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Project Manager:	Kathleen Hagan

Little Blue River Watershed Management Plan

October 2007

Shelbyville High School students
studying water quality and participating
in a river clean up, August 2006.

EXECUTIVE SUMMARY

The mission of the Little Blue River Watershed Project is to improve and monitor water quality in the Little Blue River Watershed.

The Little Blue River Watershed Steering Committee met during 2006 to study and identify primary water quality issues in the watershed. Based on information gathered through a Lake and River Enhancement (LARE) Diagnostic Study conducted in 2004 and other observations and data, the following issues emerged:

- *E. coli* levels exceed the Indiana standard at most testing sites.
- Nitrate-nitrogen concentrations regularly exceed recommended target values.
- Sedimentation is a likely contributor to poor substrate quality and embeddedness throughout streams in the watershed.
- In addition to water quality issues, the public is interested in addressing other problems such as logjams, illegal dumping, habitat/wetland degradation, and reduced recreational opportunities.

The Committee believes that water quality can be improved in the tributaries and mainstem portions of the Little Blue River by:

1. Promoting public awareness and understanding of local water resources.
2. Reducing nonpoint source runoff from urban sites involving construction, unprotected stream banks, fertilizer application, and impervious surfaces.
3. Increasing implementation of agricultural best management practices such as conservation tillage, nutrient/pest management planning, filter strip installation, stream bank stabilization, and livestock exclusion.
4. Eliminating concentrated sources of *E. coli* contamination from failing or poorly maintained septic systems, manure runoff, livestock access to streams, and nuisance wildlife.
5. Encouraging the establishment of riparian buffers along the river's mainstem segments and contributing tributaries.

The Committee has outlined the following goals for water quality improvement in the watershed.

- By the end of 2020, reduce *E. coli* bacteria levels to the state standard of 235-colonies/100 mL in the Little Blue River Watershed. Use both volunteer monitoring and lab testing to verify improvement and identify possible sources of contamination.
- By the end of 2020, reduce nitrate-nitrogen concentrations in the Little Blue River Watershed to the target value of 0.63 mg/L. Use volunteer monitoring to determine concentrations.
- Since turbidity can be an indicator of sedimentation, by the end of 2020 reduce turbidity levels in the Little Blue River Watershed to the target value of 9.89 NTU. Use volunteer monitoring and visual observation to determine NTU levels, substrate quality, and erosion issues in targeted subwatersheds.
- Cultivate citizen interest and leadership in conservation and natural resources by educating children and adults through increased hands-on learning opportunities, information brochures, workshops, and service opportunities.

These goals provide direction for specific objectives and action items identified in the Watershed Management Plan. Implementation of these ideas has already begun. The Committee has applied for a Section 319 Clean Water grant to install water quality improvement BMPs, to support educational programming, and to help realize the following vision for the watershed.

Little Blue River Vision Statement
Adopted April 2006

This vision is based on a best case scenario for water quality protection in the Little Blue River drainage basin over the next ten years.

Residents in the Little Blue River Watershed will realize that better water quality benefits everyone. Through this awareness they will voluntarily implement appropriate water quality improvements that reduce sediment, filter runoff, and minimize E. coli contamination. No regulatory action or increased taxation will be used to force compliance.

The Little Blue River Watershed Project will work with various agencies as it seeks funding through grants and other sources to provide cost share incentives to landowners when they install water quality improvements on their property. The watershed project will promote awareness of the benefits of conservation to adults and children through a variety of educational opportunities.

These actions and attitudes set the stage for water quality to improve to the point that people will feel confident they can enjoy eating fish and using the river for recreation. Everyone in the watershed will understand the Little Blue River system is a natural resource to be used wisely and protected for future generations.

If you have questions or comments regarding the content of this Watershed Management Plan or the implementation process, please contact:

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Section 1: INTRODUCTION

The Little Blue River Watershed Management Plan is intended as a guide to be used by citizens for outreach, education, implementation, and assistance when protecting local water resources. Government officials and landowners can use this information to increase their understanding of water quality issues and to develop action plans for improvement. It is a document subject to change and amendment as priorities and conditions evolve. The suggestions made in this Watershed Management Plan do not establish legal requirements. Instead they provide a framework to coordinate voluntary efforts to improve and maintain water quality.

This plan is formulated using the watershed approach. It focuses on both public and private efforts to address water quality and other water-related concerns within the Little Blue River Watershed. This type of approach combines four major features: 1) identifying priority problems, 2) involving stakeholders, 3) developing integrated solutions, and 4) measuring success. Since watersheds often include large areas with varied land use, a watershed management approach includes planning for both hydrological and ecological functions. This approach also ensures that diverse interests are represented in the planning process, and it helps to form lasting partnerships to achieve success.

1.1 Location of the Watershed

A watershed is the entire land area that contributes water to a stream or river. The Little Blue River Watershed is located in central Indiana, northeast of Shelbyville and north and west of Rushville in Shelby and Rush Counties with a small headwater section in Henry County. (Figure 1) Little Blue River Watershed lies within Addison, Marion, and Union Townships in Shelby County; Center, Jackson, Posey, and Walker Townships in Rush County; and Spiceland Township in Henry County (map inset). This watershed is part of the larger Driftwood River Watershed, which includes portions of Henry, Hancock, Marion, Rush, Shelby, Johnson, Bartholomew and Brown Counties.

1.2 Little Blue River Diagnostic Study

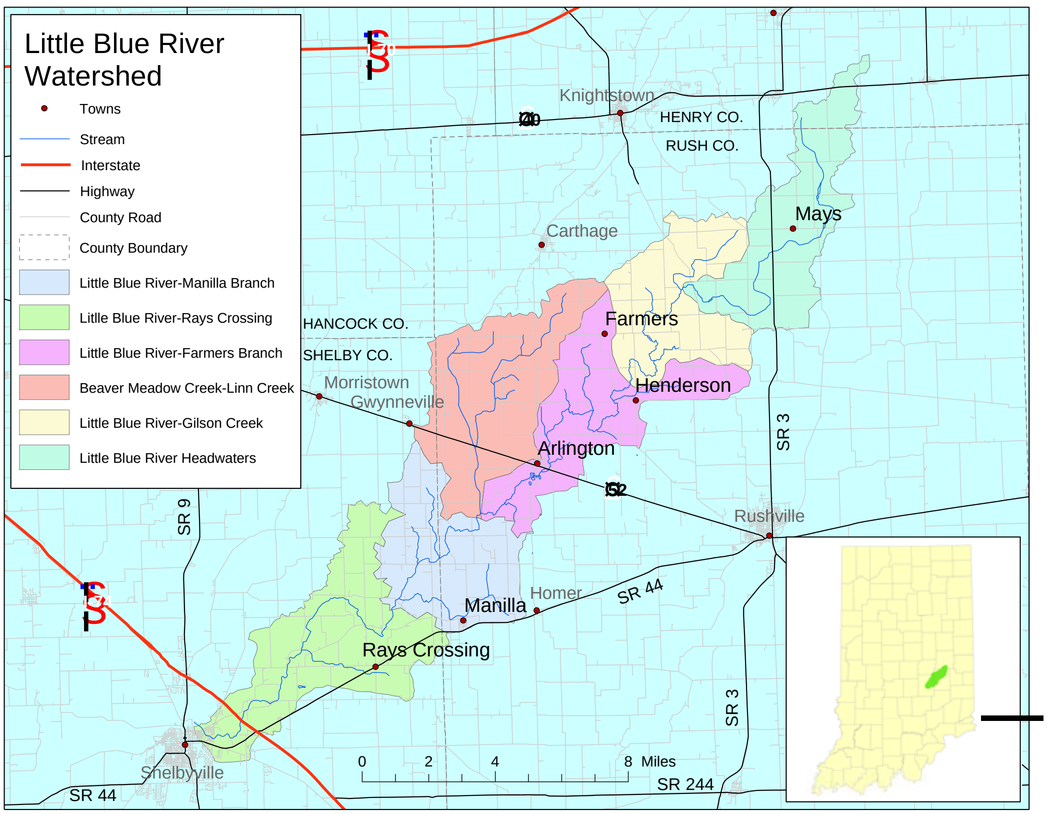
In 2004 the Rush and Shelby County Soil and Water Conservation Districts (SWCDs) used funding from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program for a diagnostic study on the Little Blue River Watershed in Rush, Shelby and Henry Counties.

Based on the findings and recommendations of this study, the SWCDs applied for and received in 2005 a Clean Water Act Section 319 grant through the Indiana Department of Environmental Management (IDEM) to establish the Little Blue River Watershed Project and develop a watershed management plan. Rush County SWCD was the 319 grant administrator and reported directly to IDEM. Both Rush and Shelby SWCD Office Administrators, along with a privately contracted watershed coordinator and a Steering Committee composed of stakeholders, led the effort to complete the grant requirements.

The Steering Committee used the LARE Diagnostic Study assessment as well as citizen concerns and comments to identify water quality issues and to develop goals and objectives that address the concerns.

The LARE Diagnostic Study in its entirety is available at the
Henry, Rush and Shelby County SWCD offices and on the IDNR website at
http://www.in.gov/dnr/fishwild/lare/lare_reports.html

Figure 1: Little Blue River Watershed: Local and Regional Location



1.3 Building Partnerships

Two public meetings were held in January 2006 at the outset of the Little Blue River Watershed Project. Citizens were encouraged to attend these meetings through press releases in both the *Shelbyville News* and the *Rushville Republican*. Individual invitations were mailed to a list of stakeholders and landowners who were identified through county plat books and the Farm Service Agency (FSA). Government officials including SWCD Boards, County Commissioners, County Council members, Mayors, Surveyors, and Plan Commissions also received invitations. A combined total of over 100 people attended these meetings in Rush and Shelby Counties. Meeting participants included representatives from government, farming, education, business, landowners, homeowners and other interested citizens.

1.3.1 Concerns and Comments

People who attended the kick-off meetings received information about results and recommendations from the previously completed LARE Diagnostic Study. They also learned of opportunities available through the Section 319 grant. Participants filled out interest surveys and offered their comments and concerns regarding the watershed. These responses are summarized in Appendix B. Important themes that emerged were:

1. The public displayed interest tempered with skepticism:
   - Our kick-off meetings attracted people who were very curious about what impact the watershed project would have on the community at large and on their personal property rights.
   - Many people liked the idea of developing a watershed management plan and seeking subsequent funding for Best Management Practice (BMP) implementation.
   - Others thought water quality in the watershed was fine and should be left alone.
   - Concerns surfaced that this was an example of government tampering and undesirable results could be the outcome.
   - Farmers wanted to be sure that agriculture wasn't unfairly blamed for all water quality problems.
   - People asked about funding for the project, if it was really needed, and if there were plans for long-term success.
   - Some people didn't like the results of a former watershed project and wanted to be sure this project didn't interfere with landowner rights.
2. Water quality concerns covered a wide range of issues:
   - *E. coli* was the primary water quality concern.
   - People wanted to know the degree of impairment in the watershed and what sources were contributing to pollution.
   - Some expressed concern that eating fish caught in the Little Blue River might not be safe.
   - Illegal dumping along riverbanks annoyed numerous people.
3. Drainage is an important topic, especially to the farming community:
   - Some people thought the river should be cleaned out so drainage is more effective. Others said poor drainage is a fact of life and the river should be left alone. In general, people were not clear on who was responsible for river maintenance.
   - Several people asserted that drainage was a more important issue than improved water quality. However, most seemed to recognize that erosion could harm water quality and sedimentation could contribute to drainage problems.
   - A lot of energy surrounded the question – will this project clean the river of logjams and sandbars? If not, some people thought the project was unnecessary.
4. People offered several pieces of advice to maximize the project's effectiveness:
   - Avoid duplicating the efforts of other agencies or organizations.
   - Use information already learned through similar successful projects.
   - Promote cost share for BMPs but make sure participation is voluntary.
   - Properly collect and evaluate water quality samples so the data is useful.
   - Educate the public on what they can do to help.

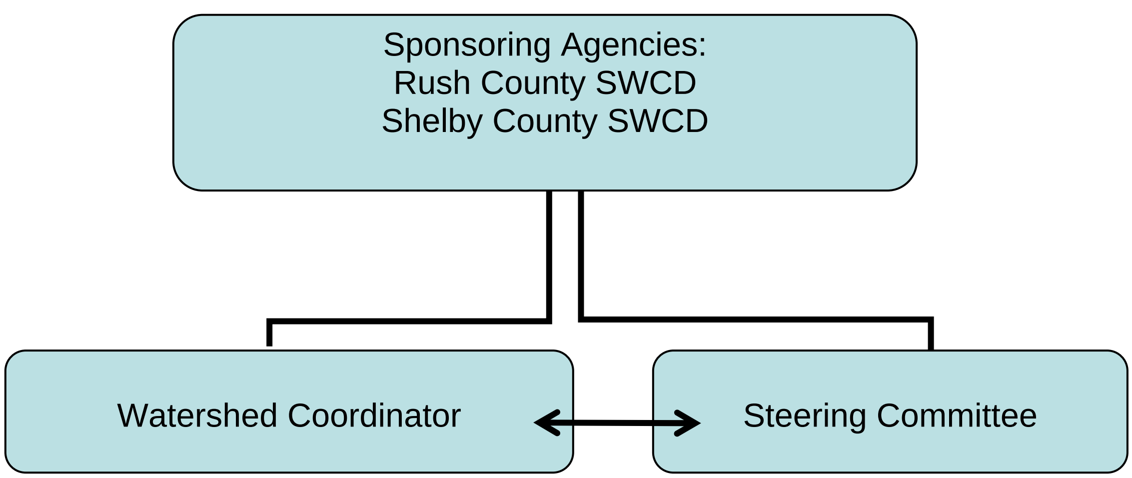
1.3.2 Information Dissemination

Throughout 2006 the public continued to receive information about watershed issues through numerous newspaper articles. Purdue Cooperative Extension offices in Rush and Shelby Counties and the Shelby County SWCD provided information in their newsletters. Monthly Steering Committee meetings were always open to the public. In 2007 near the end of the 319 grant term, the public was invited to view the Watershed Management Plan and offer comments.

1.3.3 Steering Committee Formation

At the initial public meeting in January 2006 about 20 people expressed interest in finding out more about serving on the project Steering Committee and/or volunteering to do water quality monitoring. Appendix C lists the people who eventually formed the 319 grant Steering Committee, served as technical advisors, and/or volunteered to do water quality monitoring. The Steering Committee was responsible for insuring that local values were taken into account when writing the Watershed Management Plan. Members developed the mission and vision statements and participated in planning activities and educational events. The Committee, assisted by the Watershed Coordinator, cooperated closely with the Rush and Shelby County SWCD Boards of Supervisors using the following organizational structure. (Figure 2)

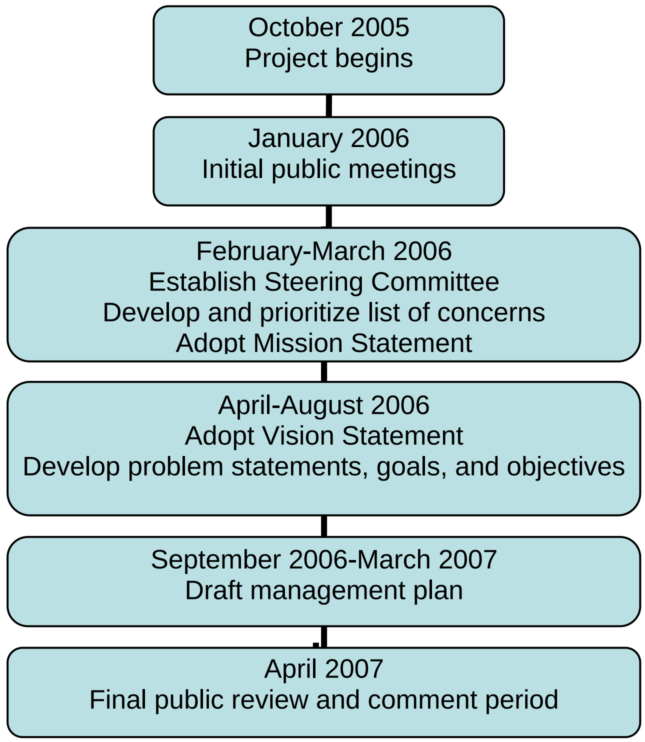
Figure 2: Organizational Structure of the Little Blue River Watershed Project



1.4 Project Timeline

The timeline for developing the Little Blue River Watershed Management Plan mirrors the timeline for the 319 grant term. (Figure 3)

Figure 3: Little Blue River Watershed Planning Process



1.5 Plan Development

Appendix D lists the agencies and organizations that were involved with project development. Initially the Steering Committee met monthly starting in January 2006. Members used the information gathered at the public kick-off meetings, as listed in Appendix B and summarized in subsection 1.3.1, plus their own input to identify primary concepts that they targeted for further exploration:

- Reduce flooding and protect property
- Reduce sedimentation and protect soil
- Pay attention to water quality as it affects humans, wildlife and habitat
- Mitigate riverbank erosion
- Maintain flow and address problems concerning logjams
- Strive for water quality in the river system that allows people to safely eat the fish and swim in the water
- Promote filter strips, grassed waterways, and other BMPs

- Serve as an advocate for conservation practices, but don't force people to comply

Throughout the plan development process the Steering Committee used information from the 2004 LARE Diagnostic Study. This study includes a detailed assessment of the watershed from physical, chemical, and biological observations and data. The study also offers recommendations for watershed improvement, which the Steering Committee carefully considered.

1.6 Mission Statement

Desiring to create a broad framework for water quality protection, the Steering Committee formulated the following Mission Statement in February 2006.

The mission of the Little Blue River Watershed Project is to improve and monitor water quality in the Little Blue River Watershed.

1.7 Vision Statement

The following Vision Statement was adopted by the Steering Committee in April 2006. It is based on a best case scenario for water quality protection in the Little Blue River drainage basin over the next ten years.

Residents in the Little Blue River Watershed will realize that better water quality benefits everyone. Through this awareness they will voluntarily implement appropriate water quality improvements that reduce sediment, filter runoff, and minimize E. coli contamination. No regulatory action or increased taxation will be used to force compliance.

The Little Blue River Watershed Project will work with various agencies as it seeks funding through grants and other sources to provide cost share incentives to landowners when they install water quality improvements on their property. The watershed project will promote awareness of the benefits of conservation to adults and children through a variety of educational opportunities.

These actions and attitudes set the stage for water quality to improve to the point that people will feel confident they can enjoy eating fish and using the river for recreation. Everyone in the watershed will understand the Little Blue River system is a natural resource to be used wisely and protected for future generations.

1.8 Prioritization Strategy

Table 1 shows how the group ranked suggestions for ways the Vision Statement could become reality. Each member (8 people) had three votes to weight the importance of each idea. A member could put all three votes on one suggestion or spread them among several ideas. Best Management Practice (BMP) implementation, education, and program management were the primary tools selected to address the components.

Table 1: Prioritization of Suggestions to Realize the Vision

Suggestion	**Tools**	**Total Votes**	**%of Votes (n=24)**
Seek funds for best management practices (BMPs) to address elevated levels of nutrients, E. coli, and sediment.	BMP implementation	6	**25%**
Promote conservation awareness to adults	Education	4	**17%**
Focus on voluntary conservation	Program Management	4	**17%**
Create ways to communicate that better water quality benefits everyone	Education	3	**13%**
Work with other agencies to solve problems	Program Management	2	**8%**
Ensure that compliance is not forced through regulation or taxes	Program Management	2	**8%**
Educate children about conservation	Education	1	**4%**
Improve water quality so there are no problems with eating the fish	BMP implementation	1	**4%**
Improve water quality so there are no problems with swimming or other recreation	BMP implementation	1	**4%**

Through the process of analyzing citizen comments and concerns as they relate to the information provided in the LARE Diagnostic Study, the Steering Committee developed problem statements, goals, objectives and strategies for water quality protection and improvement in the Little Blue River Watershed. These are described in Section 4.

Section 2: PHYSICAL DESCRIPTION OF THE WATERSHED

And through it all flows the voice of the river
which, being timeless, heeds not the passage of the years.[1]

As the quote above illustrates, local author Marian McFadden views our rivers as a comforting constant in the region's changing landscape. Ancient seas and mammoth glaciers have left their mark on the bedrock and soils. Dense forests have given way to an open, agricultural landscape. Yet the rivers remain. Understanding how natural forces along with human activities affect our rivers at a watershed level is key to preserving these water resources for generations to come.

2.1 Natural History and Human Influence

Shelbyville, the largest town in the Little Blue River Watershed, lies at the confluence of the Big Blue and Little Blue Rivers. In 1816, the year Indiana became a state, William Conner was the first known white man to enter this area. He was "an Indian trader" doing business with the Lenape (Delaware) tribe that lived in the region. In Charles Major's novel *The Bears of Blue River,* which is set in Shelby County, the 1820 landscape and his attitude toward it are clearly described:

"*Back in the twenties, when Indiana was a baby state...great forests of tall trees and tangled underbrush darkened what are now her bright plains and sunny hills..."*

Settlers cleared forests not only for timber and farming but also because they were frightened of wild animals, such as bear and wolves, as well as Native Americans who were at home in these woods. The Little Blue River Watershed's nearly total forest canopy of 200 years ago has been replaced by a very different landscape. The watershed's new natural landscape is under an open sky, consisting primarily of row crop agriculture dotted with rural residences, farming operations, small pockets of wet woodlands, and the occasional town. Wildlife is still abundant but the largest predators are foxes and coyotes. Deer, raccoon, opossum, rabbit, muskrat, beaver and a variety of other small mammals, reptiles, amphibians, and birds make the watershed their home, along with several thousand residents. Towns include Mays, Arlington, and Manilla in Rush County and Rays Crossing plus a small portion of the east side of Shelbyville in Shelby County.

When settlers cleared forests and drained wet areas to farm, they found in many places that the layer of rich forest soil was thin. Years of crop removal and erosion depleted nutrient supplies. Around 1850 fertilization with potassium and phosphorus began. Fertilization had no effect on crop yield, though, until 1940 when Dr. George Scarseth discovered that massive doses of nitrogen could significantly increase productivity. Technology and intensive farming practices, plus the recent demand for biofuels are driving agriculture to increase production even further.

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[1] McFadden, Marian, *Biography of a Town Shelbyville, Indiana 1822-1962,* Tippecanoe Press, Inc. Shelbyville, Indiana, 1968, p. 6.

2.2 Regional Location

A watershed includes surface water, like rivers and streams, as well as the land area that sheds water into those receiving waterbodies. Several watersheds that drain into a common river make a drainage basin. Figure 5 shows how the Little Blue River watershed is divided into six 14-digit HUC subwatersheds (see subsection 2.3.1); all of them contributing water to the Little Blue River drainage basin. Water from the Little Blue River discharges into the Big Blue River in Shelbyville, Indiana. The Big Blue River flows southwest where it joins Sugar Creek north of Edinburgh, Indiana and becomes the Driftwood River. The Driftwood River is a tributary of the East Fork of the White River, which joins the White River northeast of Petersburg, Indiana. The White River converges with the Wabash River east of Mount Carmel, Illinois. The Wabash flows into the Mississippi, which discharges into the Gulf of Mexico. The interconnectedness of waterbodies drives the rational for protecting water quality on a watershed basis.

Figure 4 below shows the general area of the Little Blue River Watershed (in red box) as it relates to the Mississippi River drainage basin. It also shows an area in the Gulf of Mexico called the Hypoxic Zone. Hypoxia means "low oxygen." The Gulf of Mexico Hypoxic Zone is an area along the Louisiana-Texas coast where water near the sea floor has hypoxic conditions. The hypoxic zone is thought to be caused primarily by excess nitrogen delivered from the Mississippi River in combination with seasonal stratification (layering) of Gulf waters. Nitrogen promotes algal and attendant zooplankton growth. The associated organic matter, such as dead algal cells and other debris from the algae, sinks to the bottom where it decomposes, consuming available oxygen. Stratification of fresh water from the Mississippi River and saline water from the Gulf prevents the mixing of oxygen-rich water on the surface with oxygen-depleted water on the bottom. This lack of mixing limits oxygen replenishment and sustains the hypoxic zone, creating an inhospitable environment for most aquatic life.

Figure 4: Mississippi River Drainage Basin
(Red box shows the general area of the Little Blue River Watershed)

2.3 Hydrology

Watersheds are delineated based on elevation and natural divides. Drainage areas typically coincide with stream size. Just as smaller streams combine to form larger streams, smaller watersheds make up larger watersheds. For this reason, watersheds are identified by scale and are coded as such. Larger watersheds are identified by shorter, more general codes, and smaller watersheds are identified by longer codes, designed to be more specific. These designations are referred to as Hydrologic Unit Codes (HUCs), which is a system developed in the mid-1970s by the U.S. Geological Survey (USGS).

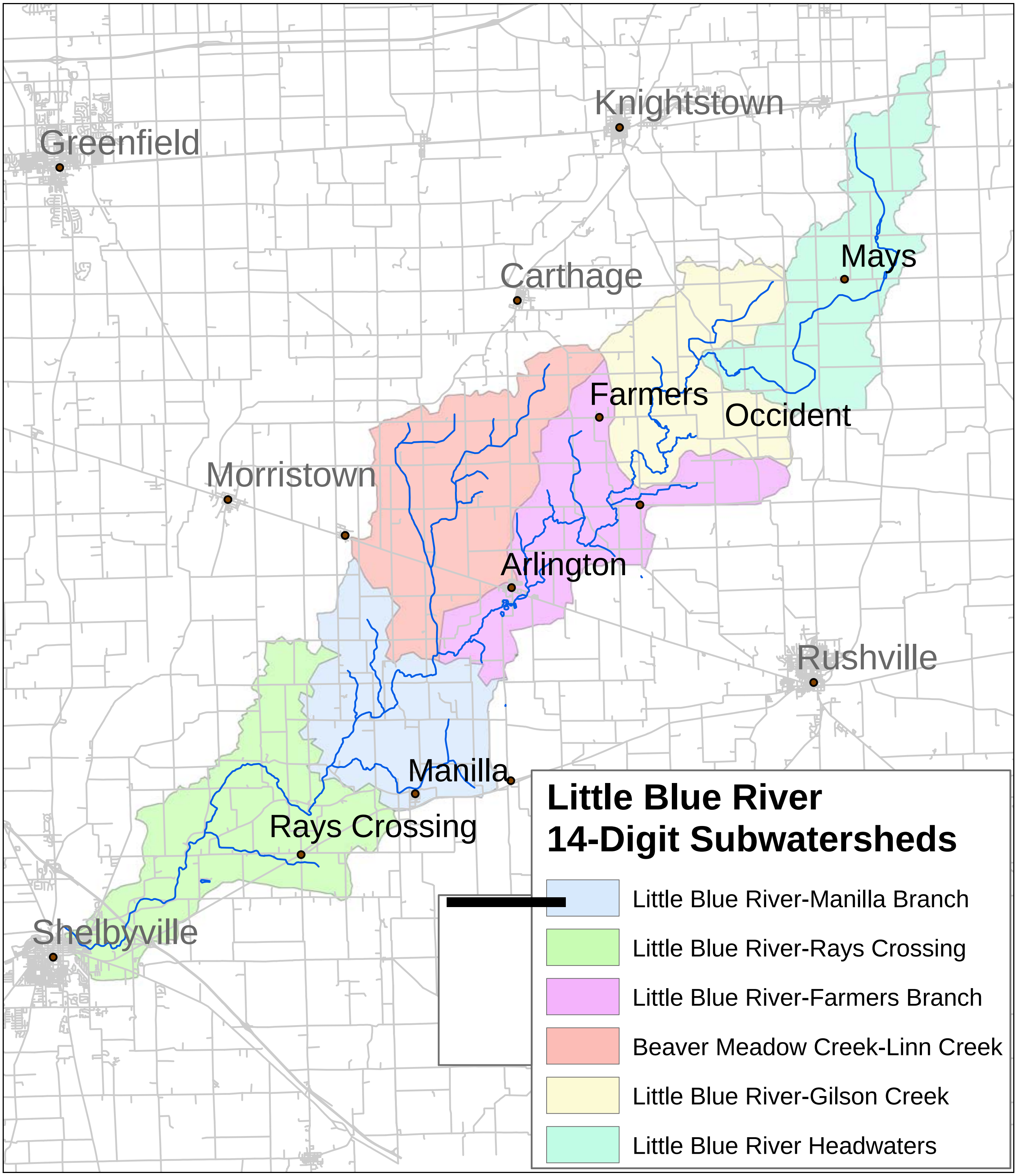
2.3.1 Hydrologic Unit Codes in the Little Blue River Watershed

The Little Blue River Watershed is identified by the 11-digit HUC 05120204030. As stated above it is part of the larger 8-digit Driftwood River watershed HUC 05120204. The six subwatersheds that contribute water to the Little Blue River are identified by 14-digit HUCs. (Figure 5 and Table 2) The entire watershed drains approximately 67,483 acres. Based on information from the IDNR Division of Water, the Little Blue River is navigable from its junction with the Big Blue River in Shelbyville for 25.6 river miles upstream to its junction with Ball Run.

Table 2: Watershed Name and Hydrologic Unit Code (HUC)

Watershed Name	HUC
Headwaters Subwatershed	05120204030010
Gilson Creek Subwatershed	05120204030020
Farmers Stream Subwatershed	05120204030030
Beaver Meadow Creek-Linn Creek Subwatershed	05120204030040
Manilla Branch Subwatershed	05120204030050
Rays Crossing Subwatershed	05120204030060
Little Blue River Watershed	05120204030
Driftwood River Watershed	05120204

Figure 5: Little Blue River Watershed 14-Digit HUC Subwatersheds



2.3.2 Contributing Tributaries

Subwatersheds are named for major contributing tributaries. Major tributaries to the Little Blue River include: Little Gilson Creek, Farmers Stream, Beaver Meadow Creek, Linn Creek, Manilla Branch, and Rays Crossing Tributary. These tributaries have a combined length of 27.6 miles. The mainstem of the river is 43.0 miles. The mainstem and major tributaries add up to 70.6 miles or about 65% of stream length in the watershed. The other named and unnamed streams and ditches, some of which are intermittent, make up the balance of 108.4 miles (174.4 kilometers) of streams in the Little Blue River watershed. (Table 3) Figures 8, 9, and 10 show where these waterbodies are in the Lower, Middle and Upper Little Blue River Watershed

Table 3: Stream Length in the Little Blue River Watershed

Creek/Ditch	Stream Length in miles	Stream Length in kilometers
Little Blue River	43.0	69.2
Beaver Meadow Creek	8.7	14.0
Little Gilson Creek	5.0	8.1
Manilla Branch	4.7	7.5
Linn Creek	3.6	5.7
Rays Crossing Tributary	3.1	4.9
Henderson Ditch	2.9	4.7
Farmers Stream	2.5	4.0
Cotton Run	2.4	3.9
Newhouse Ditch	2.4	3.9
Walker Brook	2.1	3.3
Sulpher Run	1.5	2.3
Hill Brook	1.4	2.3
Well Run	1.4	2.2
Reddick Ditch	1.2	2.0
Arlington Run	1.1	1.8
Bea Run	1.1	1.7
Ditch Creek	0.9	1.5
Pump Run	0.9	1.4
Cap Run	0.8	1.4
Walker Ditch	0.8	1.3
Dill Ditch	0.8	1.3
Ball Run	0.5	0.8
Stanley Brook	0.4	0.6
Unnamed Tributaries	15.0	24.2
Total	108.4	174.4

Figure 6: Waterbodies in the Lower Little Blue River Watershed

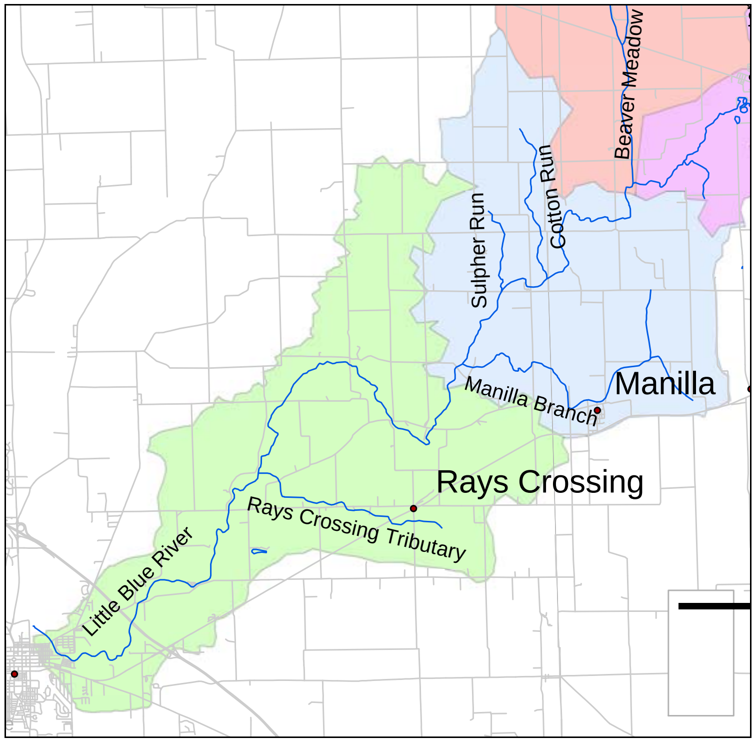


Figure 7: Waterbodies in the Middle Little Blue River Watershed

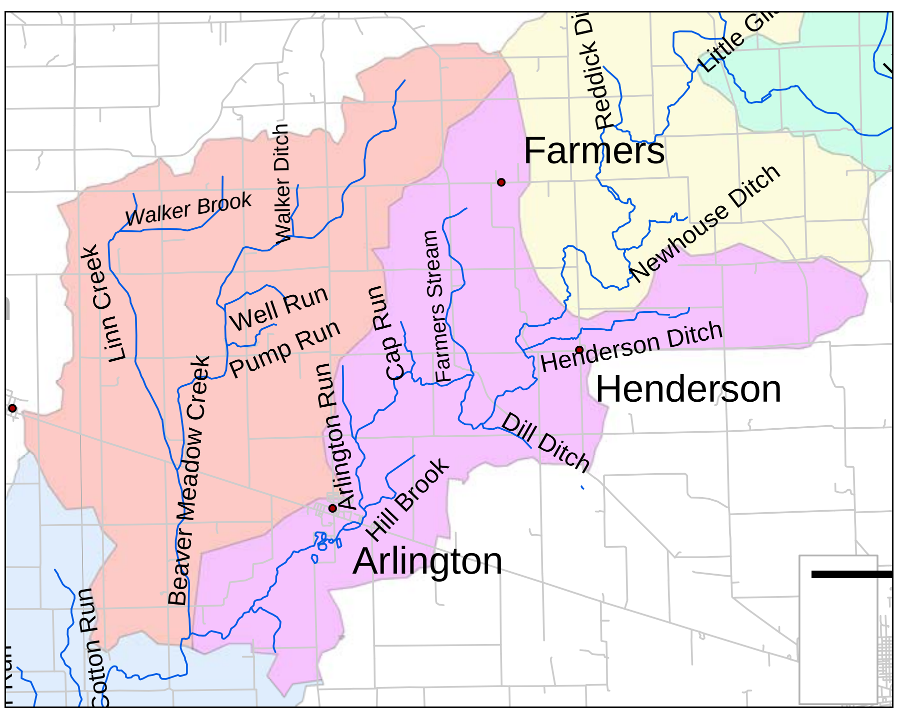
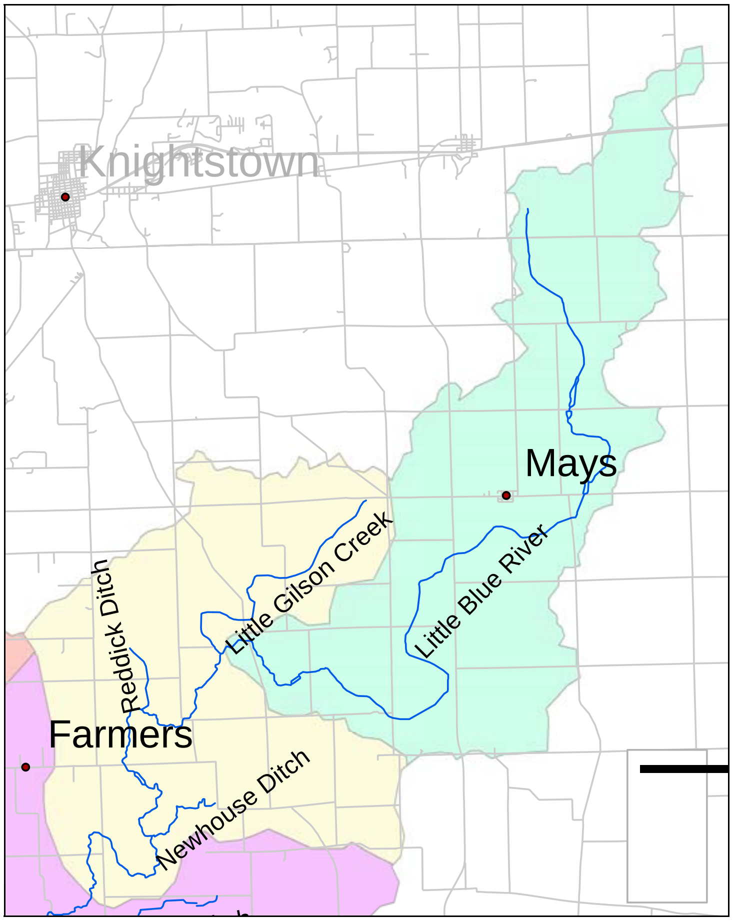


Figure 8: Waterbodies in the Upper Little Blue River Watershed



2.3.3 Legal Drains

Several of the streams in the Little Blue River Watershed are legal drains. A legal drain is a stream, ditch or tile that is managed by the County Surveyor who performs periodic drainage improvement in the legal drain using fees that are collected from landowners. Any water quality improvement project to be constructed within the drainage easement requires County Drainage Board approval. The standard legal drain easement is 75 feet from the top of a stream bank on either side of a stream or ditch; or 75 feet from the center of a tile drain.

