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LITTLE RIVER WATERSHED DIAGNOSTIC STUDY

A Lake and River Enhancement Project
funded by the Indiana Department of Natural Resources
Division of Fish and Wildlife
Indianapolis IN

For the Soil and Water Conservation Districts of
Whitley, Allen, and Huntington Counties

Submitted: January 2009

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EXECUTIVE SUMMARY

The Little River (also known as the Little Wabash River on some maps) is one of the largest tributaries of the Wabash River in northeastern Indiana. It's total watershed area is 288 square miles. Land use in the watershed is dominated by agriculture, but it is rapidly urbanizing. Many small forests and natural wetlands are also present.

The Whitley, Allen, and Huntington County Soil and Water Conservation Districts received a grant from the Indiana Department of Natural Resources Division of Fish and Wildlfe through the Indiana Lake and River Enhancement Program. The purpose of the grant was to assist the districts make a diagnosis of water quality problems in the Little River watershed and propose solutions to fix the problems identified.

All available information on the watershed was assembled. Then new chemical and biological information was gathered at 19 sites. Nutrient values at most sites were elevated compared to many other Indiana streams in agricultural areas, especially during wet weather. Other water quality measurements fell within ranges suitable for most forms of freshwater aquatic life. Aquatic habitat was generally good at most sites, especially within the Little River itself. Habitat at some sites was impaired by channelization and lack of stream bank vegetation.

A computer model was used to predict ecological changes that may be expected to occur with changes in land use. The Cow/Calf Creek and Flat Creek sub-watersheds were identified as areas in which water quality is most vulnerable. Computer modeling also predicted that reducing sediment and nutrient inputs by 25% would have measurable biological benefits, doubling the abundance of game fish in the Little River after 12 months of implementation.

Three tributary sub-watersheds (Eight Mile Creek, Robinson Creek, and Upper Little River) were identified as areas where the biological community was not as healthy as the available habitat would allow. Water quality improvements could be made in these areas. Several potential sites for wetland restorations were identified. BMPs to address excessive sediment inputs (grass waterways, filter strips, riparian buffers) were recommended for all three subwatersheds. BMPs (especially modern manure management practices) to address excessive nutrient inputs predicted by computer modeling were recommended for the Cow/Calf Creek sub-watershed.

Cow Creek and Flat Creek were identified as a sub-watershed where aquatic habitat restorations could be made, especially in areas where channel modifications for drainage improvement are planned. These include limiting cutting of trees to only one side of the stream, doing channelization projects in small portions during a year, and keeping existing riffles in place.

Bull Creek and Big Indian Creek have cool water during the summer low flow sampling period. This indicates the presence of substantial groundwater flow. Cool water streams are increasingly rare and efforts should be made to protect them.

Two public meetings were held as part of the project. The “kick-off” meeting was held on October 3, 2007 at Roanoke, Indiana. Twenty-eight people attended. The meeting explained the purpose of the study and some of the possible outcomes. A final public meeting was held on April 23, 2008 at the Roanoke Elementary School. The study results and recommendations for future work in the watershed were presented. Forty-four people attended, including representatives of government agencies, environmental groups, farmers, and other interested citizens. Additional concerns expressed at this meeting included the need to remove low-head dams that are no longer used, combined sewer overflows in the City of Huntington, the potential for mosquito problems in wetland areas, and the need to balance water quality with flood control issues.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge valuable input from all local citizens and agencies that helped develop the plan. We also thank the Town of Roanoke and the principal and staff of Roanoke Elementary School for providing excellent meeting space for our presentations.

LITTLE RIVER WATERSHED DIAGNOSTIC STUDY

I. INTRODUCTION

A. BACKGROUND

The Little River is one of the largest tributaries of the Wabash River in northeastern Indiana (Fig. 1). It has a total drainage area of 288 square miles and flows through parts of Whitley, Allen, Huntington, and Wells Counties. The geology of this area of Indiana was influenced greatly by the Wisconsin glacial period of fifteen thousand years ago. The Little River formed from outwash of the Ontario-Erie glacial lobe, forming clay and gravel-rich moraines along its length. Gravel deposits are abundant in this area. Average annual precipitation is thirty-six inches, with a normal peak of about four inches in June [31].

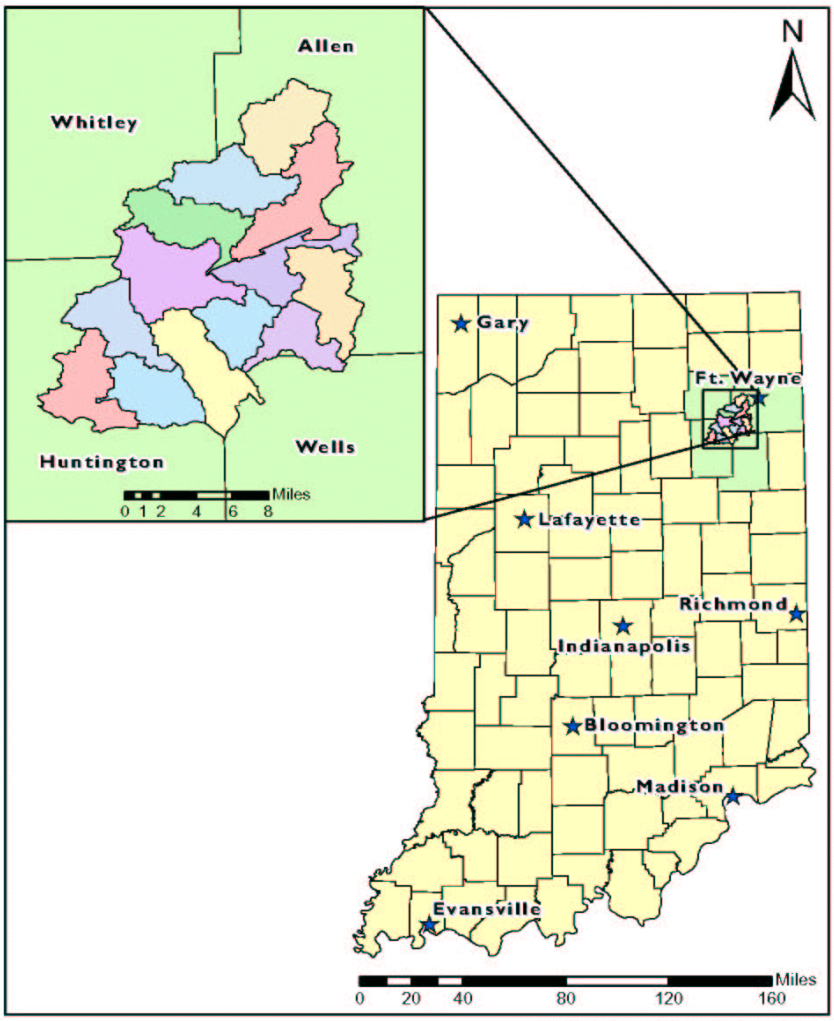
Much of the watershed is used for agriculture but areas around western Fort Wayne are rapidly urbanizing. According to recent census data, Aboite Township in Allen County has a population density of about eight hundred people per square mile. The lowest population density is Union Township in Huntington County, with a population density of about thirty-seven people per square mile. In addition to Fort Wayne, other incorporated cities and towns in the watershed include Huntington, Roanoke, and Ossian.

Historically, the short 2-mile portage between the Maumee River and the Little River provided travelers from the St. Laurence seaway easy access to the Mississippi River basin and was used for trade many centuries prior to European settlement. In more recent times, the Little River was also an important part of the Wabash and Erie Canal system. The Town of Roanoke on the banks of the Little River developed as a typical “canal town” in the 1840s, serving the needs of canal travelers.

Today, local citizens are concerned about preserving water quality of the river for future generations. To address these concerns, the Whitley County Soil and Water Conservation District, in cooperation with SWCDs in Allen and Huntington Counties, applied to the Indiana Department of Natural Resources for a Lake and River Enhancement (LARE) grant to prepare a “watershed diagnostic study.” The purpose of the study is to measure water quality chemically and biologically, to identify problem areas, and to prepare a plan to address the problems.

The LARE program approved the grant application in early 2007. The Whitley County SWCD then assigned experts on water quality monitoring and planning to help carry out the project. Each of the 13 “subwatersheds” of the Little River shown in Fig. 1 were examined individually to help carry out the plan.

Figure 1. Little River Watershed



Watershed Location Map
Little Wabash Watershed
Allen, Huntington, Wells, & Whitley Counties, Indiana

STEPS NECESSARY TO FORMULATE A PLAN

The Lake and River Enhancement (LARE) Program of DNR specifies ten key elements of a watershed diagnostic study:

1. Critical information gaps are identified.

2. Current conditions are described from available maps and land use information.

3. Water chemistry, biology, and habitat information are collected.

4. Computer models are used to predict changes expected to occur with potential changes in land use and management practices.

5. Specific problems in the watershed which could interfere with water quality are identified

6. Practical, economical solutions to the problems are identified

7. Specific sites for management are identified and their selections are justified

8. Potential project constraints (excessive costs, land uses, etc.) are identified. Available institutional resources already in place are assessed to determine their capacity for helping carry out the plan.

9. Potential sources of funding for future work necessary to carry out the plan are identified

10. An information handout explaining the plan (and made available at a public meeting) is presented

IDENTIFYING CRITICAL INFORMATION:
WHAT DO WE ALREADY KNOW ABOUT THE WATERSHED?

A. *ITEMIZED INFORMATION ABOUT THE WATERSHED*

USGS, 1980. Drainage atlas of Indiana [1].

Total drainage area of the Little River	288 sq. mil
Drainage areas of the major tributaries:	
Seegar Ditch	17 sq. mi.
Beal-Taylor Ditch	10 sq. mi.
Indian Creek	9 sq. mi.
Little Indian Creek	5 sq. mi.
Aboite Creek (includes all of the watersheds above)	51 sq.mi.
Graham-McCullough Ditch	18 sq. mi.
Cow Creek	8 sq. mi.
Calf Creek	10 sq. mi.
Bull Creek	15 sq. mi.
Flat Creek	26 sq. mi.
Robinson Creek	16 sq. mi
Pleasant Run	4 sq. mi
Eightmile Creek	81 sq. mi.
Mud Creek	8 sq. mi

.
Indiana Department of Environmental Management, Unified watershed assessment data, 1999 [12].

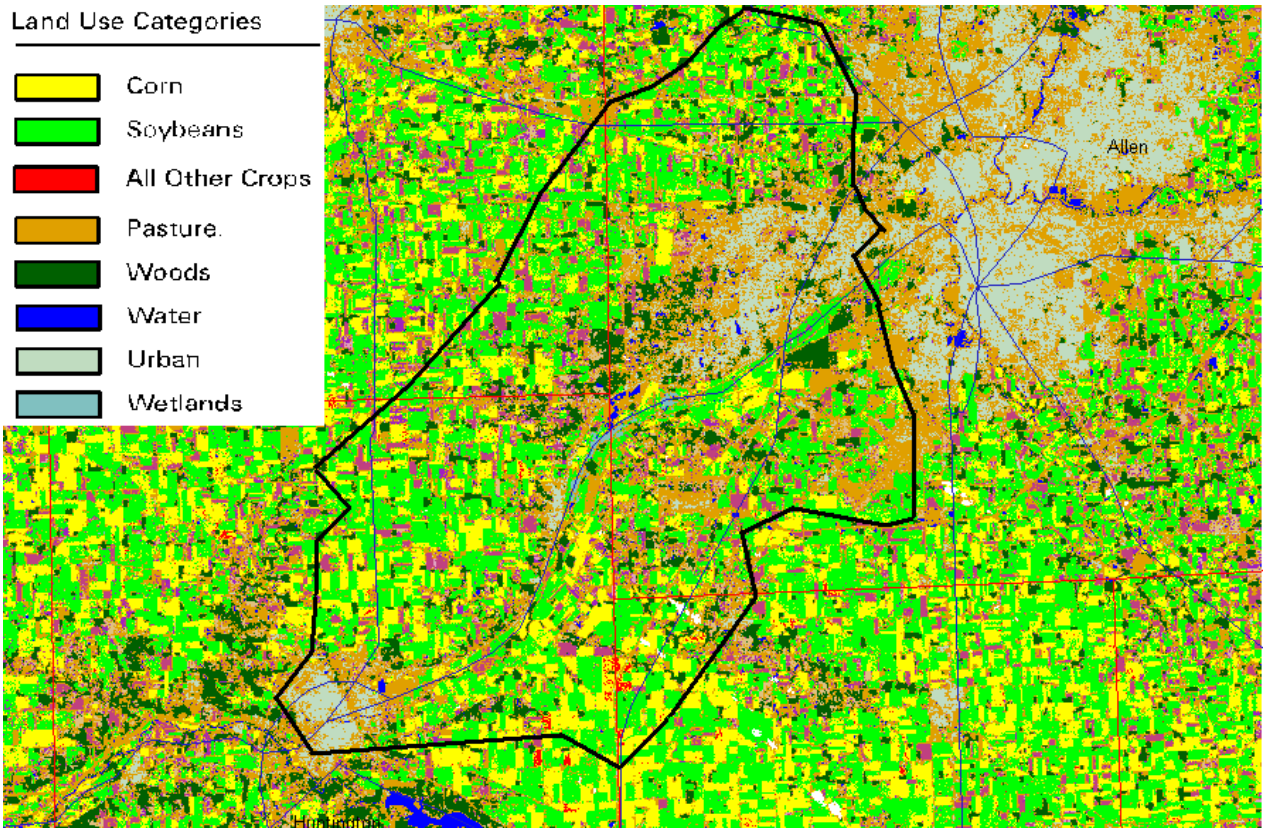
Information includes local data on residential septic system density, livestock density, and cropland pressure. The watershed has the following ratings (the scale ranges from 1 [low concern] to 5 [high concern]):

Septic System Density	4
Aquifer Vulnerability	4
% Developed Land	4
Livestock Density	4
Cropland Pressure	5

The 11-digit HUC identification for this watershed is 05120101120. There are thirteen 14-digit sub-watersheds present (010 through 130).

National Agricultural Statistics Service (USDA). Cropland for 2000 [10].
A detailed map showing major crops grown in the watershed is displayed in Fig. 2.
Corn and soybean row crops predominate.

Fig. 2. Agricultural Crops and Other Land Uses



CEES Land Use Data, 2003 [22]

The Center for Earth and Environmental Science has converted aerial maps to various land use categories. A summary for the 13 subwatersheds in the Little River Basin is shown in Table 1.

Table 1. Major land uses in the Little River Watershed

		Land Use				
Watershed	**Watershed Acreage**	**1**	**2**	**3**	**4**	**5**
Aboite Creek - Beal Taylor Ditch	11570	50%	10%	7%	6%	22%
Aboite Creek - Big/Little Indian Creeks	11058	55%	14%	1%	2%	23%
Eightmile Creek - Pleasant Run	7961	55%	11%	5%	1%	24%
Eightmile Creek - Witzgall Ditch	7465	77%	6%	1%	1%	13%
Graham McCulloch Ditch #1	13852	20%	19%	15%	18%	21%
Little River - Allen	8584	55%	14%	2%	2%	19%
Little River - Bull Creek	9652	81%	8%	1%	0%	49%
Little River - Calf/Cow Creeks	15471	58%	14%	2%	2%	21%
Little River - Flat Creek (Lower)	12857	77%	7%	1%	1%	12%
Little River - Flint Creek	10831	41%	12%	12%	15%	17%
Little River - Mud Creek	10063	76%	11%	2%	1%	10%
Robinson Creek	10570	73%	6%	5%	1%	13%
Seager Ditch	11100	65%	10%	2%	1%	17%
Totals	141034	59%	11%	5%	4%	17%

Land uses

1 = Agriculture
2 = Forest
3 = High Density Urban
4 = Low Density Urban
5 = Grassland/Suburban

USGS, 1989. Statistical summary of streamflow data for Indiana. Report 89-62, Water Resources Division, Indianapolis IN [2].

There is one gauging station in the watershed, on the Little River at Huntington. The drainage area at this site is 263 square miles. Average flow is 241 cfs, but flows as low as 30 cfs are observed there during autumn in most years.

IDEM, 2006. List of impaired waterbodies (303d) list [16]

Mud Creek (high E.coli counts and impaired biotic communities)
Eight Mile Creek (impaired biotic communities)
Aboite/Little Indian Creek (impaired biotic communities)

Homoya et al., 1985. The natural regions of Indiana [3].

This area is in the "Bluffton Till Plain" of central Indiana. Soils are generally rich in clays, formed under glacial influence. The area is poorly drained. In wetter sites, wetland trees such as red maple, swamp white oak, and green ash predominate. In drier areas, sugar maple, red oak, white ash and beech are the most common trees.

EPA Pollution Compliance System Data for Wastewater Dischargers. 2008 [13].

There are ten permitted wastewater discharges in the watershed.

Roanoke Municipal Wastewater Treatment Plant (0.15 mgd)
Ossian Municipal Wastewater Treatment Plant (0.6 mgd)
Main Aboite Wastewater Treatment Plant (3.25 mgd)
Hanson Aggregate (Fort Wayne)
Roanoke Baptist Church
IMI Stone (Huntington)
Koch Fertilizer (Huntington)
Marathon Ashland Petroleum (Huntington)
Arcola Rest Area
Flat Creek Rest Area

U.S. Department of Agriculture. Soil surveys of Whitley, Allen, and Huntington Counties. Soil Conservation Service. Available in the NRCS Indiana office, Indianapolis, IN [7-9].

