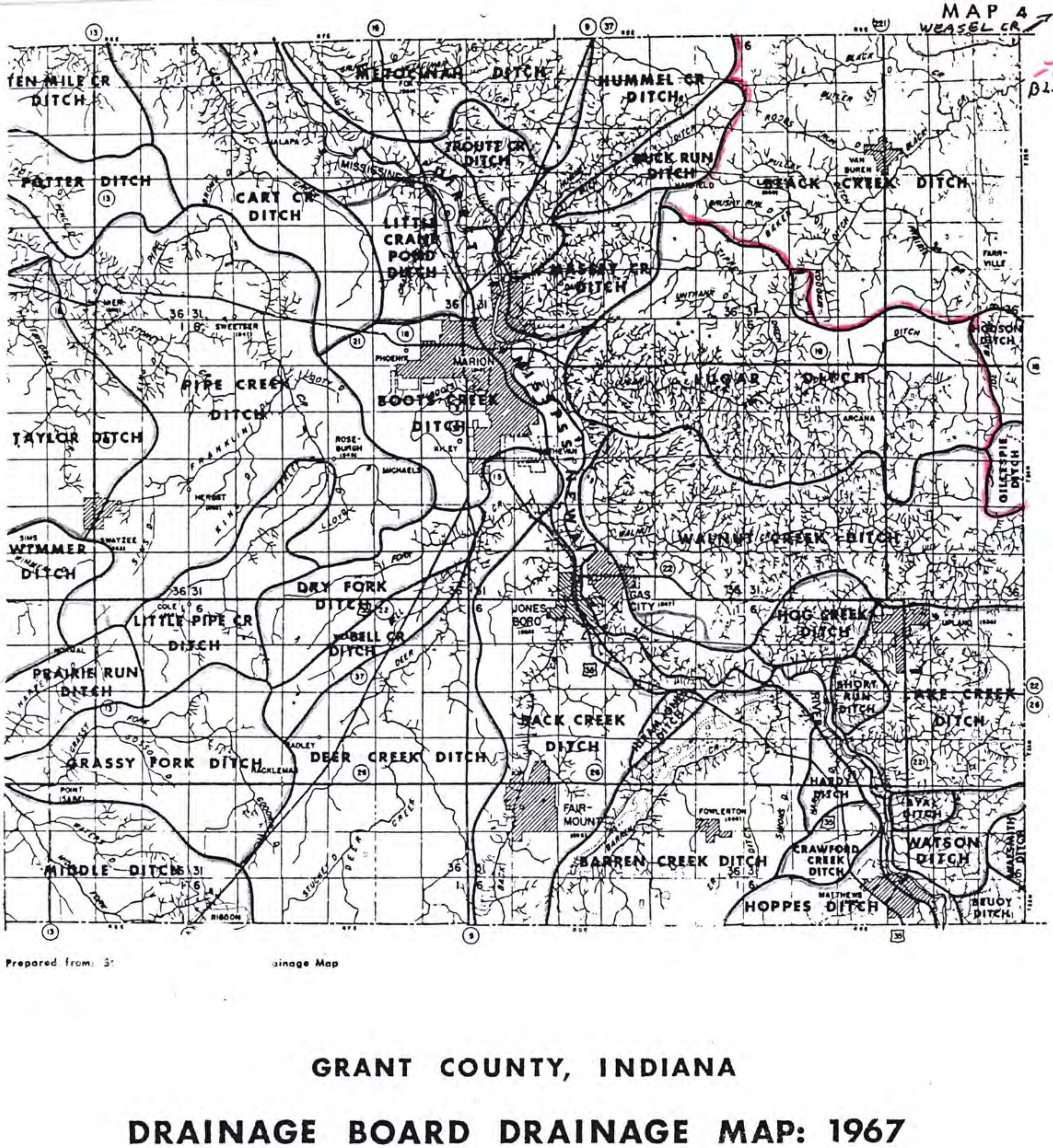

\

# Huntington County Drainage Map



# Blackford County Drainage Map






Prepared from: St... ...ainage Map

## GRANT COUNTY, INDIANA

## DRAINAGE BOARD DRAINAGE MAP: 1967

1 0 1 2 3 4 MI

Wabash County Surveyor
Cheri Slee
**Assistant Surveyor**
Kelvin Grumpp

# WABASH COUNTY DRAINAGE SYSTEM




Prepared by:
Wabash County Surveyor's Office
September, 2012

Disclaimer: Wabash County assumes no legal responsibility for the information contained herein.