Legal drains in the watershed include portions or entire reaches of Rays Crossing Tributary, Manilla Branch, Cotton Run, Beaver Meadow Creek and its tributaries, Henderson Ditch, Reddick Ditch, and the Little Blue mainstem from one mile west of State Road 3 to its headwaters in Henry County. Numerous ditches and tiles are also on maintenance through the County Surveyor's office. To determine the current legal status of a ditch or other water body, contact your local County Surveyor. Regardless of legal drain status some water quality improvement projects might require permits from the U.S. Army Corps of Engineers, the Indiana Department of Environmental Management, and/or the Indiana Department of Natural Resources.

2.4 Climate

The climate of the Little Blue River Watershed has four well-defined seasons. Winter temperatures average 30°F while summers are warm, with temperatures averaging 85°F. The growing season typically begins in early April and ends in mid-October. Annual rainfall averages 39.97 inches as recorded at the Shelbyville Wastewater Treatment Plant. Winter snowfall averages about 14 inches. During summers, relative humidity varies from about 60 percent in mid-afternoon to near 90 percent at dawn. Prevailing winds typically blow from the southwest except during the winter when westerly and northwesterly winds predominate.

LARE Little Blue River Diagnostic Study data was collected in 2003, so precipitation amounts from 2002 and 2003 are relevant when analyzing information gathered in the study. In 2002, almost 42 inches of precipitation was recorded at Morristown in Shelby County (Table 4). When compared to the 30-year average rainfall for the area, 2002 exceeded the average by over one and one-half inches, with significant wetter-than-normal and drier-than-normal periods. During 2003, rainfall was above normal with an unusually wet summer and fall. Shelby County received almost 46.5 inches of rain or nearly 6.5 inches more rain than is average.

Table 4: Monthly Rainfall Data for Years 2002 through 2006
(Recorded in inches and compared to average monthly rainfall)

Data in the table below was recorded at the Morristown gage station in Shelby County.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2002	1.45	1.92	4.35	6.48	7.12	3.61	2.60	1.04	4.61	3.28	2.39	2.95	41.80
2003	1.18	1.25	2.48	2.55	5.99	4.15	8.01	2.18	8.92	3.71	3.45	2.59	46.46

Data in the table below was recorded at the Shelbyville Wastewater Treatment Plant in 2004-2006. Averages are 30-year normals based on available weather observations taken during the years of 1971-2000 at the Shelbyville Wastewater Treatment Plant (Purdue Applied Meteorology Group, 2006).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2004	5.54	0.85	2.07	1.64	6.79	4.83	4.53	3.32	0.07	3.07	3.66	3.66	40.03
2005	8.48	1.42	1.42	5.87	3.72	2.67	5.37	5.84	3.94	1.35	4.87	2.55	47.50
2006	2.78	1.93	3.73	4.49	6.61	6.75	5.98	5.58	4.44	4.76	2.26	6.15	55.46
30 year Average	**2.38**	**2.38**	**3.42**	**3.94**	**4.47**	**3.93**	**4.03**	**3.49**	**2.74**	**2.82**	**3.56**	**2.81**	**39.97**

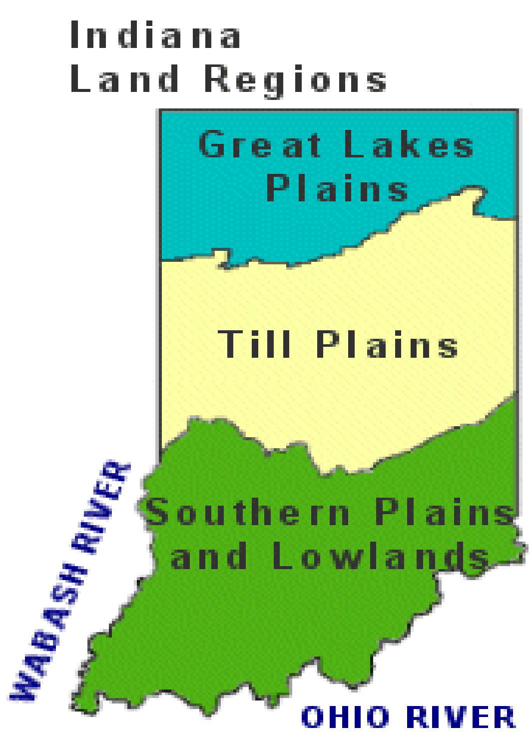
Rainfall in 2004-2006 was also above the 30-year average, with 2006 soaking the area in almost 40% more precipitation than is normal. High rainfall amounts in Indiana tend to have the following effects:

- The concentration of chemicals transported by runoff tends to be diluted, so milligrams/Liter (mg/L) of a water-soluble chemical such as nitrogen could actually go down in the local area.
- The total amount of nitrogen present in runoff during high rainfall events likely increases, so the total load into receiving watersheds could also increase. This has particular significance when these concentrations make their way to the Gulf of Mexico Hypoxic Zone.
- Sediment that is present in runoff can increase. Phosphorus is a chemical that attaches to sediment particles, so higher phosphorus concentrations may be detected.
- Erosion of unprotected land during rainfall can send dislodged soil particles into receiving waterbodies. Some problems attributed to erosion include:
  - Sedimentation in riverbeds, which may increase the flooding potential.
  - Embedded river bottom rocks and cloudy water that damage habitat for aquatic species.
  - Lost top soil.
  - Degraded riverbanks increasing the likelihood of trees falling into the streambed.

2.5 Physical Geography

The Little Blue River Watershed lies within the Tipton Till Plain Section of the Central Till Plain Region. Glacial deposits formed till plains. They are characterized by fairly low relief with occasional terminal moraines and knolls that rise above the level ground.

The Little Blue River flows from northeast to southwest, following former glacial meltwater channels. The Muscatatuck Regional Slope, which parallels the southern boundary of the Little Blue River Watershed, was formed by the southern boundary of glaciation in Indiana. The Central Till Plain Region is bordered by the Wabash River Valley to the north, the Crawfordsville and Shelbyville Moraines to the south, and the state line to the east.



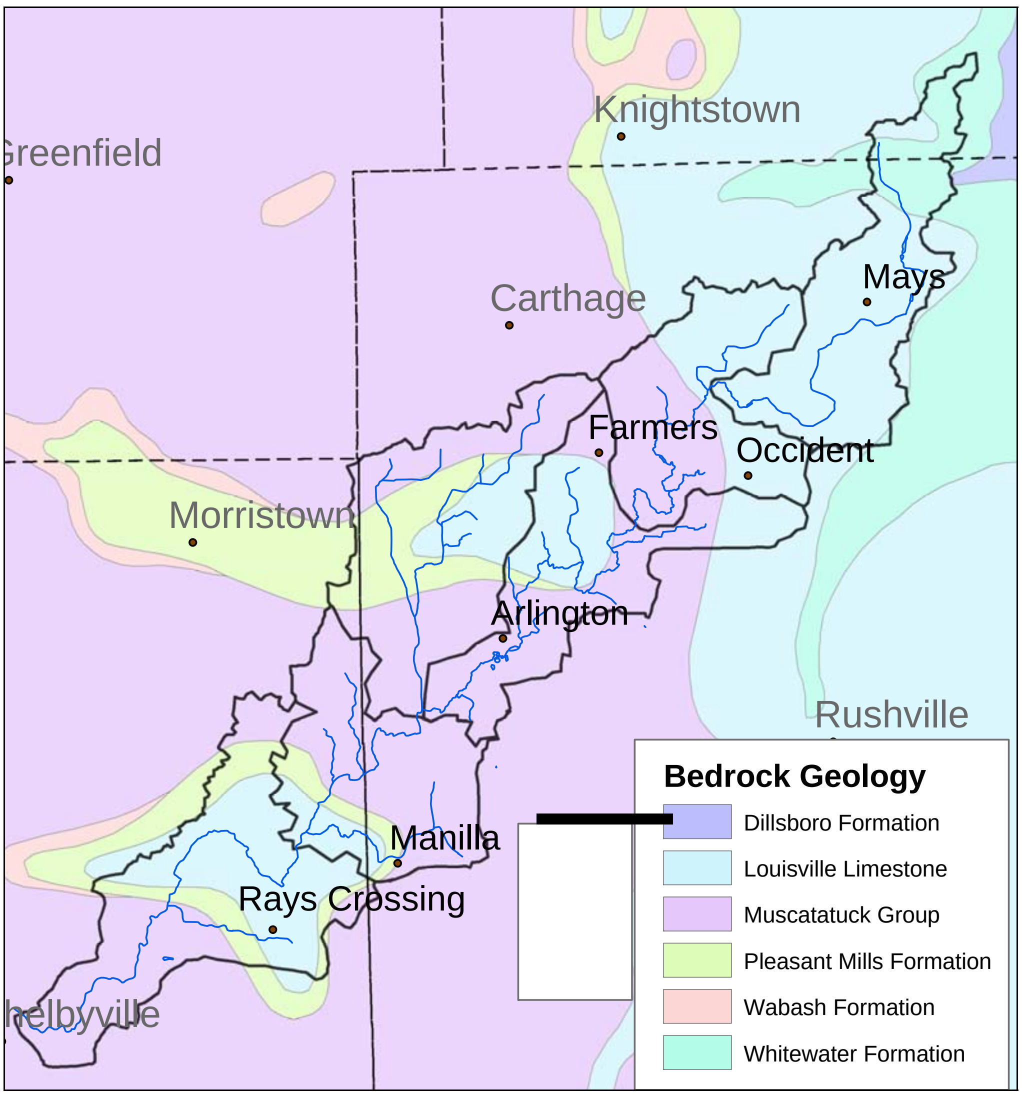
http://www.netstate.com/states/geography/in_

2.6 Geology

2.6.1 Bedrock Geology

Bedrock in the Little Blue River watershed was formed on the bottom of ancient seas during the Ordovician, Silurian, and Devonian Ages about 40 million years ago. Limestone, shale and dolomite of Silurian Age (predominately Louisville Limestone) form the headwaters and portions of the middle and lower Little Blue River Watershed. Devonian Age dolomite and limestone (Muscatatuck Group) cover the remainder of the watershed to the Big Blue River confluence.(Figure 9) Most of the bedrock is now covered by glacial surface deposits of sand, silt, gravel, and loam, which varies in thickness from less than two feet to twenty feet or more. The limestone component of the bedrock can contribute to higher than neutral pH values in surface water and soil.

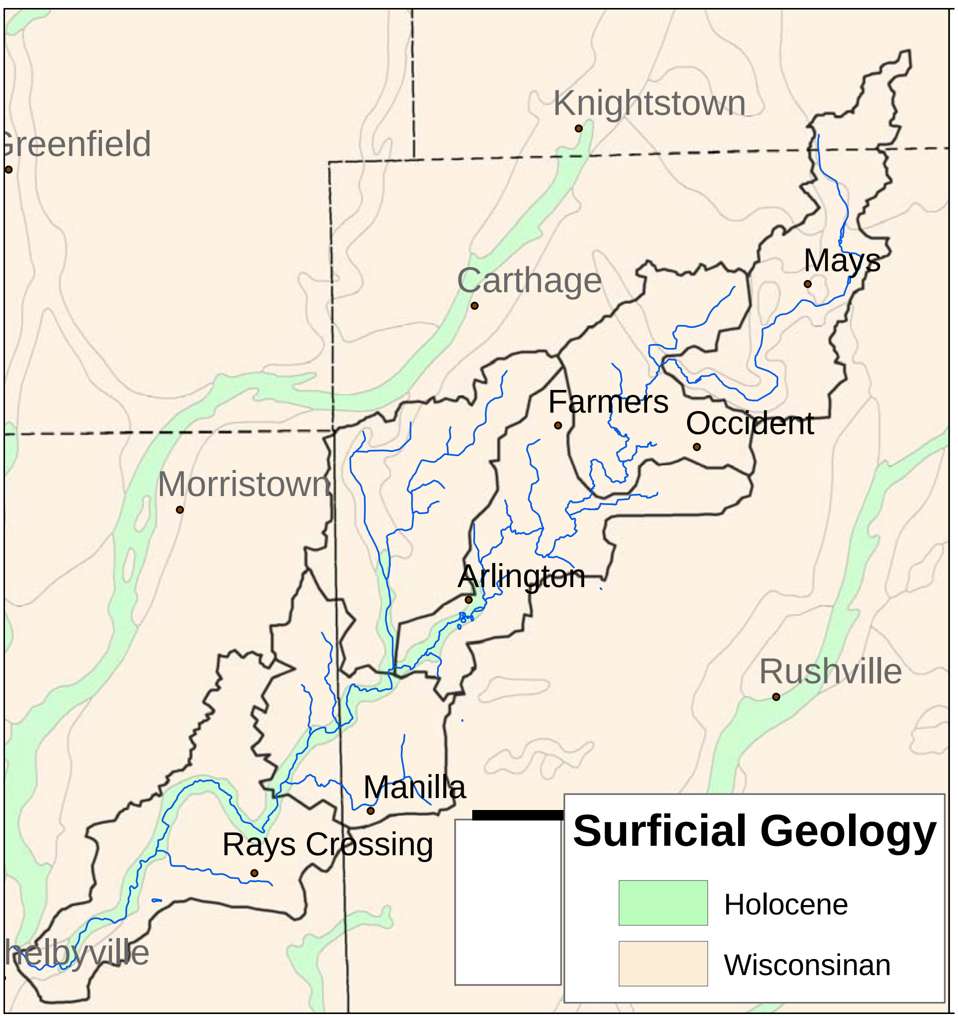
Figure 9. Bedrock Geology



2.6.2 Surface Geology

The advance and retreat of the glaciers in the last ice age shaped much of the surface geology found in Indiana today. As the glaciers moved, they laid thick till material over the northern two thirds of the state, which includes the Little Blue River watershed. Topographically, the terrain in the watershed area slopes from eastern Rush County, which is 900 feet msl (mean sea level) southwest to Johnson County, which is 100 feet msl. The flow of the Little Blue River from northeast to southwest parallels glacial deposits, or moraines, from the advance and retreat of Wisconsin Age glaciers. The Shelbyville Moraine forms the southern boundary of the Little Blue River Watershed, while the Knightstown Moraine forms the northern boundary. The Shelbyville Moraine roughly marks the terminus of the first Wisconsin glacier and the southern boundary of glaciation in Indiana. A later Wisconsin Age glacial advance and retreat deposited the Knightstown Moraine, which forms the northern boundary of the Little Blue River Watershed. The Holocene features were deposited along river beds in more recent times from about 10,000 years ago to present. (Figure 10)

Figure 10: Surficial Geology



2.7 Soils

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), in cooperation with other conservation partners, has developed a Web site called the "Web Soil Survey" at http://websoilsurvey.nrcs.usda.gov/app. The site allows users to find soils information for most locations in the Unites States. This digital information for the Little Blue River Watershed is based on data provided from county surveys first issued in 1974 and reissued in 1991.Besides accessing the information on the Web, people can visit local Soil and Water Conservation Districts to get copies of soil information in the county's Soil Survey.

The soil types found in the watershed within Henry, Rush, and Shelby Counties are a product of the original material deposited by the glaciers that covered the area 12,000 to 15,000 years ago. The main parent materials found in the counties are glacial outwash and till, ice-contact sand and gravel deposits, alluvium, and organic materials that were left as the glaciers receded. The interaction of these parent materials with the physical, chemical, and biological variables found in the area (climate, plant, and animal life), time, and the physical and mineralogical composition of the parent material formed the soils located in the three counties today.

Due to the large number of individual soil types within the Little Blue River Watershed, this report discusses soil associations. A soil association is a landscape that is comprised of a distinctive pattern of individual soils in defined proportions. The soil association is named for the most prevalent soil types within the association.

There are eight major soil associations in the Little Blue River Watershed. Table 5 contains information on these general soil associations and where they may be found within the general topography of the watershed.

Definition of some terms in Table 5:
Clay – Contains mineral soil particles less than 0.002 millimeters in diameter.
Glacial outwash – Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.
Glacial till – Unsorted, nonstratified pulverized rock material consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
Loam – Soil material that is 7-27% clay particles, 28-50% silt particles, and less than 52% sand particles.
Loess – Fine grained material, dominantly of silt-sized particles, deposited by wind.
Sand – Individual rock or mineral fragments from 0.05-2.0 millimeters in diameter. Most sand grains consist of quartz.
Silt – Individual mineral particles range in diameter from the upper limit of clay to the lower limit of very fine sand.

Table 5: Characteristics of General Soil Associations Found Within the Watershed

County	Association	Description	Texture	Formation Process	Location
Henry	Crosby-Cyclone-Miamian	Silt loam, silty clay loam, clay loam, clay	Medium to moderately fine	In loess and the underlying glacial till	On glacial till plains and outwash moraines
Rush	Crosby-Treaty	Silt loam, silty clay loam, clay loam, loam	Medium to coarse	In loess and the underlying glacial till	On glacial till plains
Rush	Ockley-Westland-Sleeth	Sit loam, clay loam, sandy clay loam, sand, gravel	Fine to coarse	In glacial outwash	On glacial terraces and outwash plains
Rush	Genessee-Sloan-Shoals	Loam, silt loam	Medium	In alluvial deposits	Bottom land
Rush	Miamian	Silt loam, clay, clay loam	Fine to medium	In loess and the underlying glacial till	On glacial till plains
Shelby	Genessee-Ross-Shoals	Loam, sandy loam, silt loam	Medium	In alluvium washed from areas of calcareous glacial till	On flood plains adjacent to major streams and their tributaries; in old stream meanders
Shelby	Miami-Crosby-Hennepin	Silt loam, clay loam, loam	Medium	In thin loess and glacial drift	On knolls, ridges and breaks; on uplands
Shelby	Crosby-Brookston	Silt loam, silty clay loam	Fine to medium	In thin loess and glacial drift	On depressional areas, swales, and narrow drainageways; on uplands

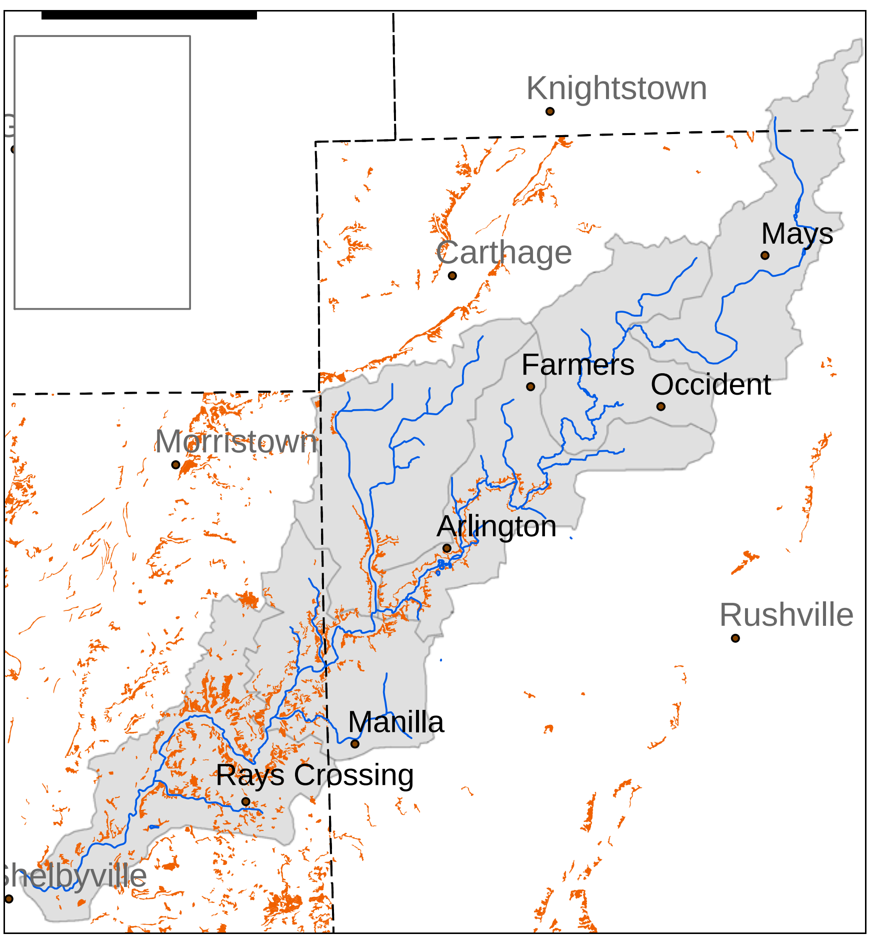
Source: Brock, 1986; Hillis and Neely, 1987; Brownfield, 1991.

2.7.1 Highly Erodible Soils

Depending on their characteristics and percent of slope, some soils erode more easily than others. Soil particles that are transported to waterbodies degrade water quality, interfere with recreational uses, and impair aquatic habitat and health. In addition, such soils carry attached nutrients, which further impair water quality by increasing plant and algae growth. Soil-associated chemicals like some herbicides and pesticides can kill aquatic life and damage water quality.

Seven highly erodible soils are of special concern, especially when they directly border the Little Blue River: Miamian silt loam (MpE) and Miamian clay loam (MuD3) soils in Rush County and Crosby silt loam (CrB), Miami silt loam (MlB2), Miami clay loam (MmD3), Fox clay loam (FxC3), and Hennepin loam (HeE) soils in Shelby County. Highly erodible soils appear in orange on the map below. (Figure 11) Special care should be taken at locations where highly erodible soils directly border the river or its tributaries. Cover crops are recommended at all times at these locations.

Figure 11: Highly Erodible Soils



2.7.2 Highly Erodible Land

Highly Erodible Land (HEL) is a designation used by the FSA. For the FSA to label a field or tract of land as HEL, at least one-third of the parcel must be situated in highly erodible soils and the tract of land must be used for agricultural production. HEL appears in purple on the map in Figure 12. Table 6 lists the percentage of HEL in the watershed.

Some of the issues relating to HEL in the Little Blue River Watershed include:

- Approximately 3,398 acres are mapped as HEL within the boundaries of the watershed, which is about 5% of the watershed acreage. It is important to note that the FSA only tracks HEL if the tract of land is used to produce crops. Parcels of land may be highly erodible but are not recorded as such if it is not used for production. Therefore, 5% may be an underestimate of the actual amount of HEL acreage.
- Of the tributary subwatersheds, the Beaver Meadow Creek Subwatershed contains the most HEL acreage, 485.2 acres. The Lower Little Blue River Subwatershed contains the most acreage mapped as HEL (1,382.5 acres) for the mainstem subwatersheds. The Rays Crossing Tributary and Manilla Branch Subwatersheds contain the highest percentages of HEL, 9.7% and 9.7%, respectively. All of the Little Blue River tributary subwatersheds, except the Farmers Stream and Little Gilson Creek Subwatersheds, contain some HEL acreage.
- Generally, more HEL acreage is concentrated lower in the watershed in Shelby County and the western portion of Rush County. Most highly erodible lands within the Little Blue River Watershed occur where the slopes are steeper causing greater erosion potential. Since the upper portion of the watershed is very flat, it contains little HEL area.
- Many of the tracts mapped as HEL in the watershed are currently being used for row crop agriculture. This type of land use on highly erodible, marginal soils can impact water quality in receiving waterbodies.
- Of all the subwatersheds with land enrolled in the program, less than 1% of the Little Blue River Watershed is enrolled in the Conservation Reserve Program (CRP). The CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.

Figure 12: Areas Mapped as Highly Erodible Land

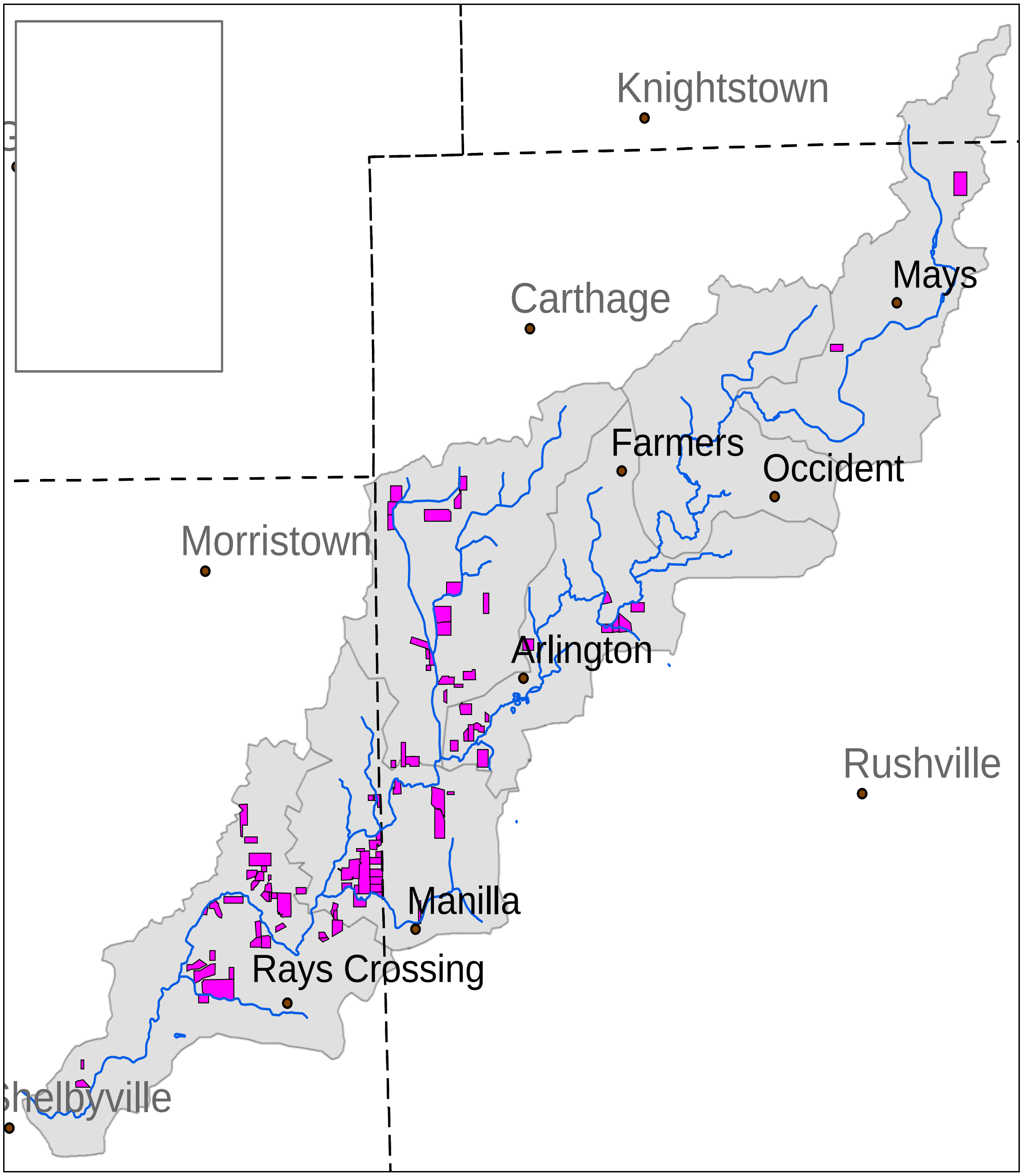


Table 6: Acreage Mapped as Highly Erodible Land in the Watershed.

Site #	Subwatershed	Subwatershed Type	Subwatershed HEL Acres	Percent of Subwatershed	Percent of Total Watershed
1	Lower Little Blue River	Mainstem	1,382.5	5.9%	2.05%
2	Rays Crossing	Tributary	242.6	9.7%	0.36%
3	Manilla Branch	Tributary	282.6	9.7%	0.42%
4	Cotton Run	Tributary	23.3	1.1%	0.03%
5	Middle Little Blue River	Mainstem	789.5	3.9%	1.17%
6	Beaver Meadow Creek	Tributary	485.2	3.9%	0.72%
7	Farmers Stream	Tributary	0.0	0.0%	0.00%
8	Upper Little Blue River	Mainstem	95.9	0.4%	0.14%
9	Little Gilson Creek	Tributary	0.0	0.0%	0.00%
10	Headwaters	Tributary	95.9	0.9%	0.14%
	Total		**3,397.5**		**5.03%**

2.7.3 Soils Utilized for Septic Systems

As is common in rural Indiana, septic tanks and septic tank absorption fields are commonly utilized for onsite wastewater treatment in the Little Blue River Watershed. NRCS ranks each soil series in terms of its limitations for use as a septic tank absorption field. Each soil series is placed in one of three categories: slightly limited, moderately limited, or severely limited. Use of septic absorption fields on soils in the moderately to severely limited categories generally requires special designs, planning or maintenance to overcome the limitations because:

- Poorly drained soils don't filter well.
- A high water table, slow percolation, seasonal wetness, or ponding can lead to anoxic conditions and improper treatment within leach fields.
- Steep slopes can promote drainage that is too rapid and doesn't allow for filtration.

Table 7 summarizes the soil series located in the Little Blue River Watershed in terms of their suitability for use as septic tank absorption fields. A soil scientist should test local soil conditions before any septic absorption field is established.