Morley, Blount, and Pewamo soils predominate in the watershed. These are mapped in Figure 3 and described below:

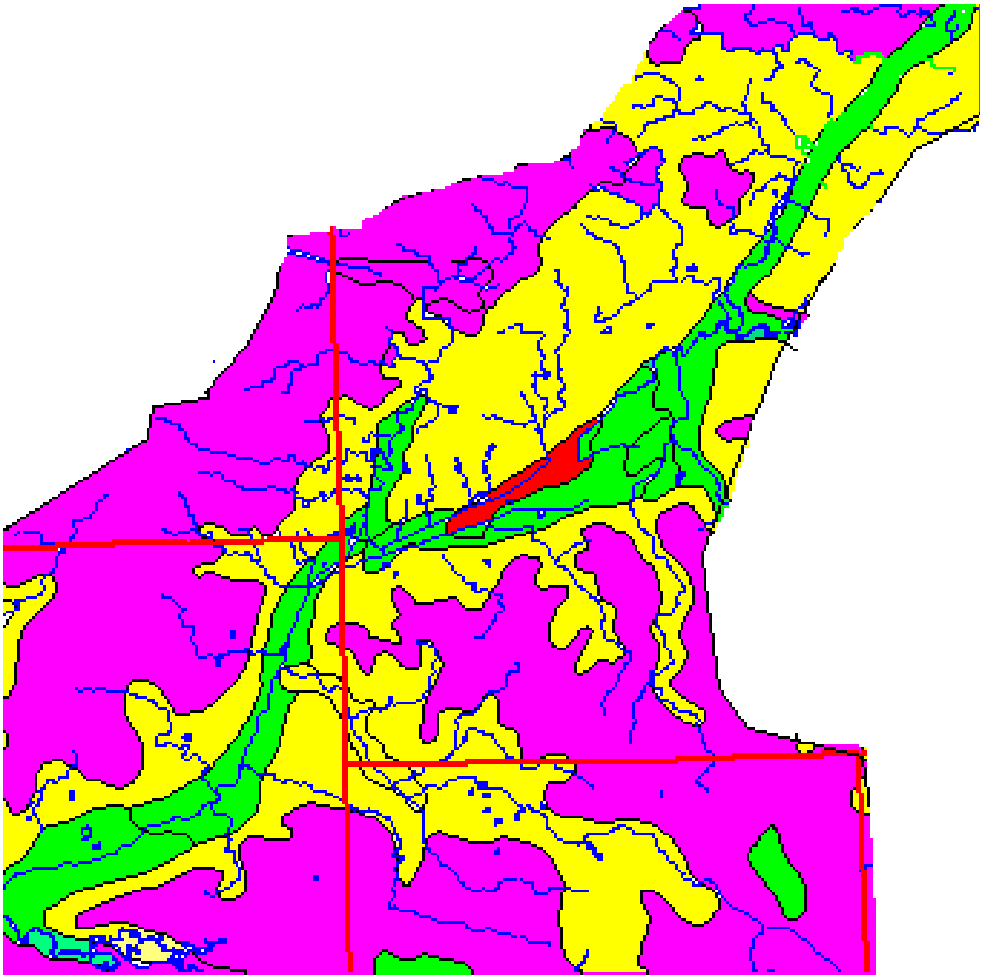
Fig. 3. Soil associations

Purple = Pewamo - Morley - Glynwood - Blount (more upland conditions)

Yellow = Pewamo -Glynwood - Blount (increasingly hydric soils)

Red = Houghton (strictly hydric soils)

Green = various hydric soils (esp. Shoals, Rensellaer, Patton)



Common characteristics of each soil type are:

Houghton - muck - frequently flooded

Blount, Glynwood - silt loam - on uplands

Morley - clay loam - well drained

Pewamo - silty clay loam - very poorly drained

The soil types most prone to water erosion are Blount, Morley and Glynwood (purple areas). These have K values greater than 0.4 and may be present on steep slopes.

The soil types least prone to water erosion are Houghton and other hydric soils (the red and green areas). These soils predominate the river floodplain.

Simon & Dufour, 1997. Fish community data for the watershed [11].

As part of a study of all streams in this area, fish were collected from the Little River at Broadway Street in Huntington (downstream site) and at Smith Road in Fort Wayne (upstream site). Samples were also collected from tributaries (Robinson Creek, Witzgall Ditch, and Graham McCulloch Ditch near Fort Wayne). All collections were made in 1991. The index of biotic integrity indicated relatively healthy conditions at the downstream Little River site (IBI of 46 out of a total possible score of 60). Poor conditions were measured in both Robinson Creek and Witzgall Ditch (IBI scores of 12). These two streams supported practically no fish community, despite the presence of adequate habitat.

Braun, E. 1995. Fisheries survey of the Little River in 1995 [21].

Fish samples were collected from the Little River at four sites, and from a major tributary (Eight Mile Creek) at one site. Fish communities were relatively healthy at the most downstream site (44 species were present, which is very high diversity) but community health declined at sites farther upstream. Lowest community health was in Eight Mile Creek, where fish tolerant to degraded conditions were dominant.

J.F.New, 2002. LARE Watershed Diagnostic Study for Flat Creek [25].

Macroinvertebrates were collected from Eight Mile Creek and Flat Creek during May 2000. Flat Creek had a relatively healthy aquatic community (mIBI = 5.7) but Eight Mile Creek was degraded (mIBI = 2.0).

IDEM, 2008 [26].

Macroinvertebrates have been collected and analyzed from the following sites in the watershed during 1998 and 2003:

Aboite Creek (Allen County)
Witzgall Ditch (Allen County)
Mud Creek (Huntington County)
Eight Mile Creek (Huntington County)
Bull Creek (Huntington County)
Flat Creek (Huntington County)
Little River (Huntington County)

Aquatic communities with scores less than 2 (of a possible 8 points on the mIBI scale) and indicating rather serious impairments were on Mud Creek and Eight Mile Creek. Healthy aquatic communities (scores greater than 5) were present on the lower Little River (Broadway Street near Huntington).

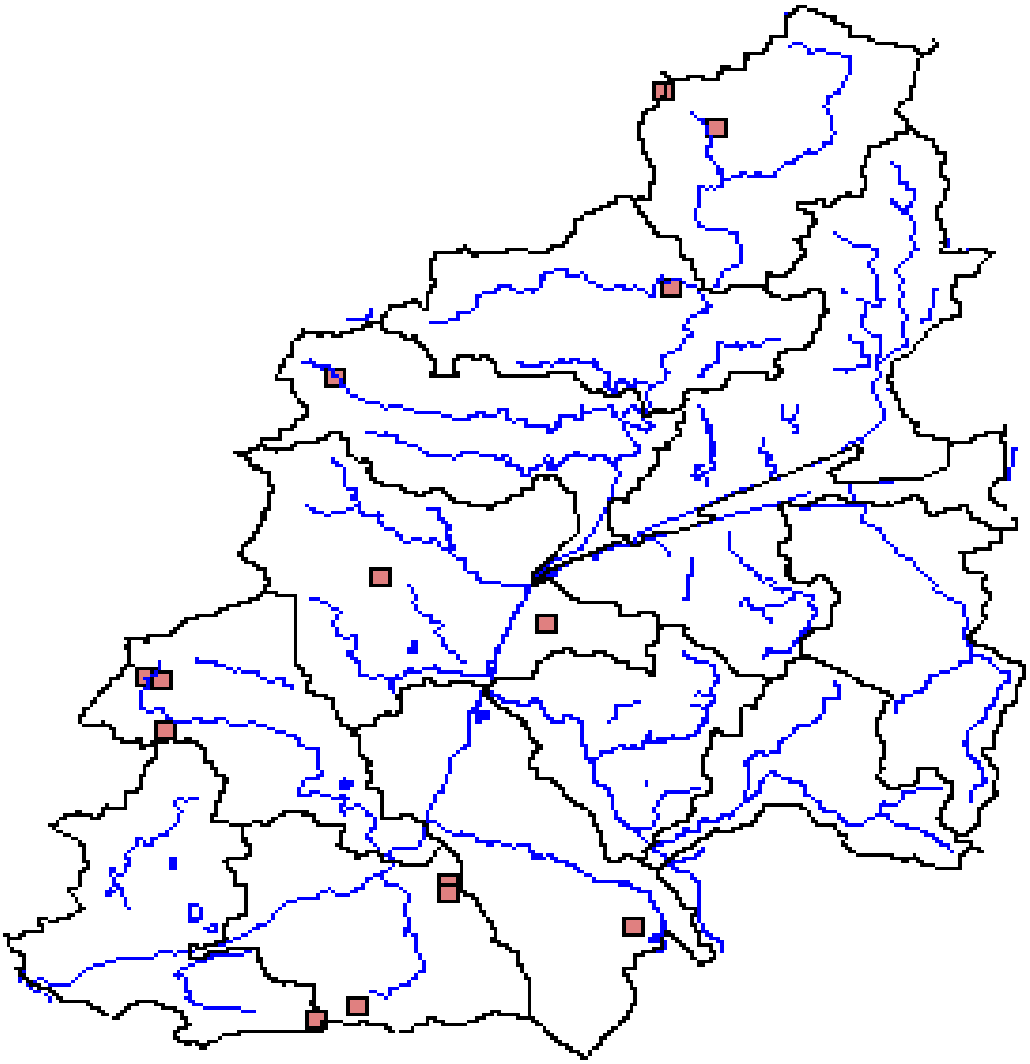
Hoosier River Watch, 2008 [24].

Volunteers from the Hoosier River Watch Program have been monitoring chemistry and biology regularly from four sites on the Upper Little River in Fort Wayne since September 2000. Dissolved oxygen levels have remained high enough to support aquatic life (greater than 5 mg/l). Nutrient levels are variable but the average has been elevated above normal values for Indiana streams (total P of 0.56 mg/l, nitrate of 7 mg/l). Turbidity is quite high (average 40 NTU) even during base flow conditions. Few pollution-intolerant macroinvertebrates are present.

IDEM, Office of Land Quality, 2007, List of confined feeding operations [14].
NASS, 2002. Census of livestock [10]

There are 14 confined feeding operations with state permits in the watershed. Approximately 100,000 hogs and 30,000 cattle are raised in the watershed.

Fig. 4. Confined feeding operations in the watershed.



IDNR Natural Heritage Data. Division of Nature Preserves, 2008.

IDNR Natural Heritage specialist Ron Hellmich supplied information on uncommon species known to be present in the watershed. These are listed below. References for endangered animals is found in [4].

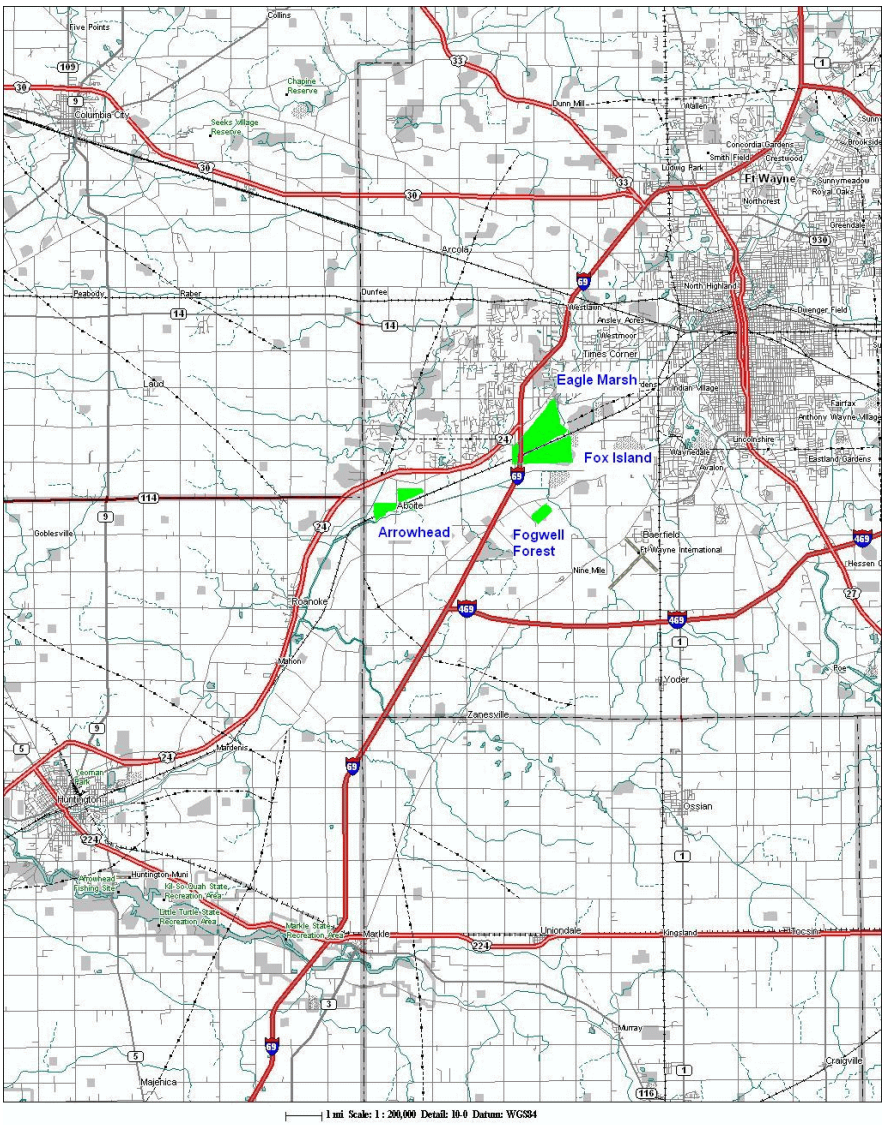
TYPE	SPECIES NAME	COMMON NAME	FED	STATE	TRS	LASTOBS
from Jackson Township, Huntington County, Indiana						
Mammal	Mustela nivalis	Least Weasel		SSC	029N010E	1925-12
Mollusk	Pleurobema clava	Clubshell	LE	SE	029N010E24	2005-07-21
from Lake Township, Allen County, Indiana						
Amphibian	Hemidactylium scutatum	Four-toed Salamander		SE	031N011E8	2004-05-01
Plant	Andromeda glaucophylla	Bog Rosemary		SR	031N011E08	1916-07
Plant	Phlox ovata	Mountain Phlox		SE	031N011E08	1914-05-31
High Quality Natural Communities						
	Lake - pond Pond			SG	031N011E08 SE SE SW	1983-09-09
	Wetland - swamp forest Forested Swamp			SG	031N011E08 SH SH	
	Wetland - swamp shrub Shrub Swamp			SG	031N011E20 NWQ SEQ	1983-05-25
from Lafayette Township, Allen County, Indiana						
Bird	Buteo lineatus	Red-shouldered Hawk		SSC	030N011E	1940-04
Bird	Nycticorax nycticorax	Black-crowned Night-heron		SE	029N011E	1938
Plant	Circaea alpina	Enchanter's Nightshade		SX	029N011E01	1931-06
FOGWELL FOREST NATURE PRESERVE						
High Quality Natural Community						
	Central Till Plain Flatwoods			SG	029N011E01 NWQ	1986-06
from Aboite Township, Allen County, Indiana						
Bird	Ardea herodias	Great Blue Heron			030N011E19	1983-05
					030N011E16	1983-05
Bird	Buteo lineatus	Red-shouldered Hawk		SSC	030N011E	1940-04
Bird	Buteo platypterus	Broad-winged Hawk		SSC	030N011E26	1994-07-08
Bird	Nycticorax nycticorax	Black-crowned Night-heron		SE	029N011E	1938
FOX ISLAND NATURE PRESERVE						
Bird	Certhia americana	Brown Creeper			030N011E25	2001-06-24
Bird	Dendroica cerulea	Cerulean Warbler		SE	030N011E25	1994-06-01
Bird	Lanius ludovicianus	Loggerhead Shrike		SE	030N011E25	1991-05-02
Bird	Wilsonia citrina	Hooded Warbler		SSC	030N011E25	1997-06-29
Reptile	Emydoidea blandingii	Blanding's Turtle		SE	030N011E25	
Reptile	Sistrurus catenatus	Eastern Massasauga	C	SE	030N011E25	1994-07
Plant	Coeloglossum viride	Long-bract Green Orchis		ST	030N011E25	1974-05
High Quality Natural Communities						
	Dry Upland Forest			SG	030N011E25	1980
	Marsh			SG	030N011E25	1980
	Shrub Swamp			SG	030N011E25	1980

1
Fed: LE = listed federal endangered; C = federal candidate species
State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SG = state significant; WL = watch list; no rank = not ranked but tracked to monitor status

The dedicated nature preserves in the watershed [referred to in the Natural Heritage data shown above] are Fox Island and Fogwell-Forest. Fox Island is part of the Allen County Parks Department. About two hundred seventy acres of the property are wooded [the largest contiguous forest in the county] and contain marsh, seasonal pond, sand dune, wetland forest, old field, and prairie habitats. Fogwell Forest is owned by ACRES Land Trust. The preserve includes nearly sixty acres of woods and meadows.

In addition to these dedicated nature preserves, a local non-profit group is restoring wetlands in the Upper Little River watershed. The group's two properties include Eagle Marsh [over seven hundred acres] and Arrowhead Marsh and Prairie [nearly two hundred acres]. A map showing the location of all these natural area properties is shown below.

Fig. 5. Natural areas in the watershed



B. SUMMARY OF AVAILABLE INFORMATION

Total drainage area of the Little River is 288 square miles. The three largest tributaries are Eight Mile Creek, Aboite Creek, and Flat Creek. Many of the tributaries of the Little River have been artificially straightened and are presently classified as “legal drains.” They are under the authority of the County Surveyor, who is legally mandated to maintain their channels to promote drainage.

According to IDEM, the Little River watershed has high water quality vulnerability for septic tank density, livestock density, percent cropland, and percent developed area. Common soil types prone to water erosion include Blount, Morley, and Glynwood.

About 60% of the watershed is devoted to row-crop agriculture. Livestock production is higher than the state average, especially for hogs. There are 14 confined feeding operations in the watershed.

There are ten wastewater dischargers in the watershed. All of them are currently meeting their NPDES permit limits.

Little water quality information has been collected from the watershed. E.coli bacteria levels exceed the Indiana water quality standard for recreational uses in Mud Creek. Nutrient and turbidity levels are higher than normal in the Upper Little River watershed.

The fish and macroinvertebrate communities of the river are indicative of an ecologically healthy stream in the lower reaches of the Little River but some of the tributaries are impaired. The worst impairment occurs in Eight Mile Creek, Flat Creek, and Robinson Creek.

There are several rare or threatened species and communities known from the watershed. Those that are dependent on good water quality and aquatic or wetland habitat include the clubshell mussel, the massasauga rattlesnake, blanding’s turtle, the four-toed salamader, least weasel black-crowned night heron [4], and bog rosemary.

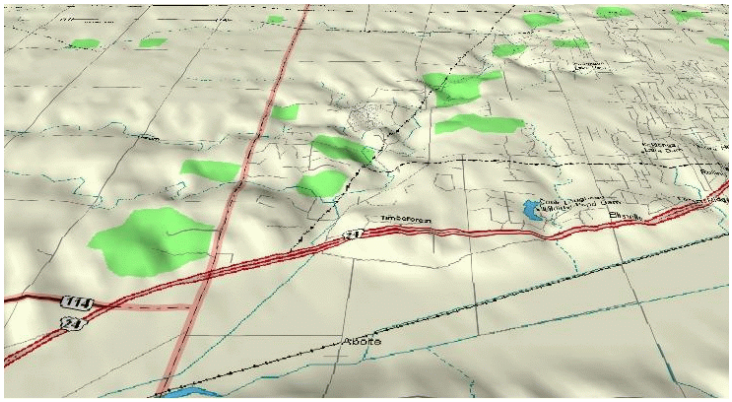
III. COLLECTION OF ADDITIONAL NECESSARY INFORMATION

WHAT ADDITIONAL INFORMATION DO WE NEED TO MAKE GOOD DECISIONS ABOUT WATER QUALITY MANAGEMENT IN THIS WATERSHED?

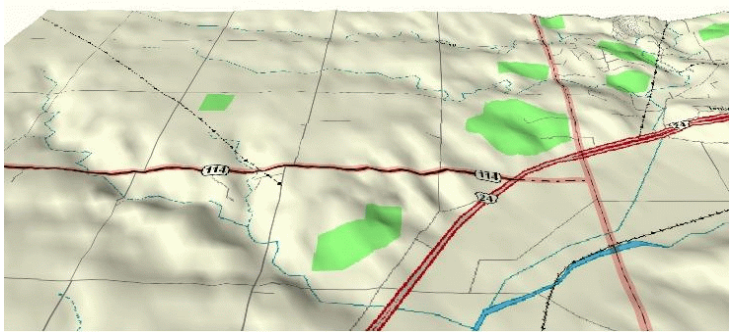
A. WATERCOURSES ON STEEP SLOPES

Portions of streams which flow through areas of steep slopes on soils which are vulnerable to erosion are most likely to contribute to excessive sediment loading. Therefore, it is important to identify areas within a watershed on steep slopes. Digital elevation maps (DEMs) produced by the U.S.Geological Survey are useful for this type of analysis. A DEM was used to locate stream segments flowing directly through areas with slopes greater than 10% highlighted. These sites are shown in Fig. 6.

Fig. 6. Stream segments with high erosion potential



Aboite Creek between Covington Road and Highway 24 in Allen County. The lower end of Big Indian Creek in Whitley County.



Cow Creek, north and south of the Whitley/Huntington County Line at Highway 114

B. WETLANDS

There are numerous wetlands in the watershed. A map of the most concentrated area of wetlands in the upper part of the Little River basin is shown in Figure 6. Most of these are forested and exist along waterways. These wetlands have a high potential for sediment and nutrient filtration and for wildlife habitat. Some wetlands in this map have been severely drained for agriculture but could be restored at relatively low cost to assist with sediment and nutrient control. This option and more precise mapping of wetlands is discussed in more detail in Section V.

Fig. 7. Location of major wetlands in the watershed

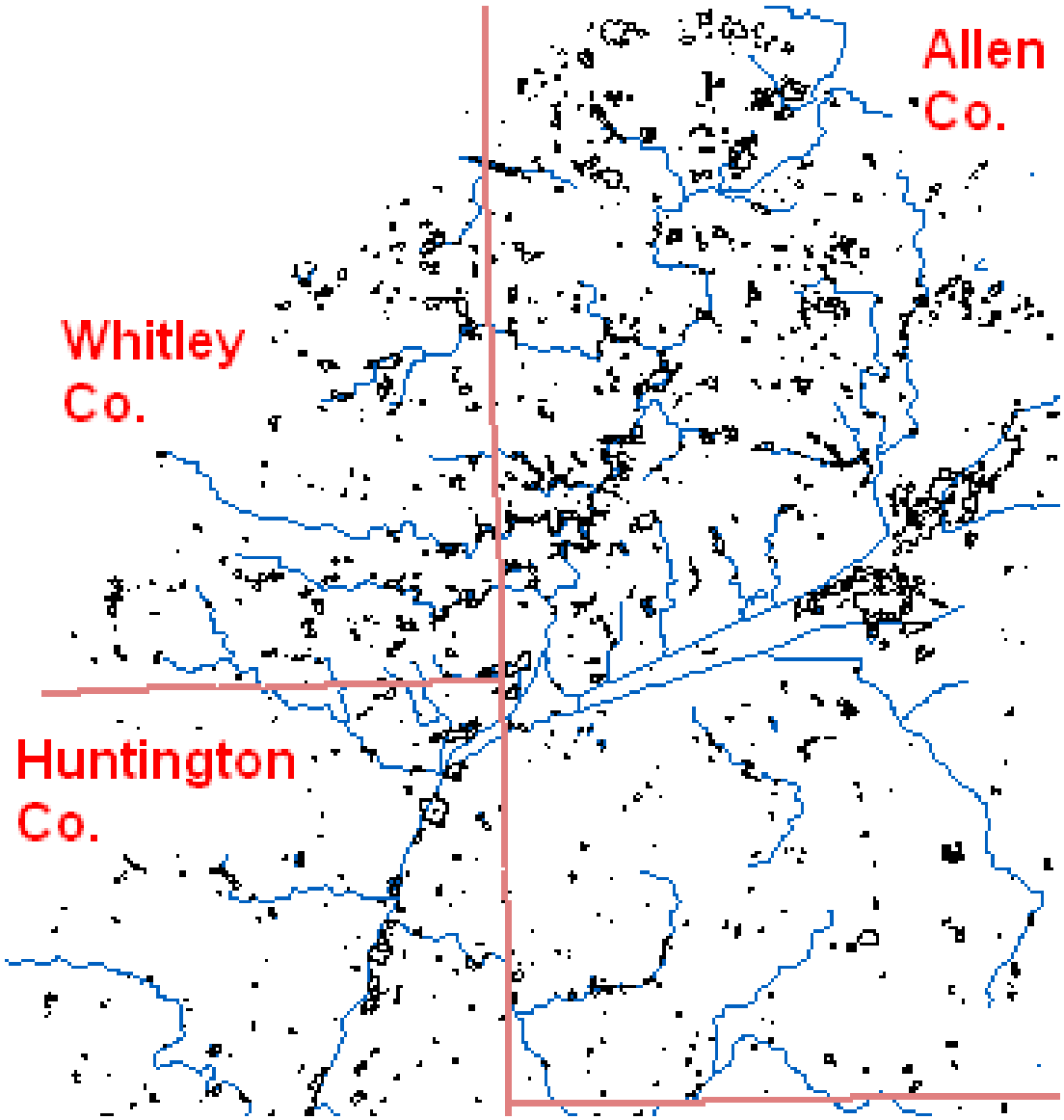


Table 2. Wetland Resources

Watershed	Forested Acres	Scrub-Shrub Acres	Emergent Acres	Open Water Acres	Total Wetland Acres
Aboite Creek - Beal Taylor Ditch	38.14	6.63	5.74	4.83	55.34
Aboite Creek - Big Indian/Little Indian Creeks	33.12	2.27	6.66	9.21	51.26
Eightmile Creek - Pleasant Run	12.92	0.28	0.61	2.58	16.39
Eightmile Creek - Witzgall Ditch	10.28	0.29	0.13	1.15	11.85
Graham McCulloch Ditch #1	39.48	24.17	9.65	8.85	82.15
Little River - Allen	11.43	2.95	3.95	5.92	24.25
Little River - Bull Creek	9.60	1.47	1.57	2.10	14.74
Little River - Calf/Cow Creeks	19.86	1.96	6.30	10.57	38.69
Little River - Flat Creek (lower)	20.73	0.32	0.66	1.99	23.70
Little River - Flint Creek	3.00	1.11	1.91	18.91	24.93
Little River - Mud Creek	3.75	1.34	1.21	1.67	7.97
Robinson Creek	10.12	0.00	0.62	0.80	11.54
Seager Ditch	38.54	2.86	7.20	1.33	49.93
Total Acres	250.97	45.65	46.21	69.91	412.74

Table 3. Hydric Soils, NWI, & Floodplains

Watershed	Percent Hydric Soil	Percent NWI Wetlands	Percent Floodplain
Aboite Creek - Beal Taylor Ditch	14.20%	0.48%	12.12%
Aboite Creek - Big Indian/Little Indian Creeks	23.02%	0.46%	19.01%
Eightmile Creek - Pleasant Run Ditch	16.07%	0.21%	17.84%
Eightmile Creek - Witzgall Ditch	34.01%	0.16%	14.64%
Graham McCulloch Ditch #1	20.44%	0.59%	25.00%
Little River - Allen	36.01%	0.28%	41.70%
Little River - Bull Creek	37.61%	0.15%	12.24%
Little River - Calf/Cow Creeks	23.99%	0.25%	17.19%
Little River - Flat Creek (lower)	34.45%	0.18%	20.43%
Little River - Flint Creek	22.66%	0.23%	8.41%
Little River - Mud Creek	43.52%	0.08%	15.00%
Robinson Creek	36.49%	0.11%	22.80%
Seager Ditch	43.16%	0.45%	14.84%
Totals	29.20%	0.29%	18.44%

C. FLOOD PLAINS

Flood plains in the watershed have been mapped by the Federal Emergency Management Agency. The flood plain between Fort Wayne and Huntington along the Little River is over 1 mile wide in most places. Knowledge of the location of flood plains is necessary if a construction permit is needed for installation of certain best management practices. Maps of flood plain locations will be included in Section V.

D. CHEMICAL AND BIOLOGICAL SAMPLING

Chemical and biological sampling within the watershed was conducted to provide a diagnosis of what kinds of water quality problems exist and how severe they are. Chemical sampling provides a “snapshot” of conditions as they exist when the water sample is collected. In contrast,, biological sampling provides a “movie” of water quality at the site. This is because animals that live in the water are exposed to conditions there continuously.

Chemical sampling included the following parameters, collected once during base flow and once during storm flow conditions:

	Indicator Value
Dissolved Oxygen	Oxygen must be present above 5 mg/l for most aquatic life
pH	pH above 8 indicates the potential for excessive algal growth
Conductivity	A quick measure of total dissolved solids present in the water
Temperature	Temperatures above 30 degrees C hurt most aquatic life
Ammonia	A nutrient that also can be toxic to aquatic life
Nitrate	A nutrient that accelerates algal growth
Phosphorus	A nutrient that accelerates algal growth
Suspended Solids	Turbidity and suspended solids reduce light and clogs gills of animals

Biological sampling was done one time during the summer at 19 sites (see below). This technique resulted in two measurements:

The index of biotic integrity (IBI)
A score that ranges from 0 (indicator of a life-less stream)
to 100 (the healthiest possible stream for this part of the country).
The qualitative habitat evaluation index (QHEI)
A score that ranges from 0 (a dry, formless stream)
to 100 (the best possible habitat for this part of the country).

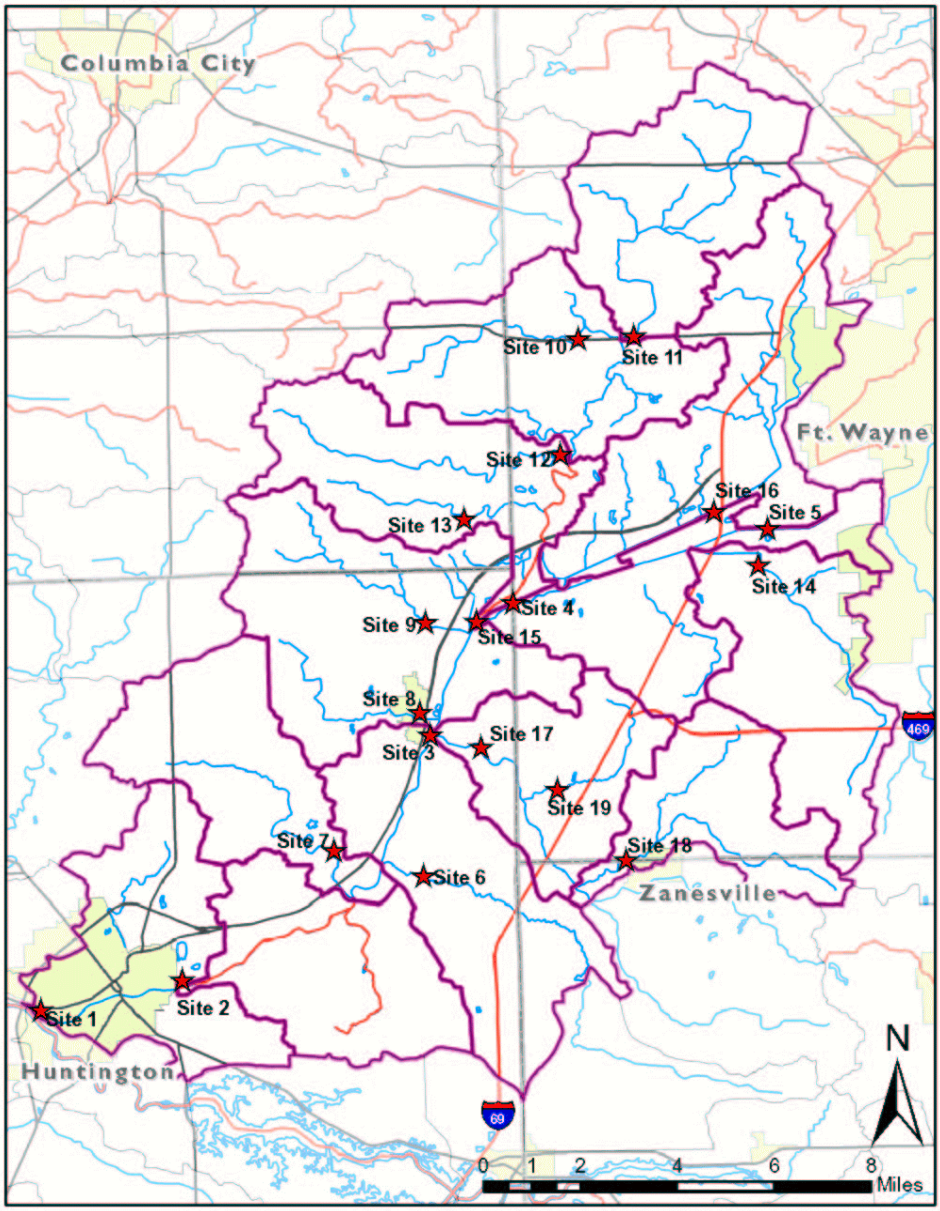
Both the IBI and QHEI provide scores that allow one site to be compared with others and provide a system for prioritizing problems.

Nineteen sampling sites were chosen for this study (see Fig. 9). Watershed areas of each site [1] and their locations are shown below:

Table 4. Sampling Sites

Site #		Latitude	Longitude	Drainage Area square miles
1	Little River below Huntington	40.52.27	85.31.29	288
2	Little River above Huntington	40.52.54	85.28.08	263
3	Little River at Roanoke	40.57.20	85.22.07	209
4	Little River at County Line	40.59.22	85.20.43	28
5	Upper Little River	41.00.57	85.14.05	3
6	Flat Creek	40.54.28	85.22.24	26
7	Bull Creek	40.55.21	85.24.48	15
8	Cow Creek	40.57.42	85.22.23	8
9	Calf Creek	40.59.22	85.22.13	10
10	Beal Taylor Ditch	41.04.24	85.18.26	10
11	Seegar Ditch	41.04.24	85.17.10	17
12	Big Indian Creek	41.02.17	85.18.58	9
13	Little Indian Creek	41.01.13	85.21.16	5
14	Robinson Creek	41.00.19	85.14.15	16
15	Aboite Creek	40.59.22	85.20.58	51
16	Graham McCullough Ditch	41.01.15	85.15.21	18
17	Eight Mile Creek	40.57.06	85.20.57	81
18	Witzgall Ditch	40.54.59	85.17.39	11
19	Pleasant Run	40.56.20	85.19.10	4

Figure 8
Study Sites - Little River Watershed



Water Quality Monitoring Sites
Little Wabash Watershed
Allen, Huntington, & Whitley Counties

METHODS

Water Chemistry

Water chemistry measurements were made at each study site on the same day that macroinvertebrate samples were collected. Dissolved oxygen was measured by the membrane electrode method. The pH measurements were made with a Cole-Parmer pH probe. Conductivity was measured with a Hanna Instruments meter. Temperature was measured with a mercury thermometer. All instruments were calibrated in the field prior to measurements.

Samples for nutrient and bacteria analysis were collected as grabs and returned to the lab for analysis using methods approved by the APHA. Nitrate and phosphorus were measured by spectrophotometry. Ammonia was measured by the ion-specific probe method. Data sheets are attached in an appendix.

Biological Communities

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to environmental change, benthic (bottom-dwelling) organisms were used to document the biological condition of each stream. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [7] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used EPA's Protocol III to conduct this study. Protocol III requires a standardized collection technique, a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site." The reference site in this study was Little River at site 2. Macroinvertebrate and habitat data from previous IDEM sampling [26] had shown this site to have very high habitat and biological index scores.

Habitat Analysis

Habitat analysis was conducted on September 7, 2007 according to Ohio EPA methods [23]. In this technique, various characteristics of a stream and its watershed are assigned numeric values. All assigned values are added together to obtain a "Qualitative Habitat Evaluation Index " or QHEI. The highest value possible with this habitat assessment technique is 100.

Macroinvertebrate Sample Collection

Benthic samples in this study were collected by the “kick net” method from riffles on June 5, 2007. The samples were preserved in the field with 70% isopropanol and returned to the lab for analysis.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified a representative specimen was preserved as a "voucher." All voucher specimens have been deposited in the Purdue University Department of Entomology collection.

RESULTS

Water Quality Measurements

Water chemistry results collected during dry weather are shown in Table 1. Data collected in wet weather are shown in Table 2. Wet weather flows were defined as having at least an inch of rain within the previous day.