Table 7: Soil Types with Septic Limitations

County	Name	Symbol*	Depth to Water Table	Limitations for Septic Absorption Field
Henry	Cyclone silty clay loam	Cy	+0.5-1.0 ft	Severe: ponding
Henry	Eldean silt loam	EdA; EdB2	>6 ft	Severe: poor filter
Henry	Losantville silt loam	LeB2	4-6 ft	Severe: percolates slowly
Henry & Rush	Eldean clay loam	ElC3; ExC3	>6 ft	Severe: poor filter
Henry, Rush & Shelby	Sleeth silt loam	Sk; Sm	1-3 ft	Severe: wetness; seasonal high water table
Henry & Shelby	Westland clay loam	Wc; We	0-1 ft	Severe: percolates slowly; ponding; seasonal high water table
Rush	Celina silt loam	CeB2	2-3.5 ft	Severe: wetness; percolates slowly
Rush	Eldean loam	EdB2	>6 ft	Severe: poor filter
Rush	Genesee loam	Ge	3-6 ft	Severe: flooding; wetness
Rush	Miamian silt loam	MpB2; MpC-MpE	>6 ft	Severe: percolates slowly; slope
Rush	Miamian clay loam	MuC3-MuD3	>6 ft	Severe: percolates slowly; slope
Rush	Patton silty clay loam	Pn	+0.5-2 ft	Severe: percolates slowly; ponding
Rush	Sloan silt loam	So	0-1 ft	Severe: flooding; percolates slowly; wetness
Rush	Treaty silty clay loam	Tr	+0.5-1 ft	Severe: ponding; percolates slowly
Rush	Westland clay loam	Ws	+0.5-1 ft	Severe: ponding
Rush & Shelby	Crosby silt loam	CrA-CrB	1-3 ft	Severe: wetness; percolates slowly; seasonal high water table
Rush & Shelby	Miami silt loam	MrA; MlA	>6 ft	Moderate: percolates slowly
Rush & Shelby	Ockley silt loam	OcA; OcB2	>6 ft	Slight: some hazard of polluting nearby wells
Rush & Shelby	Shoals silt loam	Sh; Sk	0.5-1.5 ft	Severe: wetness; flooding seasonal high water table
Shelby	Brookston silty clay loam	Br	0-1 ft	Severe: percolates slowly; ponding; seasonal high water table
Shelby	Crosby-Miami silt loam	CsB	1-3 ft	Moderate-Severe: percolates slowly; ponding; seasonal high water table
Shelby	Eel silt loam	Ee	3-6 ft	Severe: flooding
Shelby	Fox loam	FoA-FoB2	>6 ft	Slight: 0-6% slopes; some hazard of polluting nearby wells Moderate-Severe: 6-18% slopes due to rapid drainage

County	Name	Symbol*	Depth to Water Table	Limitations for Septic Absorption Field
Shelby	Fox clay loam	FxB3	>6 ft	Slight: (some hazard of polluting nearby wells)
Shelby	Genesee loam	Ge	>6 ft	Severe: flooding
Shelby	Gravel pits	Gp	--	
Shelby	Hennepin loam	HeE-HeF	>6 ft	Severe: steep slopes
Shelby	Martinsville loam	MaA-MaB2	>6 ft	Slight: 0-6% slopes; some hazard of polluting nearby wells Moderate: 6-12 % slopes due to rapid drainage
Shelby	Medway silt loam	Me	3-6 ft	Severe: flooding
Shelby	Miami clay loam	MmB3-MmD3	>6 ft	Moderate: 0-12% slopes due to slow permeability Severe: 12-18% slopes due to steep slopes
Shelby	Nineveh loam	NnA	>6 ft	Slight: some hazard of polluting nearby wells
Shelby	Rensselaer clay loam	Re	0-1 ft	Severe: percolates slowly; ponding; high seasonal water table
Shelby	Rodman gravelly loam	RoE	>6 ft	Severe: steep slopes
Shelby	Ross silt loam	Rt	>6 ft	Severe: flooding
Shelby	Saranac silty clay loam	Sa	0-1 ft	Severe: percolates slowly; ponding; seasonal high water table
Shelby	Whitaker loam	Wh	1-3 ft	Severe: ponding; seasonal high water table

*Different counties may use the same symbol for different soil units. Also, different counties may use different symbols for the same soil units.
Source: Brock, 1986; Hillis and Neely, 1987; Brownfield, 1991.

2.8 Current Landscape

Today approximately 94% of the Little Blue River Watershed is used for agricultural purposes. Installation of subsurface tile drain networks, excavation of drainage channels, and straightening of many of the smaller streams throughout the watershed has allowed for the conversion of forests and wetlands to agricultural land use.

2.8.1 Prime Farmland

The majority of the land in the central and southern portions of the Little Blue River Watershed is classified as prime farmland. The USDA classifies prime farmland as land that is best suited for crops. The land is used for cultivation, pasture, woodland or other production, but it is not urban land or water areas. This type of land produces the highest yields with minimal inputs of energy and economic resources. Therefore, when possible, the optimal land use strategy places industrial and residential development on the marginal lands while keeping prime farmland available for production.

According to the USDA soil surveys of Henry, Rush, and Shelby Counties, approximately 75-80% of the acreage in the area meets prime farmland requirements. Currently, the Little Blue River Watershed is not undergoing rapid urbanization, however new development is taking place in and around Shelbyville in the lower part of the watershed. This type of change in land use can impact water quality, especially if it displaces farming from prime farmland to marginal land. Careful land use and development planning should be used to minimize the need to produce crops on marginal land.

2.8.2 Natural Vegetation

Only remnants of the beech-maple-oak forests, typical of Tipton Till Plain vegetation, are known to exist today in the watershed. The remaining forests are usually in areas too wet to farm or along river banks. The Northern Flatwoods Community, which is characterized by red maple, pin oak, bur oak, swamp white oak, Shumard's oak, American elm, and green ash, is typically associated with poorly drained soils. In slightly better drained areas, beech, sugar maple, black maple, white oak, red oak, shagbark hickory, tulip poplar, red elm, basswood and white ash predominate. About 4% of the watershed is in forest.

2.8.3 Wetlands

National Wetland Inventory (NWI) data indicates most wet areas are palustrine forested wetlands (Table 8). Ponds, along with woody and herbaceous wetlands, make up the balance. Wetlands total about 1.7% of the watershed landscape. Palustrine comes from a Latin word for marsh. Lacustrine has to do with living or growing in or along the edges of lakes or rivers. Figures 13, 14, and 15 use the color purple to show locations of current wetlands identified from the NWI. Most wetlands remaining in the watershed are adjacent to the Little Blue River mainstem.

Table 8: National Wetland Inventory Data for the Little Blue River Watershed.

Wetland type	Area (acres)
Palustrine forested	931.4
Palustrine emergent	119.2
Ponds	82.1
Palustrine scrub/shrub	25.5
Lacustrine	11.2
Non Wetland type	
Uplands	66,313.1

Figure 13. National Wetlands Inventory Map, Lower Subwatersheds

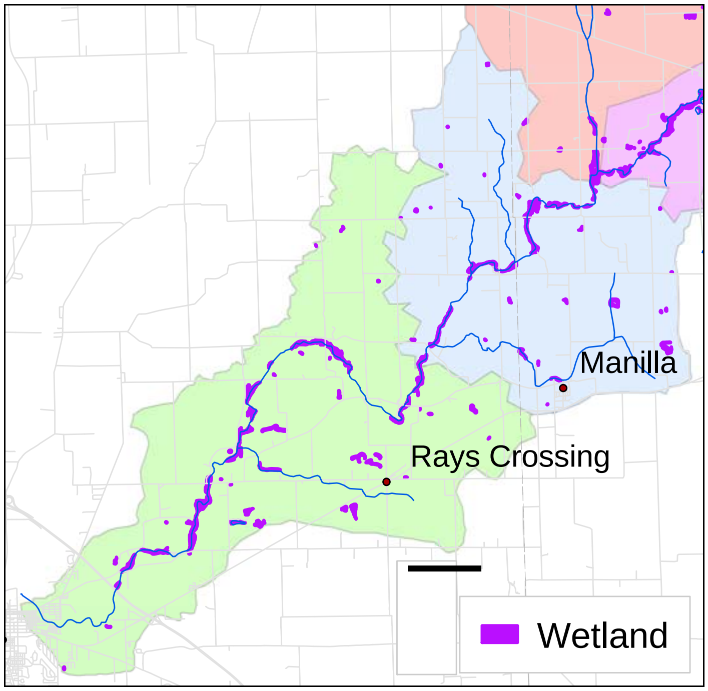


Figure 14. National Wetlands Inventory Map, Middle Subwatersheds

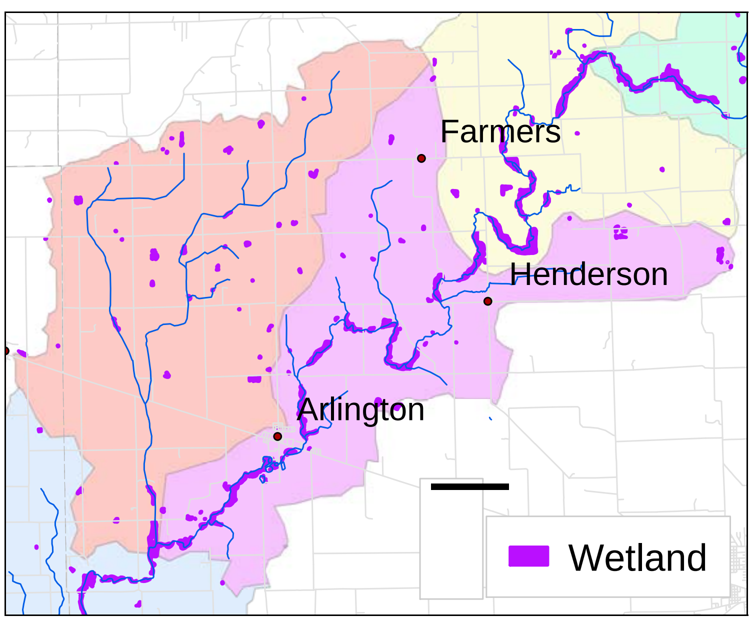
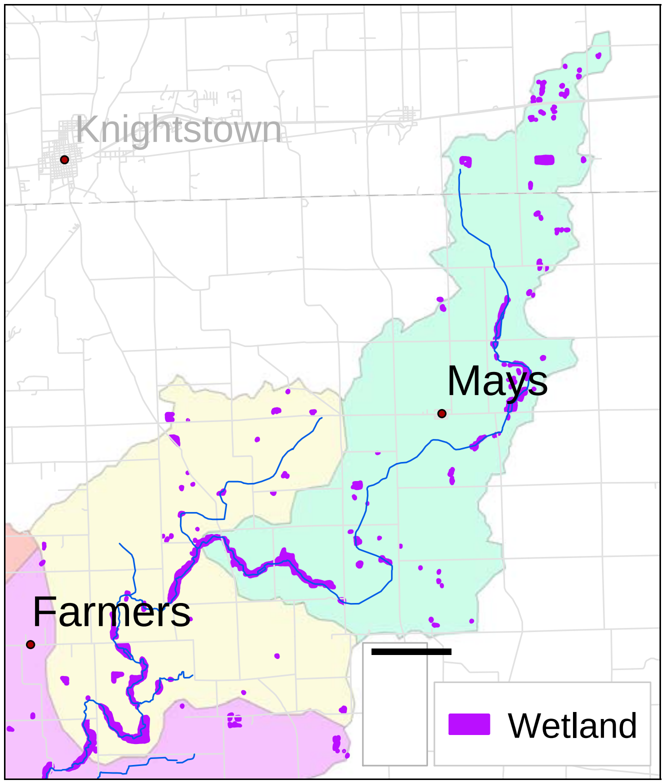


Figure 15: National Wetlands Inventory Map, Upper Subwatersheds



2.8.4 Endangered, Threatened, and Rare Species

The Indiana Natural Heritage Data Center database provides information on the presence of endangered, threatened, and rare species, high quality natural communities, and natural areas in Indiana. According to the database, the Little Blue River Watershed supports one high quality community type: the Central Till Plain Flatwoods habitat was noted in one location in Posey Township north of Arlington. The database also lists sightings of one state endangered mussel species, the clubshell (*Pleurobema clava),* which has also been proposed for federally endangered status. Five other species of special concern, the wavy-rayed lampmussel (*Lampsilis fasciola),* the purple lilliput (*Toxolosma lividus),* the lilliput (*Toxolasma parvum*), the little spectaclecase (*Villosa lienosa),* and the kidneyshell (*Ptychopranchus fasciolaris*), have also been sighted in the Little Blue River Watershed. Two additional species have also been observed in the watershed, the great blue heron (*Ardea herodias)* and the slippershell mussel (*Alasmidonta viridis).* These are not considered endangered or threatened but their rarity warrants special interest. Forests and wetlands combined make up only about 5% of the watershed. The ongoing fragmentation of native habitat has a significant impact on plant and wildlife communities.

2.9 Current Land Use

Both Shelbyville and Shelby County have Comprehensive Plans for Land Use and Development. Shelbyville's plan was adopted in 2001 and ordinances have been established. Shelby County updated its plan in 2006 and is in the process of developing ordinances to implement the plan. Both contain land use chapters that address environmentally sensitive areas and agricultural lands. These plans can be obtained through the Shelbyville or Shelby County Plan Commissions and the Shelby County public library. Rush County relies on Area Subdivision Control and Zoning Ordinances to define agriculture districts and address environmental issues such as sewage disposal, drainage issues, and erosion control. This information can be accessed through the Rush County Plan Commission.

2.9.1 Population

Towns in the watershed are Mays, Arlington, and Manilla in Rush County; Rays Crossing and Shelbyville in Shelby County. Population in the watershed is difficult to measure since agencies collect this data on a township, county, or census basis rather than by watershed. Population in Shelbyville's Addison Township, which contains a small portion of the lower reaches of the watershed averages 554 people/square mile, while the other townships in the watershed combined average about 24 people/square mile. In the last 100 years Rush County's population has remained fairly constant with about 17,823 individuals counted in 2005. In the same period Shelby County's population has increased from about 25,000 to approximately 43,776. In general the lower portion of the Little Blue River Watershed is outpacing the average growth in both counties.

2.9.2 Septic Systems

According to the Rush County Health Department, septic system failures and straight pipe discharges to surface waterbodies are decreasing every year. During the 1990s, piping of septic effluent to drainage tiles connected to surface water systems were the predominant method for treating septic waste in many of the small towns in Rush County. Nearly half of the dye tests conducted in the towns of Arlington, Homer, and Manilla indicated septic discharge to surface tiles (Ryan Cassidy, Rush County Health Department). *E. coli* samples collected near Arlington during the early to mid-1990s contained concentrations ranging from 49,000 to 8,700,000 colonies/100 mL (Donna Cloud, Rush County Sanitarian). Many *E. coli* samples collected near Homer also contained concentrations 100-150 times the Indiana state standard (235 colonies/100mL). The dye testing and *E. coli* sampling program conducted by the Rush County Health Department prompted the formation of the Western Rush County Regional Sewer District in 2001. The wastewater treatment plant that serves the sewer district is located in Homer (Rush County). It is fully functional and treats effluent from Arlington, Homer, and Manilla (Reno Gosser, Rush County Sanitarian). Mr. Gosser states that education efforts on the part of the Western Rush County Regional Sewer District and the Rush County Health Department have helped to curtail septic problems throughout Rush County. In early 2007 he plans to test rivers and streams within the sewer district for current levels of fecal contamination.

Robert Lewis (Shelby County Sanitarian) states that septic system failures are also decreasing in Shelby County. In general this is due to homes being place on larger lot sizes, guidelines that are more stringently enforced, and the abandonment of old, poorly-functioning septic systems. The town of Rays Crossing, which contains about 25 homes and 3-4 business establishments, is still utilizing septic systems for wastewater treatment.

2.9.3: Land Use

Table 9 presents land use percentages for the Little Blue River Watershed. Figures 16, 17 and 18 are maps showing land use in the lower, middle and upper subwatersheds. Land use data was obtained from the United States Geological Survey (USGS) Earth Resources Observation and Science (EROS) Land Use Data coverage. The EROS Land use Data coverage was last corrected to reflect current conditions during December 1998. The EROS data was checked with recent aerial photography and in some cases was field checked and corrected to reflect watershed conditions as of 2003.

Table 9: General Land Use in Area and Percentages for the Little Blue River Watershed.

Land Use	Area (acres)	Percent of Watershed
Agriculture Row Crop	53,336	79.04%
Agriculture Pasture/Hay	10,038	14.88%
Forest	2,715	4.02%
Woody and Herbaceous Wetlands	423	0.63%
Low Intensity Residential	337	0.50%
High Intensity Commercial	336	0.50%
Urban Parkland	150	0.22%
High Intensity Residential	91	0.13%
Open Water	57	0.08%
Little Blue River Watershed	**67,483**	**100%**

Figure 16: Land use in the Lower Little Blue River Watershed.

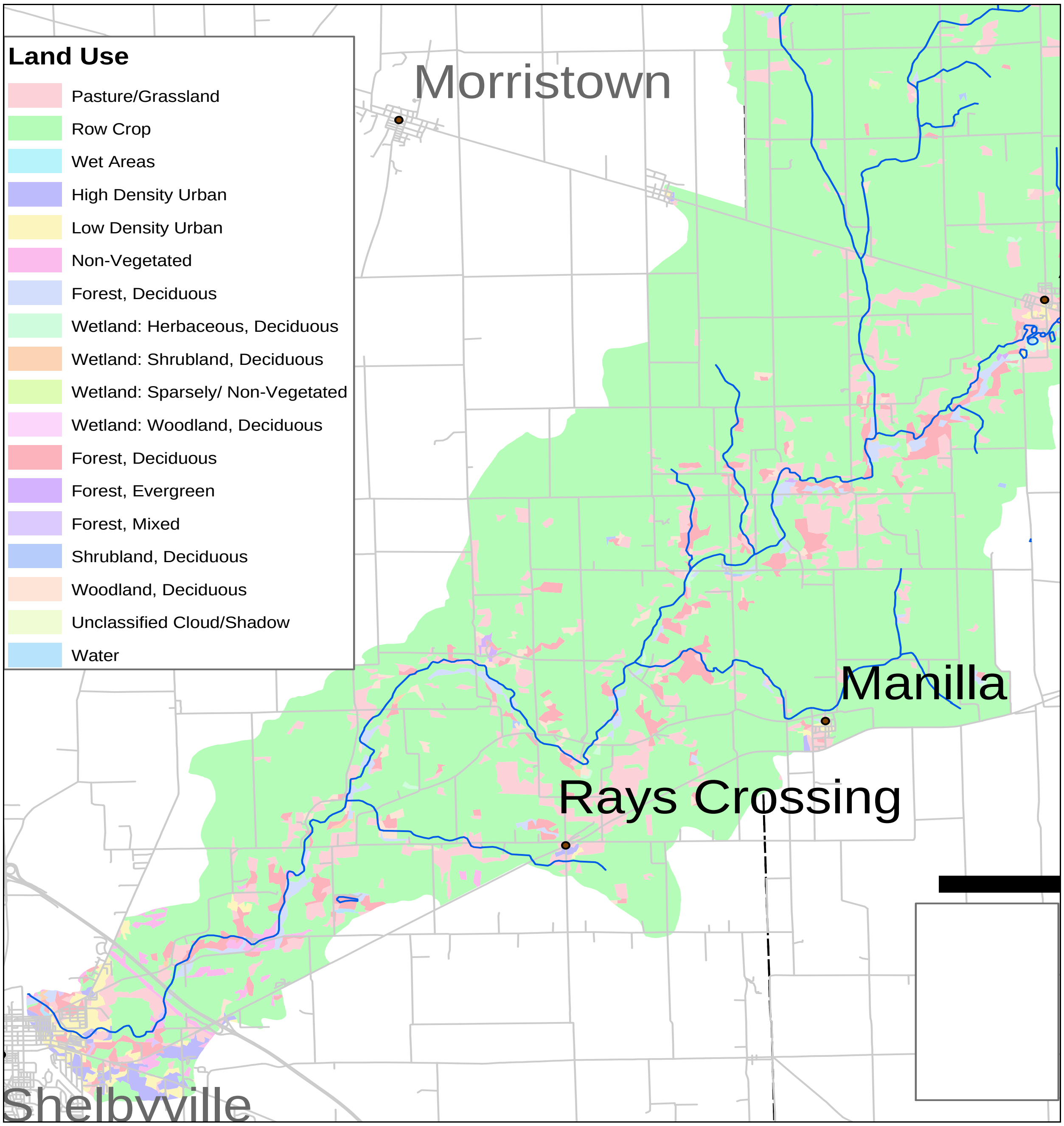


Figure 17: Land Use in the Middle Little Blue River Watershed.

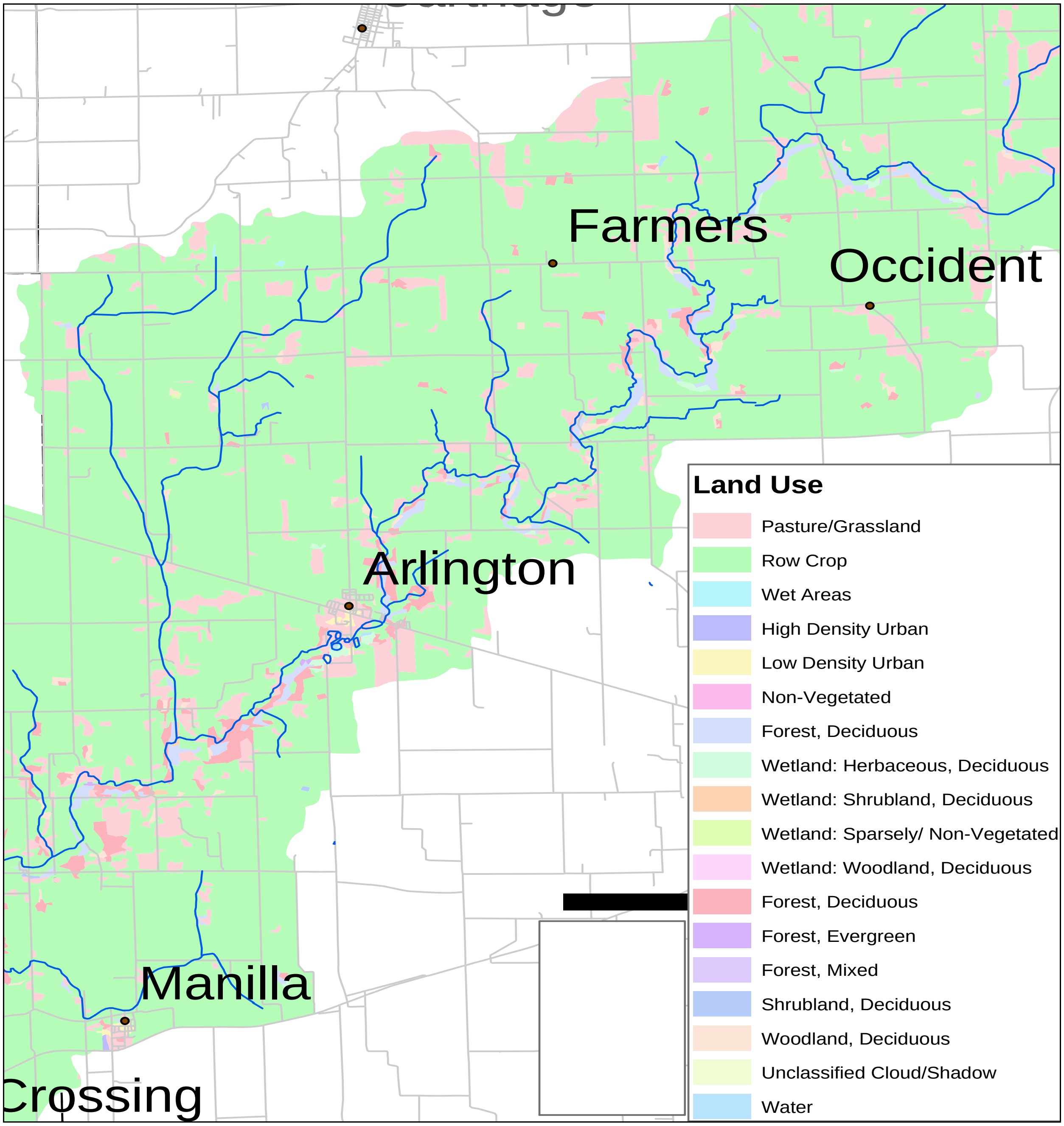
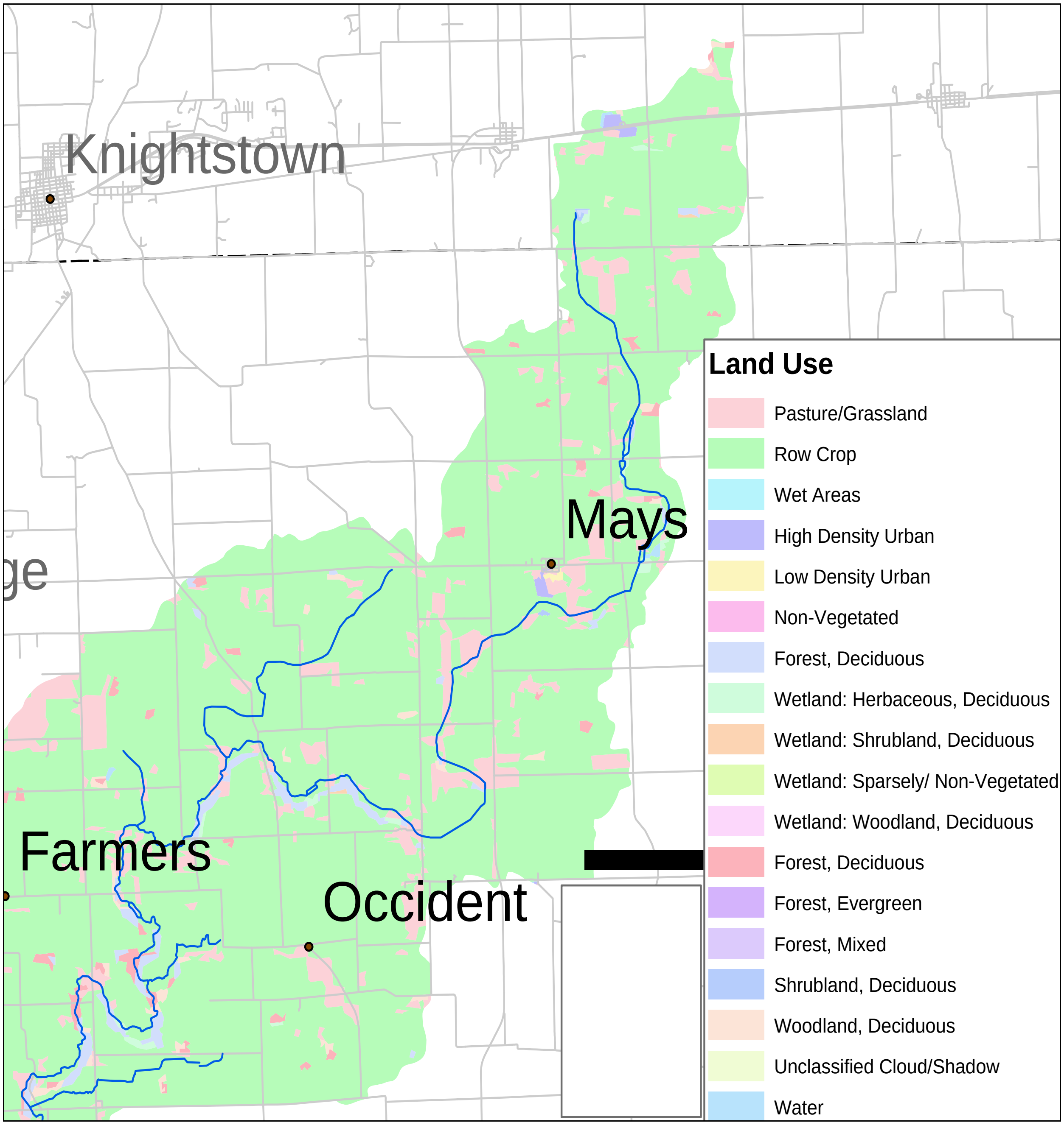


Figure 18: Land Use in the Upper Little Blue River Watershed.



2.9.4 Agriculture

Agriculture accounts for all but approximately 6% of the Little Blue River Watershed land use. Corn, soybeans, small grains, and forage are the major crops. Livestock including dairy and beef cattle, horses, swine, sheep, goats, and poultry are dispersed throughout the watershed, some in Confined Feeding Operations (CFOs).

2.9.5 Conservation Tillage

Crop tillage data was collected in 2004 by the IDNR in both Rush and Shelby County (Table 10). Conservation tillage leaves at least 30 percent residue cover and can reduce soil erosion by 50 percent or more compared to bare soil. Increased conservation tillage is one of the most effective ways to reduce sedimentation and accompanying water quality degradation in receiving waterbodies.

Table 10: 2004 Crop Tillage Data by County

County	Corn No till	Corn Mulch till	Corn Conventional Till	Soybeans No Till	Soybeans Mulch till	Soybeans Conventional Till
Shelby	26%	22%	52%	81%	12%	7%
Rush	27%	36%	37%	65%	20%	15%

Producers in Rush and Shelby Counties grow increasing amounts of their corn and soybean crops using conservation tillage methods (Table 11). Conventional tillage is still more common with corn production, however since 2004 most soybean producers utilize no-till methods. No-till has increased in both counties since 1990. In general small grains (wheat, rye, etc. and oil crops such as soy) are grown using no or limited tillage methods.

Table 11: No-till Percentages in Rush and Shelby Counties from 1990 to 2004.

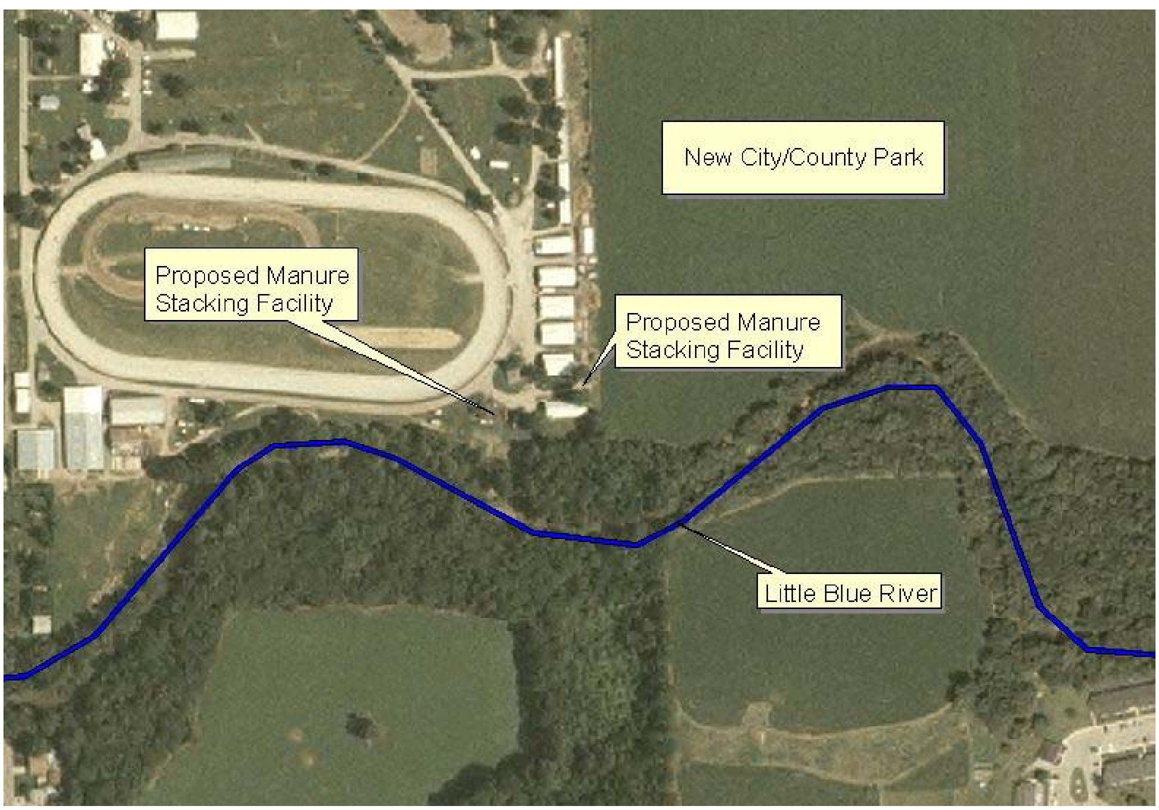
Year	County	% no till corn	% no till beans
1990	Shelby	1-20%	1-20%
	Rush	1-20%	1-20%
1996	Shelby	1-20%	21-40%
	Rush	1-20%	41-60%
2004	Shelby	21-40%	81-100%
	Rush	21-40%	61-80%

2.9.6 Public Access

Some small privately-owned recreational areas are located in the Little Blue River Watershed. In Rush County camping and picnicking is available at Little Blue River Trailer Park near Arlington. On 775 E and 500 N in Shelby County reservations can be made with a nearby landowner to picnic at Pitt's Ford. A point of interest in Rush County is Offutt's Covered Bridge on Offutt Bridge Road north of 400 N and west of Henderson Road.

As the Little Blue River enters Shelbyville, it flows through a series of public access areas. A newly establish city/county park is under development. If all plans are realized, recreational opportunities will include a river walk and other trails, fishing nodes, canoe access, soccer fields, a softball quadruplex, food concessions, a nature center, a splash pad area, playgrounds, picnic areas, and observation blinds. West of the new park the river passes the Shelby County Fairgrounds. Besides the annual county fair each summer this site hosts numerous gatherings, meeting and activities. Standard-bred horses train year round at the fairground racetrack. Between 150 and 200 race horses are housed at the fairground horse barns during the year. The Fair Board has been exploring the possibility of building manure stacking facilities to contain the manure from the horse barns (Figure 19) until it can be removed to a local composting facility/sanitary landfill. Next the river goes through Kennedy Park. This is the site of an old ford that is no longer used for automobile traffic, but remains a popular spot for fishing. A playground, softball diamond, and picnic tables are also available at Kennedy Park.