Table 5. Water Quality (Base Flow)

June 13, 2007 Samples
Sunny, 80 degree F

Flow cfs		Site	TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O mg/l	pH SU	Cond. uS	Temp. C
44	Little River d/s Huntington	1	0.9	0.6	1.5	<0.1	0.5	7.5	10.2	8.2	970	24.9
40	Little River u/s Huntington	2	0.65	0.32	1.7	<0.1	0.5	13	8.1	8.0	1000	22.8
32	Little River at Roanoke	3	0.65	0.26	2.4	0.8	0.9	37	6.2	7.8	1040	23.4
4.4	Little River at County Line	4	0.44	0.16	4.6	0.1	0.5	87.5	5.7	7.8	1320	23.9
0.4	Upper Little River	5	0.22	0.18	1.9	0.16	0.5	35.4	10.7	8.1	1510	27.5
4.0	Flat Creek	6	0.12	0.04	0.8	<0.1	0.5	37	10.3	7.9	630	29.1
2.4	Bull Creek	7	0.36	0.26	1.3	<0.1	0.5	5	7.6	8.0	610	20.7
1.2	Cow Creek	8	0.26	0.1	1.1	0.13	0.5	6.5	11.0	8.1	630	27.8
1.6	Calf Creek	9	0.26	0.11	1.2	<0.1	0.5	6	8.0	8.1	680	22.5
1.6	Beal Taylor Ditch	10	0.32	0.14	1.3	0.3	0.5	10	9.3	8.3	630	24.4
2.4	Seegar Ditch	11	0.1	0.06	1.8	0.16	0.5	11.5	12.8	8.2	720	24.5
1.6	Big Indian Creek	12	0.36	0.14	4.6	0.9	1	4	7.3	8.1	620	21.7
0.8	Little Indian Creek	13	0.1	0.07	1.5	<0.1	0.5	11	12.7	8.7	440	32.3
2.4	Robinson Creek	14	0.1	0.06	0.6	0.13	0.5	7	9.6	8.3	590	25.2
7.6	Aboite Creek	15	0.13	0.11	0.7	<0.1	0.5	8	13.8	8.1	710	30.1
2.8	Graham McCullough Ditch	16	2.6	0.5	7.5	0.2	0.5	51	7.6	8.0	1230	26.8
12.4	Eight Mile Creek	17	0.07	0.05	1.3	0.4	0.5	3.5	7.8	7.9	1060	22.1
1.6	Witzgall Ditch	18	0.26	0.1	0.9	0.1	0.5	5	5.8	8.1	630	24.8
0.0	Pleasant Run	19	2.2	0.9	2.9	9	10	17.5	7.7	8.1	2650	25.5

D.O. = Dissolved Oxygen
pH = acidity of the water
Cond. = Conductivity
Temp. = Temperature in degrees Celcius
TSS= Total Suspended Solids
NO3 = Nitrite + nitrate (as Nitrogen)
NH3 = Ammonia (as Nitrogen)
TKN = Organic Nitrogen + Ammonia
PO4 = Phosphate (as Phosphorus)

Table 6. Water Quality (Storm Flow)

December 12, 2007 Samples
cloudy, 40F air temperature

Flow cfs		Site	TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C
3300	Little River d/s Huntington	1	0.7	0.28	5	1.2	1.7	197	11.0	7.6	300	4.0
3000	Little River u/s Huntington	2	0.75	0.26	5	1.5	1.7	190	10.8	7.6	300	4.0
2370	Little River at Roanoke	3	0.4	0.28	3.2	1.5	2.1	82	10.6	7.6	300	4.0
330	Little River at County Line	4	0.75	0.58	2	1.5	1.7	116	10.2	7.6	300	4.0
30	Upper Little River	5	0.14	0.06	1.2	0.8	0.8	30	10.6	7.6	750	5.0
300	Flat Creek	6	0.6	0.24	8	1.6	1.6	151	10.1	7.5	300	4.0
180	Bull Creek	7	0.8	0.57	4.8	1.5	1.6	80	10.6	7.5	250	4.0
90	Cow Creek	8	0.85	0.57	4.6	1.5	1.7	74	11.3	7.6	250	4.0
120	Calf Creek	9	0.58	0.22	4.4	1.5	1.7	71	11.0	7.6	300	4.0
120	Beal Taylor Ditch	10	0.34	0.24	3.5	0.6	1	97	10.9	7.1	100	3.0
180	Seegar Ditch	11	0.57	0.44	3.5	1	1	118	10.5	7.1	200	3.0
120	Big Indian Creek	12	0.57	0.34	4.4	1.5	1.7	147	11.1	7.3	200	3.0
60	Little Indian Creek	13	0.28	0.24	2.5	0.9	1	81	11.0	7.4	200	3.0
180	Robinson Creek	14	0.7	0.44	2.3	0.6	1.2	87	10.4	7.6	350	5.0
570	Aboite Creek	15	0.4	0.24	3	0.6	1.3	109	11.1	7.6	250	4.0
210	Graham McCullough Ditch	16	0.4	0.26	2.3	1	1.2	81	10.9	7.7	500	4.0
930	Eight Mile Creek	17	1.4	0.7	7	1.2	1.4	320	10.8	7.5	250	3.0
120	Witzgall Ditch	18	0.34	0.25	4.4	0.4	1.1	138	10.8	7.6	250	5.0
45	Pleasant Run	19	0.25	0.16	1.8	0.6	1.4	70	11.6	7.7	400	3.0

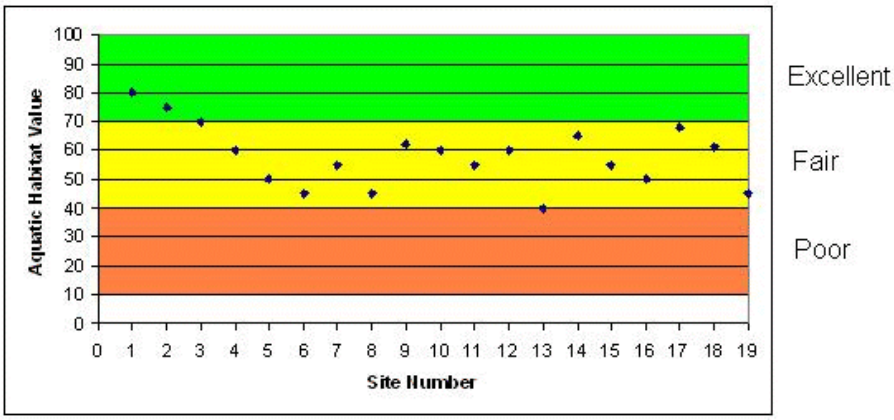
Aquatic Habitat Analysis

The following aquatic habitat values were obtained for each site in the study:

Site #		QHEI Score
1	Little River below Huntington	80
2	Little River above Huntington	75
3	Little River at Roanoke	70
4	Little River at County Line	60
5	Upper Little River	50
6	Flat Creek	45
7	Bull Creek	55
8	Cow Creek	45
9	Calf Creek	60
10	Beal Taylor Ditch	60
11	Seegar Ditch	55
12	Big Indian Creek	60
13	Little Indian Creek	40
14	Robinson Creek	65
15	Aboite Creek	55
16	Graham McCullough Ditch	50
17	Eight Mile Creek	65
18	Witzgall Ditch	60
19	Pleasant Run	50

The maximum value obtainable is 100. Higher values indicate better aquatic habitat. Sites with lower habitat values normally have lower biotic index values as well. Most streams in this watershed had “fair” habitat. The best aquatic habitat occurred in the lower end of the Little River near Huntington. The lowest habitat scores occurred in Flat Creek, Cow Creek, and Little Indian Creek. Habitat there was hampered by a paucity of stable bottom substrate and instream cover, by a lack of riparian buffer vegetation, and by channelization. Nuisance wildlife or exotic invasive species did not appear to be a major problem at any site.

Fig. 9. Aquatic Habitat Scores



Biotic Index Analysis

A total of 53 macroivertebrate genera were found during the study. Predominant forms included mayflies (Baetis spp), riffle beetles (Stenelmis spp.) and midge larvae (Chironomidae). Biotic scores by site number are presented in Table 7.

Table 7. IBI metrics and scoring by site number

	Site Number									
	1	2	3	4	5	6	7	8	9	10
Ohio EPA *	60	47	57	47	27	43	43	50	63	57
mIBI *	50	90	65	48	8	58	55	65	50	50
LARE **	100	100	87	82	64	64	64	73	91	91
US EPA **	67	100	64	64	52	60	60	64	68	60

	Site Number									
	11	12	13	13d	14	15	16	17	18	19
Ohio EPA *	43	53	50	57	37	53	40	47	43	40
mIBI *	48	40	40	52	53	45	28	55	65	58
LARE **	64	76	73	87	60	93	47	64	69	60
US EPA **	60	64	60	60	60	64	40	60	52	64

* values are a percentage of maximum possible score
** values are percentage of reference site (Site 2)

Each of the four different sets of metrics has advantages when interpreting the data. For example, the Ohio EPA method uses more taxonomic information (genus/species level identification), while mIBI, LARE, and US EPA methods take into account the presence of stoneflies (one of the EPT [ephemeroptera, plecoptera, trichoptera] taxa known to be environmentally sensitive) and the ecological role of functional feeding groups. While each of the four protocols may not produce the exact same ranking of sites from best to worse, patterns do emerge.

Site 5 (the upper Little River) is the most impaired. The sample from Site 5 contained many organisms considered to be tolerant of environmental degradation including oligochaete worms and a midge species (Cricotopus bicinctus). In addition to the presence of tolerant organisms, it did not support any mayflies or stoneflies, and very few caddisflies. A decrease in the diversity and abundance of EPT taxa can be the result of sedimentation. This site appears to be impacted by suspended solids in drainage from a nearby stone quarry.

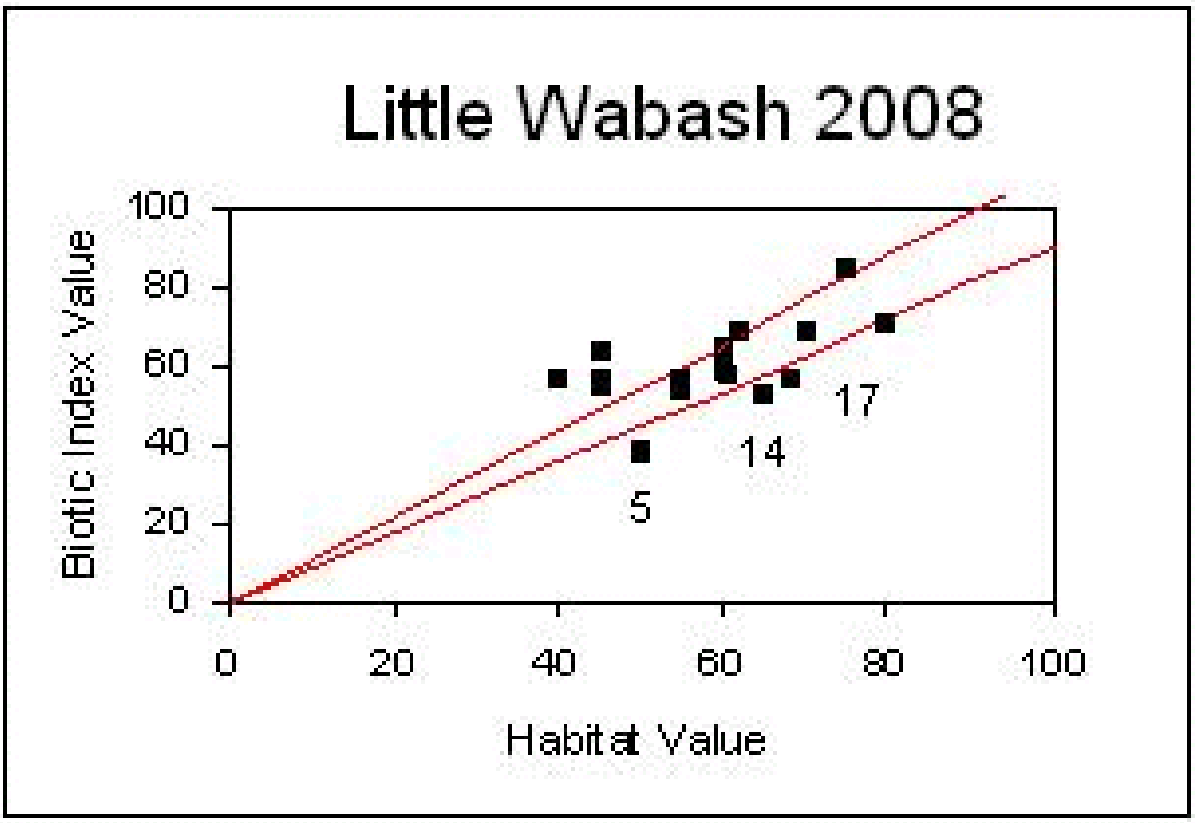
Several other sites had scores lower than what would be expected based on their habitat scores. Site 17 (Eight Mile Creek) had a habitat score of 65, but its Ohio EPA biotic score was only 47. The functional feeding groups scrapers and filterers were

decreased in abundance, which may be a response to sedimentation. The benthic community was not diverse, as it was dominated by one type of mayfly (Baetis flavistriga). Baetis flavistriga is the most commonly found mayfly in urban streams, and an abundance of these organisms is an indicator of nutrient enrichment. Baetis mayflies are in the functional feeding group collector-gatherer, which tend to increase their proportional abundance under environmental stress.

Site 14 (Robinson Creek), whose watershed includes Fort Wayne International airport, supported relatively few species despite possessing good habitat. There were no caddisflies or stoneflies present in the sample, and only two species of mayflies. The dominant organism was the mayfly Baetis flavistriga.

When the biotic index value of a site is plotted against its habitat value, the values usually correspond closely unless water quality is degraded [6]. A plot of the values obtained in this study is shown below. Sites falling below the plus or minus 10% of the normal relationship marked by the red lines probably have some type of water quality problem and are highlighted.

Fig. 10.. Habitat vs. Biotic Index Scores.



The highlighted sites are 5 (Upper Little River), 14 (Robinson Creek), and 17 (Eight Mile Creek).

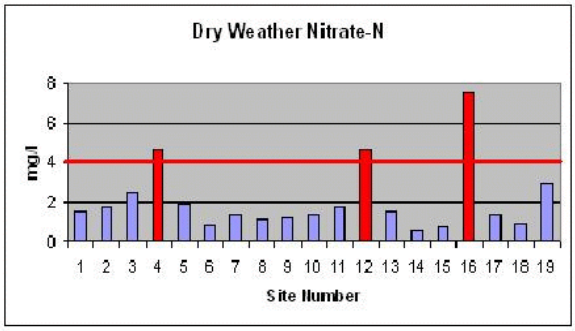
E. Aerial Photography Analysis

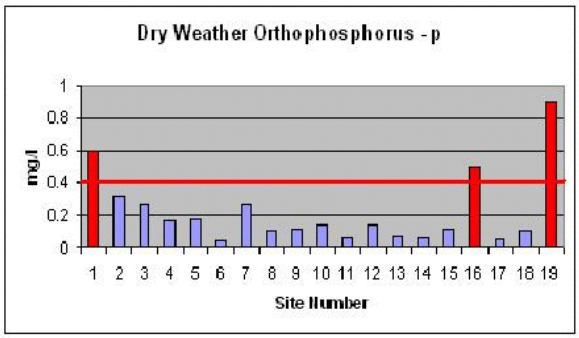
The most recent available aerial photographs of the watershed were examined closely to determine the status of riparian buffers. These were delineated as “poor, fair, and good” along each stream segment. Those with large areas of poor riparian buffer are shown in more detail in Section 5 [Proposed Solutions].

RESULTS AND IDENTIFICATION OF PROBLEM AREAS

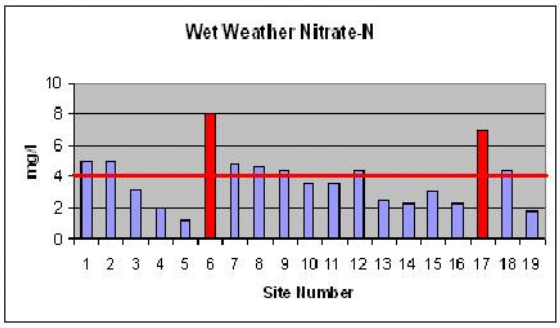
Instream chemical parameters measured at each site indicate that dissolved oxygen (D.O.), pH, temperature, and conductivity fell within acceptable ranges for most forms of aquatic life. Abundant algal growth (stimulated by high nutrient inputs) is usually indicated by pH readings significantly higher than 8.0. This situation was observed at Site 13 on the Little Indian Creek during base flow. High algal growth rates are also indicated at sites where dissolved oxygen is much higher than the saturation level. This situation was observed during dry weather sampling at Sites 11 (Seegar Ditch), 13 (Little Indian Creek), and 15 (Aboite Creek). Because algae also use oxygen when light is not present, sites with abundant algae typically have large variations in D.O. During the night or on cloudy days the D.O. at such sites may drop below the 5 mg/l minimum required for healthy aquatic communities.

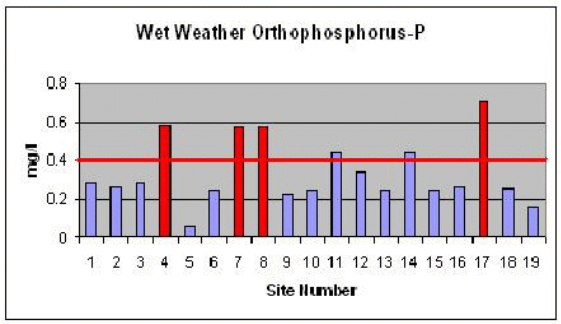
Nutrient and suspended solids concentrations were high compared to other streams in Indiana flowing through areas with primarily agricultural land uses [20]. Nitrogen and phosphorus concentrations were about 2 times higher than the criteria [2 mg/l for N and 0.1 mg/l for P] proposed for Midwestern streams [25]. Nutrient values observed during base flow conditions [very high sites are highlighted] are shown below:





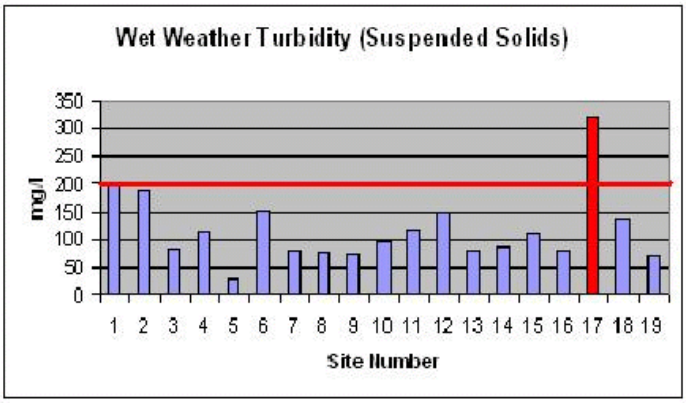
Site 16 (downstream from a large wastewater treatment plant) was identified as having higher than normal inputs of both nutrients during base flow. Similar graphs of nutrient levels during storm flow are shown below. Site 17 (Eight Mile Creek) had especially high levels of both nutrients during storm events.





Turbidity, as measured by “total suspended solids” concentrations, was low at most sites during base flow conditions. An important exception occurred at site 4 (Upper Little River). This stream had a milky appearance during low flow sampling and the suspended solids concentration was at least 5 times higher than most other sites.

During wet weather sampling, the suspended solids concentrations were much higher. Concentrations greater than 100 mg/l over an extended period rarely have good fisheries [32]. Wet weather results for Little River are shown below:

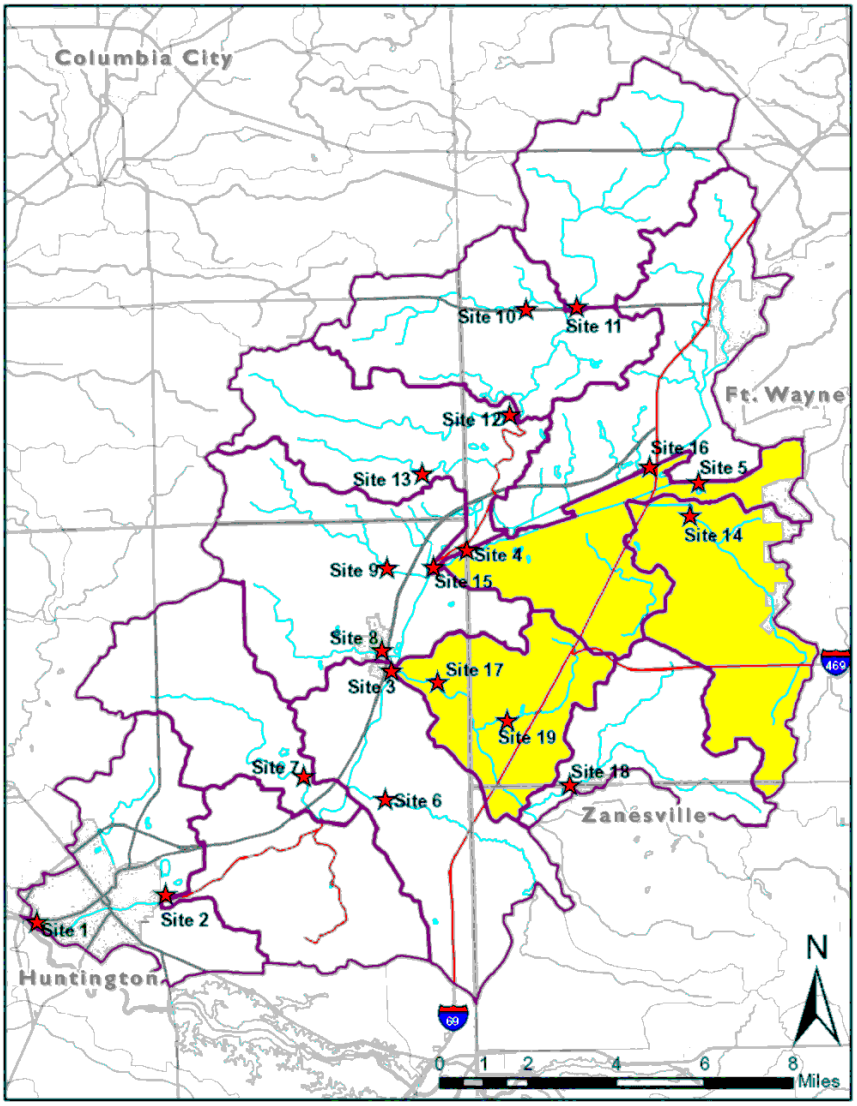


Site 17 (Eight Mile Creek) had especially high suspended solids levels during wet weather sampling.