Figure 19: Shelby County Fairgrounds and Horse Barns



2.9.7 Business/Industry

Some manufacturing and various small businesses are located in the watershed, usually near population centers. Businesses of note include:

- In the town of Mays: a restaurant and tool & die shop.
- On State Road 3 and 1100 N in Rush County: a stockyard and veterinary clinic.
- In the town of Arlington: Arlington Cab, which manufactures tractor cabs and Cranewerks, which makes structural steel supports. Arlington area businesses that were located near the river but are no longer in operation include a fertilizer company and a gravel company.
- In the town of Manilla: a convenience store and blacksmith shop.
- West of Manilla on 775 E (Shelby County): Crim & Sons Asphalt Paving Company.
- In the town of Rays Crossing: an auto repair shop, a grain elevator, and a Farm Bureau Co-op Branch, which sells farm chemicals, fertilizer and fuel.
- On the east side of the city of Shelbyville: a Super Wal-Mart and other retail establishments. Knauf Fiberglass Corporation, a fiberglass insulation manufacturer, is at the confluence of Big and Little Blue Rivers in Shelbyville.

2.9.8 Schools

Mays Elementary in Mays (Rush County Schools)
Arlington Elementary in Arlington (Rush County Schools)
Coulston Elementary on Knightstown Road in Shelbyville (Shelbyville Central Schools)
Shelby Eastern Administration office is north of Rays Crossing, but the school buildings are not in the watershed.

2.9.9 Cemeteries

Cemeteries are dotted throughout the watershed. If cemetery lawns are over fertilized they might contribute excess nutrients to nearby streams. Some active cemeteries that are close to the river or tributaries are:
Hannegan Cemetery on the Little Blue mainstem near Henderson, Rush County
East Hill Cemetery on the Little Blue mainstem near Arlington, Rush County
Manilla Cemetery on Ditch Creek near Manilla, Rush County
Bennett's Cemetery on Little Blue mainstem near Rays Crossing, Shelby County
Forest Hill Cemetery and St. Joseph Cemetery on Little Blue mainstem in Shelbyville, Shelby County

2.10 Shelbyville Municipal Separate Storm Sewer System (MS4)

The National Pollutant Discharge Elimination System (NPDES) is a set of federal regulations administered through the U.S. Environmental Protection Agency (EPA). The regulations are intended to improve water quality in surface waters of the United States. Phase II of the NPDES program began in early 2003. Phase II requires certain urbanized areas with a Municipal Separate Storm Sewer System (MS4) to establish a plan for storm water quality improvement within their jurisdictions. Shelbyville is an MS4 community. Water that enters Shelbyville's storm drains goes straight to the river rather than through the municipal wastewater treatment plant.

In compliance with the law, Shelbyville is implementing a plan and adopting ordinances that fulfill the six minimum control measures:

1. Public education and outreach
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site runoff control
5. Post-construction storm water management in new development and redevelopment
6. Pollution prevention/Good housekeeping for municipal operations

2.11 Nonpoint Source/Point Source Discharge

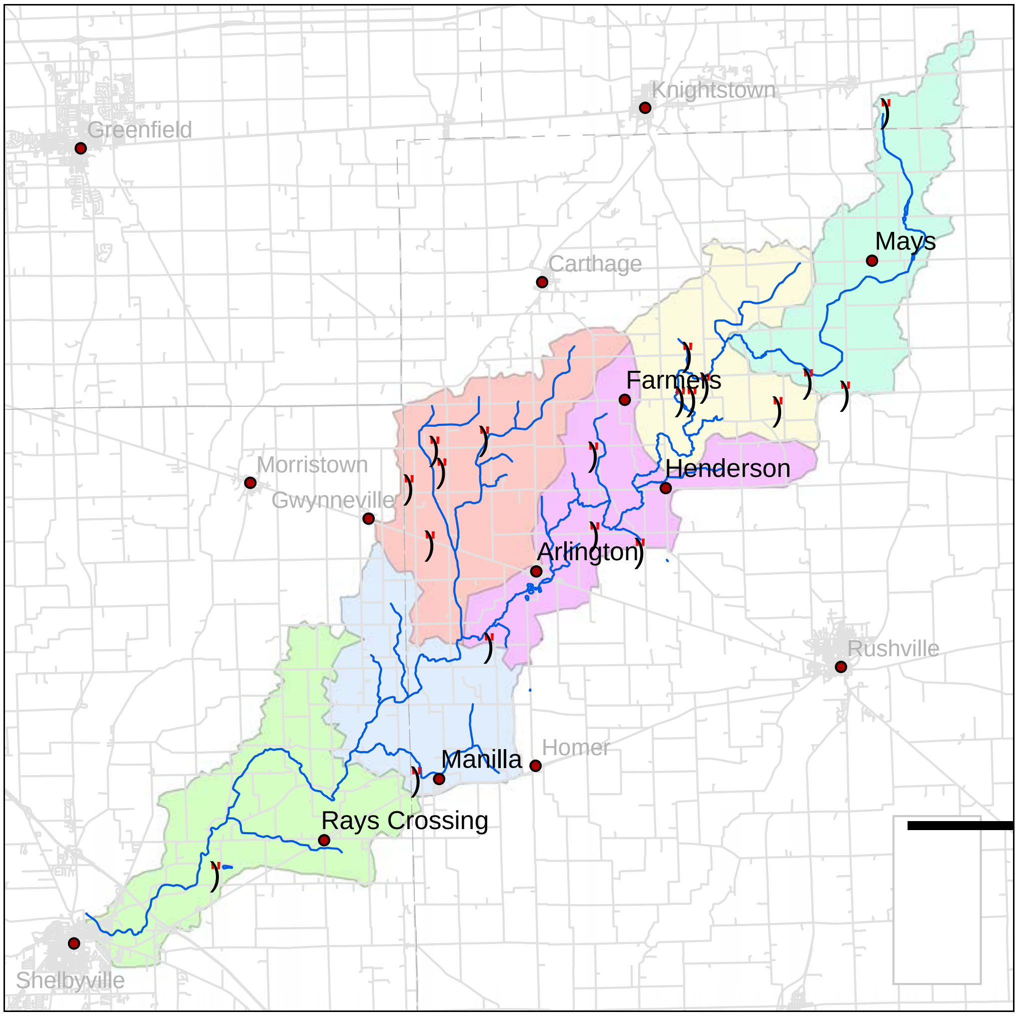
Nonpoint Source Discharge refers to water that enters a river or stream as overland flow. If contaminants enter a receiving water body through Nonpoint Source discharge, there is no specific spot that someone could point to and say, “Pollution is entering the stream here.” Public education and the establishment of BMPs are major tools for preventing water quality degradation through Nonpoint Source contamination.

Point Source Discharge refers to water entering a river or stream from a specific source, like a pipe coming from a factory or discharge from a wastewater treatment plant. Point source discharges are regulated by the government through oversight and permitting. Facilities that have the potential to discharge point source pollutants into waters of the State of Indiana must apply for an NPDES permit from IDEM. The Industrial Permits Section issues permits covering discharges from all industries. Discharges from sewage treatment facilities are covered by the Municipal NPDES Permit Section while industrial facilities discharging wastewater into non-pretreatment program municipal sewage treatment systems are covered by the Pretreatment Section. According to IDEM there are no NPDES permits held in the Little Blue River Watershed at this time.

2.11.1: Confined Feeding Operations

Confined Feeding Operations (CFOs) must comply with permitting requirements set forth by IDEM for point source discharge. CFOs are defined by the state of Indiana as those operations where animals are confined for more than 45 consecutive or non-consecutive days per year; more than 50% of the confinement area is non-vegetated; and the number of animals exceeds 300 cattle or horses, 600 swine, 600 sheep, or 30,000 fowl (IDEM, 2002). CFOs must operate within predetermined performance standards. Standards must be maintained to prevent manure runoff from entering waters of the state or leaching beyond the root zone when it is applied to agricultural fields. According to IDEM, in January 2007 approximately 18 CFO permits had been issued in the watershed (Figure20), but only four of them were active at the time. The rest were either voided or pending. For current CFO information contact IDEM.

Figure 20: Confined Feeding Operation Permits in the Watershed.



Section 3: WATER QUALITY INVESTIGATION

As already stated, an analysis of water quality in the Little Blue River Watershed was done through a 2004 LARE funded diagnostic study.[2] Data gathered in this study, plus information from IDEM, IDNR, and volunteer water quality monitors were the primary sources to determine current water quality issues in the watershed. As land use changes and practices evolve, it will be necessary to modify this section to reflect new information.

3.1 Water Quality Studies

Various stream chemistry studies have been conducted in the Little Blue River Watershed by the Rush County Health Department, IDEM Office of Water Quality, IDNR Division of Fish and Wildlife, Hoosier Riverwatch, and the Indiana State Board of Health. Instream and riparian habitat of the Little Blue River and its major tributaries have been evaluated by IDEM and IDNR. Studies involving macroinvertebrates, mussel communities, and fish communities have been conducted by IDEM and IDNR, as well as information gathered by a private contractor hired by the City of Shelbyville. Table 12 lists dates of the studies and the agencies that collected the information. Detailed information on these studies can be found from the agencies that performed them or in the 2004 LARE Diagnostic Study. A summary of Shelbyville Storm Water Baseline Characterization is in Appendix F.

Table 12: Little Blue River Watershed Water Quality Studies.

Type of study	Dates of study	Agency that conducted the study
Stream chemistry, macroinvertebrate and fish community surveys	1964	Indiana State Board of Health and IDNR
E. coli concentrations in the vicinity of Arlington and Manilla, Indiana	1991-2002	Rush County Health Department
Assessment of stream temperature, dissolved oxygen, conductivity, pH, habitat, and macroinvertebrate communities	1993	IDEM
Mussel survey	1993	IDNR Division of Fish and Wildlife
Stream chemistry, habitat and fish community survey in the lower Little Blue River mainstem	1995	IDNR
Stream chemistry at German Road (Shelby County)	1997	IDEM
Stream chemistry and E. coli sampling in lower Little Blue River and Rays Crossing Tributary	2002	IDEM

[2] Little Blue River Watershed Diagnostic Study, Shelby, Rush, and Henry Counties, Indiana, April 5, 2004, Prepared by JFNew, 708 Roosevelt Road, Walkerton, IN 46574.

Type of study	Dates of study	Agency that conducted the study
Water chemistry, habitat data, & macroinvertebrate surveys	2002-2006	Hoosier Riverwatch
Watershed Diagnostic Study	2003-2004	JFNew hired by the Rush and Shelby County SWCDs through a LARE grant
Storm Water Baseline Characterization	2006	Commonwealth Biomonitoring hired by the City of Shelbyville MS4 Program

3.2 Designated Use and Impairment Status

Streams throughout the United States are classified on a state-by-state basis according to provisions established in the amended Federal Clean Water Act (1977). Classification is based on specific use designations such as the support of aquatic life, human health, and recreation. Indiana waters are designated by the Indiana Water Pollution Control Board, which requires that waterbodies outside of the Great Lakes System support:

- full body contact recreation from April to October,
- a well-balanced, warm water aquatic community,
- and (where temperatures permit) put-and-take trout fishing.

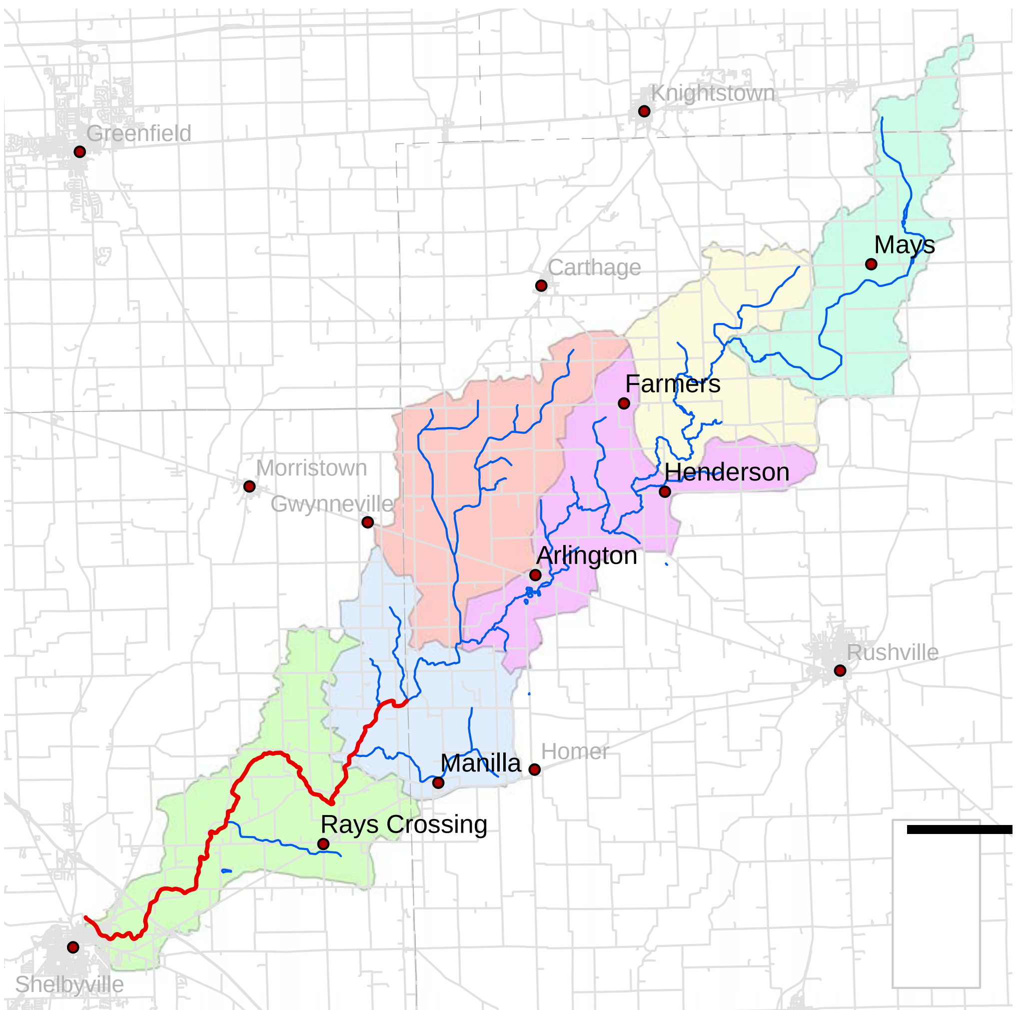
Section 303 of the Clean Water Act requires that states assess and prioritize the condition of waters every two years. This assessment relies on the state minimum water quality standards set forth in Indiana Administrative Code (IAC) 327 2-1-6. The waterbodies not meeting state standards for designated use are considered impaired and are included on IDEM's 303 (d) list for impaired waterbodies.

Based on testing by IDEM in 2002, sections of the Little Blue River were found to exceed the state standard of 235 colonies/100 mL for *E. coli* and don't meet state designated recreational standards for full body contact. Figure 21 shows the section in red that has been designated as impaired. As a result the Little Blue River is included on IDEM's 2006 303(d) list for impaired waterbodies and is targeted for Total Maximum Daily Load (TMDL) development. TMDL is the maximum amount of a pollutant that can be discharged into a water body from all sources and still maintain water quality standards. Under Clean Water Act section 303(d), TMDLs must be developed for all water bodies that do not meet water quality standards after application of technology-based controls.

In addition, two subwatersheds (Manilla Branch HUC 05120204030050 and Rays Crossing HUC 05120204030060) are listed on the Fish Consumption Advisory (FCA) for PolyChlorinated Biphenyls (PCBs). The manufacture of PCBs was stopped in the United States in 1977 because of evidence they build up in the environment and can cause harmful health effects. PCBs enter the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during transport; and from leaks or fires in products containing PCBs. PCBs might be found in electrical equipment manufactured before 1977, particularly transformers, capacitors, electromagnets, circuit breakers, voltage regulators, and switches. PCBs have also been used in heat transfer systems and hydraulic systems, and as plasticizers and additives in lubricating and cutting oils. PCBs can still be released to the environment from hazardous waste sites, illegal or improper disposal of industrial wastes and consumer products, leaks from old electrical transformers containing PCBs, and burning of some wastes in incinerators. The source of PCBs in the Little Blue River has not been determined.

Only a few species of fish are listed in the Little Blue River FCA. For current information on fish consumption advisories contact your local County Health Department or visit a Web site such as http://fn.cfs.purdue.edu/fish4health/INFishConsumptionAdvisory06.pdf

Figure 21: Impaired Section of Little Blue River for E. coli (Marked in red)



3.3 LARE Watershed Diagnostic Study Assessment

Water quality assessment conducted during the 2004 LARE study consisted of:

- Water chemistry sampling during base flow and storm runoff events
- A macroinvertebrate community assessment
- A habitat assessment
- Two visual investigations – one from the air and one from the ground

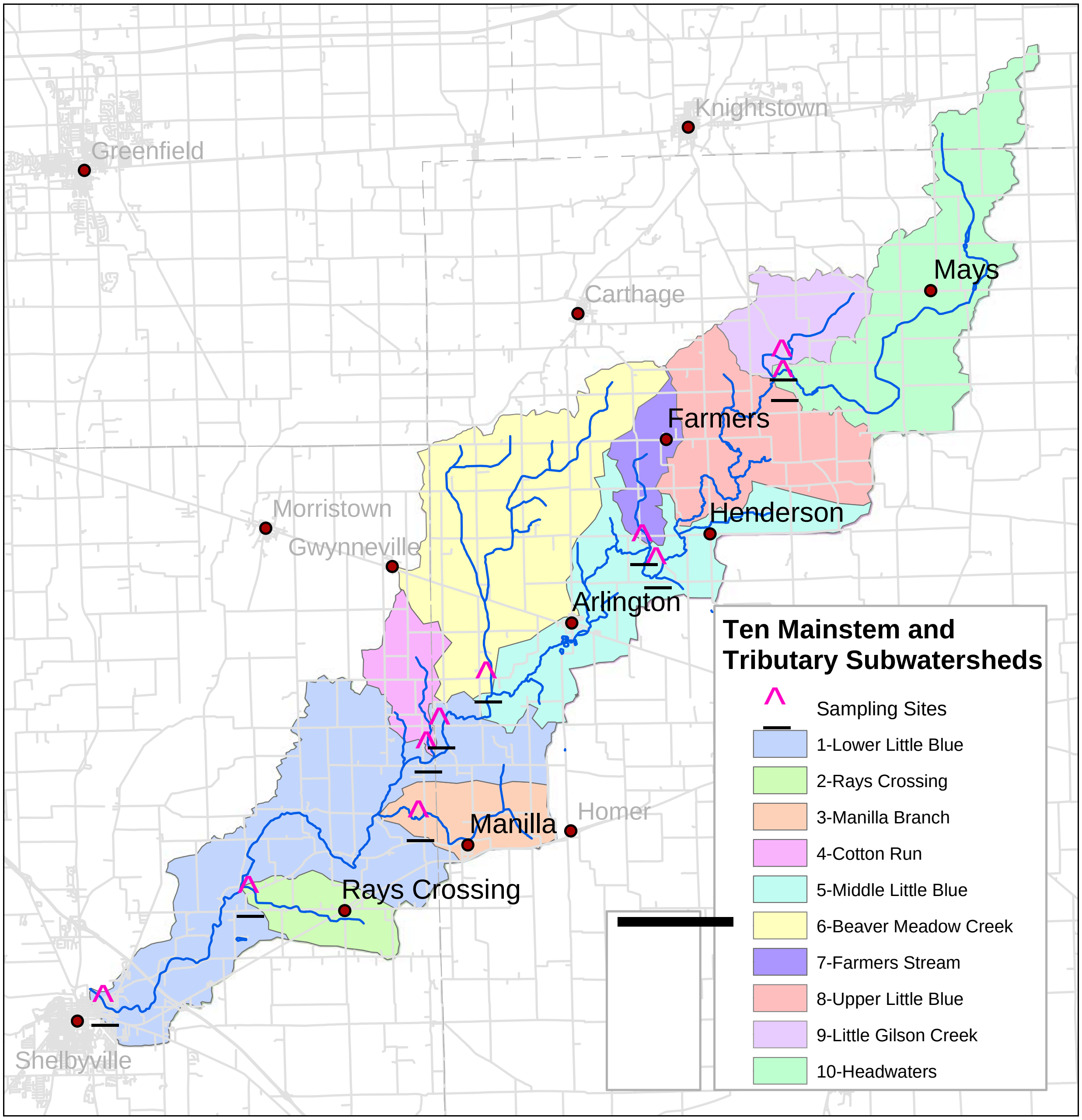
3.3.1 LARE Diagnostic Study Sampling Sites

LARE Diagnostic Study water quality sampling was conducted at ten sites in the watershed. Based on the sampling sites, the watershed was divided into ten subwatersheds, which are delineated not by the HUC system but by common drainage areas (Figure 22). The drainage areas are referred to as mainstem and tributary subwatersheds and are organized according to similar land use practices, hydrology, and datasets (Table 13). Site #1 is the "bottom" of the watershed where Little Blue River flows into Big Blue River; Site #10 is the "top" or Headwaters of the watershed.

Table 13: Area in Acres of the Mainstem and Tributary Subwatersheds

Subwatershed	Site Number	Subwatershed Type	Area in Acres
Lower Little Blue River	1	Mainstem	23,512
Rays Crossing Tributary	2	Tributary	2,500
Manilla Branch	3	Tributary	2,923
Cotton Run	4	Tributary	2,206
Middle Little Blue River	5	Mainstem	20,493
Beaver Meadow Creek	6	Tributary	12,584
Farmers Stream	7	Tributary	2,006
Upper Little Blue River	8	Mainstem	23,478
Little Gilson Creek	9	Tributary	3,164
Headwaters	10	Tributary	10,891
Total			**67,483**

Figure 22: LARE Diagnostic Study Sampling Locations in the Ten Mainstem and Tributary Subwatersheds



3.3.2 LARE Study Water Chemistry Parameters

All but one of the base flow chemical tests were collected during July 2003 (Site #5 – Middle Little Blue River – was sampled in October 2003). Base flow is measured when there is 0.25 inches or less of rain over a 5-day period. All storm flow chemical tests were collected during June 2003. Storm flow samples are collected after 1.75 or more inches of rain has fallen in a 24-hour period.

The water chemistry parameters of interest were *E. coli*, nitrogen (nitrate-nitrogen, ammonia nitrogen, and total Kjeldahl-nitrogen), turbidity, total suspended solids, and total phosphorus. An explanation of the parameters of interest follows.

1. ***E. coli***: *E. coli* is a specific species of fecal coliform bacteria and is an indicator organism, which can suggest that pathogenic organisms may be present in a water sample. *E. coli* can come from the feces of any warm-blooded animal including wildlife, livestock, domestic animals, and humans. Other sources are manure fertilizers, previously contaminated sediments, and failing or improperly sited septic systems. The Indiana state water quality standard for *E. coli* is 235 colonies/100mL in any one sample within a 30-day period. The wording of the Indiana Administrative Code states:

   > *E. coli bacteria, using membrane filter (MF) count, shall not exceed:*
   > *(1) one hundred twenty-five per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty day period; and*
   > *(2) two hundred thirty-five per one hundred milliliters in any one sample in a thirty day period.*
   > *(If a geometric mean cannot be calculated because five equally space samples are not available, then the criterion stated in subdivision (2) must be met.)*

2. **Nitrogen:** Nitrogen is an essential plant nutrient found in soil humus or soil organic matter, fertilizers, human and animal wastes, yard waste, and the air. About 80% of the air we breathe is nitrogen gas. Nitrogen gas diffuses into water where it can be converted by blue-green algae to ammonia for their use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia. Unpolluted waters generally have a nitrate level below 4 parts per million (ppm). High levels of nitrate in the water promote increased aquatic plant growth with resulting eutrophication. Eutrophication, also called nutrient overload, occurs when excessive fertilizer stimulates increased aquatic plant growth. When plants begin to die and decompose they deplete the dissolved oxygen supply in the water, – a condition called hypoxia – which harms aquatic life.

   The three common forms of nitrogen in water are:

   - ***Nitrate-nitrogen (NO3-N)*** Nitrate is an oxidized form of dissolved nitrogen that is converted to ammonia by algae. It is found in streams and runoff when dissolved oxygen is present, usually in surface waters.

Ammonia applied to farmland is rapidly oxidized or converted to nitrate and usually enters surface and groundwater as nitrate. The Ohio EPA (1999) found that the median nitrate-nitrogen concentration in wadeable streams classified as warmwater habitat was 1.0 mg/L. Warmwater habitat refers to those streams, which possess minor modifications, and little human influence, like the mainstem of the Little Blue River. The recommended nitrate-nitrogen concentration for the Central Corn Belt Plains, in which the Little Blue River lies, is 0.63 mg/L. Nitrate-nitrogen concentrations exceeding 10 mg/L in drinking water are considered hazardous to human health (IAC 2-1-6).

- ***Ammonia-nitrogen (NH3-N)*** Ammonia-nitrogen is a form of dissolved nitrogen that is the preferred form for algae use. Bacteria produce ammonia as they decompose dead plant and animal matter. Ammonia is the reduced form of nitrogen and is found in water where dissolved oxygen is lacking. Important sources of ammonia include fertilizers and animal manure. According to the IAC, maximum ionized ammonia concentrations for the Little Blue River Watershed streams should not exceed approximately 1.94 to 7.12 mg/L, depending on the water's pH and temperature.
- ***Organic Nitrogen*** Organic nitrogen includes nitrogen found in plant and animal materials. It may be in dissolved or particulate form. During chemical testing, total Kjeldahl nitrogen (TKN) was analyzed. Organic nitrogen is TKN minus ammonia. The recommended total Kjeldahl nitrogen concentration for the Central Corn Belt Plains is 0.591 mg/L. (USEPA 2000)

3. **Turbidity:** Turbidity (measured in Nephelometric Turbidity Units or NTU) is the relative clarity of the water and is measured by shining light through the water column. Turbid water is cloudy and is caused by suspended matter including clay, silt, organic and inorganic matter, algae, and other microscopic organisms. If a stream is very turbid, light will not reach through the water column and many reactions, especially photosynthesis, is limited. Suspended material absorbs heat from the sun and water temperature increases, lowering dissolved oxygen levels. Suspended particles can kill fish and aquatic invertebrates by clogging their gills and settling to the bottom, thereby smothering their habitat. According to Hoosier Riverwatch, the average turbidity of an Indiana stream is 36 NTU with a typical range of 0-173 NTU. Turbidity measurements >20 NTU have been found to cause undesirable changes in aquatic life (Walker, 1978).

4. **Total Suspended Solids (TSS):** TSS is closely related to turbidity and quantifies sediment particles and other solid compounds typically found in stream water. In general, higher overland flow velocities can result in an increase in sediment particles in runoff. Additionally, greater stream bank and streambed erosion usually occurs during high flow. Therefore, higher concentrations of suspended solids are typically measured in storm flow samples. The State of Indiana does not

have a TSS standard, however, TSS concentrations greater than 80 mg/L have been found to be harmful to aquatic life. (Waters 1995)

5. **Total Phosphorus (TP):** Phosphorus is essential to plant and animal life and occurs naturally in the environment. Very little phosphorus is needed in aquatic ecosystems, so seemingly small amounts of additional phosphorus can lead to problematic algal blooms resulting in eutrophication. The U.S. EPA recommended TP criterion for the Central Corn Belt Plains, in which the Little Blue River lies, is 0.076 mg/L.

3.3.3 LARE Study Water Chemistry Results

Water chemistry results are in Table 14. An explanation of the results follows:

- ***E. coli data assessment***
  E. coli concentrations exceeded the Indiana state standard (235 colonies/100 mL) at the Lower (Site #1) and Middle Little Blue River (Site #5), Manilla Branch (Site #3), and Farmers Stream (Site #7) during base flow and at all sites during storm flow. At sites where elevated concentrations were observed, concentrations were 1.2 to 76 times the state standard. Additionally, bacteria levels were high when compared with other agricultural watersheds in Indiana.

- ***Nitrogen data assessment***
  - Nitrate-nitrogen concentrations exceeded the recommended EPA target value of 0.63 mg/L at all sites during base and storm flow conditions. Rays Crossing (Site #2), Manilla Branch (Site #3), Cotton Run (Site #4), Beaver Meadow (Site #6), Farmers Stream (Site #7) and Little Gilson Creek (Site #9) exceeded the state standard during storm flow.
  - Ammonia-nitrogen concentrations were elevated in the Lower Little Blue (Site #1), Rays Crossing (Site #2), Upper Little Blue (Site #8) and Headwaters (Site #10). The highest level was detected in Rays Crossing, which was coupled with lowered levels of dissolved oxygen suggesting that decomposition may be occurring at this site.
  - Total Kjeldahl nitrogen (TKN) concentrations were higher at Rays Crossing (Site #2) and the Lower Little Blue (Site #1), which suggest the presence of organic matter at these sites. TKN levels exceeded USEPA recommended concentration (0.591 mg/L) at the Lower Little Blue and Rays Crossing sites during storm flow and at the Headwaters (Site #10) during base flow.

- ***Turbidity data assessment***
  The U.S. EPA recommended turbidity concentrations for the Central Corn Belt Plains, in which the Little Blue River lies, are 9.89 NTU (USEPA, 2000). During storm flow conditions five sites – Lower Little Blue (Site #1), Rays Crossing (Site #2), Middle Little Blue (Site #5), Upper Little Blue (Site #8), and Headwaters (Site #10) - exceeded the U.S. EPA recommended turbidity target value of 9.89 NTU. This increase in turbidity following storm events suggests that storm water

throughout the Little Blue River Watershed carries larger amounts of dissolved and suspended solids than is present during base flow conditions.

- ***Total Suspended Solids data assessment***
  TSS concentration measured during storm flow exceeded concentrations measured during base flow samples at all sample sites. During both base and storm flow, the Little Blue River mainstem sites (Sites #1, #5, #8) possessed higher total suspended solids concentrations than those measured in all of the tributary sites except in the Headwaters (Site #10) during storm flow.

- ***Total Phosphorus:***
  Generally, TP concentrations measured during storm flow sampling exceeded those measured during base flow. Six sites during storm flow – Lower Little Blue (Site #1), Rays Crossing (Site #2), Middle Little Blue (Site #5), Beaver Meadow (Site #6), Upper Little Blue (Site #8), and Headwaters (Site #10) – exceeded the recommended Central Corn Belt Plains target value of 0.076 mg/L.

  All of the Little Blue River mainstem sites (Sites #1, #5, #8) during storm flow possessed TP concentrations greater than the median level (0.10 mg/L) measured in streams classified as warmwater habitat (Ohio EPA, 1999). The Ohio EPA uses the median level of 0.10 mg/L as the maximum total phosphorus concentration to avoid impairment of aquatic life in warmwater habitat streams. The elevated TP concentrations and resultant productivity (eutrophication) along the Little Blue River mainstem and in Rays Crossing, Beaver Meadow Creek, and the Headwaters may be altering the biotic community structure and impairing aquatic life in these streams.

Table 14: LARE Study Water Quality Assessment Results

	Subwatershed	Date	Timing	E. coli (cfu/100mL)	Nitrate-N NO3-N (mg/L)	Ammonia-N NH3-N (mg/L)	Total Kjeldahl-N TKN (mg/L)	Turbidity (NTU)	Total Suspended Solids TSS (mg/L)	Total Phosphorus TP (mg/L)
1	Lower Little Blue	7/30/2003	Base	310	3.956	0.018	0.382	2.50	6.04	0.061
		6/13/2003	Storm	18,000	8.680	0.114	0.744	11.00	31.67	0.140
2	Rays Crossing	7/30/2003	Base	170	3.937	0.029	0.339	2.40	3.33	0.066
		6/13/2003	Storm	3,100	12.880	0.228	0.794	29.00	25.14	0.196
3	Manilla Branch	7/30/2003	Base	650	5.823	0.018	0.340	1.30	1.87	0.073
		6/13/2003	Storm	3,200	12.246	0.067	0.230	1.40	4.00	0.065
4	Cotton Run	7/30/2003	Base	110	4.084	0.018	0.367	1.70	3.73	0.061
		6/13/2003	Storm	760	12.199	0.041	0.271	3.10	4.25	0.040
5	Middle Little Blue	7/30/2003	Base	280	4.699	0.018	0.230	0.90	1.33	0.049
		6/13/2003	Storm	2,000	6.409	0.047	0.463	10.00	25.25	0.103
6	Beaver Meadow	7/30/2003	Base	190	4.177	0.018	0.383	1.20	1.20	0.037
		6/13/2003	Storm	11,000	10.984	0.051	0.259	4.80	11.00	0.095
7	Farmers Stream	7/30/2003	Base	330	8.697	0.018	0.230	0.80	1.28	0.017
		6/13/2003	Storm	530	12.520	0.018	0.230	1.60	2.75	0.050
8	Upper Little Blue	7/30/2003	Base	170	3.963	0.018	0.359	3.00	10.00	0.045
		6/13/2003	Storm	3,500	8.875	0.087	0.458	19.00	31.71	0.136
9	Little Gilson Creek	7/30/2003	Base	66	8.839	0.018	0.230	1.60	4.20	0.028
		6/13/2003	Storm	360	13.785	0.050	0.230	1.70	5.00	0.057
10	Headwaters	7/30/2003	Base	140	2.678	0.018	0.615	3.10	6.00	0.010
		6/13/2003	Storm	780	8.013	0.130	0.435	16.00	34.67	0.120

Samples that exceed Indiana state water quality standards (dark shading) or recommended target values (light shading)

3.3.4 LARE Study Macroinvertebrate Community Assessment

Benthic macroinvertebrates are creatures that are big enough to be seen without a microscope, have no backbone, and live at least part of their lives in or on the bottom of a body of water. Biological monitoring looks at the health of an aquatic system by studying these organisms to determine:

- The diversity of the biological community.
- The density of the community.
- The changes in aquatic communities over time.

Different macroinvertebrate species react to pollution in different ways. For example pollution-sensitive organisms decrease in number or disappear entirely when a stream becomes polluted. Since benthic macroinvertebrates are relatively immobile and spend a large part of their life cycle in the same part of a stream, they can serve as continuous indicators of environmental quality.

Two indices were used during the LARE diagnostic study to assess the health of macroinvertebrate communities in the Little Blue River Watershed.

- **Hilsenhoff Biotic Index (HBI)*:*** The HBI uses the macroinvertebrate community to assess the level of organic pollution in a stream. The HBI is based on the premise that different families of aquatic insects possess different tolerance levels to organic pollution. Each aquatic insect family is assigned a tolerance value from 1 to 9; those families with lower tolerances to organic pollution were assigned lower values, while those families that were more tolerant of organic pollution were assigned higher values. Benthic communities dominated by organisms that are tolerant of organic pollution will exhibit higher HBI scores compared to benthic communities dominated by intolerant organisms.

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

- **macroinvertebrate Index of Biotic Integrity (mIBI):** Macroinvertebrate results were analyzed using a modified version of IDEM’s mIBI. This is a multi-metric (10 metrics) index designed to provide a complete assessment of a stream’s biological integrity. Karr and Dudley (1981) define biological integrity as “the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization compared to the best natural habitats within the region.” IDEM developed the mIBI using five years of wadeable data collected in Indiana. Classification scores are 0, 2, 4, and 8.

mIBI Score	Stream's Biological Integrity
0-2	Severely impaired
2-4	Moderately impaired
4-6	Slightly impaired
6-8	Non-impaired

3.3.5 LARE Study Macroinvertebrate Data Analysis

Table 15 documents the results of macroinvertebrate communities observed during the LARE Diagnostic Study.

Table 15: LARE Diagnostic Study Macroinvertebrate Indices Scores and Ratings

Site #	Subwatershed	HBI Score	HBI Water Quality Rating	mIBI Score	mIBI Biological Integrity Rating
1	Lower Little Blue	4.8	Good	4.25	Slightly impaired
2	Rays Crossing	4.2	Very good	5.25	Slightly impaired
3	Manilla Branch	5.9	Fairly poor	2.75	Moderately impaired
4	Cotton Run	5.4	Fair	3.25	Moderately impaired
5	Middle Little Blue	3.1	Excellent	7.25	Non-impaired
6	Beaver Meadow	4.9	Good	5.00	Slightly impaired
7	Farmers Stream	4.2	Very good	6.00	Non-impaired
8	Upper Little Blue	4.8	Good	5.50	Slightly impaired
9	Little Gilson Creek	6.2	Fairly poor	2.50	Moderately impaired
10	Headwaters	6.6	Poor	4.75	Slightly impaired

In general, the Little Blue River Lower, Middle, and Upper mainstem (Sites #1, #5, #8) supported more diverse and more pollution intolerant communities than the Headwaters and tributaries. Manilla Branch (Site #3), Cotton Run (Site #4), Little Gilson Creek (Site #9), and the Headwaters (Site #10) exhibited the worst HBI scores suggesting high levels of organic pollution in these streams. This is consistent with the water chemistry results. All of these streams had elevated concentrations of TKN relative to the other tributary sites. Also all sites except the Headwaters exhibited elevated TP concentrations relative to other tributary sites. This evidence suggests that organic matter in these streams may be impairing the biological integrity. Organic matter accumulation was also observed during site inspections at these locations.

The mIBI scores indicate that all the watershed streams are at least partially supportive of aquatic life use. The three sites that appear to provide the least support are Manilla Branch (Site #3), Cotton Run (Site #4), and Little Gilson Creek (Site #9). These scores support the hypothesis that poor water quality may be impairing these streams' biological integrity. Elevated nutrient and TSS concentrations and loads were recorded at the Lower Little Blue (Site #1) and Manilla Branch (Site #3) during both base and storm flow sampling. Little Gilson Creek (Site #9) possessed the highest nitrate-nitrogen concentrations during both base and storm flow, and Cotton Run (Site #4) loaded the highest amount of sediment and sediment-attached pollutants per unit area during base flow.

3.3.6 LARE Study Habitat Quality Assessment

Physical habitat was evaluated at each site using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio. The evaluation is based on a stream reach of 200 feet - 100 feet downstream plus 100 feet upstream from the sampling location. Various attributes of the stream and riparian zone habitat were scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic life.

The attributes that were evaluated include:

- Type(s) and quality of substrates. This is the condition of the river bottom. Substrate diversity (i.e. different sizes of rocks) receives a higher score because it provides more habitat opportunities for bottom dwelling organisms. If there are high levels of silt in a streambed, the rocks can become "embedded" resulting in habitat loss. Sites with heavy embeddedness and siltation receive lower QHEI scores in this category.
- Amount and quality of instream cover: Examples of instream cover are logs and debris, overhanging vegetation, and root wads. This cover provides hiding places for fish.
- Channel morphology: This refers to the stream shape or sinuosity of the channel as well as human alterations. Mostly natural streams with multiple bends receive a higher score.
- Extent and quality of riparian vegetation: A wooded riparian buffer is instrumental in the detention, removal, and assimilation of nutrients such as nitrogen and phosphorus. For the purposes of this study, a riparian buffer is a zone that is forest, shrub, swamp, or woody old field vegetation; not weedy, herbaceous vegetation, which does not offer as much infiltration potential as woody components.
- Pool, run, and riffle development and quality: These zones in a stream provide diverse habitat.
- Gradient: This is calculated using topographic data. The score is based on the premise that both very low and very high gradients will have negative effects on habitat quality in the stream. Moderate gradients receive the highest score of 10 in this category.

The total QHEI score ranges from 20 to 100 and, according to IDEM, indicates the following habitat conditions:

QHEI Score	**Indicators for Habitat Conditions**
100	Maximum possible score
>75	Typify habitat conditions to support exceptional warmwater faunas
>64	Capable of supporting a balanced warmwater community
51-64	Partially supportive of a stream's aquatic life use designation
< 51	Non-supportive of a stream's aquatic life use designation

3.3.7 LARE Study Habitat Analysis Results

Table 16 lists the QHEI scores documented during the LARE Diagnostic Study for the Little Blue River Watershed.

Table 16: LARE Qualitative Habitat Evaluation Index Results
(Sites sampled on July 30-31, 2003)

Site #	Site	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score	Level of Aquatic Support
	Maximum possible score	20	20	20	10	12	8	10	100	
1	Lower Little Blue	11	8	12	2	0	0	10	43	Non-support
2	Rays Crossing	8	12	14	4	8	2	10	58	Partial support
3	Manilla Branch	13	11	14	5	7	3	10	63	Partial support
4	Cotton Run	13	12	5	2	3	0	10	45	Non-support
5	Middle Little Blue	11	11	8	6	4	5	10	55	Partial support
6	Beaver Meadow Creek	14	11	12	6	9	0	8	60	Partial support
7	Farmers Stream	7	9	17	4	7	5	4	53	Partial support
8	Upper Little Blue	16	10	16	4	9	4	4	63	Partial support
9	Little Gilson Creek	1	6	8	8	2	1	8	30	Non-support
10	Headwaters	14	8	11	4	4	5	10	56	Partial support

None of the sampling sites yielded a score above 64, which indicates the current habitat cannot completely support a balanced warmwater community. Most sites are at least partially supportive of the stream's aquatic life use designation, however three sites – Lower Little Blue (Site #1), Cotton Run (Site #4), and Little Gilson Creek (Site #9) – had scores which suggest that the stream habitat is non-supportive of the aquatic life use designation.

The overall evaluation of biotic health and habitat quality in the Little Blue River Watershed indicates that these waterways are slightly to moderately degraded. Many of the study sites lacked or had low scores for at least one of the key elements of natural, healthy stream habitats. These missing key elements limit the functionality of these systems. The QHEI evaluations from each site describe moderate to poor substrate quality throughout streams in the watershed; an indicator of embeddedness. Additionally, QHEI scores generally reflected poor pool and riffle development in watershed streams. There was almost a complete absence of sufficient riffle development within some stream channels, as well as very poor pool habitat at some sites. Channel alterations and minimal riparian buffer zones reduce the Little Blue River resilience to agricultural runoff. These factors are critical for habitat diversity and biological integrity in the stream ecosystems and are generally reflected in the slightly to moderately poor mIBI scores listed in Table 15.

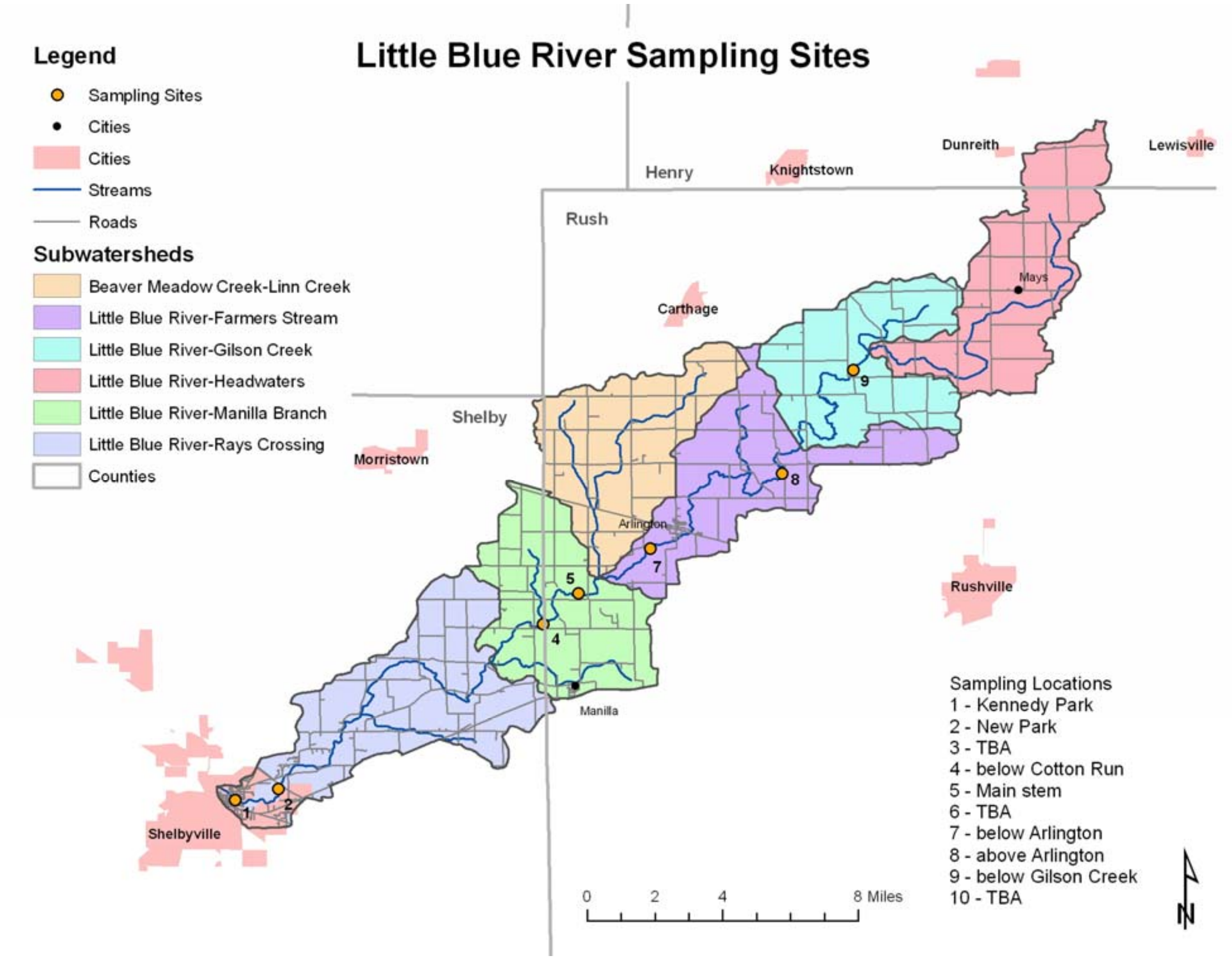
3.3.8 LARE Study Visual Investigations

Two visual investigations were conducted during the LARE study. JFNew employees documented land use and conservation related issues during an aerial tour from a small, low flying plane in late spring of 2003. A windshield survey involving Rush and Shelby County SWCD and NRCS employees, accompanied by JFNew consultants, was done from a van on 12/2/03. Participants on this second tour drove the watershed and assessed the streams where they crossed or were adjacent to roads. When possible, locations of particular concern were examined more closely by stopping and walking areas within the public right-of-way. The need for BMP implementation was the most common observation made during the windshield tour. Tables 18, 19, and 20 in Section 4 list sites of concern that were noted from these two visual investigations.

3.4 Volunteer Water Quality Monitoring

The Little Blue River Watershed Project established a volunteer water quality monitoring network beginning in April 2006. Volunteers collect and analyze data based on the Hoosier Riverwatch Program at seven sites throughout the watershed. Data collection is in accordance with the Little Blue River Watershed Quality Assurance Program Plan (QAPP), submitted to IDEM and approved in 2006. The QAPP is available for review at the Rush and Shelby County SWCD offices. Water chemistry and habitat data is collected quarterly. Biological sampling occurs twice yearly in late spring and early fall. Data collection incorporates in-field sampling methods. Analysis is both on-site and off-site, since some parameters require time or incubation before results are recorded. Sampling sites are identified in Figure 23.

Figure 23: Sampling Sites for Volunteer Monitors (Using Hoosier Riverwatch Techniques)



3.4.1 Volunteer Water Quality Monitoring Parameters

Volunteer monitors evaluate the sites identified in Figure 21 using:

1. The Citizen's Qualitative Habitat Evaluation Index (CQHEI), which is similar to the QHEI described in Subsection 3.8, but does not include the gradient component. Maximum total points for the CQHEI is 114. A score over 100 is considered an exceptionally high-quality stream.

2. A Water Quality Index Rating derived from water chemistry parameters including:
    - Dissolved Oxygen (DO) concentration. Most aquatic plants and animals require oxygen to survive. DO levels of 5 to 6ppm are usually required for healthy aquatic life growth and activity.

- Dissolved Oxygen percent saturation. This is the level of DO in the water compared to the total amount of DO that the water has the ability to hold at a given temperature and pressure. Cold water can hold more DO than warm water. 100% saturation is considered ideal.
- Biochemical Oxygen Demand (BOD). BOD is a measure of the amount of oxygen used by oxygen-consuming bacteria as they break down organic wastes over a five day period. Streams that are relatively clean and free from excessive plant growth typically have low BOD5 levels. Indiana average BOD5 is 1.5 mg/L.
- *E. coli* bacteria. Levels in excess of 235 colonies/100 mL do not meet the state designated recreational standards for full body contact. See Subsection 3.4 for more detailed information.
- pH measures whether a water sample is considered acidic or basic. pH of 7 is neutral. A pH range of 6.5 to 8.2 is optimal for most organisms.
- Water temperature change. Volunteer monitors compared the water temperature at their sampling site to the water temperature one mile upstream. Aquatic organisms have narrow optimal temperature ranges. The State Water Quality Standard is <5° F change downstream.
- Orthophosphate concentrations. Orthophosphates are dissolved in the water and are readily available for plant uptake. Therefore, the orthophosphate concentration is useful as an indicator of current potential for algae blooms and eutrophication. Low-range is 0-1ppm. High range is 1-10ppm. Volunteers did not test for total phosphate because additional equipment and complicated procedures are required for this test.
- Nitrate concentrations. See Subsection 3.5 for more information about nitrogen's effect on water quality. Unpolluted waters generally have a nitrate level below 4ppm.
- Turbidity. See Subsection 3.6 for more information about turbidity and transparency as they relate to water quality. Indiana's average turbidity is 36 NTU.

3. A Pollution Tolerance Index (PTI) rating derived from biological monitoring of benthic macroinvertebrates. Volunteers gathered macroinvertebrates and classified them according to:
    - Pollution intolerant organisms
    - Moderately pollution intolerant organisms
    - Fairly pollution tolerant organisms
    - Very pollution tolerant organisms.

   After counting the number of taxa (insects that have the same body shape) and applying appropriate weighting factors, the PTI score is calculated:

PTI score of 23 or more	=	Excellent
PTI score of 17-22	=	Good
PTI score of 11-16	=	Fair
PTI score of 10 or less	=	Poor

3.4.2 Volunteer Water Quality Monitoring Results

Volunteer water quality monitoring is based on a testing method called trend monitoring. As stated in the Hoosier Riverwatch Training Manuel[3], "To get an accurate picture of a stream's water quality, tests have to be performed on a regular basis (consistently), over a period of years (persistently). Without long-term continued monitoring, data obtained by Riverwatch volunteers may have limited uses. A random, one-time sample provides a limited picture of water quality and overall health of a water body at the particular site and time it was monitored."

Since most volunteer monitoring in the Little Blue River Watershed began in 2006, the data has not been collected long enough to indicate trends in the watershed. After several years of data are collected, this information will become more useful. Appendix E contains results from volunteer monitoring during 2006. This Appendix will be updated as more data becomes available. The information is also available at the Hoosier Riverwatch website www.HoosierRiverwatch.com.

3.5 Sediment and Chemical Loading

Information gathered about the volume of pollutants entering watershed streams, allows us to figure the mass of sediment and chemical loading in kilograms/day (kg/d). Table 17 lists the chemical and sediment mass loading data for the Little Blue River Watershed by site. Under storm flow conditions, the Lower Little Blue River (Site #1) possessed the greatest loads for all parameters. During base flow this site also possessed the greatest loads of nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, soluble reactive phosphorus, total phosphorus, and total suspended solids. This is to be expected since the Lower Little Blue River is located furthest downstream and receives pollutants from all other sites.

Some stream systems can process or assimilate pollutants rather than transporting them downstream. The drop in ammonia-nitrogen concentration between the Upper Little Blue River (Site #8) and the Middle Little Blue River (Site #5) may be due to the conversion of ammonia to nitrate. Ammonia readily oxidizes to nitrate in the presence of oxygen. The riffle habitat present at the Middle Little Blue River provides an excellent opportunity for oxygen to diffuse into the water column.

Of the six major tributaries to the Little Blue River, Rays Crossing (Site #2) during storm flow and Beaver Meadow Creek (Site #6), Farmers Stream (Site #7), and Little Gilson Creek (Site #9) during base flow delivered the greatest pollutant loads to the Little Blue River mainstem. Under storm flow conditions, Rays Crossing (Site #2) delivered more nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, soluble reactive phosphorus, total phosphorus, and total suspended solids than the other tributaries to the Little Blue River. Farmers Stream (Site #7) carried more nitrate-nitrogen and ammonia-nitrogen to the Little Blue River under base flow conditions. During base flow, Beaver Meadow Creek (Site #6) delivered more total Kjeldahl nitrogen, soluble reactive phosphorus, and total phosphorus to the Little Blue River mainstem. Little Gilson Creek (Site #9) carried the higher load of total suspended solids to the Little Blue River mainstem during base flow.

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[3] Volunteer Stream Monitoring Training Manual, Hoosier Riverwatch, Sixth Edition, published by the IDNR, Division of Fish and Wildlife, 2006, p. 3.

Table 17: Chemical Loading Data for Watershed Streams.

Site	Date	Flow Condition	Nitrate-Nitrogen Load (kg/d)	Ammonia-Nitrogen Load (kg/d)	Total Kjeldahl Nitrogen Load (kg/d)	Soluble Reactive Phosphorus Load (kg/d)	Total Phosphorus Load (kg/d)	Total Suspended Solids Load (kg/d)
1	7/30/03	Base	304.6	1.4	29.4	3.6	4.7	465.4
	6/13/03	Storm	2,597.8	34.1	222.7	23.9	41.9	9,477.4
2	7/31/03	Base	1.5	0.0	0.1	0.0	0.0	1.3
	6/13/03	Storm	415.7	7.4	25.6	4.0	6.3	811.5
3	7/31/03	Base	12.0	0.0	0.7	0.1	0.1	3.8
	6/13/03	Storm	149.7	0.8	2.8	0.7	0.8	48.9
4	7/31/03	Base	0.3	0.0	0.0	0.0	0.0	0.3
	6/13/03	Storm	107.4	0.4	2.4	0.3	0.4	37.4
5	10/31/03	Base	247.6	0.9	12.1	1.3	2.6	70.2
	6/13/03	Storm	982.6	7.2	71.0	8.1	15.8	3,871.1
6	7/31/03	Base	45.2	0.2	4.1	0.5	0.4	13.0
	6/13/03	Storm	311.5	1.4	7.3	1.9	2.7	312.0
7	7/31/03	Base	134.2	0.3	3.5	0.3	0.3	19.7
	6/13/03	Storm	49.0	0.1	0.9	0.2	0.2	10.8
8	7/30/03	Base	130.9	0.6	11.9	1.4	1.5	330.3
	6/13/03	Storm	902.7	8.8	46.6	6.3	13.8	3,225.9
9	7/30/03	Base	70.2	0.1	1.8	0.1	0.2	33.4
	6/13/03	Storm	80.9	0.3	1.3	0.2	0.3	29.3
10	7/30/03	Base	33.9	0.2	7.8	0.6	0.1	76.0
	6/13/03	Storm	309.6	5.0	16.8	2.2	4.6	1,339.3

3.6 Groundwater Studies

3.6.1 Cooperative Private Well Testing Program

The Cooperative Private Well Testing Program (CPWTP) analyzed samples from over 300 wells in Shelby County during the summer of 1991 and the fall and winter of 1992. In Rush County the program conducted two rounds of sample analysis - from 160 wells that were analyzed during the summer of 1993 and from nearly 100 wells sampled during the late summer to early fall of 1999. (CPWTP Database, 2003)

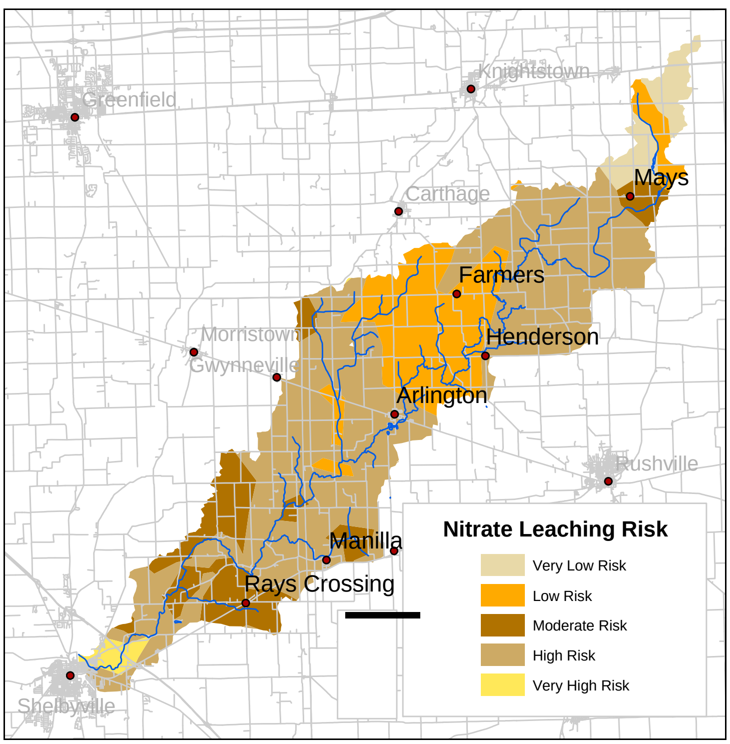
Although there is very low to high nitrate leaching risk within the Little Blue River surface watershed (Figure 24), based on the CPWTP studies nitrate-nitrogen does not appear to be reaching groundwater wells throughout most of the watershed. However, nitrate-nitrogen concentrations in groundwater may be an issue near the headwaters of the Little Blue River in Center Township, Rush County.

Organic compound screening (for alachlor and triazine containing compounds) was conducted on all the well water samples. The presence of pesticides and/or herbicides was indicated in all but two of the drinking water wells. Although none of the concentrations exceeded state or federal recommended criteria for public drinking water systems, pesticides are not normally present in private well samples collected in most areas, so concentrations measured throughout

Shelby and Rush Counties are of concern (Heidelberg College, 2002). There appears to be a moderate risk of pesticide leaching along the lower portion of the mainstem of the Little Blue River and low pesticide leaching risk within the remainder of the surface watershed (Figure 25).

3.6.2 Nitrate Leaching Study
Purdue University professor Bernie Engel created the Nitrate Leaching and Economic Analysis Package (NLEAP). The model combines a nitrogen budget with water balance to calculate the amount nitrate-nitrogen leached below the root zone. The model generates an annual leaching risk potential score that can be used to qualitatively assess the affects of nitrate-nitrogen leaching. Figure 24 displays five broad nitrate-nitrogen leaching risk potential categories as calculated by the NLEAP model for the Little Blue River Watershed. No areas of extreme or very extreme risk were calculated, so these scores are not represented on the map. Much of the watershed is considered at moderate to high risk for nitrate-nitrogen leaching. Areas at the northeast edge of Shelbyville are at the greatest risk for nitrate-nitrogen leaching, while the headwaters area near the intersection of state Road 3 and State Road 40 has very low risk for nitrate-nitrogen leaching potential.

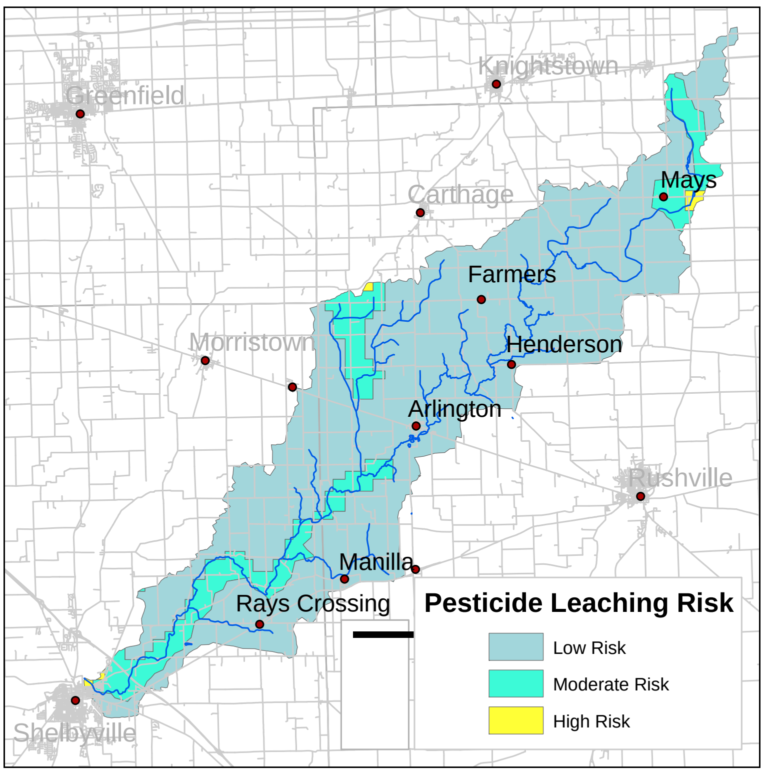
Figure 24: Nitrate Leaching Risk Map



3.6.3 Pesticide Leaching Study

Engel also initiated a model program, which calculates pesticide leaching risk potential. The pesticide model generates only three categories: low risk, moderate risk, and high risk. Much of the Little Blue River from southeast of Arlington to the northwest edge of Shelbyville, a portion of the headwaters and much of the area lying between Beaver Meadow Creek and Linn Creek are at moderate risk for pesticide leaching. High risk areas are located in Shelbyville near the confluence with the Big Blue River and in the headwaters east of State Road 3. (Figure 25)

Figure 25: Pesticide Leaching Risk Map



3.7 Other Watershed Issues

During the formation of this Watershed Management Plan, the Steering Committee repeatedly heard reports from numerous individuals about logjams that cause flooding problems, illegal dumping along riverbanks, wildlife habitat degradation, and decreased recreation opportunities. Additionally, wetlands continue to disappear in the watershed as land is converted to housing, agriculture, roads, and urban uses.

3.7.1 Logjams

Logjams can impede the flow of the river and result in bank erosion and flooding. There seems to be general confusion and frustration about who is responsible for removing fallen trees from the riverbed. Because of this concern the Little Blue River Watershed Project held an Open Streams Management Workshop at the Manilla Fire Station on January 31, 2007. Over 75 individuals attended. George Bowman, Assistant Director for the IDNR Division of Water, spoke about logjam removal techniques and the permitting process. The primary messages were:

- Remove logjams when they are small.
- Logjams are classified by size and not all require a permit.
- IDNR is glad to consult on logjam removal projects, however funding is not available through the agency.

Further education and perhaps a pilot project would be helpful in dispelling misinformation and confusion regarding this topic.

3.7.2 Illegal Dumping Prevention/Clean up

Trash is unsightly and often lodges in logjams during flooding events. Many landowners have taken the initiative to remove trash, tires, and appliances from the river where it runs through their property. However increased education and enforcement is needed to prevent continued dumping. The Rush and Shelby County Solid Waste Management Districts are both interested in promoting river clean up projects. The Shelbyville Parks Department has adopted a section of the Little Blue River through the Hoosier Riverwatch Adopt-A-River program. The adopted section begins at the new park located on the eastern edge of Shelbyville and flows past the Shelby County Fairgrounds and another city park (Kennedy Park). An annual clean up event is sponsored by the Parks Department to remove trash that has accumulated and to increase public awareness of the problems related to illegal dumping. Additional volunteers are needed to adopt other sections of the Little Blue River and its tributaries.

3.7.3 Wildlife Habitat

The LARE Diagnostic Study found habitat for aquatic life somewhat degraded throughout the watershed. In addition, land use patterns (Table 9) reveal that natural habitat for wildlife is limited. Habitat improvements along rivers and streams can have a significant impact on increased wildlife in the watershed. In 2007 the IDNR Division of Fish and Wildlife reopened spring wild turkey hunting season in both Shelby and Rush Counties. Henry County is closed to spring turkey hunting. There is no fall turkey hunting season in the watershed. Since a healthy wild turkey population requires adequate riparian habitat, increased installation of riparian buffers should be promoted to develop wildlife habitat and improve transportation corridors. Riparian buffers have the additional benefit of improving water quality and stabilizing stream banks.

3.7.4 Recreation Opportunities

Reliable wastewater treatment for rural homes and communities, as well as proper manure management for livestock operations, should be encouraged so people can enjoy the river without fear of health threats from fecal contamination. This is especially important since two public parks and the Shelby County fairgrounds are located adjacent to the Lower Little Blue River. Providing local, up-to-date public health information about the river will serve to protect residents and dispel any myths or misinformation about water quality.

3.7.5 Wetlands

Wetlands benefit water quality in numerous ways such as reducing nitrogen concentrations in runoff, trapping *E. coli* and other pathogens, and limiting nutrient leaching to groundwater. Wetland restoration on marginal land is a useful land use option and should be promoted through local government zoning and planning. The LARE Diagnostic Study recommends assisting livestock operations, especially CFOs, in implementing innovative waste management systems such as wastewater treatment wetlands. A wastewater treatment wetland can reduce the high nitrogen concentration present in CFO wastewater.

Section 4: PROBLEM IDENTIFICATION AND STRATEGY DEVELOPMENT

Based on the information gathered and presented in the preceding Sections of this Watershed Management Plan, the Project Steering Committee has identified the following problems that effect water quality in the Little Blue River Watershed.

- *E. coli* levels that exceed the state standard.
- Elevated nitrate-nitrogen concentrations.
- Increased sedimentation.
- Need for increased public education and outreach.

In order to effectively address local concerns and bring the vision for the Little Blue River Watershed into reality, the Steering Committee prioritized suggestions to address concerns (Table 1) and studied the results from various water quality investigations as described in Section 3. The Committee then developed problem statements based on probable causes and sources of water quality impairments and threats.

4.1 Problem Statements

4.1.1 *E. coli L*evels Exceed the Indiana Standard

<u>Problem</u>: The Little Blue River does not meet the state designated recreational standards for full body contact and is included on IDEM's 2006 303(d) list for impaired waterbodies due to *E. coli* contamination.

According to the 2004 LARE Diagnostic Study, *E. coli* concentrations exceeded the Indiana state standard (235 colonies/100 ml) at water quality monitoring sites located in the Lower Little Blue, Middle Little Blue, Manilla Branch, and Farmers Stream during base flow and at all sites during storm flow. At sites where elevated concentrations were observed, concentrations were 1.2 to 76 times the state standard. Additionally, bacteria levels were high when compared with other agricultural watersheds in Indiana.

E. coli serves as an indicator organism for other pathogenic species. Pathogenic organisms can be a threat to human health through a variety of serious diseases including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses. Excessive amounts of nutrients such as nitrogen may also accompany elevated *E. coli* levels. These nutrients contribute to overproduction of algal growth and resulting eutrophication in a water body.

<u>**Situations in the watershed that contribute to high *E. coli levels:***</u>

Humans: The most likely human source comes from failing, improperly constructed, or poorly maintained septic systems. To prevent problems, a soil scientist must evaluate any potential septic site for evidence of poor water movement, soil development, or filtering ability. It is possible that some soils are too wet, too shallow, too impermeable, too steep, or too well-drained for any type of system. Many of the soil types in the watershed have severe limitation for septic suitability (Table 7), which can result in surface and groundwater pollution from fecal contaminants. Wastewater treatment plants are the preferred option for treating sewage where homes are concentrated in rural areas and small towns.

Livestock: Livestock with access to a stream naturally use it as a watering source. Cattle, in particular, tend to stand in the stream during hot weather, which increases the chance of defecation in the water. As animals with unrestricted access trample the stream bank, vegetated buffers are destroyed, removing the capacity for plants to filter *E. coli* and other contaminants from pasture runoff. In addition to concerns about *E. coli*, erosion and sedimentation become a problem when stream banks are damaged. Table 18 contains information from the diagnostic study aerial and windshield tours that identified approximately 55 locations as potential *E. coli* sources from livestock and suggests BMPs to address the concerns.