The most commonly collected macroinvertebrate groups were midge larvae, aquatic beetles, mayflies, and net-spinning caddisflies. The pollution intolerant groups Ephemeroptera and Trichoptera (mayflies and caddisflies) were abundant at most sites but noticeably absent at site 4 (Upper Little River). Even though the mayfly and caddisfly groups are generally considered “pollution intolerant,” the dominant species in these two groups (*Baetis flavistriga* and *Chematopsyche* spp.) are known to be among the more tolerant species. Few truly intolerant species were abundant. Possible exceptions may be the abundant perlid stoneflies at sites 19 (Pleasant Run) and 18 (Witzgall Ditch).

Earlier, sites on the Upper Little River, Eight Mile Creek, and Robinson Creek were identified as having impaired aquatic communities. What kinds of water quality problems are contributing to impairment? The proportion of sediment and turbidity-intolerant forms was higher at the reference site than at most other sites. No intolerant animals were observed at 11 of the 19 sites. These results indicate that sediment-related impairment may be contributing to the water quality problems in many of the watersheds. Best management practices which reduce soil erosion and increase streambank stability should be used in the sub-watersheds shown in Fig. 11.

Fig. 11. Sub-watersheds dominated by "sediment indicator" animals



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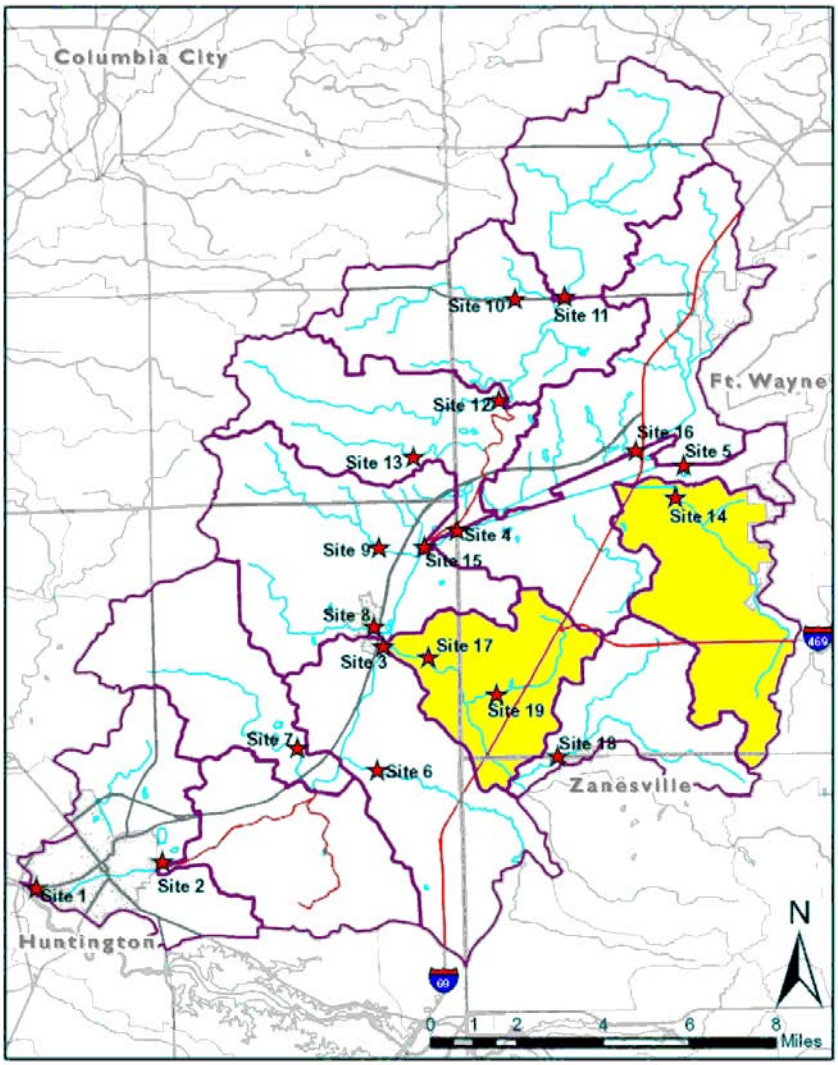
When the number of animals which eat algae attached to rocks ("scraper" organisms) become numerically dominant, excessive nutrient inputs are often the cause. Scrapers dominated at many sites but were especially abundant at Robinson Creek and Eight Mile Creek. These sub-watersheds are shown in Fig. 12.

Fig. 12. Sub-watersheds with abundant "scraper" organisms



Water Quality Monitoring Sites
Little Wabash Watershed
Allen, Huntington, & Whitley Counties

D. LOADING PREDICTIONS BASED ON MODELING

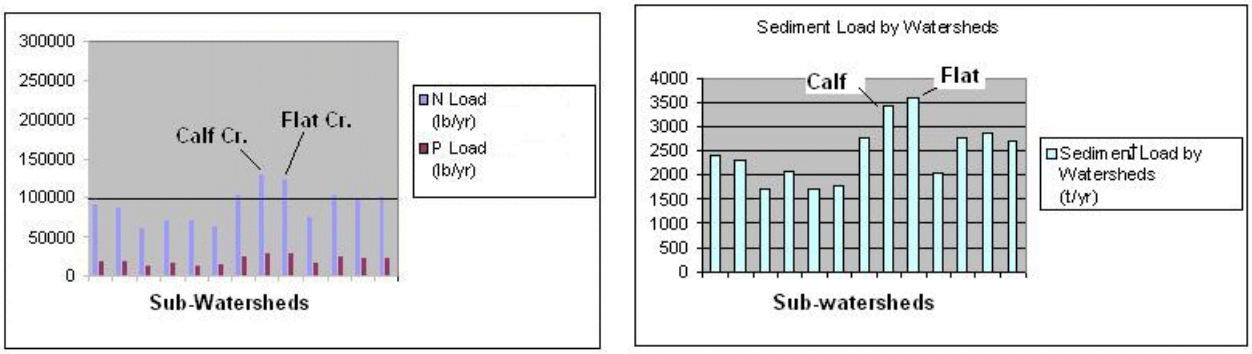
Computer models are sometimes useful for helping water resource managers visualize water quality and biological changes that could occur when changes in land use are made. A model used by some scientists involved in the TMDL (total maximum daily load) program of U.S.EPA is called STEPL [28]. This is a computer program that uses information about land use, soils, population density, and number of livestock to predict nutrient and sediment runoff. It also calculates improvements that may be expected with various best management practices (BMPs). A print-out of model input and results is attached in an appendix. A summary of present loading productions is shown in Table 8 below:

Table 8. Load predictions from the STEPL model

Sub-Watershed	N Load	P Load	Sediment Load
	lb/year	lb/year	tons/year
Aboite/Beal	92050	20134	2375
Aboite/Indian	88418	19907	2314
8Mile/Pleasant Run	63138	14126	1693
8Mile/Witz.	72655	17479	2094
G-McCulloch	73420	13675	1724
Upper Little	64419	14807	1769
Little/Bull	103689	25033	2787
Little/Calf	129814	29556	3404
Little/Flat	126187	30305	3573
Little/Flint	76869	16317	2027
Little/Mud	103197	24668	2758
Robinson	99727	23654	2848
Seager	101160	23492	2682
Total	1194748	273159	32054

Most of the sediment and nutrient loading originates from agricultural uses. The model predicts that the highest potential loading will occur in the Calf Creek and Flat Creek watersheds, as shown in Fig. 13. The limited amount of sampling in this study did not support the model prediction, perhaps due to conservation measures already implemented in these watersheds.

Fig. 13. Computer predictions of nutrient and sediment loading in the Little River



Because computer modeling suggests there is a potential for high nutrient and sediment loading in these watersheds, they are targeted as areas of "medium priority" for management. The high priority (red) and medium priority (yellow) watersheds are shown in Fig. 14.

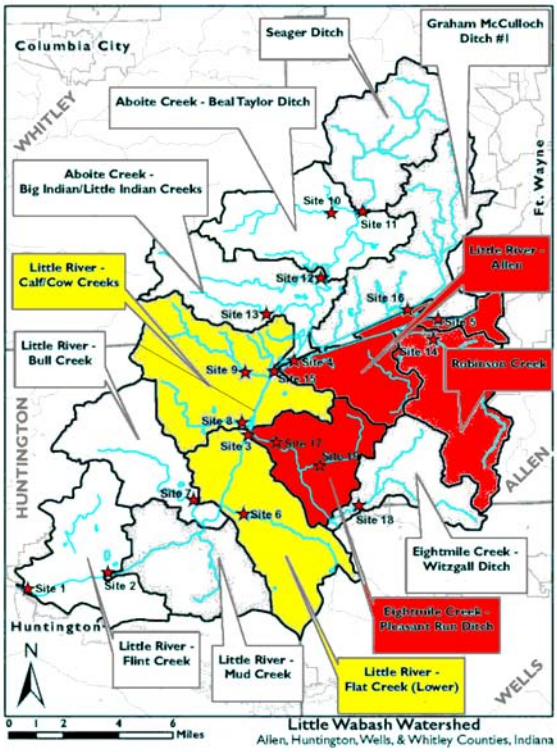


Fig. 14.
Priority watersheds for management

U.S. EPA has recently released a new computer model called AQUATOX.[5] that combines water chemistry with aquatic ecology. The model allows a user to set up a model ecosystem (e.g. a stream with a given depth, length, flow, climate, and water chemistry) and observe how that ecosystem's chemistry and biology changes over time. The model also allows the user to change the ecosystem by increasing or decreasing the amount of pollutant loading that occurs. For example, the user could tell the model that Best Management Practices for agricultural land uses are going to be implemented in a watershed and that phosphorus, nitrogen, and suspended solids concentrations are going to be cut in half by these BMPs. AQUATOX tells the user how BMP implementation would affect the chemistry and biology of a stream in that watershed.

The AQUATOX model was used to predict biological changes in the Little River watershed that could occur with BMP implementation. The model used the following assumptions, based on actual measurements in the watershed made as part of this study:

Physical Parameters

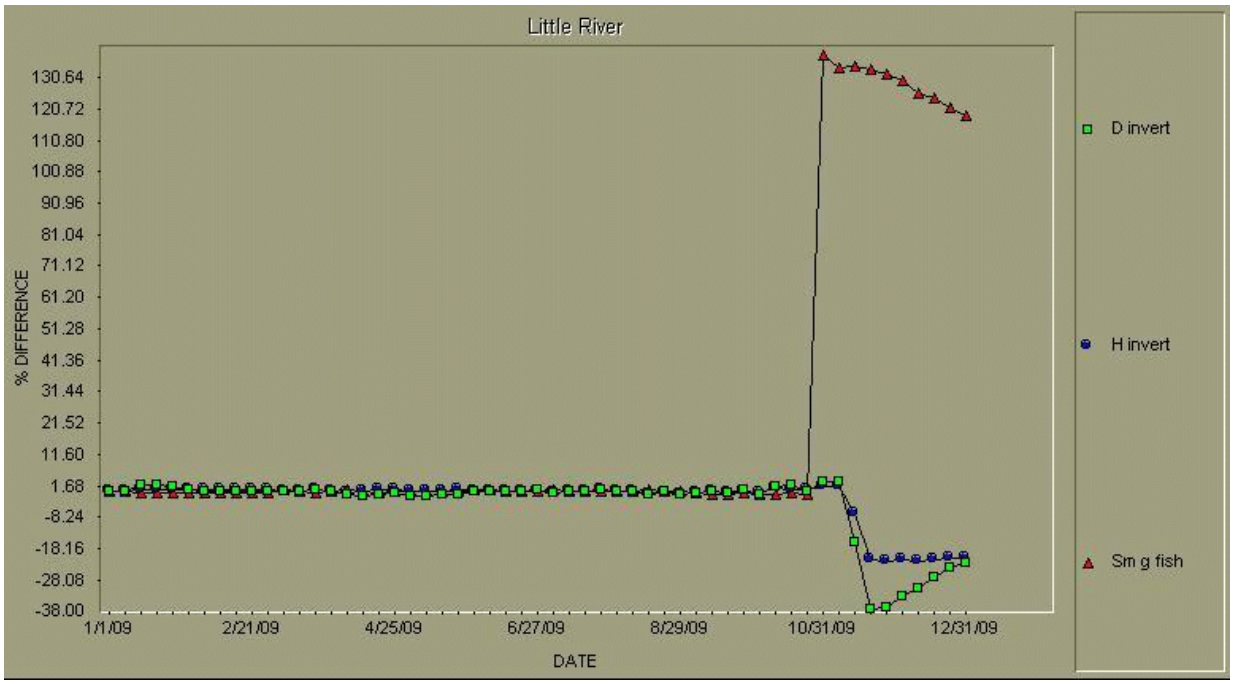
Reach Length	50 km
Mean Depth	0.5 m
Maximum Depth	1.0 m
Surface Area	100,000 sq. m
Volume	50,000 cu. m
Temperature Range	0 - 30 degrees C
Light	361 Ly/d
Latitude	40 degrees N

Initial Chemistry (dry weather average)

Ammonia	0.1 mg/l
Nitrate	2 mg/l
Phosphate	0.3 mg/l
Oxygen	12 mg/l
TSS	10 mg/l

To measure the changes expected to occur with BMP implementation, a 25% reduction in nutrients and sediment inputs within the drainage area of the project was plugged into the model. This represents a reasonable goal for the watershed, since most best management practices commonly reduce nonpoint source pollution by more than 25%. The changes predicted by the model are shown in Figure 15. The model predicts that within nine months of BMP implementation, biological improvements will begin to occur. The number of game fish such as bass will double following the first summer growing season.

Fig. 15. Expected biological changes expected following BMP implementation. "D invert" are caddisflies, "H invert" are mayflies, and "Sm g fish" are largemouth bass



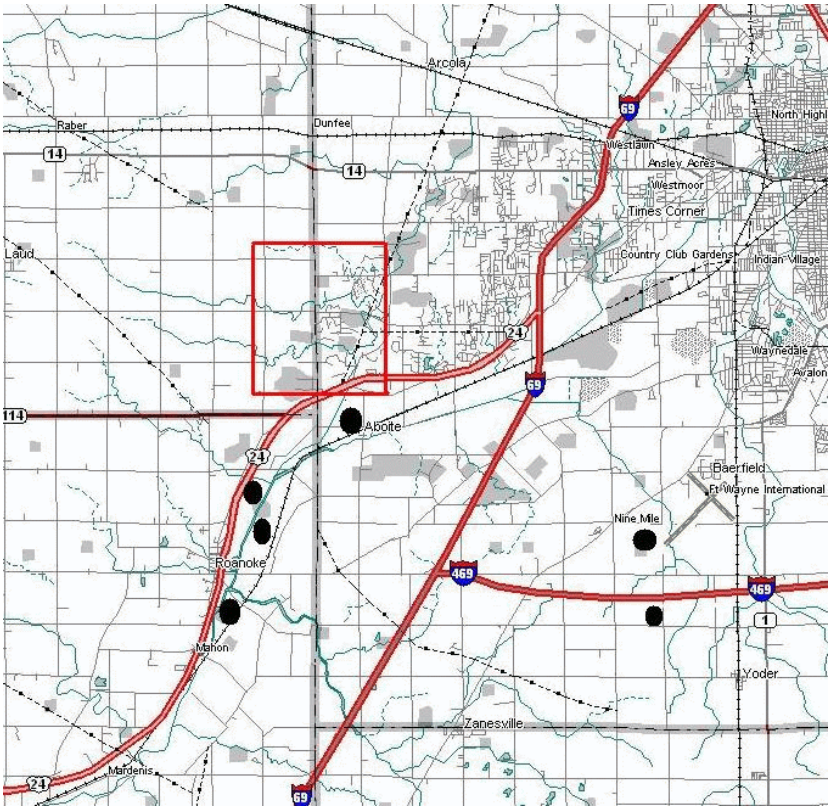
IV. SUMMARY OF PROBLEMS

	Problems	***Priority***
Eight Mile Creek	Sediment	High
Upper Little River	Sediment	High
Robinson Creek	Sediment	High
Cow/Calf Creek	Nutrients	Medium
Flat Creek	Sediment	Medium

V. PROPOSED SOLUTIONS

This plan proposes to reduce nutrient and sediment loading in the Little River watershed by 25%. Proposed BMP sites are shown in Fig. 16.