Table 18: Visual Observations Identifying
Potential *E. coli* Sources from Livestock and Suggested BMPs

Aerial and Windshield Tour Observations	Subwatershed Location(s)	Suggested BMPs
Heavily grazed land and/or livestock with access to stream	Lower Little Blue, Rays Crossing Tributary, Middle Little Blue, Beaver Meadow Creek, Upper Little Blue, Little Gilson Creek, Headwaters	Livestock fencing, restore riparian habitat; filter strip installation; alternative water source; grazing management
Potential source: hog farms	Middle Little Blue, Beaver Meadow Creek, Upper Little Blue, Headwaters	On the ground investigation to determine if BMPs are recommended and manure management plans are utilized
Potential sources: fenced feed lots and/or CFOs	Lower Little Blue, Manilla Branch, Beaver Meadow, Middle Little Blue, Little Gilson Creek, Headwaters	On the ground investigation to determine if BMPs are recommended and manure management plans are utilized

Wildlife: Deer and geese as well as other mammals and birds can contribute significant amounts of fecal material to rivers and ponds. Lawns that are mowed to the water's edge give geese, in particular, easy access to surface water. There is no data on the amount of *E. coli* in the watershed that originates from wildlife. Educating homeowners about ways to protect water on their property from wildlife is the key to minimizing this water quality threat.

Manure fertilizer: A useful and accepted method of manure management is to apply it to agricultural land. However proper testing of manure and soil, as well as appropriate application methods and rates must be followed so excess manure isn't washed into receiving waterbodies. When these procedures aren't followed, elevated *E. coli* concentrations can result.

4.1.2 High Nitrate-Nitrogen Concentrations

Problem: The 2004 LARE Diagnostic Study found nitrate/nitrogen concentrations during base and storm flow conditions were elevated at all sites. All sites exceeded the USEPA recommended criterion for nitrate/nitrogen of 0.63 mg/L for streams in the Central Corn Belt Plains Ecoregion.

High intensity rainfall events can cause surface and subsurface nitrates to flow into streams. This loss can harm crop production and waste farmers' economic resources. When too many nutrients end up in water bodies, a condition called eutrophication occurs, which depletes oxygen supply in the water and harms habitat.

Situations in the watershed that contribute to excessive nitrogen concentrations:

Excess nitrogen can enter the water when:

- Land is farmed to a stream’s edge. When the riparian buffer is removed, vegetation is not available to filter runoff or uptake nitrogen through plant roots. In addition unprotected stream banks are susceptible to erosion.
- Lawns are mowed to the stream’s edge. (This also is a potential *E*. coli source, particularly from geese.) Grass clippings and other yard waste debris that is deposited into the water will decompose and lead to hypoxic conditions.
- Fertilizers are improperly applied.
- Septic systems are improperly constructed, maintained or fail.
- Animals, including livestock and wildlife, defecate in the water. (This is also a potential *E. coli* source.)

The diagnostic study aerial and windshield tours identified approximately 77 locations that might be contributing too much nitrogen to receiving waterbodies due to some of the conditions listed above (Table 19). Information in Table 18, which identifies possible *E. coli* sources, should also be considered as locations that could contribute excessive nitrogen.

Table 19: Visual Observations Identifying Potential Nitrogen Sources and Suggested BMPs

Aerial and Windshield Tour Observations	Subwatershed Location(s)	Suggested BMPs
Vegetation mowed to stream edge	Lower Little Blue River, Rays Crossing Tributary	Restore riparian habitat
Potential pollution source: County Fairgrounds	Lower Little Blue River	On the ground investigation to determine if BMPs are recommended
Land is farmed to stream edge	Lower Little Blue River, Rays Crossing Tributary, Cotton Run Tributary, Middle Little Blue River, Beaver Meadow Creek,	Filter strip installation
Insufficient or absent filter strips protecting receiving waterbodies	Lower Little Blue River, Rays Crossing Tributary, Manilla Branch, Cotton Run, Middle Little Blue River, Beaver Meadow Creek, Farmers Stream, Upper Little Blue River, Little Gilson Creek, Headwaters	Filter strip installation, widen filter strip, filter strip maintenance needed

4.1.3 Sedimentation

Problem: Water quality testing done by the LARE Diagnostic Study showed turbidity levels that exceed recommended target values at 5 out of 10 sampling sites. The QHEI evaluations describe moderate to poor substrate quality throughout streams in the watershed. Six sampling sites exceeded the recommended Central Corn Belt Plains target value of 0.076 mg/L for Total Phosphorus, a nutrient that enters water attached to soil particles through the process of erosion. These indicators point to sedimentation issues in the Little Blue River Watershed.

Sediment has a substantial impact on a stream's physical and chemical makeup. Fine particles of sediment fill crevices in streambeds, smothering habitat and harming aquatic life. Poor substrate quality throughout the watershed reflects this condition. As streams fill in with sediment their capacity to carry water decreases and flooding may be more likely to occur in high rainfall events.

Suspended particles of soil that lead to turbidity in the water can kill fish and aquatic invertebrates by clogging their gills. These particles also serve as carrying agents for attached phosphorus, pesticides, and other pollutants. Turbid water does not allow light to reach through the water column so many reactions, especially photosynthesis, is limited. Turbid water absorbs heat from the sun and water temperature increases, lowering dissolved oxygen levels. Turbidity can also be caused by increased algal growth, which results from excessive nutrients such as phosphorus and nitrogen entering the water.

Situations in the watershed that contribute to increased sedimentation:

Causes of sedimentation include:

- Delayed implementation of erosion control mechanisms in agricultural fields and at construction sites.
- Lack of conservation tillage.
- Unprotected highly erodible land.
- Runoff from impervious surfaces such as parking lots, buildings, and roads.
- Eroding stream banks.
- Removal of natural vegetation in riparian buffers.
- Disturbances of the stream bank and streambed from livestock that have unrestricted access to the river.

The LARE Diagnostic Study aerial and windshield tours identified approximately 49 locations that might be contributing factors to increased sediment (Table 20). This table does not include locations where livestock may be trampling the stream bank and causing erosion (Table 18) or where land is farmed all the way to the river's edge leaving bare soil susceptible to erosion (Table 19).

Table 20: Visual Observations Identifying Potential Sediment Sources and Suggested BMPs

Aerial and Windshield Tour Observations	Subwatershed Location(s)	Suggested BMPs
Potential pollution source: Sedimentation basin outlets to stream	Lower Little Blue River	Biofilter or other urban BMP to treat storm water
Eroding stream banks	Lower Little Blue River, Middle Little Blue River, Beaver Meadow, Upper Little Blue River, Little Gilson Creek, Headwaters	Stabilize stream banks, restore riparian habitat,
Potential pollution source: Urban construction sites	Lower Little Blue River	Urban BMPs
Natural vegetation has been removed	Lower Little Blue River, Middle Little Blue River, Upper Little Blue River, Headwaters	Restore riparian habitat, stabilize stream banks
Rill and gully erosion	Lower Little Blue River, Middle Little Blue River, Farmers Stream, Upper Little Blue River	Grassed waterway installation or maintenance
Stream crossing causing bed erosion	Lower Little Blue River, Manilla Branch, Upper Little Blue River	Stabilize stream bed

4.1.4 Need for Increased Public Education and Outreach

Problem: Many people are interested in protecting water quality but seem confused about how individual actions contribute to overall concerns. Misinformation abounds regarding issues such as logjams, illegal dumping, wildlife habitat, recreational opportunities, and the cumulative impact of human activity on water quality.

Appendix B documents the concerns and comments brought up during public meetings held in the watershed. During the process of developing the Watershed Management Plan, the Steering Committee became aware of issues that indicated the need for additional education and outreach. The following strategies were devised to increase general knowledge about water quality and to improve the long-term results of watershed efforts.

1. Provide accurate, up-to-date information about water quality on a regular basis.
2. Create stewardship opportunities for everyone to protect and improve the physical, chemical, and biological health of the river.
3. Address misinformation about watershed issues.
4. Develop a network of interested people to continue the work.
5. Cooperate with other agencies and groups.

Issues in the watershed that would benefit from increased education and outreach:

The Steering Committee proposes using the strategies mentioned above to support education and outreach action items. For example:

- Some citizens worry about the safety of getting in the water and eating fish from the Little Blue River
  - Work with the US Geological Survey to place a continuously transmitting water quality probe in Little Blue River at Kennedy Park. This equipment will allow citizens to access current water quality information at any time via the Web.

- Yard waste and grass clippings deposited into ditches and streams contribute nitrate/nitrogen to receiving water bodies, however, according to the City of Shelbyville, people routinely rake yard waste into ditches to get rid of the material even though Shelbyville has curbside yard waste pickup.
  - ➢ The Shelbyville MS4 operator will contact nearby residents about improper yard waste disposal and suggest alternatives.
- Local officials don't always seem to have the information they need to make wise decisions about issues that can impact water quality.
  - ➢ The Steering Committee will provide this Watershed Management Plan to local officials and meet individually with them when appropriate.
- Landowners express confusion and frustration about laws governing stream maintenance.
  - ➢ The SWCD will provide information about river maintenance to the public. A demonstration project to remove a local logjam is in the planning stages.
- Some people point to agriculture as the source of water quality problems, but they are not aware that cities, businesses and private residences cause some of the problems, too.
  - ➢ Local environmental educators will be scheduled to contribute to a monthly column that appears in area newspapers. Topics will cover a wide range of environmental issues that impact water quality.
- More farmers would consider implementing BMPs if they understood their benefits and had the resources to establish and maintain the practices.
  - ➢ The SWCDs have applied for an EPA Section 319 grant to implement BMPs in the watershed.
- Illegal dumping and littering are unsightly, but trash items continue to be deposited in the river in remote locations. Some items can leach toxic chemicals into the water and soil.
  - ➢ Local Solid Waste Management Districts are willing to work with the SWCDs to promote river clean ups and to provide safe ways to dispose of chemicals and other wastes.
- Wetlands continue to disappear and wildlife habitat is becoming increasingly fragmented.
  - ➢ The SWCDs are working to provide cost share money through grants and NRCS programs that improve habitat and protect wetlands.
- Additional volunteer monitors are needed to get better data for water quality trends in the watershed.
  - ➢ The SWCDs will promote annual workshops to support and train volunteer water quality monitors.
- Children and adults are interested in the environment, but don't understand how they contribute to a healthy ecosystem.
  - ➢ Both the Rush and Shelby County SWCDs have educators on staff that regularly present programs to school age children. These educators also develop workshops, displays, and service opportunities for the general public.

4.2 Compilation of Visual Observations by Subwatershed

As outlined in Tables 18, 19, and 20 visual observations are important to understanding why there are water quality problems in the watershed. The following tables further illustrate by subwatershed what situations are contributing to a cross section of issues.

Table 21: Observations in Subwatershed #1: Lower Little Blue River

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Shelbyville	Streamside factories, interstate stream crossings					X	X
Shelbyville	Construction projects, refuse piled adjacent to the stream channel			X	X	X	X
Shelbyville	Sedimentation basin discharge, parking lot runoff			X	X	X	X
Shelbyville	Riparian vegetation removed or degraded, lawns mowed to river edge		X	X	X	X	
Northwest edge of Shelbyville to I-74	Very high nitrate leaching risk		X		X		
Shelbyville and mainstem to Manilla	High and moderately high pesticide leaching risk				X		
Fairgrounds	Horse barns, lawns mowed to river edge, septic system, manure, race track (auto and horse)	X	X	X	X	X	X
Mainstem from Shelbyville to Manilla	Riparian vegetation removed through mowing, grazing, or farming to river's edge		X	X	X	X	
Mainstem from Shelbyville to Manilla	Gully and rill erosion, stream bank stabilization and revegetation needed			X	X	X	
Mainstem from Shelbyville to Manilla	Livestock grazing along river, trampling banks	X	X	X	X	X	
Mainstem from Shelbyville to Manilla drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Homes throughout Lower Little Blue River	Potential septic system issues	X	X		X		
Shelbyville at Kennedy Park monitoring site	Low stream bank stability, severe erosion, algal growth, moderate silt cover, high E. coli	X	X	X	X	X	X

Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 22: Observations in Subwatershed #2: Rays Crossing

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Rays Crossing Tributary	High HEL:CRP ratio		X	X	X		
Rays Crossing Tributary	High nitrate leaching risk		X		X		
Rays Crossing Tributary	Riparian revegetation and filter strips needed, vegetation mowed and farmed to stream		X	X	X	X	
Rays Crossing Tributary	Wetland restoration needed	X	X	X	X	X	
Rays Crossing Tributary	Heavily grazed land and livestock with access to the stream	X	X	X	X	X	
Rays Crossing Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Town of Rays Crossing	Concentration of homes and businesses using onsite wastewater treatment systems (septic)	X	X		X		X
Homes throughout Rays Crossing Tributary	Potential septic system issues	X	X		X		
Rays Crossing Tributary monitoring	Moderate embedded substrate, moderate bank stability, moderate	X	X	X	X	X	X

site	stream bank erosion, slightly impaired biotic community, high E. coli						
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 23: Observations in Subwatershed #3: Manilla Branch

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Manilla Branch Tributary	Fenced feed lot	X	X		X	X	
Manilla Branch Tributary	Insufficient filter strips		X	X	X	X	
Manilla Branch Tributary	Stream crossing causing bed erosion			X	X	X	
Manilla Branch Tributary	High HEL:CRP ratio		X	X	X		
Manilla Branch Tributary	Moderate to high nitrate leaching risk		X		X		
Manilla Branch Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Town of Manilla	Potential point source pollution	X	X	X	X	X	X
Homes throughout Manilla Branch Tributary	Potential septic system issues	X	X		X		
Manilla Branch monitoring site	Moderately impaired biotic community, high E. coli	X	X	X	X		X
Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve			X	X		

	drainage						

Table 24: Observations in Subwatershed #4: Cotton Run

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Cotton Run Tributary	Farming to edge of stream		X	X	X	X	
Cotton Run Tributary	Insufficient filter strips		X	X	X	X	
Cotton Run Tributary	Natural vegetation removed, insufficient riparian buffers		X	X	X	X	
Cotton Run Tributary	High nitrate leaching risk		X		X		
Cotton Run Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Homes throughout Cotton Run Tributary	Potential septic system issues	X	X		X		
Cotton Run Tributary monitoring site	Moderately embedded substrate, heavy to severe bank erosion, moderately impaired biotic community, high E. coli	X	X	X	X	X	X
Wet areas	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 25: Observations in Subwatershed #5: Middle Little Blue River

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Town of Arlington	Potential point source pollution and high nitrate leaching risk	X	X	X	X	X	X
Middle Little Blue mainstem	Riparian buffers are degraded or removed, insufficient filter strips		X	X	X	X	
Middle Little Blue mainstem	Heavily grazed land, livestock with access to the stream	X	X	X	X	X	
Middle Little Blue	High percentage of row crop agriculture		X		X	X	

drainage basin	with chemical and/or manure fertilizer application						
Middle Little Blue mainstem	Hog farms	X	X		X	X	
Middle Little Blue mainstem	Land farmed to stream edge		X	X	X	X	
Middle Little Blue mainstem	Eroding stream banks			X	X	X	
Middle Little Blue mainstem	Rill and gully erosion			X	X	X	
Homes throughout the Middle Little Blue River	Potential septic system issues	X	X		X		
Middle Little Blue monitoring site	Moderate silt, extensively embedded substrate, high E. coli	X	X	X	X	X	X
Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 26: Observations in Subwatershed #6: Beaver Meadow

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Beaver Meadow Tributary	Farming to steam edge, insufficient filter strips		X	X	X	X	
Beaver Meadow Tributary	Livestock with access to stream, heavily grazed land	X	X	X	X	X	
Beaver Meadow Tributary	Eroding stream banks			X	X	X	
Beaver Meadow Tributary	High HEL:CRP ratio		X	X	X		

Beaver Meadow Tributary	Potential wetland restoration	X	X	X	X	X	
Beaver Meadow Tributary	Confined animal feeding operation	X	X		X	X	
Beaver Meadow Tributary	Hog farms	X	X		X	X	
Beaver Meadow Tributary	High nitrate leaching risk, moderate pesticide leaching risk		X		X		
Beaver Meadow Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Homes throughout the Beaver Meadow Tributary	Potential septic system issues	X	X		X		
Beaver Meadow Tributary monitoring site	Low to moderately embedded substrate, slightly impaired biotic community, high E. coli	X	X	X	X		X
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 27: Observations in Subwatershed #7: Farmers Stream

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Farmers Stream Tributary	Insufficient filter strips		X	X	X	X	
Farmers Stream Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Farmers Stream Tributary	Rill and gully erosion			X	X	X	
Farmers Stream Tributary	Low to moderate nitrate leaching risk		X		X		
Homes throughout the Farmers Stream	Potential septic system issues	X	X		X		

Tributary							
Farmers Stream Tributary monitoring site	Moderately embedded substrate, moderate to severe stream bank erosion, high E. coli	X	X	X	X	X	X
Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 28: Observations in Subwatershed #8: Upper Little Blue River

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Upper Little Blue mainstem	Dirt access road with fairly severe bank compaction and riparian zone disturbance			X	X	X	
Upper Little Blue mainstem	Heavily grazed land and livestock with access to the stream	X	X	X	X	X	
Upper Little Blue mainstem	Hog farms	X	X		X	X	
Upper Little Blue mainstem	Insufficient filter strips and buffer zone, natural vegetation removed		X	X	X	X	
Upper Little Blue drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Upper Little Blue mainstem	Eroding stream banks, rill and gully erosion			X	X	X	
Upper Little Blue mainstem	Moderate and high nitrate leaching risk		X		X		
Homes throughout the Upper Little Blue River	Potential septic system issues	X	X		X		
Upper Little Blue monitoring site	Moderate to heavy erosion along both stream banks, slightly impaired biotic community, high E. coli	X	X	X	X	X	X

Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 29: Observations in Subwatershed #9: Little Gilson Creek

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Little Gilson Creek Tributary	Heavily grazed land and livestock with access to stream	X	X	X	X	X	
Little Gilson Creek Tributary	Insufficient filter strips		X	X	X	X	
Little Gilson Creek Tributary	Eroding stream banks			X	X	X	
Little Gilson Creek Tributary	High nitrate leaching risk		X		X		
Little Gilson Creek Tributary drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Homes throughout the Little Gilson Creek Tributary	Potential septic system issues	X	X		X		
Little Gilson Creek Tributary monitoring site	Extensively embedded substrate, heavy silt cover, moderately impaired biotic community, high E. coli	X	X	X	X		X
Wet areas	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

Table 30: Observations in Subwatershed #10: Little Blue River Headwaters

Location	Description	E.coli issue	Nitrogen issue	Sediment issue	Education issue	Possible BMP implementation	Monitoring recommended
Little Blue River Headwaters	Heavily grazed land and livestock with access to stream	X	X	X	X	X	
Little Blue River Headwaters	Hog farms	X	X		X	X	
Little Blue River Headwaters	Insufficient filter strips, natural vegetation removed		X	X	X	X	
Little Blue River Headwaters drainage basin	High percentage of row crop agriculture with chemical and/or manure fertilizer application		X		X	X	
Little Blue River Headwaters	Eroding stream banks			X	X	X	
Little Blue River Headwaters	Moderate to very low nitrate leaching risk, low to high pesticide leaching risk		X		X		
Town of Mays	Potential point source pollution	X	X	X	X	X	X
Homes throughout the Little Blue River Headwaters	Potential septic system issues	X	X		X		
Headwaters monitoring site	Moderate silt cover, very narrow buffer zone, slightly impaired biotic community, high E. coli	X	X	X	X	X	X
Wet areas and CFO sites	Wetland restoration/development needed to filter runoff and protect groundwater	X	X	X	X	X	
Accumulation sites of trash and/or logjams	River clean up and/or open stream management is needed to protect water quality, improve recreation, and preserve drainage			X	X		

4.3 Setting Goals and Choosing Measures to Apply

The Steering Committee believes focusing on a few specific goals will yield better results than spreading efforts too thin over many goals. The Committee recognizes that the short-term benefits of tangible, on-the-ground water quality improvements must be balanced with the slower process of educating the general public. Implementation of BMPs throughout the watershed will be vital for the purposes of load reduction, public interest, and project sustainability. As conditions improve, accomplishments will be shared with the community to positively reinforce better stewardship that sustains environmental resources.

In the following section each problem (from Subsection 4.1) is followed by:

- An overarching goal, which states water quality improvements we hope to reach by 2020.
- Interim goals, which provide direction for the steps needed to realize the overarching goal.
- Critical areas, which help define where efforts will be applied.
- Strategies that include BMPs to address the identified problem.
- A chart with objectives, action items, target audience, responsible party, schedule, and indicators, which spell out strategies for meeting the interim goals.

This information is designed to be a guide for the SWCDs and the Watershed Project Steering Committee. As new information becomes available and conditions in the watershed change, the strategies listed here should be reviewed and modified. Review of the watershed management plan will be a standing item on the Rush and Shelby County SWCD Plans of Work, so goals and objectives can be updated and remain at the forefront of project

*E. coli L*evels Exceed the State Standard

Problem: The Little Blue River does not meet the state designated recreational standards for full body contact and is included on IDEM's 2006 303(d) list for impaired waterbodies due to *E. coli* contamination.

Overarching Goal: By the end of 2020, reduce *E. coli* bacteria levels to the state standard of 235-colonies/100 mL in the Little Blue River Watershed. Use both volunteer monitoring and lab testing to verify improvement and identify possible sources of contamination.

Interim Goal 1: Reduce E. coli spikes by 20% in the Manilla Branch and Rays Crossing Tributaries by the end of 2010 (percent reduction is determined from peak E. coli counts recorded in the LARE Diagnostic Study for Manilla Branch and Rays Crossing Tributaries.)

Interim Goal 2: Every residence that receives a new septic permit that is issued in Rush and Shelby County will receive information about septic maintenance beginning in 2008.

Interim Goal 3: Encourage livestock owners to limit livestock access to 20 acres of stream by the end of 2010.

Interim Goal 4: Review the interim goals in 2011 and establish new interim goals to meet the overarching goal in 2020.

Critical Area(s): The lower section of Little Blue River starting at the Rush/Shelby County line and extending west to the confluence with Big Blue River is a critical area for E. coli (see Figure 21). This section of the river is included on IDEM's 2006 303(d) list for impaired waterbodies due to elevated E. coli contamination. Tables 21-30 also show there are numerous locations where human activity could be contributing to high E. coli levels. These areas should be included as potential sites for BMPs and increased education.

Strategies: Depending on land use and human activity, improvements that address the problem of high E. coli concentrations are: manure management, riparian buffers, filter strips, septic system construction and maintenance, wetland restoration, nuisance wildlife control, grazing management, livestock fencing, and alternative watering systems. See Figure 26 for a map that shows possible locations for BMPs.

High E. coli Levels					
Objective	**Action Item**	**Target Audience**	**Responsible Party**	**Schedule**	**Indicators**
Promote proper septic system construction and maintenance	Increase distribution of septic system information packets through the SWCD office and website.	Homeowners and businesses throughout the watershed in towns and rural areas	SWCD staff and Watershed Project	Initiate immediately and continue through 2010.	Number of information packets distributed; website visits on septic page; new septic permits that have maintenance instructions provided. Number of builders and realtors who receive information.
	Foster cooperative partnerships with County Health Departments to distribute septic maintenance information.	Shelby and Rush County Health Departments			
	Provide information to local builders and realtors regarding septic issues in rural settings.	Local home builders and realtors			
Facilitate discussion on wastewater treatment options.	Research and discuss with local government officials wastewater treatment options appropriate for clusters of rural homes.	County Commissioners and other officials	SWCDs and Watershed Project	Initiate in 2008	Number of contacts made with government officials.
Increase proper manure management awareness among livestock owners.	Contact livestock owners in the watershed to distribute information and explain cost share opportunities if available.	Livestock owners of horses, beef & dairy cattle, hogs, sheep, goats, and other livestock species	Clean Water Indiana (CWI) Technician, Watershed Project, SWCDs	Initiate in 2008.	Number of livestock owners contacted.
Increase awareness of grazing management techniques that preserve	Hold a grazing management workshop with the NRCS grazing specialist	Current or future grazing operations.	CWI Technician, Watershed Project,	Current to 2010	Number of stream acres protected; number of
	Provide cost share and technical assistance to fence livestock out of at least 20 acres of stream.				

water quality.	Provide cost share and technical assistance to install 5 alternative watering sources.		SWCDs, NRCS		participants at workshop

High E. coli Levels

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Increase awareness of goose control	Partner with real estate companies, County Health Departments, and the Shelbyville MS4 Operator to educate the public about goose control methods. Explain control measures that discourage mowing to the water's edge. Provide information on the SWCD website.	Homeowners and businesses that have property adjoining open water	SWCDs, real estate companies, County Health Departments, Shelbyville MS4 Operator	Current to 2010	Visits to website; articles written; increased acreage around water bodies that utilize goose control measures.
Collect data on E. coli contamination at targeted sites in the watershed.	Test stream samples using techniques that reveal the origin of E. coli contamination so control efforts can be targeted at the source(s). Use volunteer monitors to collect data on E. coli levels.	SWCD Supervisors, Project Steering Committee, County Health Departments, government officials	SWCDs, volunteer water quality monitors	Initiated in 2006. Continue through 2010	Laboratory analysis; volunteer water quality data results.
Set new interim goals based on previous accomplishments	Review the watershed management plan goals and set new goals to meet the overarching goal.	Project Steering Committee, Rush and Shelby County SWCDs	SWCD Supervisors in Rush and Shelby Counties	2011	Accomplishments of current goals and establishment of new measurable goals.

High Nitrate-Nitrogen Concentrations

Problem: The 2004 LARE Diagnostic Study found that nitrate/nitrogen concentrations during base and storm flow conditions were elevated at all sites. All sites exceeded the USEPA recommended criterion for nitrate/nitrogen of 0.63 mg/L for streams in the Central Corn Belt Plains Ecoregion.

Overarching Goal: By the end of 2020, reduce nitrate-nitrogen concentrations in the Little Blue River Watershed to the value of 0.63 mg/L. Use volunteer monitoring to determine concentrations.

Interim Goal 1: By the end of 2010 during base flow conditions, reduce nitrate-nitrogen concentrations by 20% at the Lower Little Blue River sampling site (percent reduction is determined from levels reported in the LARE Diagnostic Study).

Interim Goal 2: Increase utilization of filter strips in the watershed by 20 acres by the end of 2010.

Interim Goal 3: Increase utilization of structures for water control (NRCS FOTG Code #587) that will retain water from approximately 100 farmable acres by 2010.

Interim Goal 4: Review the interim goals in 2011 and establish new interim goals to meet the overarching goal for 2020.

Critical Area(s): Table 14 shows that nitrogen concentrations exceed target values throughout the watershed during base and storm flow conditions. Therefore the entire watershed is considered a critical area for nitrogen reduction. However six subwatersheds – Rays Crossing, Manilla Branch, Cotton Run, Beaver Meadow, Farmers Stream, and Little Gilson Creek - are of special concern since concentrations exceeded state water quality standards at those monitoring sites during storm flow. Tables 21-30 indicate numerous locations where human activity could be contributing to high nitrogen levels. These areas should be considered for BMPs and increased education.

Strategies: Depending on land use and human activity, improvements that address the problem of high nitrogen levels are: nutrient management planning, manure management, livestock fencing, filter strips, riparian buffers, structures for water control, septic system construction and maintenance, wetland restoration, nuisance wildlife control, grazing management, stream crossing protection, and alternative watering systems. See Figure 26 for a map that shows the possible location for suggested BMPs.

High Nitrate-Nitrogen Concentrations					
Objective	**Action Item**	**Target Audience**	**Responsible Party**	**Schedule**	**Indicator(s)**
Develop and implement nutrient/pesticide management plans.	Research recent technology developments that reduce application rates and offer alternatives.	Farming operations.	Watershed Project, Clean Water Indiana (CWI) Technician, SWCDs, NRCS	Current to 2010	Number of participants who receive technical assistance. Number of acres involved in planning.
	Investigate cost-share opportunities for management plan development and conservation practices.				
	Market existing conservation planning resources and programs.				
	Develop outreach methods specific to non-agricultural, commercial applicators.	Commercial applicators: farmers landscape professionals, and park managers.			
Showcase innovative methods for managing runoff from farm fields.	Create a demonstration site showcasing structures for water control; develop a cost-share program for installing these structures that will retain water from approximately 100 farmable acres	Row crop agriculture operations	Watershed Project, CWI Technician, SWCDs, NRCS	2007-2008	Number of people who visit the demonstration site.
Increase participation in conservation practices	Provide cost share opportunities to modify manure application equipment contingent upon adopting an appropriate schedule of manure testing and utilization of NRCS recommended application rates.	Livestock	Watershed Project, CWI	Present to	Number of applicators that are modified; operations that adopt NRCS

for the reduction of nutrient infiltration from livestock sources	Develop a cost-share program for livestock exclusion and alternative watering sources	operations.	Technician, SWCDs, NRCS	2010	application rates; number of animals excluded from stream; number of alternative watering sources installed; nitrogen load reduction.

High Nitrate-Nitrogen Concentrations

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Increase percentage of stream corridor that is protected by filter strips and riparian buffers.	Market existing conservation planning, resources, and programs. Target outreach to areas that currently lack vegetative buffers. Incorporate urban/suburban/rural residential segments into outreach. Develop a cost-share program to increase utilization of filter strips in the watershed by at least 20 acres.	Landowners along the Little Blue River and its tributaries.	Watershed Project, CWI Technician, SWCDs, NRCS	Present to 2010	Increased acreage of filter strips. Increased area of buffer zones. Reduction of nitrate-nitrogen concentrations at targeted monitoring sites.
Promote the benefits of wetlands	Provide information to CFOs to promote the use of constructed wetlands to filter drainage from a manure containment facility. Utilize local media and the SWCD website to explain the benefits a wetland can provide.	CFOs and other livestock owners; general public	Watershed Project, CWI Technician, SWCDs, NRCS	Present to 2010	CFOs that receive information; visitors to website page; articles written.
Increase homeowner awareness of ways to protect water quality	Provide educational workshops for Backyard Conservation and soil testing. Provide information about proper yard waste disposal and composting alternatives on SWCD website.	Homeowners and residents in the watershed.	Watershed Project and SWCDs (Partners: NRCS, Purdue Cooperative	Present to 2010	Number of participants at workshops; number of visits to the website;
	Support existing educational efforts by Purdue Cooperative Extension through the annual Garden Clinic and Master Gardeners programs.	Homeowners, residents, Master Gardeners,			

from excessive nutrients.	Initiate dialogue with commercial lawn care companies, local landscape architects and residential contractors.	landscape professionals, contractors, and lawn chemical companies.	Extension, Solid Waste Management Districts)		professional participation; nitrogen load reduction.

High Nitrate-Nitrogen Concentrations

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Determine nitrate/nitrogen concentrations in the Little Blue River and its tributaries.	Utilize Hoosier Riverwatch volunteers to collect data 6 times/year. Develop funding sources for USGS equipment to collect continuous data on nitrate nitrogen concentrations at Kennedy Park in Shelbyville.	Watershed Steering Committee, SWCD Supervisors, government officials	Hoosier Riverwatch Volunteers; USGS; Watershed Project	Current to 2010	Results of water quality testing; nitrogen load reduction.
Increase public awareness of groundwater protection, particularly in areas of very high and high nitrate leaching risk	Cooperate with County Health Departments and Purdue Cooperative Extension offices to provide literature on groundwater protection. Utilize the SWCD website to provide information to homeowners who own private wells.	Homeowners on private wells.	SWCDs, County Health Departments, Purdue Cooperative Extension offices	Current to 2010	Number of people who receive the groundwater protection literature. Number of website page visits.
Set new interim goals based on previous accomplishments	Review the watershed management plan goals and set new goals to meet the overarching goal.	Project Steering Committee, Rush and Shelby County SWCDs	SWCD Supervisors in Rush and Shelby Counties	2011	Accomplishments of current goals and establishment of new measurable goals.

Sedimentation

Problem: Water quality testing done by the LARE Diagnostic Study showed turbidity levels that exceed recommended target values at 5 out of 10 sampling sites. The QHEI evaluations describe moderate to poor substrate quality throughout streams in the watershed. Six sampling sites exceeded the recommended Central Corn Belt Plains target value of 0.076 mg/L for Total Phosphorus, a nutrient that enters water attached to soil particles through the process of erosion. These indicators point to sedimentation issues in the Little Blue River Watershed.

Overarching Goal: Since turbidity can be an indicator of sedimentation, by the end of 2020 reduce turbidity levels in the Little Blue River Watershed to the target value of 9.89 NTU, which is the USEPA 2000 recommended turbidity concentration. Use volunteer monitoring and visual observation to determine NTU levels, substrate quality, and erosion issues.

Interim Goal 1: By the end of 2010 reduce turbidity levels by 10% during storm flow at the Lower Little Blue River sampling site (percent reduction is determined from levels reported in the LARE Diagnostic Study).

Interim Goal 2: Increase implementation of conservation tillage for the reduction of sedimentation and smothering due to overland soil runoff from agricultural practices by 10% by the end of 2010.

Interim Goal 3: Increase BMP use in livestock operations by 20% by the end of 2010, which will reduce sedimentation and erosion from livestock without compromising the economic integrity of existing operations.

Interim Goal 4: Target owners of tracts mapped as HEL to increase cover crop utilization by 200 additional acres by 2010.

Interim Goal 5: Review the interim goals in 2011 and establish new interim goals to meet the overarching goal for 2020.

Critical Area(s): Figure 12 shows areas mapped as Highly Erodible Land, which are almost exclusively in the lower half of the watershed. Based on HEL determinations, subwatersheds of special concern for erosion issues are Lower Little Blue, Rays Crossing, Manilla Branch, Cotton Run, Middle Little Blue and Beaver Meadow. Tables 21-30 indicate numerous locations where human activity could be contributing to sedimentation. These areas should be considered for BMPs and increased education.

Strategies: Depending on land use and human activity, improvements that address the problem of sedimentation are: conservation tillage, cover crops, livestock fencing, riparian buffers, streambank stabilization and revegetation, and grassed waterways. See Figure 26 for a map that shows the possible location for suggested BMPs.