Fig. 16. Proposed BMP Sites.
Red square indicates especially vulnerable erosion sites.
Black ovals indicate potential wetland restoration sites

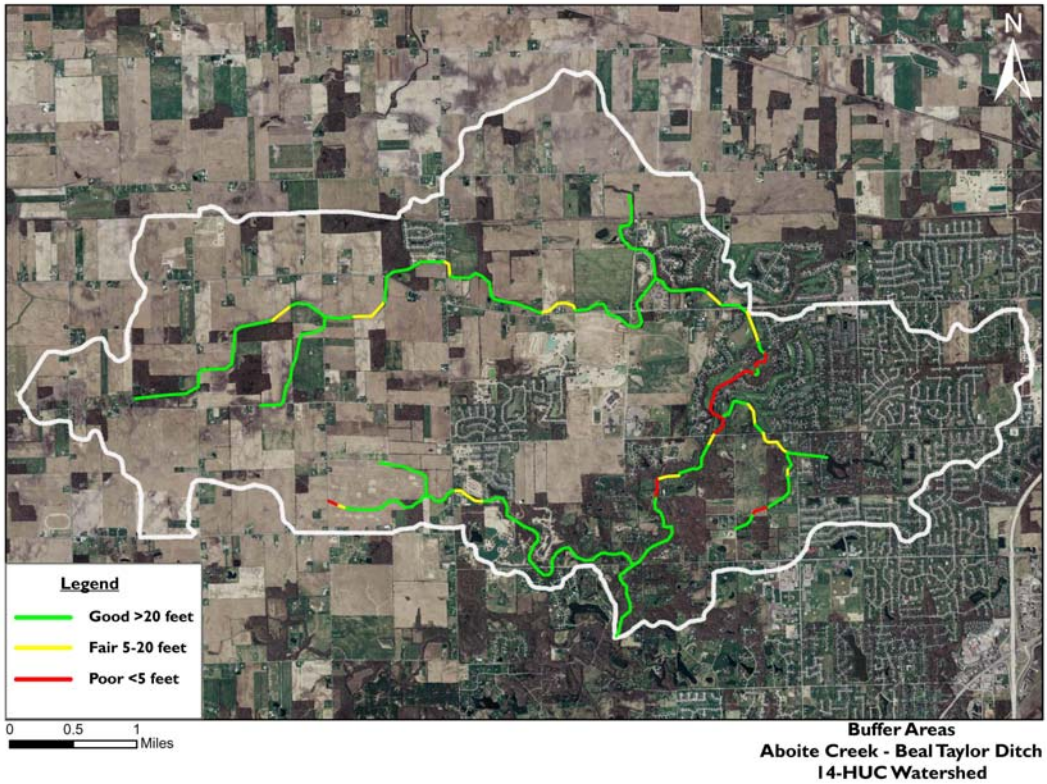


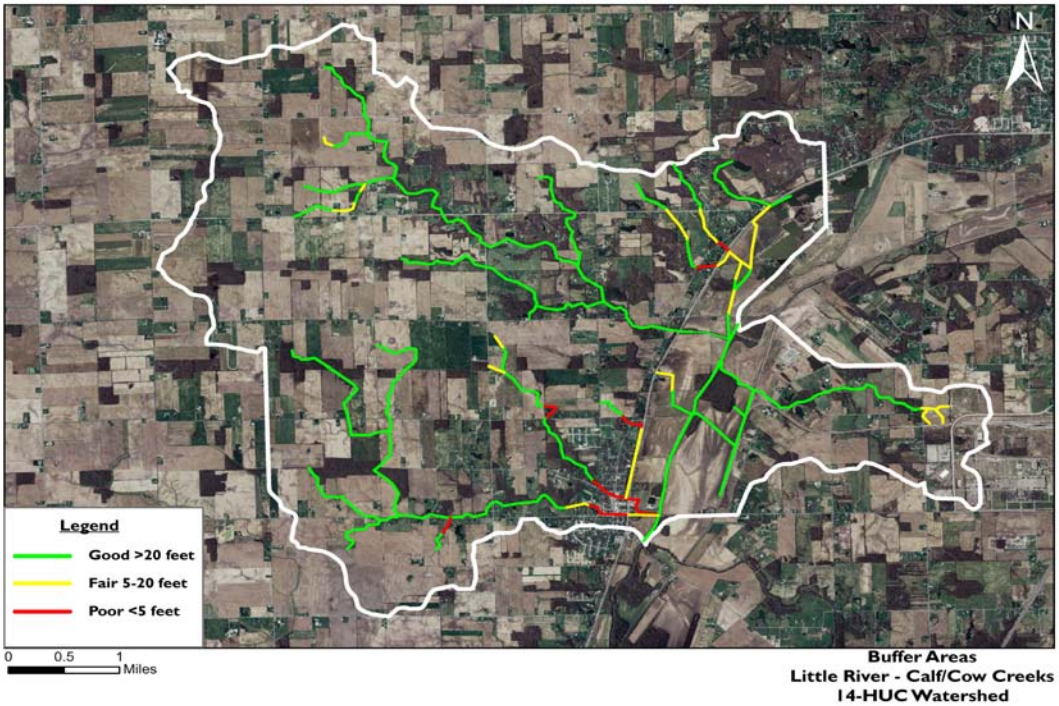
Riparian Buffers

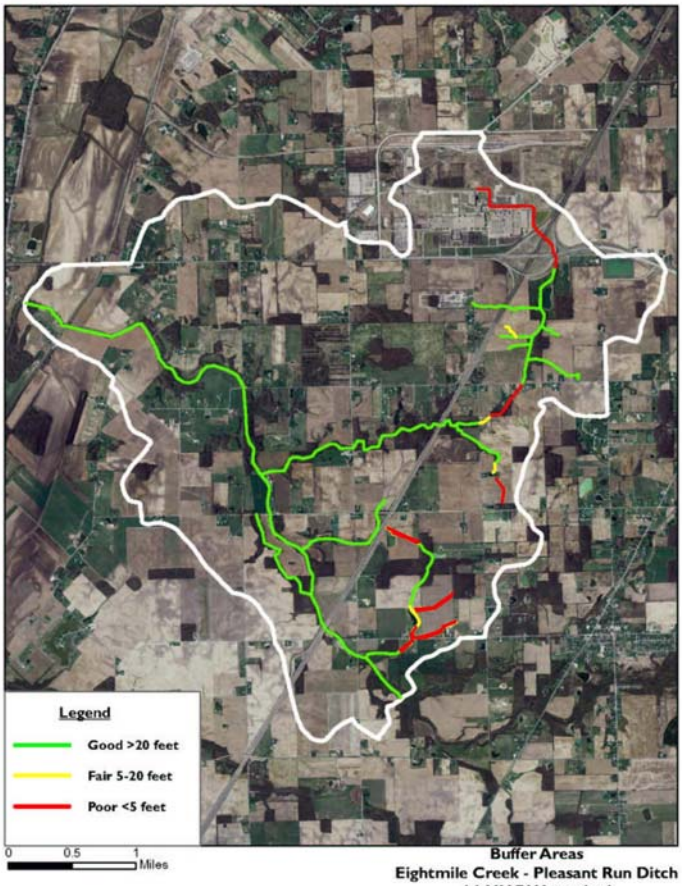
The establishment of riparian buffers 20 feet wide in 6 sub-watersheds where the present buffer is poor will have a very effective water quality benefit throughout the Little River watershed. Today, about 8 miles of stream in these sub-watersheds lack any kind of buffer at all. The sites for riparian buffer plantings are shown in Fig. 16.

Beal Taylor Ditch - 1 mile
Cow/Calf Creek - 1 mile
Eightmile Creek - 2 miles
Flat Creek - 1 mile
Graham McCulloch Ditch - 1 mile
Robinson Creek - 2 miles

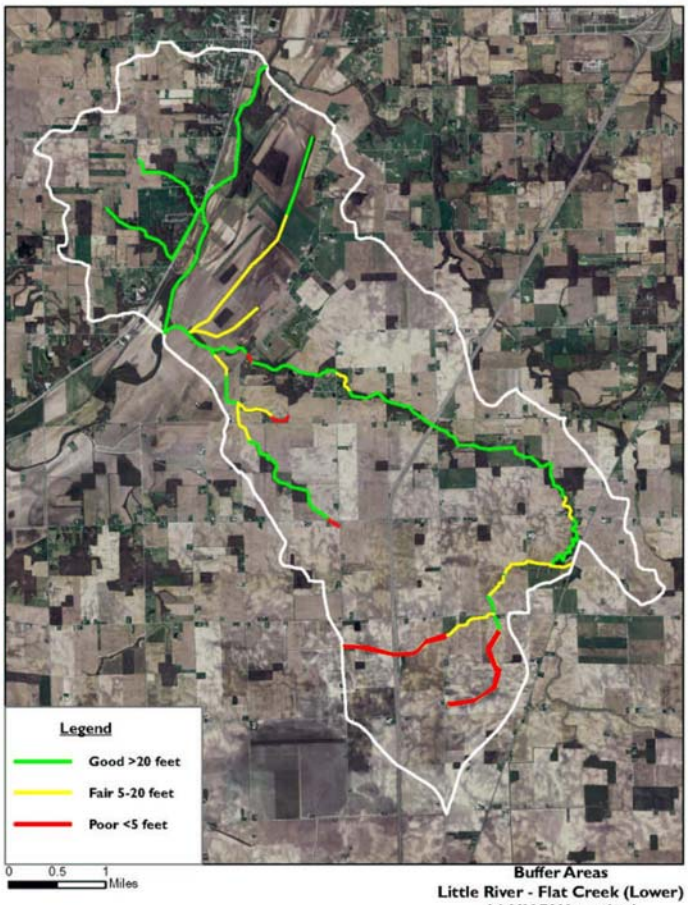
Fig. 17. Red lines indicate potential riparian buffer sites



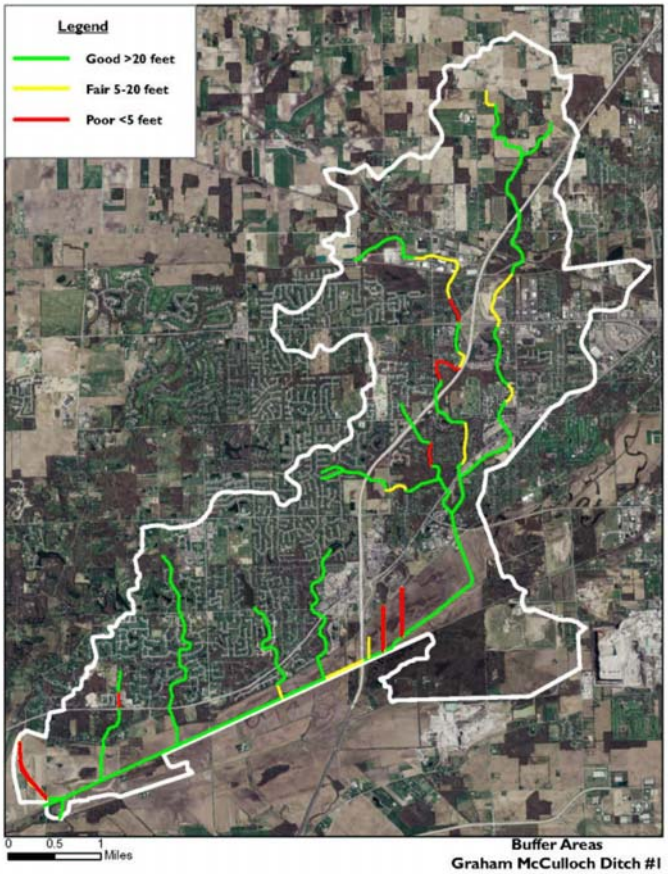




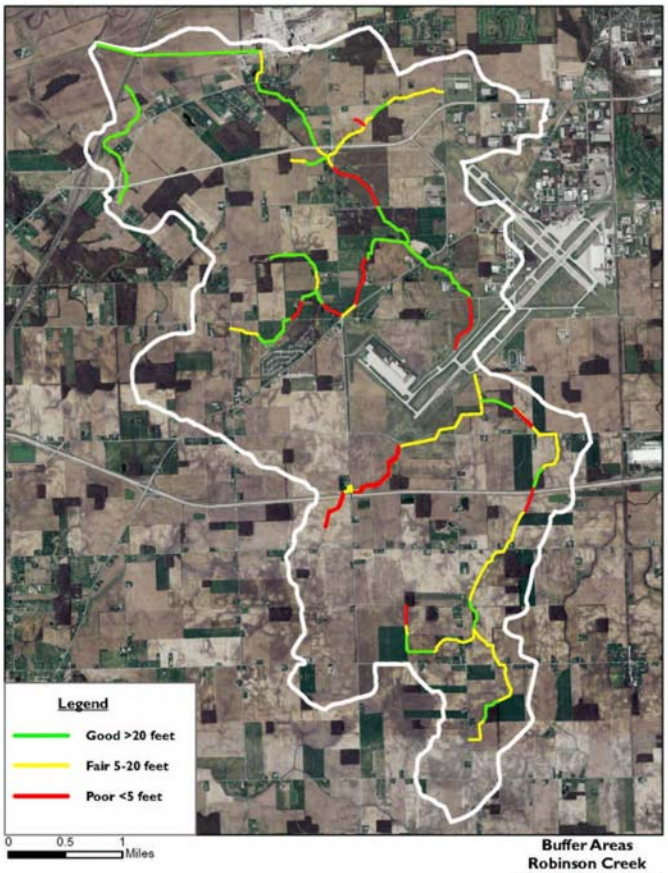
Buffer Areas
Eightmile Creek - Pleasant Run Ditch
14-HUC Watershed



Buffer Areas
Little River - Flat Creek (Lower)
14-HUC Watershed



Buffer Areas
Graham McCulloch Ditch #1
14-HUC Watershed



Buffer Areas
Robinson Creek
14-HUC Watershed

Table 9. Summary of Proposed BMPs

Best Management Practices	***Watershed Locations***	
Riparian Buffers	Six sub-watersheds	
Nutrient Reduction BMPs		
Manure Storage	Cow/Calf	Flat
Manure Testing and Land Application	Cow/Calf	Flat
Soil Testing and Nutrient Management	Cow/Calf	Flat
Wetland Restorations	Cow/Calf	Flat
Sediment Reduction BMPs		
Filter Strips	Robinson	Eightmile
Grassed Waterways	Robinson	Eightmile
Contour Buffer Strips	Robinson	Eightmile
Wetland Restorations	Robinson	Little
Erosion control on steep slopes	Aboite	
Aquatic habitat restoration	Calf	Flat

Several places in the watershed have streams flowing adjacent to steep slopes with erodible soils. Locations of these sites are given more precisely in Table 10.. These areas should be targeted for erosion-control BMPs.

Fig. 18. Potential erosion control sites

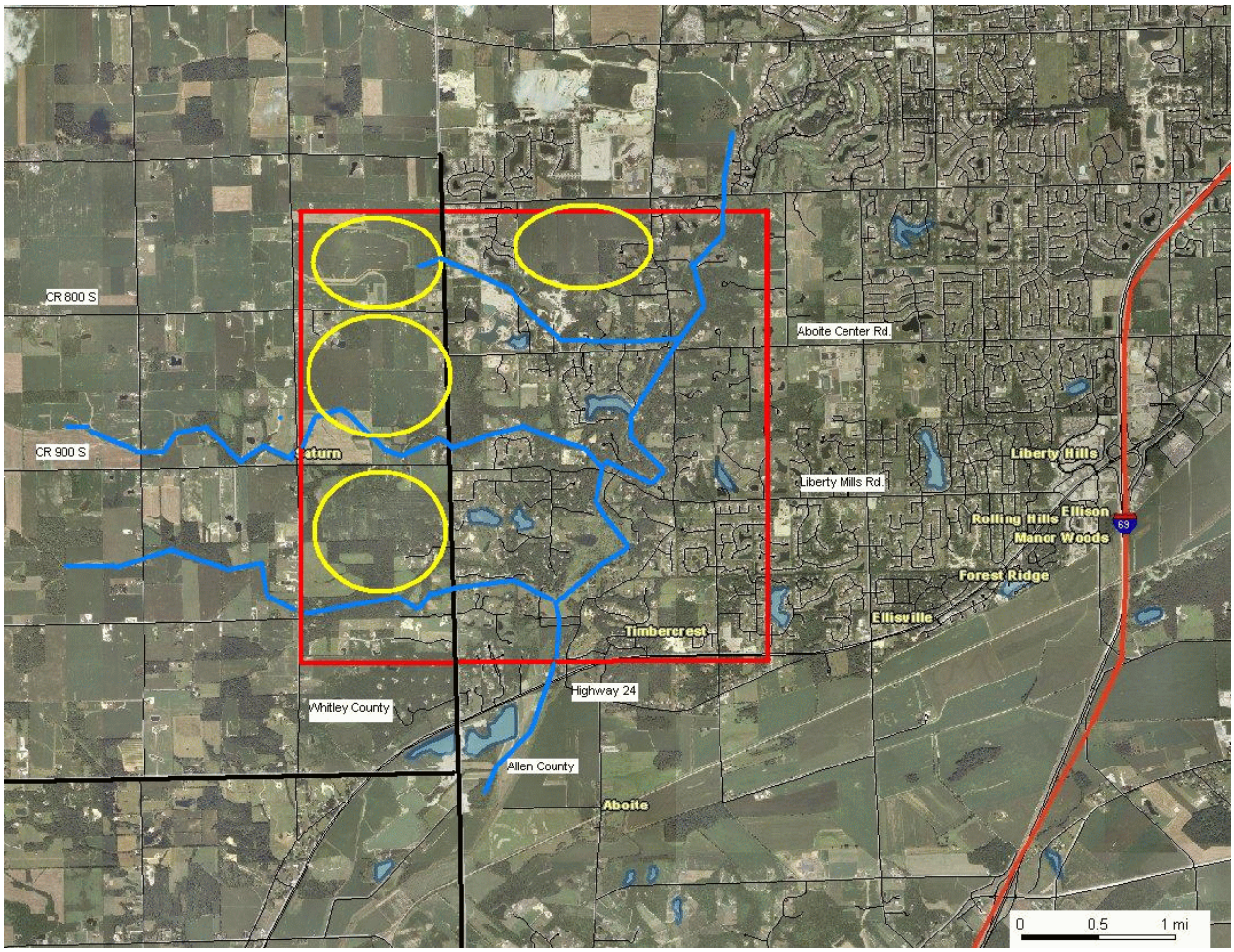


Table 10. Potential sites for erosion-control BMPs

Waterbody	***County***	***Township***	***Section***
Aboite Cr.	Whitley	Jefferson	13
Aboite Cr.	Whitley	Jefferson	24
Aboite Cr.	Whitley	Jefferson	25
Aboite Cr.	Allen	Aboite	19

Wetland restorations or enhancements would improve water quality where willing landowners would cooperate. These are especially valuable where wetlands are present immediately adjacent to a stream. Areas where such sites occur in the watershed are shown in Table 11.

Table 11. Potential sites for wetland restorations

Waterbody	***County***	***Township***	***Section***
Robinson Cr.	Allen	Pleasant	18
Robinson Cr.	Allen	Pleasant	19
Little River	Allen	Aboite	31
Little River	Huntington	Jackson	1
Little River	Huntington	Jackson	12
Little River	Huntington	Union	3

Because of the relatively large number of confined feeding operations in the watershed, many tons of manure are generated. Best management practices for manure handling should be vigorously pursued, especially in the Flat Creek and Cow/Calf Creek sub-watersheds. Grants for manure management are available and are discussed in more detail in Section VII.

Many tributaries in the watershed are already declared a “legal drain” so that channel maintenance (especially log jam removal and sediment dredging) can be done on a regular basis. If done without regard to best management practices, channelization can wreak havoc on the biological community of a stream. For maintaining and enhancing the quality of streams in the Little River watershed, it is important that the following minimum guidelines be applied:

Where tree removal is necessary for equipment access, cut only on one side. This leaves one side with a row of trees to provide shade, to help keep the water cool, and to provide a source of food for stream life.

Do channel maintenance in small chunks. This allows other areas to recover and minimizes the damage in the watershed.

Don’t dig streams out to a uniform depth. Keep shallow, swift-running areas (riffles) present. These are important places for aquatic life to grow.

VI. PRELIMINARY COST ESTIMATES OF ELEMENTS OF THE PLAN

BEST MANAGEMENT PRACTICES FOR LAND TREATMENT

The following costs are estimates based on recent expenditures by the Cass County SWCD (personal communication from Ruth Montgomery), those listed by the Noble County SWCD [29] in 1982 (doubled to provide up-to-date estimates), estimates from [30], and recent LARE grants.