Sedimentation

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Encourage implementation of conservation tillage practices	Offer modifications to conventional equipment so that it can be used for conservation tillage	Conventional farmers in the watershed	Watershed Project, NRCS, SWCDs, Clean Water Indiana (CWI) Technician	2008-2010	Increased acreage in conservation tillage; sediment load reduction.
	Target 300 additional acres of land utilizing no till	Conventional farmers in the watershed			
	Research manure application options for conservation tillage	Farmers incorporating manure application in crop practices			
Increase use of cover crops in conventional systems	Research cover crop options for conditions in the watershed.	Farmers in the watershed.	Watershed Project, NRCS, SWCDs, CWI Technician	2008-2010	Sediment and phosphorus load reduction. Acres of cover crops installed.
	Create a cost- share program designed to offset initial costs of cover crop implementation on at least 200 acres.				
	Provide technical resources and/or contacts to producers for cover crop installation.				
	Coordinate outreach and advertising for use of cover crops and respective benefits.				

Promote the benefits of reducing livestock access to streams and tributaries.	Promote stream bank fencing and alternative watering systems through cost-share opportunities. Restore stream banks with natural vegetation. Compile cost/benefit analysis of grazing marginal pastureland along stream banks.	Traditional and recreational livestock owners.	Watershed Project, NRCS, SWCDs, CWI Technician	2008-2010	Feet of fencing installed, number of watering systems installed.

Sedimentation

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Reduce intensive over grazing and year round feeding on small lots	Assist livestock owners with the development of prescribed grazing plans. Develop outreach materials for diverse livestock interests. Provide livestock owners with access to technical resources and cost-share if available	Traditional and recreational livestock owners	Watershed Project, NRCS, SWCDs, CWI Technician	2008-2010	Number of practices developed. Sediment load reduction.
Increase the number of HEL tracts in the CRP	Provide information to landowners in critical areas about opportunities through the CRP	Landowners, particularly in the Rays Crossing, Manilla Branch, and Beaver Meadow subwatersheds	Watershed Project, NRCS, SWCDs, CWI Technician	Current to 2010	Number of HEL tracts enrolled. Sediment load reduction.
Promote agriculture BMPs that reduce erosion	Provide cost share and technical assistance to landowners for BMPs including riparian buffer development, stream bank stabilization, stream crossing protection, revegetation of exposed areas, and grassed waterways	Landowners and agriculture operations	Watershed Project, NRCS, SWCDs, CWI Technician	Current to 2010	Number of landowners contacted. Number and kinds of BMPs installed. Sediment load reduction.
	Develop a list of existing conservation farmers.				

Initiate and support a cooperative mentoring network of conservation farmers.	Promote participation in the network and provide incentives for mentor farmers. Create a list of new farmers and/or those interested in developing a mentor relationship. Provide opportunities for farmers to network (see following objective). Grant an annual water quality award for outstanding conservation stewardship.	Existing and potential conservation farmers throughout the watershed.	Watershed Project, NRCS, SWCDs, CWI Technician	Current to 2010	Number of farmers involved. Interviews and farmer feedback.

Sedimentation

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Offer professional development opportunities such as field days and hands-on workshops on specific topics generated by producer interest.	Plan dates during off-season and partner with other organizations. Research farmer preferred publications and advertise in advance. Request input from producers regarding specific topics and areas of conservation interest by placing surveys in SWCD newsletters and/or at annual meetings. Develop subject-specific agendas that avoid duplication or repetition of existing efforts. Recruit top-professionals in subject fields to lead workshops.	Farmers throughout the watershed. (Secondary audience: farmers in the region.)	Watershed Project, NRCS, SWCDs, CWI Technician	Current to 2010	Number of field days provided. Participation/ attendance at events. Feedback from surveys. New interest generated.
Provide information on effective erosion control BMPs to contractors who work in urban settings.	Cooperate with the Shelbyville MS4 Operator to provide erosion control BMP information to urban contractors.	Contractors who work on construction sites.	SWCD, Shelbyville MS4 Operator, Watershed Project	2008 to 2010	Number of contractors who receive the information. Number of BMPs installed.
Set new interim goals based on previous accomplishments	Review the watershed management plan goals and set new goals to meet the overarching goal.	Project Steering Committee, Rush and Shelby County SWCDs	SWCD Supervisors in Rush and Shelby Counties	2011	Accomplishments of current goals and establishment of new measurable goals.

Need for Increased Public Education and Outreach

Problem: Many people are interested in protecting water quality but seem confused about how individual actions contribute to overall concerns. Misinformation abounds regarding issues such as logjams, illegal dumping, wildlife habitat, recreational opportunities, and the cumulative impact of human activity on water quality.

Overarching Goal: Cultivate citizen interest and leadership in conservation and natural resources by educating children and adults through increased hands-on learning opportunities, information brochures, workshops, and service opportunities.

Interim Goal 1: Provide 500 water quality specific education hours in the next three (3) years to children and youth.

Interim Goal 2: Maintain a presence throughout students' academic careers by developing and marketing annual programs for elementary, middle school/junior high, and high school students with material based on the Indiana Academic Standards.

Interim Goal 3: Provide professional development for a minimum of 30 teachers and other adults in natural resource conservation and water quality programs during the next three (3) years.

Interim Goal 4: Increase urban/suburban awareness about impacts of Nonpoint Source pollution on water quality by thirty (30) new households and three (3) new businesses by 2010.

Interim Goal 5: Increase local capacity for citizen involvement in water quality related issues, building contact list to over one hundred (100) by 2010.

Interim Goal 6: Review the interim goals in 2011 and establish new interim goals to meet the overarching goal.

Critical Need: The first priority for education and outreach is to quantify current levels of public knowledge about water quality. Both the agriculture and urban community will be surveyed to determine a baseline for educational efforts.

Strategies: Information gathering will be done through personal interview, website response forms, surveys distributed through newsletters and the local media. Educational programming tools are presentations, workshops, field days, news releases, professional development and volunteer opportunities, mentoring networks, classroom curriculum, and cooperative efforts with other agencies. BMPs.

Public Education and Outreach					
Objective	**Action Item**	**Target Audience**	**Responsible Party**	**Schedule**	**Indicators**
Quantify current levels of public knowledge regarding water quality	Utilize the SWCD website and local media to survey public knowledge regarding water quality issues.	Urban/suburban/ rural residents, businesses, and public officials	SWCDs	Soil and Water Stewardship Week 2008	Number of surveys returned; information compiled from surveys
Develop sustainable youth programming in the watershed	Provide age appropriate water quality education that teaches concepts outlined in the Indiana Academic Standards through 500 education hours.	Elementary, Middle School, and High School students	SWCD Educators and with Purdue CES	Current to 2010	Number of students and teachers served.
Promote professional development in conservation and natural resource fields	Offer service learning opportunities to youth and adults through urban/agriculture programs and other conservation initiatives	High school students, 4-H members, Junior Leaders, Scouts, Youth Groups, adults	SWCD Educators and with Purdue CES	2007- 2010	Number of participants in educational activities.
Promote use of water quality materials to classroom teachers and other interested adults	Offer training in Project WET and/or related curricula. Develop evaluation tools to determine the effectiveness of training.	Traditional and non-traditional educators.	SWCD Educators	Current to 2010	Number of educators trained; evaluation results

Work at a watershed level to promote coordinated resource management by establishing a cooperative mentoring network of conservation farmers and contractors	Create a list of those interested in the network and showcase successful practices and operators at annual meetings, field days and in newsletters	Agriculture operations	SWCDs, Clean Water Indiana (CWI) Technician, MS4 Shelbyville MS4 Operator, SWCD Educators	Current to 2010	Number of participants in the network

Public Education and Outreach

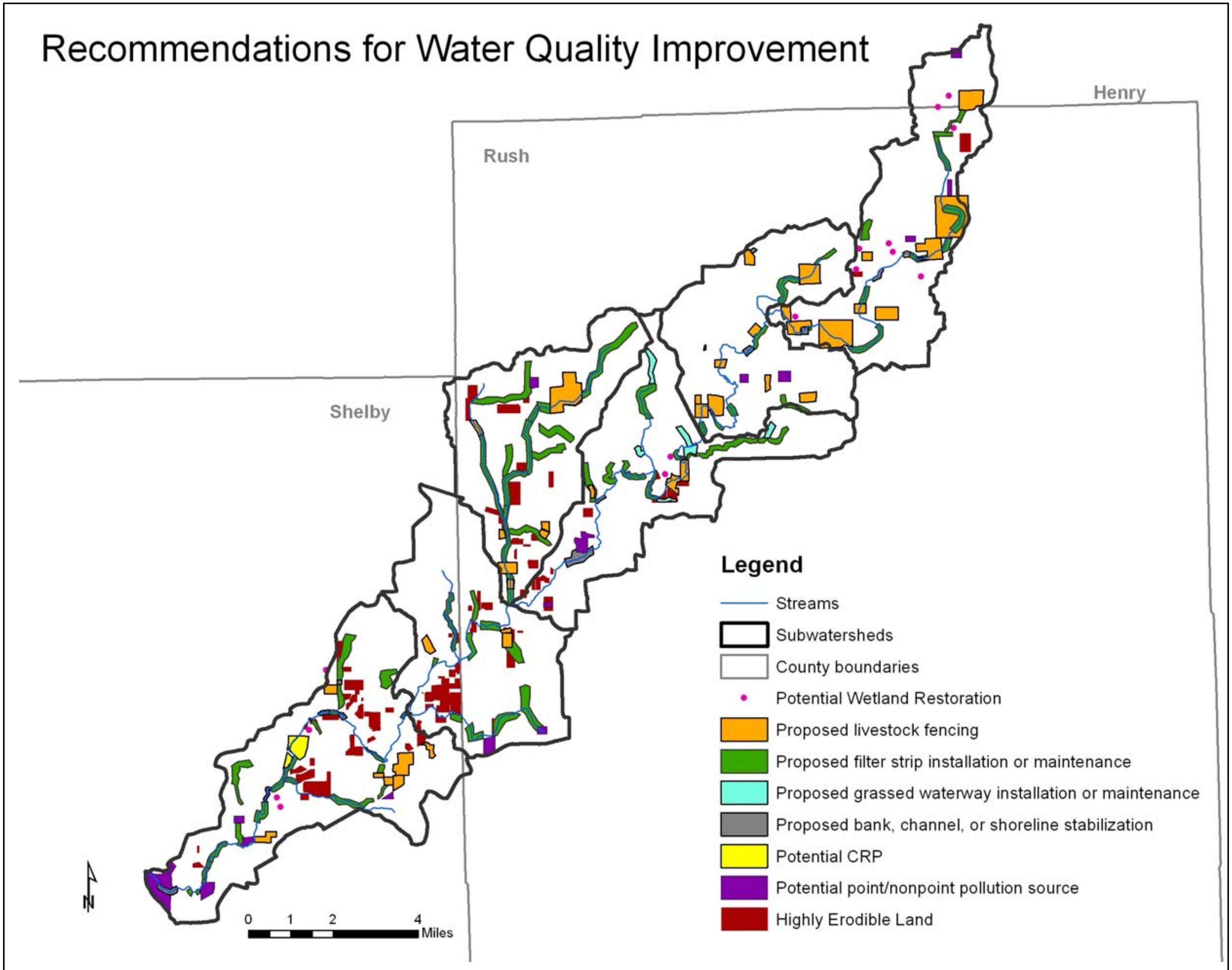
Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Provide accurate, up-to-date information on local water quality to residents and local officials	Submit regular press releases to media and maintain a project website. In cooperation with the USGS provide near real-time water quality data on the Web collected by monitoring equipment at Kennedy Park in Shelbyville.	Urban/suburban/ rural residents, businesses, and public officials	SWCD Educators, USGS	Current to 2010	Number of media contacts; visitors to website
Increase name recognition, connect with general public, and track increase in knowledge of water quality issues	Create displays and brochures to use at public libraries, fairs, garden clinics, and festivals to promote the watershed goals. Utilize a survey similar to the one distributed during Soil and Water Stewardship Week 2008 to determine level of public knowledge	Urban/suburban/ rural residents, businesses, and public officials	SWCD Educators; with Purdue CES	Soil and Water Stewardship Week 2010	Number of surveys returned; information compiled from surveys
Provide education on specific topics relating to conservation stewardship	Host workshops on topics that are requested by the public, civic groups, government officials, etc.	Urban/suburban/ rural residents, businesses, and public officials	SWCD Educators; with Purdue CES	Current to 2010	Number of participants; evaluation results
Work with local drainage boards and public officials to better utilize BMPs during legal drain maintenance	Create a dialogue with local drainage boards and provide BMP information.	Drainage Boards, other government officials	SWCD Supervisors and Staff	2007-2010	Number of drainage board contacts
		Agriculture	Watershed		

Implement pesticide management planning	Provide information, cost share, and technical assistance for pesticide management planning	operations especially in areas with high pesticide leaching risk.	Project, NRCS, SWCDs, CWI Technician	2007-2010	Number of acres with pesticide management planning
Create opportunities for residents and homeowners to improve water quality and aesthetics of the Little Blue River	Hold events that focus on stream maintenance, trash clean up, and wildlife habitat improvement.	Urban/suburban/ rural residents, businesses, and public officials	SWCD Educators; with Purdue CES	Current to 2010	Number of participants at events

Public Education and Outreach

Objective	Action Item	Target Audience	Responsible Party	Schedule	Indicators
Create opportunities for residents to enjoy the Little Blue River	Work with Shelbyville Park Department to sponsor an annual river recreation day. Activities could include a fishing derby, canoeing, wading, scavenger hunt, etc.	Urban/suburban/ rural residents, businesses, and public officials	SWCD Educators, Shelbyville Parks and Recreation Department	Annually 2008 through 2010	Number of people who participate
Create and maintain a network of volunteer water quality monitors	Hold annual Hoosier Riverwatch training. Provide quality control, physical support and equipment to volunteer water quality monitors.	Adults and students over the age of 18.	SWCDs and Educators	Current to 2010	Number of water quality monitors who collect data at a minimum of four times/year.
Cooperate with the Shelbyville MS4 program to mark storm drains	Create an annual cooperative activity to mark all storm drains in Shelbyville; partner with existing activities such as the Bears of Blue River Festival and/or Earth Day.	Adults, scouts, age appropriate students	Shelbyville MS4 Operator and Shelby County SWCD	2008-2010	Number of participants in marking program; number of drains marked
Set new interim goals based on previous accomplishments	Review the watershed management plan goals and set new goals to meet the overarching goal.	Project Steering Committee, Rush and Shelby County SWCDs	SWCD Supervisors in Rush and Shelby Counties	2011	Accomplishments of current goals and establishment of new measurable goals.

Table 26: Recommendations for Water Quality Improvement in Critical Areas of the Watershed



Section 5: IMPLEMENTING THE PLAN, LONG-TERM RESULTS, AND EVALUATION

During the process of management planning, the Steering committee recognized the financial requirements for implementation. For this reason, the committee applied for a second Section 319 Nonpoint Source Grant through the Indiana Department of Environmental Management. The grant request was submitted September 1, 2006 and is now in the review process. Another grant request was submitted to the IDNR through the LARE program. An award of $35,000 was made for three priority tributary subwatersheds – Little Gilson Creek, Cotton Run, and Rays Crossing. Another LARE grant was submitted in 2007 to expand the target areas for BMP implementation.

Included in all the grants for implementation are dollars for installation of agricultural BMPs as well as public outreach. In order to deliver BMPs throughout the watershed as funding becomes available, the Steering Committee will design a cost share program to assist producers, landowners, and residents with the cost of implementation. Projects will be ranked according to objective criteria to maximize dollars spent for improvement of water quality in the Little Blue River Watershed.

5.1 Obstacles to Implementation

According to research, the most typical obstacle encountered in implementing a watershed project is the reluctance of private landowners to participate. Participation increases if people are aware of water quality concerns, if they have access to water quality/conservation materials and information, have a higher education level, are willing to take risks, have cost-share incentives available, and experience one-to-one contact with project personnel. Research also shows that producers who were tenant farmers or were employed off-farm were less likely to participate in conservation programs. The main reason landowners don't participate in a watershed project is that they don't believe water quality is a problem.

The Shelby and Rush County SWCDs can take action to overcome these obstacles by providing landowners with information about water quality and the various programs that are available to cost share BMP initiatives. The SWCDs intend to use grant-funded watershed land treatment projects as "showcases" to build stakeholder interest and participation. The Districts plan to encourage local high school science classes to initiate volunteer monitoring not only in the Little Blue River Watershed, but also throughout both counties in order to raise awareness, provide education, and stimulate interest in careers in natural resource conservation.

5.2 Implementation Strategy

Project success involves community involvement through individual service, group activities and collaborative organizational partnerships. The watershed project is directed by local stakeholders through the Steering Committee and is sponsored by the Rush and Shelby County SWCDs.

5.2.1 Local Decision Making

The stakeholder led Steering Committee has been actively involved in the development of the Watershed Management Plan. We will continue to promote a diverse membership in the Steering Committee by seeking additional stakeholders who represent a wide array of community interests including homeowners, farmers, city and county officials, business people, and environmentalists. Steering Committee meetings will be advertised to promote public involvement. The Steering Committee will continue to be the primary decision-making body in conjunction with the Rush and Shelby SWCD Boards of Supervisors.

5.2.2 Public Involvement

Public meetings will be held in both Rush and Shelby County at the outset of any implementation phase of the project. Meetings will be used to inform the public, request input, and allow the opportunity for questions. The public will be invited to participate in river clean up activities, educational workshops, volunteer water quality monitoring, etc. to increase awareness of water quality improvements in their community and to develop a network of interested citizens to ensure long-term success.

5.2.3 Partnerships

Many community groups and local government officials are project supporters including both Rush and Shelby County SWCDs, both County Solid Waste Management Districts, both County Health Departments, the City of Shelbyville Parks Department and MS4 Project. Purdue Extension in both counties has already worked closely with the watershed project by distributing information through newsletters and holding jointly sponsored workshops and field days. Education and public outreach campaigns will be accomplished in large part through partnerships with local groups as we share knowledge and resources. Collaboration with area schools is essential for enrichment programs and classroom presentations. Regional communication and collaboration with other watershed groups, such as Clifty Creek Watershed Project, the Sugar Creek Watershed Project, and the Big Blue River Watershed Project has already begun. The USGS Indiana Division of Water is a vital technical resource. In May 2007 the Watershed Project received a grant from the American Water Company to partner with the USGS, Knauf Fiberglass, and Shelbyville MS4 to install a permanent water quality monitoring probe and flow-gage at Kennedy Park in Shelbyville. Three wire-weight gages will also be placed at priority sites in the watershed. Long-term funding for operation and maintenance of this equipment will be sought through local sources.

5.2.4 Water Quality Improvements and Interim Measurable Milestones

Project progress will be tracked by measurable items such as attendance at events, acres of conservation implemented, and contaminant load reduction. Utilizing data from the watershed inventory in conjunction with the USEPA STEPL model, estimated load reductions for nitrogen, phosphorus, biochemical oxygen demand, and sediment have been calculated (Appendix G). These numbers are based on estimated annual implementation of targeted BMP, however, BMP efficiencies do not include reduction from any urban BMPs.

5.2.5 Water Quality Monitoring

In order to monitor the effective load reduction of conservation practices throughout the watershed, the existing volunteer water quality monitoring network will continue to collect water quality data with several modifications. Existing site locations will remain and three more will be added to better cover the watershed area. Water chemistry data collection will be increased to six times/year. Monitors will calculate discharge volume when collecting water chemistry information. They will gather habitat and biological data twice annually. Site specific studies will also be planned and coordinated with any major cost-share projects. These studies will include upstream and downstream locations providing a very basic “before and after” glimpse at positive improvements made through implementation of BMPs.

As stated in Section 5.2.3, the watershed project has received a grant from the American Water Company to install flow gages and a water quality probe in the watershed. The streamflow-gage and water quality probe located at Kennedy Park in Shelbyville will provide one-hour stage, streamflow, and water quality data disseminated through the Internet. Three wire-weight gages located in high priority sites in the watershed will allow volunteer monitors to take a reading of stage from the wire-weight gage and compute streamflow at that point in time. The water quality probe will continuously monitor water temperature, specific conductivity, pH, and dissolved oxygen. Data on *E. coli*, chlorophyll, chloride, and nutrients will also be gathered. In addition to grant funds, this project was made possible through cash contributions from Knauf Fiber Glass, a local insulation manufacturer, and Shelbyville MS4; as well as a substantial in-kind contribution from the USGS. The watershed project will seek long-term funding from government, business and individuals for operation and maintenance costs. This project will help the public view watershed planning as a continuous effort that adds value to the community. All residents – with special emphasis on school teachers – will have access to near real-time flow and water quality data, which will enhance understanding of local water resources.

5.3 Ensuring Long-Term Results

The watershed project has developed the following strategies to ensure that our efforts will provide long-term water quality improvement as well as increased public awareness of water quality issues.

1. Besides having the Little Blue River Watershed Management Plan available at Henry, Rush and Shelby County Soil and Water Conservation Districts, we will distribute copies to city and county plan commissions, county commissioners, county surveyors, drainage boards, mayors, health departments and other interested officials. The county commissioners and mayors in Rush and Shelby Counties will be personally briefed on the goals of the management plan and how activities to implement the goals will benefit the community.
2. Sections of the Watershed Management Plan will be posted on the Shelby County SWCD website and linked to other appropriate sites.
3. A Nonpoint Source Pollution Enviroscape model will be purchased as money becomes available. This will be offered to educators throughout Rush and Shelby Counties including SWCDs, Purdue Extension, schools, clubs, scouts, 4-H and other interested parties. This interactive and motivational model can be used for many years to educate adults and children about Nonpoint and Point Source pollution.
4. The watershed project will seek additional funding to implement the Watershed Management Plan until water quality goals are met.
5. Permanent educational signs will be placed at demonstration sites to explain the benefits of BMPs that are installed. These signs will be a continuous reminder to the public about water quality improvements in their community. A special effort will be made to work with the new city/county park on the east side of Shelbyville to erect educational signs about BMPs that are an integral part of the plan design.

6. Volunteer water quality monitoring will continue utilizing current volunteers, and recruiting new ones annually. These volunteers will be invited to join the NRCS Earth Team program and they will receive recognition at the SWCDs' annual meetings. Information gathered by the volunteers will be available on the Hoosier Riverwatch website, which can be accessed by interested citizens at any time.

5.3.1 Estimated Financial and Technical Assistance Needed to Implement the Plan

Appendix H contains cost estimate, technical assistance, and potential funding source(s) for the action items that are listed in Subsection 4.3 "Setting Goals and Choosing Measures to Apply."

5.4 Evaluation

Rush and Shelby County SWCD Boards of Supervisors will review the Watershed Management Plan annually to determine progress toward goals and objectives. When new information becomes available, the plan will be updated by adding an Addendum. Success will be documented through tracking, surveys, and load reduction calculation.

5.4.1 Tracking

Progress will be tracked through measurable criteria such as attendance at events, acres of water quality improvements implemented, livestock excluded from streams, number of students and teachers served, number of visits to the watershed website, information distributed, and load reductions.

5.4.2 Surveys

Surveys will be included in the evaluation of events such as workshops and demonstration projects. General public knowledge about watershed issues will be assessed by surveys administered during Soil and Water Stewardship Week in 2008 and 2010. Information from these surveys will be gathered by SWCD staff and evaluated by the Boards of Supervisors. Feedback gathered from these surveys will be a driving force when developing educational programs and updating the management plan.

5.4.3 Load Reduction

In order to monitor the effective load reduction from BMPs, the watershed project will expand the existing volunteer monitoring network. The project will also utilize information from a multi-parameter water quality probe that is installed in cooperation with the USGS at Kennedy Park in Shelbyville. Subsection 5.2.5 describes how this equipment became available to the community. Through continuous monitoring of water quality at the Kennedy Park station and information gathered by volunteer monitors, major seasonal shifts and contaminant spikes can be more thoroughly documented and improvements established by implementation of BMPs will be measured.

Appendix G contains estimated pollutant load reductions calculated using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) model. Based on water quality data collected during the LARE Diagnostic Study, the percent reduction needed to meet the E. coli, nitrogen-nitrate, and phosphorus target values outlined in the goals were estimated.

A NOTE ON ESTIMATED POLLUTANT REDUCTION TARGETS: It is important that the estimated pollutant reduction targets be used as reference points and not as hard and fast indicators through which to evaluate the long term success of this watershed management plan. Both existing pollutant loadings and pollutant reduction targets are subject to a wide variety of assumptions, and are based on the best data currently available. The overall success of the watershed management plan should not only be evaluated by whether or not target load reductions or instream standards are achieved, but also on the basis of whether or not water quality improves as a result of implementing the watershed management plan. If existing pollutant loads are estimated too high, achieving target pollutant load reductions may not result in achieved in-stream pollutant concentrations. Alternatively, if existing pollutant loadings are estimated too low with goals that are easily achieved, in-stream target concentrations may be fulfilled prior to reaching target pollutant load reductions resulting in an inadequate number of BMPs to effectively improve overall water quality. (Stony Creek Watershed Management Plan, 2007)

The following table shows percent reduction needed to meet target values for E. coli, Nitrate-Nitrogen, and Total Phosphorus.

	Subwatershed	Date	Timing	E. coli (cfu/100mL)	% reduction needed to meet target (235 cfu/100 ml)	Nitrate-N NO3-N (mg/L)	% reduction needed to meet target (0.63 mg/L)	Total Phosphorus TP (mg/L)	% reduction needed to meet target (0.076 mg/L)
1	Lower Little Blue	7/30/2003	Base	310	24.2	3.956	84.1	0.061	
		6/13/2003	Storm	18,000	98.7	8.68	92.7	0.14	45.7
2	Rays Crossing	7/30/2003	Base	170		3.937	84.0	0.066	
		6/13/2003	Storm	3,100	92.4	12.88	95.1	0.196	61.2
3	Manilla Branch	7/30/2003	Base	650	63.8	5.823	89.2	0.073	
		6/13/2003	Storm	3,200	92.7	12.246	94.9	0.065	
4	Cotton Run	7/30/2003	Base	110		4.084	84.6	0.061	
		6/13/2003	Storm	760	69.1	12.199	94.8	0.04	
5	Middle Little Blue	7/30/2003	Base	280	16.1	4.699	86.6	0.049	
		6/13/2003	Storm	2,000	88.3	6.409	90.2	0.103	26.2
6	Beaver Meadow	7/30/2003	Base	190		4.177	84.9	0.037	
		6/13/2003	Storm	11,000	97.9	10.984	94.3	0.095	20.0
7	Farmers Stream	7/30/2003	Base	330	28.8	8.697	92.8	0.017	
		6/13/2003	Storm	530	55.7	12.52	95.0	0.05	
8	Upper Little Blue	7/30/2003	Base	170		3.963	84.1	0.045	
		6/13/2003	Storm	3,500	93.3	8.875	92.9	0.136	44.1
9	Little Gilson Creek	7/30/2003	Base	66		8.839	92.9	0.028	
		6/13/2003	Storm	360	34.7	13.785	95.4	0.057	
10	Headwaters	7/30/2003	Base	140		2.678	76.5	0.01	
		6/13/2003	Storm	780	69.9	8.013	92.1	0.12	36.7

Phosphorus reductions needed to meet to the target value of 0.076 mg/L ranged from 20.0% – 61.2% in the six subwatersheds that require reductions. Given that the estimated phosphorus reductions from proposed BMP implementation ranged from 82.2% - 84.5% for all subwatersheds, it appears that implementing the measures identified in the plan will be sufficient to meet the phosphorus goal.

Nitrogen - nitrate reductions needed to meet the target value of 0.63 mg/L ranged from 84.1% – 95.4% for all of the subwatersheds. While the estimated nitrogen reductions from proposed BMP implementation ranged from 79.6% - 81.2% and are slightly below the estimated reduction needed, there were several BMPs that were not accounted for in the STEPL model estimate. Given the additional reductions from these BMPs, it seems feasible that implementing the measures identified in the plan will be sufficient to meet the nitrogen goal.

APPENDICES

APPENDIX A
List of Acronyms

BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CFO	Confined Feeding Operation
CPWTP	Cooperative Private Well Testing Program
CQHEI	Citizen's Qualitative Habitat Evaluation Index
CRP	Conservation Reserve Program
CWI	Clean Water Indiana
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
EROS	Earth Resources Observation and Science
FCA	Fish Consumption Advisory
FSA	Farm Service Agency
HBI	Hilsenhoff Biotic Index
HEL	Highly Erodible Land
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
LARE	Lake and River Enhancement
mIBI	macroinvertebrate Index of Biotic Integrity
MS4	Municipal Separate Storm Sewer System
msl	mean sea level
NLEAP	Nitrate Leaching and Economic Analysis Package
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Units
NWI	National Wetland Inventory
PCBs	PolyChlorinated Biphenyls
ppm	parts per million
PTI	Pollution Tolerance Index
QAPP	Quality Assurance Program Plan
QHEI	Qualitative Habitat Evaluation Index
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWCD	Soil and Water Conservation District
TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey

APPENDIX B

Public Comments and Concerns

Compiled comments from kickoff meetings in Rush and Shelby Counties

General concerns/comments

- Prevent what happened to Shankatank from happening to the Little Blue.
- Impervious surfaces like parking lots affect the water table. The water flows away down the stream instead of replenishing the ground water.
- We shouldn't reinvent the wheel. If there are other watershed projects that are successful we should follow their example.

E. coli/water quality

- *E. coli* is a concern. What happens to the *E. coli*? Does it persist?
- How bad is the water quality?
- Is the Little Blue cleaner than years ago? How has the Rush County sewer project affected it?
- Is it safe to eat the fish?
- A study found some endangered mussels. That's evidence of some good water quality.
- Water quality is still a concern, but the new sewers in Arlington have helped clean up the Little Blue.
- Water pollution from livestock waste should be studied.

Drainage

- The river is fine. Drainage works well. We don't need the grant. Leave us alone.
- Do we want good drainage? Drainage has been a long-term problem.
- The river needs cleaning out for better drainage.
- Much flooding occurs from debris, beaver dams, etc. in portions of Little Blue. Will the plan address this problem?
- Will the plan address cleaning out streams?

Funding/costs

- How will we continue funding for this project?
- What are we doing with the money? This project seems redundant. There are plenty of fish and swimming is fine.
- If we clean up debris in the stream would there be a cost to landowners? Could this grow into assessments of landowners or regulation?
- Will this project be on-going with other projects?
- Will this affect the small farms?

Conservation practices

- Buffer strips take land out of production. How wide do buffer strips have to be?
- What do we mean by bank stabilization? Will this grant do any?
- How do you stop bank erosion?
- Bank erosion, sand & gravel bars, and log jams are a problem. I have lost 10' – 15' of bank and field in the past six years.

Dumping

- Trash dumping…especially large items is a problem.
- Where illegal dumping is a problem can signs be posted? What are the penalties? Do police check the areas? Could we use neighbors to watch?
- One group had a mass clean-up day – a family event. A business donated canoes and people filled them with trash from the river.
- Shelbyville Parks Department needs manpower and equipment to clean out large dumpsites along the riverbank at the new park and to deal with the expense.

Water quality testing

- Who did the water sampling for the previous grant (LARE Diagnostic Study)? Results must be properly evaluated. Were samples taken before the sewer project in western Rush County?
- School science classes could be used for water testing.
- We don't know if water quality is improving if we have nothing to compare data with.

Education

- Educate the public on what they can do to help.

APPENDIX C
Steering Committee Members, Advisors, and Volunteers

Steering Committee
Bob Waits – Chairman
Chris Everhart – Vice Chairman
Noell Krughoff – Secretary
Amy Skillman
Bill Keaton
Bob Longstreet
Ken Masters
John Wilson

Technical Advisory Team

Kathleen Hagan	IDEM
Jennifer Boyle	IDEM
Betty Ratcliff	IDEM
Curtis Kneuven	NRCS Rush County
Richard Lisle	NRCS Tech Team
Bill Harting	NRCS Shelby County
Linda Mahan	SWCD Rush County, Administration
Tammy Jackman	SWCD Rush County, Education
Jill Williams	SWCD Shelby County, Administration
Ashley Carlton	SWCD Shelby County, Technician
Susan Schultz	SWCD Shelby County, Education
Tara Wessler	Indiana Department of Agriculture
Scott Gabbard	Purdue Extension Shelby County
Will Schakel	Purdue Extension Rush County

Hoosier Riverwatch Volunteers 2006-2007

Volunteer Name	*Location of monitoring site*
Amy Skillman	Lower Little Blue River at Kennedy Park
Karen Martin	Lower Little Blue River at Shelbyville City/County Park
Bob Longstreet	Middle Little Blue River below Cotton Run
Rita Keaton	Middle Little Blue River
John Wilson	Middle Little Blue River below Arlington
Bill Todd	Middle Little Blue River above Arlington
Noell Krughoff	Upper Little Blue River below Gilson Creek

APPENDIX D
Municipalities, Organizations, and
Businesses Involved with Project Development

Go FishIN

Hoosier Riverwatch

Indiana Department of Agriculture

Indiana Department of Environmental Management

Indiana Department of Natural Resources

Indiana Project WET

Indiana Project WILD

Indiana Watershed Leadership Academy

Little Blue River Friends Church

Manilla Fire Department

Natural Resources Conservation Service

Purdue Cooperative Extension – Rush and Shelby Counties

Rush County
- Health Department
- Plan Commission
- SWCD
- Solid Waste Management District
- Surveyor

Shelby County
- Health Department
- Plan Commission
- Fair Board
- SWCD
- Solid Waste Management District
- Surveyor

Shelbyville
- Parks Department
- Plan Commission
- MS4 Operator
- Wastewater Treatment Plant

The Rushville Republican

The Shelbyville News

US Geological Survey

USDA Farm Service Agency

WKWH Radio

APPENDIX E
Volunteer Monitoring Water Quality Data

Site Identification Key

Site ID	Hoosier Riverwatch ID	Description	Longitude West	Latitude North
LBR 1	326	Kennedy Park Shelbyville	85 45 05	39 31 31
LBR 2		New Park Shelbyville	85 44 46	39 31 52
LBR 3	TBA	Rays Crossing Tributary		
LBR 4	1111	Mainstem below Cotton Run	85 37 51	39 36 05
LBR 5	1051	Mainstem at Rush/Shelby County Line	85 37	39 36
LBR 6	TBA	Beaver Meadow Creek		
LBR 7	1107	Mainstem below Arlington	85 35 15	39 37 45
LBR 8	1108	Mainstem above Arlington	85 31 51	39 39 57
LBR 9	1112	Mainstem below Gilson Creek	85 30 01	39 42 31
LBR 10	TBA	Headwaters		

Typical Range for Parameters

	CQHEI	Dissolved Oxygen mg/L	DO % Saturation	BOD 5 mg/L	E. coli colonies per 100 mL	pH	Water temp Change °C	Ortho Phosphate ppm	Nitrate mg/L	Nitrite	Turbidity NTU	Water Quality Index %	Biological rating
Typical range	-	5.4-14.2	-	0-6.3	133-1,157	7.2-8.8	-	No standard	0-36.08	No standard	0-173	-	-
Indiana Average	-	9.8	-	1.5	645	8.0	-	-	12.32	-	36	-	-
Poor	-	<2	0-40	10+	>235	<4;>11	-	-	50-100	-	90-100+	0-49	<10
Fair	-	3-4	40-60	6-9	-	-	-	-	10-50	-	40-90	50-69	11-16
Good	60-100	5-6	60-90	3-5	-	-	< 5°	-	2-10	-	10-40	70-89	17-22
Excellent	>100	>7	90-100	1-2	0	6.5-8.2	0°	0-1	>2	-	0-10	90-100	23+

Volunteer Data Collection (NA=not available)

Site ID	Collection Date	CQEHI	Dissolved Oxygen mg/L	DO Saturation %	BOD 5 mg/L	E. coli Colonies per 100mL	pH	Water Temp Change °C	Ortho Phosphate ppm	Nitrate mg/L	Nitrite mg/L	Turbidity NTU	Water Quality Index %	Biological Rating
1	8/10/06	85	7	77	NA	1011	9	0	.15	2.2	0	16	66.55	20
1	10/25/06	78	11	85	3	NA	6.5	0	.10	3.3	0	16	84.57	8
1	3/30/07	NA	9	86	8	833.5	7.75	-.5	.12	2.2	0	16	83.34	NA
1	8/15/07	NA	8.5	95	7	NA	8.5	-1	.1	1.1	0	15	79.12	8
2	10/18/06	72	8	80	0	617	6.5	-1	.8	22	0	22	65.36	7
2	3/29/07	NA	10	98	8	300	7.5	-1	.15	8.8	0	16	73.49	NA
2	7/17/07	55	7	80	7	50	8	1	.3	0	0	60	71,6	16
4	8/7/06	71	6	72	6	267	9	0	.15	2.2	0	55	62.11	20
4	11/10/16	79.5	8	72	8	100	7.5	0	.15	60	0	NA	61.51	NA
4	3/21/07	NA	7.5	73	7.5	350	8	0	.15	15.4	0	18	61.15	NA
5	6/12/06	91	8	83	2	1	8.25	.5	.15	22	NA	NA	77.27	31
5	2/21/07	90	10	68	0	200	7.5	0	0	2.2	0	15	84.76	NA
5	6/1/07	93	6	70	1	200	8	NA	.2	22	0	16	61.31	NA
7	10/9/06	91.5	7	65	NA	NA	9	-3	.2	8.8	0	15	64.4	30
8	10/30/06	89.5	10	91	NA	133	8.25	0	.5	2.2	0	<15	70.4	8
9	11/8/06	65	7	65	NA	83	8.5	0	.15	1.76	0	<15	73.67	21
9	3/28/07	NA	8	75	0	689	7.5	0	.15	22	0	17	69.25	NA

APPENDIX F

Storm Water Baseline Characterization
August 2006
(Summary)

Streams studied:
Little Blue River, Big Blue River, Lewis Creek using the Index of Biotic Integrity

Prepared for the
City of Shelbyville, Indiana
44 West Washington St, Shelbyville IN 46176
(317) 392-5102
Amy Skillman, MS4 Operator

Study Conducted By:
Commonwealth Biomonitoring
8061 Windham Lake Drive
Indianapolis, Indiana 46214
(317) 297- 7713

EXECUTIVE SUMMARY

The City of Shelbyville, Indiana has a storm water permit which requires a “baseline characterization” of the quality of surface water in streams within the city’s jurisdiction. Shelbyville chose to use a bioassessment technique, which quantifies the number and kinds of aquatic life present in area streams to measure their ecological health.

A previous bioassessment study produced information on the ecological health of Little Blue River. New bioassessment information was collected on Big Blue River, Little Blue River, and Lewis Creek. The sites examined did not have degraded water quality. Lewis Creek and the downstream site on Little Blue River were degraded more by loss of habitat than by storm water quality.

INTRODUCTION

The city of Shelbyville has an NPDES storm water permit, which requires a “Baseline Characterization” report. The goal of this baseline report is to describe environmental conditions of all waterbodies potentially affected by storm water runoff occurring within the city’s jurisdiction. Included in the report are (1) a review of existing data and (2) the collection of new data necessary to adequately describe the condition of the affected waterbodies.

RESULTS

Aquatic Habitat

Aquatic habitat index values ranged from 55 to 75. According to this scoring scheme, Lewis Creek and Little Blue River at Kennedy Park had “fair” habitat. The habitat at these sites is degraded by a lack of riparian vegetation. In addition, Little Blue River at Kennedy Park had moderate to severe bank erosion and evidence of silt cover on the substrate. The other three sites had “good” habitat.

Macroinvertebrate Communities

The most commonly collected species were caddisfly larvae, although mayfly larvae were also found at all sites. The standardized biotic index scores ranged from 60 to 70, which means that all sites had “good” biotic integrity.

Diagnosis

One of the most useful aspects of biological monitoring is that we can use information on the way aquatic animals respond to different types of stress to diagnose a problem. For example, degraded biotic integrity can often be directly related to degraded habitat. Aquatic life cannot thrive where habitat is lacking. In circumstances where a site has degraded biotic integrity but its habitat value is similar, habitat degradation is usually the problem. However, if the IBI score is significantly lower than the habitat score, water quality degradation is suspected.

All five sites had similar IBI and habitat scores. Water quality at these sites was probably not seriously degraded.

RECOMMENDATIONS

Storm water from the city of Shelbyville does not appear to degrade water quality in the study streams. The habitat in Little Blue River at Kennedy Park could be improved by planting more riparian vegetation and controlling bank erosion.

APPENDIX G

Estimated Pollutant Loads Using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL)

Estimated load reduction based on current conservation tillage

The following tables and graphs were generated by using the USEPA STEPL model. They contain information by subwatershed about estimated loads from cropland without BMPs compared to estimated load reductions when a current BMP (conservation tillage) is applied. Loads are calculated for nitrogen (N), phosphorus (P), biochemical oxygen demand (BOD), and sediment.

W1 = Little Blue River - Headwaters (HUC 05120204030010)
W2 = Little Blue River - Gilson Creek (HUC 05120204030020)
W3 = Little Blue River - Farmers Branch (HUC 05120204030030)
W4 = Beaver Meadow – Linn Creek (HUC 05120204030040)
W5 = Little Blue River – Manilla Branch (HUC 05120204030050)
W6 = Little Blue River – Rays Crossing (HUC 05120204030060)

Load reductions with BMPs are based on 2004 crop tillage data (Table 10).

County	No till corn	Mulch till corn	Combined BMP for corn	No till beans	Mulch till beans	Combined BMP for beans
Shelby	26%	22%	48%	81%	12%	93%
Rush	27%	36%	63%	65%	20%	85%

1. Load by subwatershed(s)

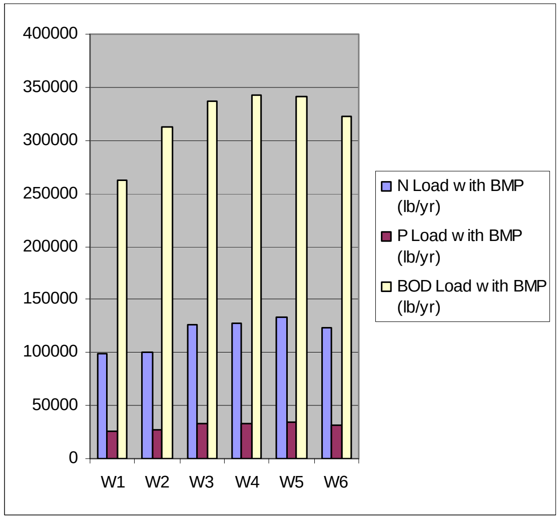
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	162959.7	39790.4	275980.4	3889.9	63683.5	13904.7	13393.4	2092.7	99276.2	25885.7	262586.9	1797.2
W2	194795.0	47037.8	328218.5	3640.2	95070.5	20365.6	15783.0	2466.1	99724.5	26672.2	312435.6	1174.1
W3	205046.2	49241.0	349042.0	3749.4	78781.6	16852.1	12819.1	2003.0	126264.6	32388.9	336222.9	1746.4
W4	206936.3	49264.6	354505.5	3678.4	78775.3	16826.7	12559.9	1962.5	128161.0	32437.9	341945.6	1715.9
W5	213128.1	52675.7	362903.1	6483.0	80395.6	17964.3	21318.2	3331.0	132732.6	34711.3	341584.9	3152.1
W6	190667.4	46503.9	344967.5	7076.7	67643.3	15507.3	22151.2	3461.1	123024.0	30996.6	322816.3	3615.6
Total	1173532.8	284513.3	2015617.0	28517.6	464349.8	101420.8	98024.8	15316.4	709183.0	183092.6	1917592.2	13201.2

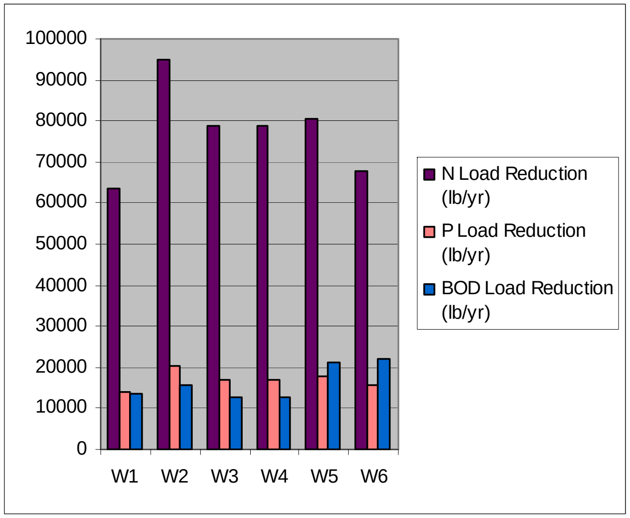
2. Percent reduction based on BMP (current conservation tillage)				
Subwatershed	% N Reduction	% P Reduction	% BOD Reduction	% Sediment Reduction
W1	39.1	34.9	4.9	53.8
W2	48.8	43.3	4.8	67.7
W3	38.4	34.2	3.7	53.4
W4	38.1	34.2	3.5	53.4
W5	37.7	34.1	5.9	51.4
W6	35.5	33.3	6.4	48.9
Total Average % Reduction	39.6	35.6	4.9	53.7

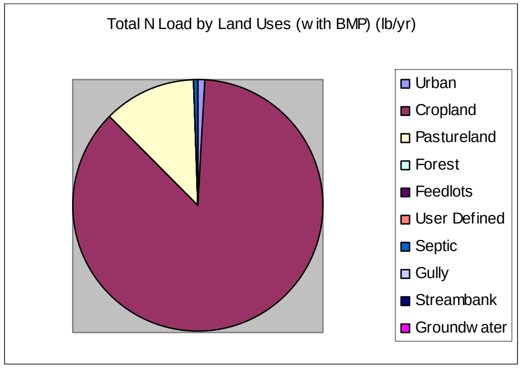
3. Total load by land uses (with BMP)

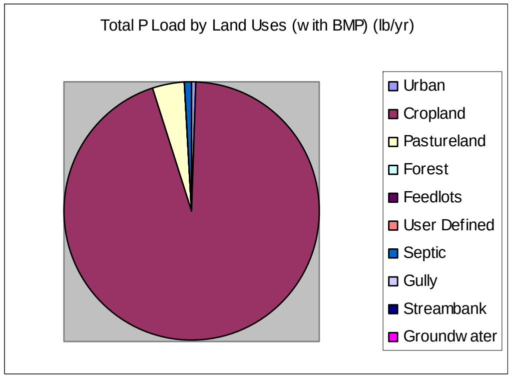
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	5853.59	842.14	23455.45	132.09
Cropland	614913.65	173170.18	1608997.80	11982.86
Pastureland	84283.81	7376.77	269666.39	1064.00
Forest	861.46	422.55	2118.09	22.23
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	3270.48	1280.94	13354.46	0.00
Gully	0.80	0.31	1.60	0.50
Streambank	0.25	0.09	0.49	0.15
Groundwater	0.00	0.00	0.00	0.00
Total	709184.04	183092.98	1917594.29	13201.83

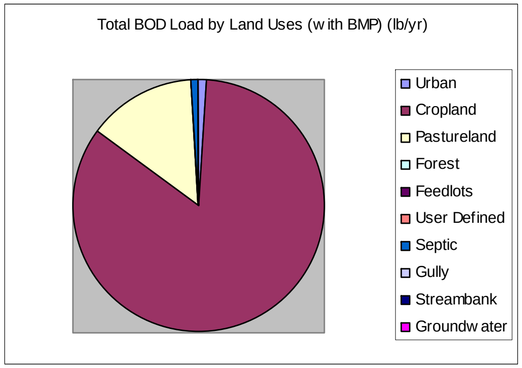
Graphs depicting loads for nitrogen (N), phosphorus (P), and biochemical oxygen demand (BOD) based on information in the previous tables:



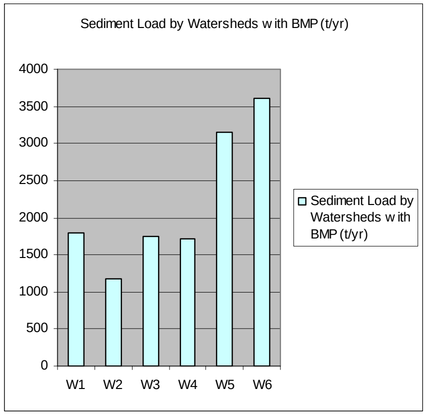


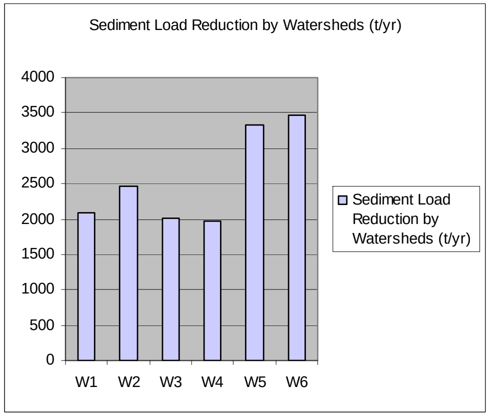


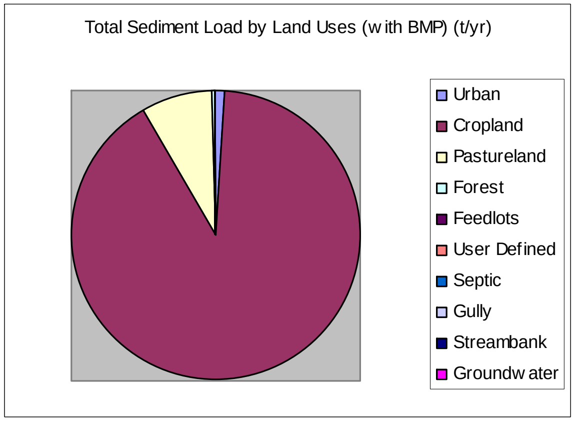




Graphs depicting sediment load based on information in the previous tables:







Estimated load reduction based on BMPs added to current conservation tillage*

The following tables and graphs were generated by using the USEPA STEPL model. They contain information by subwatershed about estimated loads from cropland without BMPs compared to estimated load reductions when a current BMP (conservation tillage) plus a 10% increase in conservation tillage and filterstrips are applied. Loads are calculated for nitrogen (N), phosphorus (P), biochemical oxygen demand (BOD), and sediment.

Watershed	HUC	Acres with BMPs (conservation tillage & filterstrips)
W1 = Little Blue River - Headwaters	05120204030010	7707
W2 = Little Blue River - Gilson Creek	05120204030020	6753
W3 = Little Blue River - Farmers Branch	05120204030030	7129
W4 = Beaver Meadow – Linn Creek	05120204030040	7141
W5 = Little Blue River – Manilla Branch	05120204030050	6734
W6 = Little Blue River – Rays Crossing	05120204030060	7607

1. Total load by subwatershed(s)

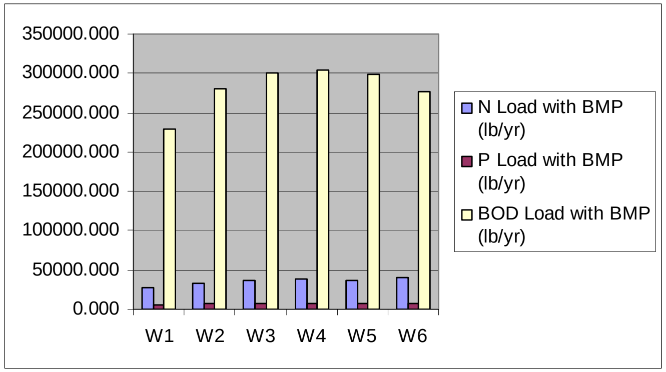
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	148137.4	36369.6	251251.0	3902.6	120238.4	30715.5	22072.7	3455.1	27898.9	5654.1	229178.3	447.5
W2	179006.4	43396.8	301814.8	3640.2	145126.8	36646.7	20659.3	3228.0	33879.7	6750.1	281155.5	412.2
W3	188386.2	45419.7	320852.8	3747.6	151178.1	38143.9	21088.0	3295.0	37208.1	7275.8	299764.8	452.6
W4	190073.0	45434.8	325726.1	3678.4	151204.5	38119.9	20661.6	3228.4	38868.4	7314.9	305064.4	450.0
W5	196539.6	48850.6	335063.0	6482.3	159514.2	41267.1	36551.2	5711.1	37025.4	7583.5	298511.8	771.2
W6	174128.5	42803.5	315614.5	7069.6	133854.3	35188.6	38522.0	6019.1	40274.2	7614.9	277092.4	1050.6
Total	1076271.1	262275.1	1850322.1	28520.6	861116.4	220081.8	159554.8	24936.7	215154.8	42193.2	1690767.3	3584.0

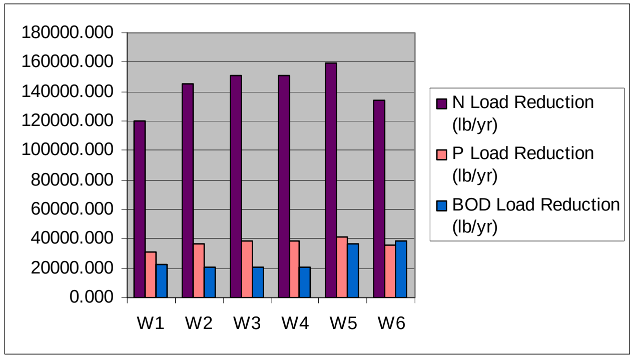
2. Percent reduction based on BMPs (10 % increase in conservation tillage combined with filter strips)				
Subwatershed	% N Reduction	% P Reduction	% BOD Reduction	% Sediment Reduction
W1	81.2	84.5	8.8	88.5
W2	81.1	84.4	6.8	88.7
W3	80.2	84.0	6.6	87.9
W4	79.6	83.9	6.3	87.8
W5	81.2	84.5	10.9	88.1
W6	76.9	82.2	12.2	85.1
Total Average % Reduction	80.0	83.9	8.6	87.4

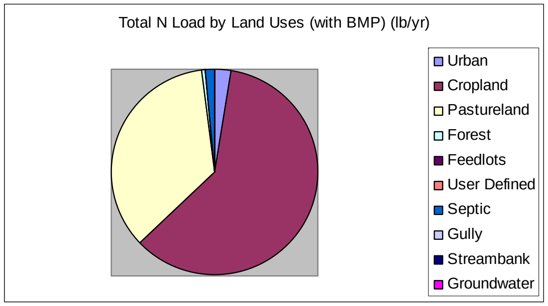
3. Total load by land uses (with BMP)

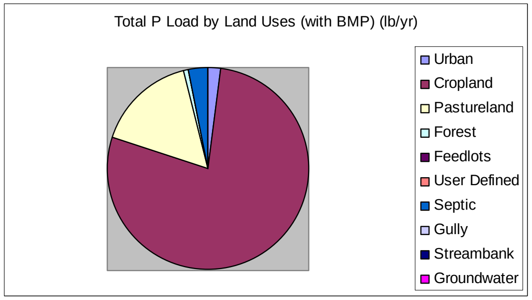
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	5853.59	842.14	23455.45	132.09
Cropland	614913.65	173170.18	1608997.80	11982.86
Pastureland	84283.81	7376.77	269666.39	1064.00
Forest	861.46	422.55	2118.09	22.23
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	3270.48	1280.94	13354.46	0.00
Gully	0.80	0.31	1.60	0.50
Streambank	0.25	0.09	0.49	0.15
Groundwater	0.00	0.00	0.00	0.00
Total	709184.04	183092.98	1917594.29	13201.83

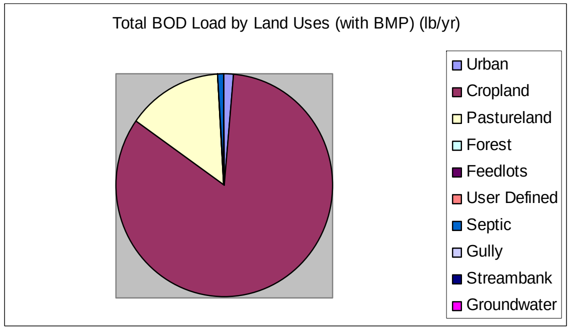
Graphs depicting loads for nitrogen (N), phosphorus (P), and biochemical oxygen demand (BOD) based on information in the tables calculated for increased conservation tillage and the addition of filterstrips.



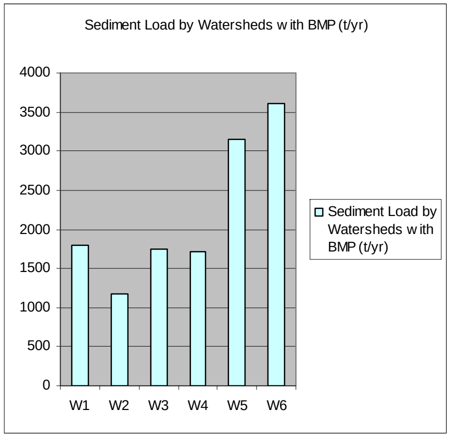


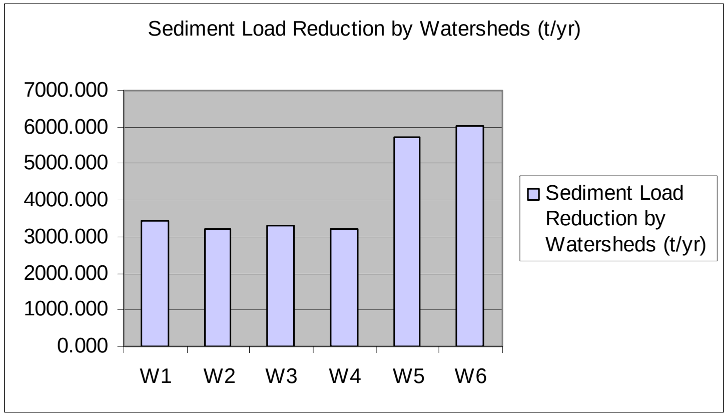


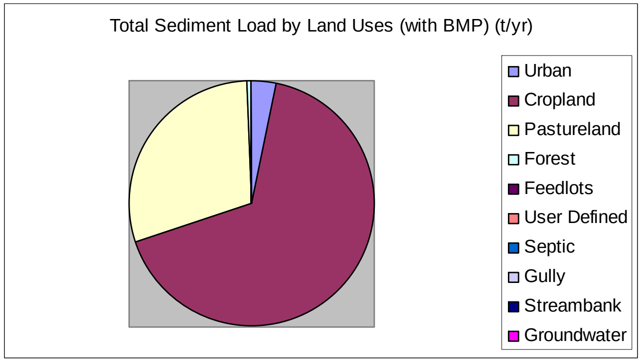




Graphs depicting sediment load based on information in the tables calculated for increased conservation tillage and the addition of filterstrips:







* Watershed Management Plan goals are to increase conservation tillage by 10% and filterstrips by 20 acres by the end of 2010. Some other goals that are not reflected in this model include:

- Increase utilization of cover crops by 200 acres
- Restrict livestock access to 20 acres of stream
- Increase utilization of structures for water control by 100 farmable acres

APPENDIX H

Estimated Financial and Technical Assistance Needed to Complete the Plan

Cost estimates include hours gilled by professionals in addition to materials required.

Small	= $0.00 - $1,500
Small – Moderate	= $1,500 - $3,000
Moderate	= $3,000 - $7,000
Moderate – Large	= $7,000 - $12,000
Large	= $12,000+

Action Item	Cost Estimate	Technical Assistance	Potential Funding Source(s)
Increase distribution of septic system information packets through the SWCD office and website.	Small	None	SWCD
Foster cooperative partnerships with County Health Departments to distribute septic maintenance information.	Small	None	NA
Provide information to local builders and realtors regarding septic issues in rural settings.	Small-Moderate	Purdue Extension, Health Department Watershed Coordinator	319 grant
Research options for wastewater treatment in rural communities.	Small	County Commissioners	NA
Contact livestock owners in the watershed to distribute information and explain cost share opportunities if available.	Small-Moderate	Clean Water Indiana (CWI) Technician, Watershed Coordinator	CWI grant, 319 grant
Promote proper manure containment and innovative waste management systems including a wastewater treatment wetland	Small-Moderate	CWI Technician, NRCS, SWCD, Purdue Extension, Watershed Coordinator	319 grant, CWI grant
Hold a grazing management workshop with the NRCS grazing specialist	Moderate	CWI Technician, NRCS, SWCD, Purdue Extension, Watershed Coordinator	319 grant, CWI grant

Action Item	Cost Estimate	Technical Assistance	Potential Funding Source(s)
Provide cost share and technical assistance to fence livestock out of at least 20 acres of stream.	Large	CWI Technician, NRCS, SWCD, Watershed Coordinator	319 grant, CWI grant
Provide cost share and technical assistance to install 5 alternative watering sources.	Large	CWI Technician, NRCS, SWCD, Watershed Coordinator	319 grant, CWI grant
Partner with real estate companies, County Health Departments, and the Shelbyville MS4 Operator to educate the public about goose control.	Small-Moderate	IDNR, SWCD	SWCD, Shelbyville MS4
Test stream samples using techniques that reveal the origin of *E. coli* contamination so control efforts can be targeted at the source(s).	Large	Health Department, Watershed Coordinator	319 grant
Used volunteer monitors to collect water quality data .	Moderate	Hoosier Riverwatch, volunteer monitors, Watershed Coordinator, SWCDs	319 grant, SWCD
Research recent technology developments that reduce fertilizer application rates and offer alternatives.	Small	CWI Technician, NRCS	SWCDs, CWI grant
Investigate cost-share opportunities for nutrient management plan development and conservation practices.	Small	CWI Technician, SWCD	SWCD, CWI grant
Market existing conservation planning resources and programs.	Small	NRCS, SWCD, CWI technician	SWCD, CWI grant
Develop outreach methods specific to non-agricultural, commercial fertilizer applicators.	Moderate	SWCD, Watershed Coordinator	SWCD, 319 grant
Create a demonstration site showcasing structures for water control; develop a cost-share program for installing these structures that will retain water from approximately 100 farmable acres	Large	NRCS, CWI Technician, Purdue Extension, Watershed Coordinator	319 grant, CWI grant
Provide cost share opportunities to modify manure application equipment contingent upon adopting an appropriate schedule of manure testing and utilization of NRCS recommended application rates.	Large	NRCS, SWCD, Watershed Coordinator	319 grant

Action Item	Cost Estimate	Technical Assistance	Potential Funding Source(s)
Develop a cost-share program for livestock exclusion and alternative watering sources	Large	NRCS, SWCD, Watershed Coordinator	319 grant, NRCS
Develop a cost-share program to increase utilization of filter strips in the watershed by at least 20 acres. Target outreach to areas that currently lack vegetative buffers.	Large	NRCS, SWCD, Watershed Coordinator	319 grant, NRCS
Utilize local media and the SWCD website to explain the benefits of wetlands.	Small	SWCD	SWCD
Provide educational workshops for Backyard Conservation and soil testing.	Small-Moderate	SWCD Educator	SWCD
Provide information about proper yard waste disposal and composting alternatives on SWCD website.	Small	SWCD	SWCD
Initiate dialogue with commercial lawn care companies, local landscapers, and residential contractors regarding nutrient application.	Small	SWCD	SWCD
Develop funding sources for USGS equipment to collect continuous water quality and flow data at Kennedy Park in Shelbyville.	Large	USGS, SWCD, Watershed Coordinator	Businesses, Shelbyville MS4, other grants
Cooperate with County Health Departments and Purdue Cooperative Extension offices to provide literature on groundwater protection.	Small	Health Department, Purdue Extension, American Water Company, SWCD	Purdue Extension, American Water Company
Offer modifications to conventional equipment so that it can be used for conservation tillage. Target 300 additional acres of land utilizing no till.	Large	NRCS, SWCD, CWI Technician, Watershed Coordinator	319 grant, CWI grant
Research manure application options for conservation tillage	Small	SWCD, CWI Technician	SWCD, CWI grant
Research cover crop options for conditions in the watershed. Provide technical resources and/or contacts to producers for cover crop installation.	Moderate-Large	SWCD, CWI Technician, NRCS, Watershed Coordinator	319 grant, CWI grant
Create a cost- share program designed to offset initial costs of cover crop implementation on at least 200 acres.	Large	NRCS, SWCD, Watershed Coordinator	319 grant
Coordinate outreach and advertising for use of cover crops and respective benefits.	Small	SWCD, NRCS	SWCD

Action Item	Cost Estimate	Technical Assistance	Potential Funding Source(s)
Promote and install alternative watering systems. When appropriate, incorporate stream bank fencing. Develop cost-share opportunities for watering systems and stream bank fencing.	Large	NRCS, SWCD, CWI Technician, Watershed Coordinator	319 grant, CWI grant, NRCS
Compile cost/benefit analysis of grazing marginal pastureland along stream banks.	Small	SWCD	SWCD
Assist livestock owners with the development of prescribed grazing plans.	Moderate	CWI Technician, NRCS, SWCD	NRCS, SWCD, CWI grant
Provide livestock owners with access to technical resources. Develop outreach materials for diverse livestock interests. Offset technical assistance and nutrient management planning costs.	Moderate-Large	CWI Technician, NRCS, SWCD, Watershed Coordinator	319 grant, CWI grant, NRCS
Provide information to landowners in critical areas about opportunities through CRP	Small	NRCS, SWCD	SWCD
Provide cost share and technical assistance to landowners for BMPs including riparian buffer development, stream bank stabilization, stream crossing protection, revegetation of exposed areas, and grassed waterways	Large	CWI Technician, NRCS, SWCD, Watershed Coordinator	319 grant, CWI grant, NRCS
Create a list of new farmers and/or those interested in developing a mentor relationship with existing conservation farmers.	Small	SWCD, CWI Technician	SWCD, CWI grant
Award an annual water quality award for outstanding conservation.	Small	SWCD	SWCD
Develop subject-specific conservation workshops and field days that avoid duplication or repetition of existing efforts. Recruit top-professionals in subject fields to lead workshops.	Moderate	SWCD, NRCS, Purdue Extension, CWI Technician, Watershed Coordinator	SWCD, 319 grant, CWI grant
Cooperate with the Shelbyville MS4 Operator to provide erosion control BMP information to urban contractors.	Small	SWCD, Shelbyville MS4	SWCD, MS4
Utilize the SWCD website and local media to survey public knowledge regarding water quality issues.	Small-Moderate	SWCD	SWCD
Provide age appropriate water quality education that teaches concepts outlined in the Indiana Academic Standards.	Moderate	SWCD Educator, Watershed Coordinator	SWCD, 319 grant
Offer service learning opportunities to youth and adults through a water quality monitoring network, agriculture programs and other conservation initiatives	Small-Moderate	SWCD, Watershed Coordinator	SWCD, 319 grant
Train educators in Project WET and/or related curricula	Small-Moderate	SWCD Educator	SWCD

Action Item	Cost Estimate	Technical Assistance	Potential Funding Source(s)
Submit regular press releases to media and maintain a watershed website	Small	SWCD	SWCD
Create displays and brochures to use at libraries, fairs, garden clinics, and festivals to promote the watershed goals.	Moderate	SWCD Educator, SWCD staff	SWCD
Create a dialogue with local drainage boards and provide BMP information.	Small	SWCD	SWCD
Provide information, cost share, and technical assistance for pesticide management planning	Moderate-Large	NRCS, SWCD, CWI Technician, Watershed Coordinator	319 grant, CWI grant, NRCS
Hold events that focus on stream maintenance, trash clean up, and wildlife habitat improvement.	Small-Moderate	SWCD, Watershed Coordinator	SWCD, Shelbyville Park Dept., 319 grant
Hold annual Hoosier Riverwatch training	Small	SWCD, Hoosier Riverwatch	SWCD
Create an annual cooperative activity to mark all storm drains in Shelbyville	Small-Moderate	SWCD, Shelbyville MS4	Shelbyville MS4
Review the watershed management plan goals and set new goals to meet the overarching goals.	Small	SWCD	SWCD