Covered manure facility	$10,000
Managed manure application	$300 per acre
Filter strip	$200 per acre + rental
Grassed waterway	$5000 per acre + rental
Streambank vegetation	$10 per linear foot
Conservation easement	$1350 per acre for 10 year rental
Constructed wetland	$50,000 per acre

The Indiana Department of Environmental Management, Office of Water, Watershed Branch uses a spreadsheet to predict loading reductions associated with various BMP practices [20]. The model also uses various published data sources to predict load reductions associated with BMPs. For example, the model predicts an average nutrient and sediment reduction of 40-70% when vegetative filter strips are installed. Using this information and the cost estimates shown above, the costs and load reductions for planned BMP implementation can be predicted:

		Predicted Benefit	
Practice	***Cost***	***Sediment tons/yr***	***Nutrients tons/yr***
Land Treatments		6,000	15
50 acres of filter strips	$ 10,000		
20 acres of grassed waterways	$100,000		
Field Practices		9,000	15
Nutrient management - 1000 acres	$ 50,000		
Conservation Easement (100 acres)	$150,000		
Riparian Buffer Planting (15 acres)	$ 15,000	2,000	15
Wetland Restorations (6 sites)	$ 45,000	100	1
Covered manure facility (3 sites)	$ 30,000		10
TOTAL	$470,000	17,000	55

VII. PROJECT CONSTRAINTS AND REMEDIES

As with most environmental restoration projects on public and private land, there are constraints which could keep the plan from being implemented. Some of the major potential constraints are listed in Table 12.

Table 12. Potential Project Constraints and Remedies

Proposed Action	Potential Constraints	Potential Remedies
Land Treatments	Treatment costs Crop production loss	Cost-share / Grants
Wetland Restorations	Loss of tillable land	Tax reduction / Grants
Aquatic Habitat Improvement	Extra drainage costs	None presently available
Manure Management	Costs to landowners	Cost-share / Grants

Because so many remedies rely on cost sharing and grants to defray the costs to local landowners, some of the potential grants available to fund implementation of this project are shown below:

IDNR LARE Program Indianapolis, IN	Nonpoint source planning, implementation (Ag BMPs)
IDEM 319 Program Indianapolis, IN	Nonpoint source planning, implementation (Ag BMPs)
IDEM Office of Land Quality Attn: Dennis Lasiter P.O. Box 6015 Indianapolis IN	Water quality improvement grant Manure handling.
Ducks Unlimited 331 Metty Dr., Ste. 4 Ann Arbor, MI 48103	Wetland restoration and construction
River Network P.O. Box 8787 Portland OR 97207	Watershed assistance grants

Cinergy Foundation 139 E. Fourth Street Cincinnati OH 45202	Environmental restoration grants
Pioneer Hi-bred Intl. 400 Locust Street Des Moines IA 50309	Agricultural environmental grants
U.S. Fish & Wildlife 4401 N. Fairfax Dr., Room 110 Arlington VA 22203	North American Wetlands Conservation Grants
Philip Morris Environment Program Manager 120 Park Ave.,17th Floor New York NY 10017	Environmental grant program Water quality enhancement
National Fish & Wildlife Foundation 1120 Connecticut Ave. NW Suite 900 Washington, D.C.	"Bring back the natives" watershed restoration grant Five Star Restoration Program
NRCS County SWCD Offices	Wildlife Habitat Incentives Program

A large variety of institutional resources exist in the watershed to aid in water quality improvement efforts. These range from local government offices, state and federal agency personnel/programs, and non-profit conservation organizations. The following sub-sections will outline some of their various roles, resources, and contact information.

Soil & Water Conservation Districts

Indiana's Soil and Water Conservation Districts (SWCDs) were established by the Indiana Conservation Act (IC 14-32). SWCDs are chartered, legal subdivisions of State Government whose territories are aligned with county boundaries. SWCDs develop and implement conservation programs based on a set of resource priorities, and channel resources from all levels of government into action at the local/county level. Indiana's 92 SWCDs are each governed by a board of supervisors, consisting of three elected supervisors, who own or rent more than 10 acres of land in the district, and two appointed supervisors who maintain their permanent residence in the district.

WHITLEY COUNTY SOIL AND WATER CONSERVATION DISTRICT
Contact: Nadean Eldien
1919 E. Business 30
Columbia City, IN 46725-8425
260.244.6266 ext. 3

ALLEN COUNTY SOIL AND WATER CONSERVATION DISTRICT
Contact: Greg Lake, District Manager
3718 New Vision Drive
Fort Wayne, IN 46845
260.484.5848 ext. 3
http://www.allenswcd.org

HUNTINGTON COUNTY SOIL AND WATER CONSERVATION DISTRICT
Contact: Cheryl Jarrett
2040 Riverfork Drive West
Huntington, IN 46750-9004
260.356.6816 ext. 3

MS4s Entities

Under NPDES Phase II stormwater regulations, several communities, universities, or other entities with concentrated populations were required to begin managing stormwater and reducing urban pollutant loads. These entities are referred to as Municipal Separate Storm Sewer Systems, or more commonly called MS4s. The name relates to the concept of understanding and managing stormwater influences from storm sewers that are not part of combine sanitary/storm sewer systems. This sort of storm sewer infrastructure and associated outfalls/discharges to local streams can be widespread geographically and often quite diverse in engineering design and discharge volumes.

There are several local MS4 entities in the Little Wabash River watershed; however, some of these have joined together to become co-permittees and therefore function as one regulated MS4 entity. Given such arrangements, there are essentially three relatively large MS4s in the watershed (Fort Wayne, Allen County, and Huntington). Huntertown and Leo-Cedarville are co-permittees with Allen County, while IPFW, Ivy Tech, University of St. Francis, and the Indiana Institute of Technology are co-permittees with the City of Fort Wayne. MS4 entities are required to address six Minimum Control Measures (MCMs) in their effort to improve water quality as it relates to storm water influences. These six MCMs include:

* Public Education/Outreach
* Public Involvement
* Illicit Discharge Detection & Elimination
* Construction Site Stormwater Runoff Control
* Post-Construction Site Stormwater Runoff Control
* Pollution Prevention & Good Housekeeping

While Fort Wayne and Allen County coordinate two of the six MS4 required Minimum Control Measures (MCMs), most of their efforts are organized separately. The two coordinated MCMs of Public Education/Outreach and Public Involvement are headed up by the Allen County Partnership for Water Quality (discussed below). The City of Fort Wayne has set up a stormwater utility to aid in implementation of its MCMs, while Allen County is currently using its general fund to support its programs.

One of the largest tasks for each MS4 is to inventory and map all stormwater outfalls that discharge to streams within their boundaries. Known stormwater outfalls within the Aboite area have been mapped by Fort Wayne's MS4 staff and are shown in Figure X. At the time of this report no other illicit discharge mapping was available within the watershed; however, other MS4s in the watershed will eventually work to finish mapping outfalls within their boundaries. Currently, Allen County has mapped outfalls in the northern one-third of the county.

The development of stormwater ordinances are a common and necessary part to stormwater management for MS4s. The City of Fort Wayne has developed ordinances for Construction and Post-Construction Stormwater Management, as well as Illicit Discharges. The County is anticipating draft ordinances for the same MCMs to be complete in late 2007/early 2008. Both Fort Wayne and Allen County have Technical Standard Manuals to assist in the design and implementation of BMPs.

Each MS4s had to submit an Implementation Plan as part of their NPDES Phase II General Permit Application, Stormwater Quality Management Plan. The permits and associated Implementation Programs outline the MS4Æs intended activities as they relate to implementation of each MCM. Details of the Implementation Program are outline in the part of the permit application known as Part C. These activities and commitments for each MS4 are summarized below. Contact information for each of the MS4s is also listed below.

ALLEN COUNTY
Contact: Matt Jarrett
Allen County Surveyor's Office
260-449-7625

* Public Education and Outreach
* Training for Construction Professionals - Ongoing promotion of training opportunities
* Newsletter Articles - 6 articles/year, every other month
* Web Site - Ongoing updates
* Stormwater Survey - 2008 survey may be repeated (2005 survey first conducted)
* Solid Waste Management District Promotions - Ongoing promotions
* Training for Construction Professionals - Ongoing promotion of training opportunities
* Storm Drain Marking - Ongoing
* Citizen Complaints - Illicit Discharge Detection and Elimination BMPs
* Stormwater System Map - 100% complete by the end of 2008
* Illicit Discharge Detection & Elimination (IDDE) Plan - Updated annually

* Citizen Complaints - Ongoing
* Storm Drain Marking - Ongoing
* Solid Waste Management District Promotions - Ongoing promotions
* Annual IDDE, Good Housekeeping, & Pollution Prevention Staff Training
* Construction Site Stormwater Runoff Control BMPs
* Plan Review, Site Inspection, & Enforcement
* Erosion & Sediment Control & Post-Construction BMP Tracking Database
* Training for Construction Professionals
* Inspection and Enforcement Documentation - Ongoing
* QA/QC of Overall Program
* Post-Construction Site Stormwater Runoff Control BMPs
* Plan Review, Site Inspection, & Enforcement - Ongoing
* Staff Training - Annually
* Inspection and Enforcement Documentation - Ongoing
* Post-Construction BMP Operation & Maintenance (O&M) Plan - If situation arises
* Erosion & Sediment Control & Post-Construction BMP Tracking Database
* MS4 Conveyance System Maintenance - Ongoing
* Snow Disposal Areas - Ongoing each winter
* Spill Prevention & Clean Up - Ongoing
* Vehicle Maintenance Areas - Ongoing
* Fertilizer & Pesticide Management - Ongoing
* Canine Park Location - If necessary
* Waste Disposal - Ongoing
* Annual IDDE, Good Housekeeping, & Pollution Prevention Staff Training

FORT WAYNE
Contact: Brandi Wallace
Water Quality Regulatory Compliance Specialist
City of Fort Wayne
1 E. Main St. Room 480
Fort Wayne, IN 46802
260-427-5582

* Public Education & Outreach BMPs
* Public Information Materials - Annual distribution
* Posting of Public Education Materials on City Web Site - Ongoing
* Develop SpeakersÆ Bureau Resource Materials - Ongoing
* Promote Stormwater Program at Community Functions - Annual Events
* Coordinate with other Wet Weather Education Programs
* Assess the PublicÆs Existing Awareness Level of Wet Weather Issues
* Promote Household Hazardous Waste Programs - Ongoing
* Promote a Public Reporting Program - New procedure implementation
* Promote Water Quality Education in the Schools
* Public Involvement Programs - Facilitate citizen advisory committee
* Stream & Greenway Clean-Up Programs - Annually
* Wet Weather Program Workshops - Annually

* Advertise Volunteer Opportunities Related to Stormwater
* Storm Drain Marking
* Storm Sewer Mapping - Perform 25% of mapping annually
* Illicit Discharge Detection & Elimination Plan - Implementation
* Dry Weather Outfall Observation - Screen prioritized outfalls
* Industrial Facility Program - Maintain database
* Household Hazardous Waste & Recycling
* Stormwater Ordinance - Publicity and enforcement
* Erosion & Sediment Control BMP Manual
* Plan Review Process Modification - Implementation
* Construction Site Inspection Program - Implementation
* Construction Site Runoff Control Training - Conduct training courses
* Coordination with IDEM, IDNR, and SWCD - Review of plans by SWCD or IDNR
* Construction Site Public Information Program
* Post-Construction BMP Manual - Identify BMPs for approval and addition to manual
* Plan Review Procedure - Annual training
* BMP Inspections - Ongoing
* BMP Database - Track BMP information for Ft. Wayne
* Street Sweeping - Ongoing
* Catch Basin Cleaning - Ongoing
* Storm Sewer Cleaning & Maintenance - Ongoing
* Winter Weather Chemical Applications - Ongoing
* Pesticide & Herbicide Applications - Ongoing
* Standard Operating Procedures (SOPs) for Municipal Operations - Implementation
* Evaluate Flood Control Projects for Water Quality Issues û Ongoing
* Staff Training on Stormwater Pollution Prevention - Annually

HUNTINGTON
Colin Bullock
Huntington County Surveyors Office
colin.bullock@huntington.in.us

* Public Education and Outreach
* Stormwater WebsiteTraining for Construction Professionals
* Activity Book - Purchase and distribute book to all 2nd graders in City of Huntington
* Brochures and Fact Sheets
* Educational Displays
* Stormwater Presenations
* News Articles
* Consistency with Long Term Control Plan (LCTP)
* Public Participation and Involvement
* Storm Drain Stenciling and Decaling
* Streamside and Little Clean-up
* Tree Planting
* Household Hazardous Waste Collection
* Incident Reporting

* Illicit Discharge Detection and Elimination
* Develop MS4 Conveyance Map
* Development of Regulatory Mechanism
* Development of a Detection and Elimination of Illicit Discharges Plan
* Public Education and Participation
* Combined with Public Outreach and Education MCM (above)
* Annual Training of MS4 Personnel
* Construction Site Stormwater Runoff Control
* Development of a Regulatory Mechanism
* Site Plan Review Process
* Stormwater Structure and Conveyance Inspection, Cleaning, and Maintenance
* Pavement Sweeping
* Roadside Shoulder and Ditch Stabilization
* Roadside Vegetation Care
* Outfall Scouring Inspections and Remediation
* Salt and Sand Storage and Application
* Designated Snow Disposal Areas
* Containment Facilities for Accidental Pollution
* Spill Prevention and Response
* BMPs for Vehicular Maintenance Areas
* Operational Waste Water Controls
* Minimization of Pesticide and Fertilizer Usage
* Proper Disposal of Animal Wastes
* Waste Disposal from MS4 Systems and Operational Areas
* Flood Management and Stormwater Quality Standards
* Annual Training of MS4 Personnel

The Allen County Partnership for Water Quality

As noted above, Allen County and Fort Wayne MS4s coordinate public education and involvement efforts via the Allen County Partnership for Water Quality (ACPWQ). The ACPWQ focuses its educational efforts on stormwater pollution, combine sewer overflow concerns, drinking water, and homeowner BMPs. The ACPWQ offers a speakers bureau, presentations, activities, a website, and a resource library. ACPWQ staff offer guided tours of many water treatment facilities, the Camp Scott Wetlands site, and interpretative tours along various greenway systems. Other activities that can be coordinated via the Partnership include river clean-up events, storm drain marking, and project WET classroom curriculum introduction. The ACPWQ also recently produced two educational CDs that can be viewed as documentaries or used to train local water quality and landuse planners. These CDs are entitled “Watershed Mentality” and “Green Sells.”

For more information contact:
Mr. Matt Jones
3718 New Vision Dr.

Fort Wayne, IN 46845
260-484-5848 x 111

Matt Jones also coordinated Watershed Team Meetings as part of the ACPWQ efforts. These meetings include members of the Partnership, as well as area utilities, county Surveyors' offices, county planning offices, county health departments, and several offices within the City of Fort Wayne including transportation, planning, and landuse. These meetings are not aimed at any one watershed, but rather at the coordination and communication of these entitiesÆ activities in all Allen County watersheds. The Watershed Planning team does have a formal structure; however, participation is voluntary and seems to vary from meeting to meeting. The overall objective of the Team is to create efficiencies and coordination or programs and projects.

Surveyors & Drainage Boards

County surveyors and drainage boards play a critical role in the implementation of streamside BMPs, as well as potential restoration efforts that may involve the manipulation of current above or below ground drainage infrastructure.
The Indiana Drainage Code of 1965 sets forth the authority to create a Drainage Board in each County. The Drainage Board consists of either the County Commissioners or a citizen board with one Commissioner as a member. The County Surveyor sits on the Board as an Ex-Officio Member. This position is a non-voting position, and the County Surveyor serves as a technical advisor to the Board. The Drainage Board has the authority to construct, maintain, reconstruct or vacate a regulated drain. They may also create new regulated drains if so petitioned by landowners. The Board is in charge of maintaining drains by putting the drain back to its original specifications by dredging, repair tile, clearing, removing obstructions or other work necessary to keep the drain in proper working order. The County surveyors are often the best contact for drainage projects or concerns, or to coordinate with the Drainage Boards.

ALLEN COUNTY SURVEYOR
Allan D. Frisinger, PLS
City-County Building
1 E. Main St., Room 610
Fort Wayne, INá 46802-1804
260-449-7625
allan.frisinger@co.allen.in.us
Drainage Board meetings: 2nd and 4th Thursday at 9:00am

HUNTINGTON COUNTY SURVEYOR
Jay D. Poe, LS
Room #203 Courthouse
Huntington, INá 46750
260-358-4856
surveyor@huntington.in.us
Drainage Board meetings: 1st and 3rd Thursdays at 8:30am

WHITLEY COUNTY SURVEYOR
Keith N. Hood, PE (acting surveyor)
220 W. Van Buren Street, Suite 203
Columbia City, IN 46725
260-248-3185
wcengineer@whitleynet.org
Drainage Board meetings: 3rd Mondays 9 am

Due to the cross-county concerns regarding flooding associated with the Little Wabash River, a Little Wabash River Joint Drainage Board was formed to help make decisions within the watershed. The meetings for the Little Wabash River Joint Drainage Board occur on an as needed basis. For example, if someone proposes a project within the watershed that may affect downstream flow or erosion, and/or affect upstream drainage, the Joint Board will call a meeting to order with the various representatives to hear input and vote on the proposed project. Alan Frisinger, Allen County Surveyor, is one of the key contacts regarding activities of the Joint Board.

Many of the streams and ditches in the watershed are official æregulated drainsÆ and are therefore under the authority of the drainage boards and surveyors. Any project proposed along these waterways should be coordinated with the appropriate County Surveyor.

Planning & Zoning Authorities

County-wide Comprehensive Plans can provide a significant amount of information on both natural resources in an area, as well as population statistics, traffic plans, and current and future landuse zoning. Such zoning designations, if enforced, often drive where future residential and commercial/industrial growth will occur. The authority to rezone land into different landuse categories and the power to grant variances from local ordinances related to development, often lie with local Zoning Boards or Plan Commissions.

ALLEN COUNTY
Allen CountyÆs most recent Comprehensive Plan is dated 9/4/07. The final draft was only recently accepted; therefore there are no plans for any near future updates.
The Plan Commission oversees all rezoning requests that deviate from the assigned landuse categories outlined in the Plan. There is also Board of Zoning Appeals (BZA), as well as a Zoning Hearing Officer that assists in dealing with noncontroversial and routine cases. The Plan Commission meets the second and third Thursdays of the month at 1pm. The BZA meets the second Wednesdays at 1pm and the Hearing Officer meets on the first Tuesday at 8:15am. The best contacts for watershed landuse

concerns related to development or zoning in Allen County are:

Executive Director
Kimberly Bowman, AICP
630 City-County Building
One East Main Street
Fort Wayne, IN 46802
(260)-449-7607áá
kim.bowman@co.allen.in.us

Senior Planner û Plan Commission Staff
Michelle B. Wood, RLA
630 City-County Building
One East Main Street
Fort Wayne, IN 46802
(260)-449-7607áá
michelle.wood@co.allen.in.us

HUNTINGTON COUNTY
Huntington County is currently working on their Comprehensive Plan. The Plan Commission oversees all rezoning requests that deviate from previously assigned landuse categories. There is also Board of Zoning Appeals (BZA), as well as a Hearing Officer that assists in dealing with noncontroversial and routine cases. The Plan Commission meets the second Wednesday of the month at 6:30pm. The BZA meets the fourth Tuesday at 6:30pm and the Hearing Officer meets on the second and fourth Thursdays at 10am. The best contact for watershed landuse concerns related to development or zoning in Huntington County is:

Nate Schacht, Director
201 N. Jefferson Street, Room 204
Huntington, IN 46750
(260)-358-4837
nate.schacht@huntington.in.us

WHITLEY COUNTY
Whitley County has a comprehensive plan that was adopted in 1993. Printed copies are available. There is not a current schedule to amend the comp plan, but discussions of doing so have recently surfaced. The Whitley County Commissioners approve any rezoning requests upon a recommendation by the Whitley County Plan Commission. The Plan Commission meets monthly on the third Wednesday of the month at 7:00 p.m. at the County Government Center. There is also a County Board of Zoning Appeals that meets on the fourth Tuesday of the month at 7:30 p.m.á The best contact for watershed landuse concerns related to development or zoning in Huntington County is:

David M. Sewell, AICP
Executive Director

260-248-3112
wcplanning@whitleynet.org

Health Departments

ALLEN COUNTY
The Allen County Health Department conducts weekly water quality monitoring from April to October. The Department is currently finishing DVD on septic maintenance that will be available to customer and installers. Conversations with representatives from the Health Department indicated that there are many septic system concern areas throughout county, notably several old subdivisions in newly annexed Aboite area. The best contact for watershed septic system concerns is:

Gary Chapple
260-449-7695
gary.chapple@co.allen.in.us

HUNTINGTON
The Huntington County Health Department does not conduct regular water quality monitoring; however, the municipalities are required to submit drinking water sampling to IDEM. Currently Huntington does not have an active septic education program. The Department is, however, aware of general problem locations for failing septic systems. Some of these include: Yakes Subdivision (WQ), Bel Aire, Lakeside, Zham Acres, Lake Forest, Zham Lake, Skyline Subdivisions, Northwest Elementary, and Lancaster Elementary. The best contact for watershed septic system concerns is:

Joshua Williams
Joshua.williams@huntington.in.us
(260) 358 - 4834

WHITLEY
The Whitley County Health Department does not conduct regular water quality monitoring. The Department does require septic system installers to go through annual training and pass a test (80%), as well as be insured for $300,000 liability in order to install systems in the county. Conversations with representatives from the Health Department indicated that one of the primary concerns in rural areas is septic discharges into field tiles. The Department seems to know where the problems areas are located; however, they are in need of funding to implement sewer connections to these areas. The best contact for watershed septic system concerns is:

Scott Wagner
260-248-3121

IDNR & IDEM

The Indiana Department of Natural Resources (IDNR) and the Indiana Department of Environmental Management (IDEM) have a variety of programs and staff dedicated to water quality assessments and watershed planning initiatives. The most relevant contacts at these agencies to assist local leaders in water quality planning efforts are listed below. While there are countless specialists at these agencies, the below staff should be able to guide local questions to appropriate personnel.

Indiana Department of Natural Resources, Division of Fish & Wildlife

Lake & River Enhancement Program (LARE)
Ms. Gwen White, Biologist
402 W. Washington St. Rm W273
Indianapolis, IN 46202
317-234-4407

District Fisheries Biologists
Jed Pearson [Allen County]
Ed Braun [Wells, Whitley, Huntington Counties]
1353 S. Governors Drive
Columbia City, IN 46725
260-244-6805

Indiana Department of Environmental Management
Office of Water Quality
Ms. Angie Brown, Watershed Specialist
100 N. Senate Ave.
Indianapolis, IN 46206
317-234-3405

ISDA

The Division of Soil Conservation belongs to the Indiana Conservation Partnership; however is situated in the State Department of Agriculture (ISDA). As part of the Partnership ISDA provides technical, educational, and financial assistance to citizens to solve erosion and sediment-related problems occurring on the land or impacting public waters. The Division of Soil Conservation is divided into Conservation Implementation Teams (CIT) that cover specific counties. These teams can deliver advice to landowners regarding best management practices, assist with engineering design, and secure/coordinate associated project permits and cost share amounts.

CIT Leader for Allen and Whitley Counties is:
Julie Harrold
100 E. Park Drive
Albion, IN 46701-1478
260-636-7682 ext. 8

CIT Leader for Huntington & Wells Counties is:
Cassandra Vondran
2040 Riverfork Drive West
Huntington, IN 46750
260-356-6816 ext. 8

Local Non-profit Organizations

ACRES Land Trust

ACRES is a nonprofit land trust founded in 1960. It's purpose is to buy and preserve natural areas, discourage unnecessary development in natural areas, and educate individuals and communities about the value and appreciation of natural areas. It's focus is on northeastern Indiana. ACRES can be contacted at:

ACRES, Inc.
1802 Chapman Road
Huntertown, IN 46748
260-637-2273
acres@acreslandtrust.org

The Little River Wetlands Project (LRWP)

The LRWP is a nonprofit land trust founded in 1990. The LRWP focuses on restoring and preserving wetlands, as well as providing educational opportunities to all in the historical Little River Valley of Allen and Huntington Counties. The project area of the LRWP encompasses 25,000 acres. This land has formerly been known as the Great Marsh, southwest of Fort Wayne. The group now owns nearly 900 acres in the Little River Valley and plans on acquiring more as land becomes available. For more information about the Little River Wetlands Project contact:

Little River Wetlands Project
2403 Fairoak Dr.
Fort Wayne, IN 46809
260-478-2515
info@lrwp.org

Wood-Land-Lakes RC&D Council

The Wood-Land-Lakes Resource Conservation and Development Council is a nonprofit organization established in 1994 and serves DeKalb, Elkhart, LaGrange, Noble, Steuben, and Whitley Counties, as well as some neighboring counties. The RC&D works to address natural resource needs and cultivate opportunities in economic, environmental, and social areas. The primary natural resource focus is on air, water, land, woods, plants, and wildlife. The combined efforts of the community and volunteers look to achieve four primary goals:

1. Promote Better Woodland Management
2. Balance Rural and Urban Land Use Needs
3. Develop Partnerships to Address Water Quality and Quantity
4. Increase Community Involvement in Natural Concerns

The Wood-Land-Lakes RC&D Council can be contacted at:
Wood-Land-Lakes RC&D Council
1220N 200W, Suite J
Angola, IN 46703-9171
Phone 260.665.3211, ext 5
www.woodland-lakes.org

VIII. PUBLIC PARTICIPATION

Two public meetings were held as part of this project. The first "kick-off" meeting was held on October 20, 2003 at the Roanoke, Indiana town hall. Twenty-eight people attended (see participant list in the Appendix). A flier explaining the purpose of the project and its results was prepared and passed out to each person attending the opening meeting (a copy is included in the Appendix). There was a question and answer period.

A final public meeting was held on April 23, 2008 at the Roanoke Elementary School. The study results and recommendations for future work in the watershed were presented. Forty-four people attended, including representatives of government agencies, environmental groups, farmers, and other interested citizens. Additional concerns expressed at this meeting included the need to remove low-head dams that are no longer used, combined sewer overflows in the City of Huntington, the potential for mosquito problems in wetland areas, and the need to balance water quality with flood control issues.

One education aspect of the project was the establishment of a project website (www.littlewabash.net). As BMPs are carried out, the website can be updated with accomplishments and directions for future work. The Little River Wetlands Project website (www.lrwp.org) could also be used for this purpose.

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Habitat Evaluation Results

Habitat (QHEI) Scoring Results by Individual Metrics

	Site Number											
	1	2	3	4	5	6	7	8	9	10	11	12
SUBSTRATE	18	18	16	14	14	10	14	10	14	16	14	16
COVER	15	15	14	12	7	6	9	6	12	12	12	11
CHANNEL	16	14	13	11	7	7	8	8	11	11	11	11
RIPARIAN	9	6	6	4	8	4	6	3	6	4	4	7
POOL/CURRENT	10	10	9	9	7	7	7	6	7	5	4	5
RIFFLE/RUN	6	6	6	4	8	5	5	6	4	6	4	4
GRADIENT	6	6	6	6	6	6	6	6	6	6	6	6
TOTAL	80	75	70	60	50	45	55	45	60	60	55	60

	13	14	15	16	17	18	19
SUBSTRATE	10	16	14	10	14	16	10
COVER	6	11	8	7	12	9	9
CHANNEL	6	13	10	9	12	11	9
RIPARIAN	3	6	3	4	6	5	7
POOL/CURRENT	5	7	10	10	9	7	5
RIFFLE/RUN	4	6	4	4	6	6	4
GRADIENT	6	6	6	6	6	6	6
TOTAL	40	65	55	50	65	60	50

Macroinvertebrate Data

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ephemeroptera	Baetis flavistriga	7		60	12		20	52	37	7	23	35	20	32	48	8	9	66	20	6
(mayflies)	B. hageni			5														2		
	B. amplus																			
	Stenacron interpuctatum	8	5	1	19		1	4	1	3	6	1			1	13				
	Stenonema femoratum	1			2					2	2		1			1				1
	S. terminatum	1	2	1																
	S. pulchellum	1																		
	Caenis spp.	1	1		1						1			7					3	
	Tricorythodes spp.	15																		
Trichoptera	Cheumatopsyche spp.	9	37	2	6	1		3	1	14	11	12	3			5	1	3	3	11
(caddisflies)	Hydropsyche betteni						4			2	1							1		
	Ceratopsyche bifida		3																	
	Ceratopsyche sparna												1							
	Chimarra obscura		1				1		1											
	Ochotrichia spp.					2				1										
	Leptoceridae							1								1				
Plecoptera	Perlidae-Perlinella spp.			3															10	11
(stoneflies)																				
Coleoptera	Dytisidae													10						
(beetles)	Stenelmis spp.	5	17	5	6	7	57	7	23	17	7	5	30	9	26	11		6	49	57
	Dubiraphia spp.	2				2										6				
	Optioservus fastiditus		3					1	13	5	1			1						
	Macronychus glabratus												3			1				
	Psephenus herricki								6											
	Ectopria spp.															1				
Odonata	Argia spp.	2			1	2														
damsel & dragonflies	Boyeria spp.												1				1			
Diptera (flies)	Simuliidae	1		2				2	8	5			2	4	15			3		
	Ephydridae									1			1							
	Hemerodromia spp.					1	1												1	
	Tipula												2			1				
	spp.																			
	Antocha spp.						1												1	
	Hexatoma spp.									1										
	unknown dipteran pupa					2											1			
Chironomidae	Thienemanninyia spp.	2	3		10		1			7	2	4	6			4	3			7
(midges)	Brillia flavifrons	2		1						1										
	Cardiocladius spp.										2		2	8						
	Cricotopus bicinctus	16	2	7		28		7	1	7	2	18	2	7		18	3	3	3	
	C. sylvestris	3	4									6	4			2	18		1	
	C. tremuls			1				4							1					
	C. trifascia																	8		
	Eukiefferiella claripennis				2									2			15			
	Nanocladius spp.	2			2													1		
	Orthocladius obumbratus	14	10	2			8	10	5	18	6	6		10	3	7		4	1	
	Parametriocnemus lundbeckii											2	14						1	1
	Rheocricotopus robacki			1	6										4					
	Stilocladius spp.			1																
	Chironomus spp.	2				2														
	Cryptochironomus fulvus													2						

Dicrotendipes nervosus	2																	
Glyptotendipes lobiferus															3			
Microtendipes caelum										2					3			
Paratendipes albimanus										4		2		8				
Polypediilum convictum		11	7	30	25	6	9	2	7	30	10		2		27	3	7	6
Saetheria tylus			1															
Polypediilum fallax	2																	
Rheotanytarsus exiguus												3		8				
Paratanytarsus spp.					14							3	2					
Tanytarsus spp.									2				2	2	3			
Oligochaetes (worms)	2	1		3	13			2			1	1	2	3	9			
Hirudinea (leeches)															1			
Decapoda (Crayfish)					1							1			2			
Collembola (Springtails)															1			

STEPL Model Results

1. Input watershed land use area (ac) and precipitation (in)							
Watershed	Urban	Cropland	Pasture land	Forest	User Defined	Feedlots	Feedlot Percent Paved
Aboite/Beal	1575	5804	2535	1104	0	1	0-24%
Aboite/Indian	370	6078	2553	1594	0	1	0-24%
8Mile/Pleas.	425	4380	1944	905	0	0	0-24%
8Mile/Witz.	158	5775	946	452	0	0	0-24%
G-McCulloch	4587	2736	2893	2577	0	0	0-24%
Upper Little	326	4682	1599	1178	0	0	0-24%
Little/Bull	100	7790	824	800	0	3	0-24%
Little/Calf	506	9029	3263	2158	0	2	0-24%
Little/Flat	292	9863	1485	838	0	1	0-24%
Little/Flint	2840	4436	1803	1296	0	1	0-24%
Little/Mud	267	7620	970	1075	0	3	0-24%
Robinson	675	7669	1380	602	0	0	0-24%
Seager	370	7228	1896	1118	0	2	0-24%

2. Agricultural animals							
Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey
Aboite/Beal	450	90	1800	40	0	0	0
Aboite/Indian	450	90	1700	40	0	0	0
8Mile/Pleas.	300	50	1300	25	0	0	0
8Mile/Witz.	300	50	1200	25	0	0	0
G-McCulloch	50	10	200	5	0	0	0
Upper Little	50	10	200	5	0	0	0
Little/Bull	400	50	1500	30	0	0	0
Little/Calf	300	50	1200	25	0	0	0
Little/Flat	500	50	2000	25	0	0	0
Little/Flint	0	0	0	0	0	0	0
Little/Mud	400	50	1600	40	0	0	0
Robinson	250	40	1000	20	0	0	0
Seager	450	50	1700	35	0	0	0
Total	3900	590	15400	315	0	0	0

3. Septic system and illegal wastewater discharge data							
Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Discharge	Direct Discharge Reduction, %		
Aboite/Beal	435	2.43	2	0	0		
Aboite/Indian	416	2.43	2	0	0		
8Mile/Pleas.	397	2.43	2	0	0		
8Mile/Witz.	372	2.43	2	0	0		
G-McCulloch	712	2.43	2	0	0		
Upper Little	442	2.43	2	0	0		
Little/Bull	674	2.43	2	0	0		
Little/Calf	523	2.43	2	0	0		
Little/Flat	308	2.43	2	0	0		
Little/Flint	0	2.43	2	0	0		
Little/Mud	240	2.43	2	0	0		
Robinson	397	2.43	2	0	0		
Seager	404	2.43	2	0	0		

Watershed	Cropland BMPs				
	N	P	Sediment	BMPs	% Area BMP Applied
Aboite/Beal	0	0	0	No BMP	
Aboite/Indian	0	0	0	No BMP	
8Mile/Pleas.	0	0	0	No BMP	
8Mile/Witz.	0.7	0.75	0.65	Filter strip	100
G-McCulloch	0	0	0	No BMP	
Upper Little	0.75	0.75	0.75	Streambank stabilization and fencing	100
Little/Bull	0	0	0	No BMP	
Little/Calf	0.7	0.75	0.65	Filter strip	100
Little/Flat	0.7	0.75	0.65	Filter strip	100
Little/Flint	0	0	0	No BMP	
Little/Mud	0	0	0	No BMP	
Robinson	0.7	0.75	0.65	Filter strip	100
Seager	0	0	0	No BMP	

Watershed	N Reduction	P Reduction	Sediment Reduction	%N Reduction	%P Reduction	%Sed Reduction
	lb/year	lb/year	t/year	%	%	%
Aboite/Beal	0.0	0.0	0.0	0.0	0.0	0.0
Aboite/Indian	0.0	0.0	0.0	0.0	0.0	0.0
8Mile/Pleas.	0.0	0.0	0.0	0.0	0.0	0.0
8Mile/Witz.	46384	12355	1315	63.8	70.7	62.8
G-McCulloch	0.0	0.0	0.0	0.0	0.0	0.0
Upper Little	40573	10219	1230	63.0	69.0	69.5
Little/Bull	0.0	0.0	0.0	0.0	0.0	0.0
Little/Calf	72521	19317	2056	55.9	65.4	60.4
Little/Flat	79219	21102	2245	62.8	69.6	62.9
Little/Flint	0.0	0.0	0.0	0.0	0.0	0.0
Little/Mud	0.0	0.0	0.0	0.0	0.0	0.0
Robinson	61597	16408	1746	61.8	69.4	61.3
Seager	0.0	0.0	0.0	0.0	0.0	0.0
Total	300296	79402	8593	25.1	29.1	26.8

Public meeting attendance

Press Release

Local Effort Needed to Protect the Little River

A large scale, multi-county study was recently completed on the health of the Little Wabash River, commonly known as the "Little River." A public informational meeting will be held on April 23rd at 7 pm at the Roanoke Elementary School, 423 West Vine Street, Roanoke, IN. All interested citizens, area landowners, public officials, and interest groups are welcome and encouraged to join the consultant team and Indiana Department of Natural Resource professionals to discuss some of the project's findings. The study area encompassed the river and its tributaries from the southwest corner of Fort Wayne, including the Aboite area, south to Roanoke, and down to Huntington. Water quality assessments, landuse connections, and potential solutions were evaluated across this 141,034 acre watershed. Needed improvements to local water quality and quantity concerns rely on wide-spread public participation. The meeting will focus on what local citizens can do to protect critical resources in north-east Indiana. For more information, please call Nadean Eldien at the Whitley County Soil & Water Conservation District, 260.244.6266 ext. 3.

Attendance Roster for Public Meetings

Kenny Foust
Nadean Eldian
Betsy Yankowiak
Gene Haskins
Kyle Lund
Hal Hoffman
Dave Schultz
Susan Schultz
Edward Tremain
Matt Jarrett
David Obriant
Ann Obriant
Trent Ellis
Jim Ellis
Christa Goff
Leonard Proffitt
Joan Dennis
M.W. Dennis
Cheryl Jarrett
Brian Secor
Deloss Hartley
R. Augspercek
Jay Sagers
Pam Sagers
Robert Binder
Dan Bacon
Richard Kyler
Barry Ellis
Greg Lake
Rod Edgell
Jim Pulver
Harry Klein
Dick Crowl
The Schor family
Phil Cler
Dee Cler
Mary Jane Shearer
Amy Lybarger
Gwen White
Angie Brown

Project Information Handouts

Watershed Basics

Source: Arkansas Watershed Advisory Group

A watershed is defined as an area that drains to a common point. That common point may be a lake, the outlet of a river, or any point within a river system.

Brief Watershed Facts:

- **The Little River is a historic tributary to the Wabash River - it once was a part of the Wabash and Erie Canal system.**
- **The Little River Valley was formerly 25,000 acres of swamp called the Great Marsh which was drained in the late 1880s so the land could be farmed.**
- **Currently, nearly 60% of the watershed is used for agricultural purposes.**

Data collection and subwatershed prioritization was determined as part of a watershed diagnostic study funded by the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program. Water quality sampling occurred between Fall 2007 and Spring 2008.

This project was sponsored by the Whitley County Soil and Water Conservation District.

To read the full watershed report go to:

http://www.littlewabash.net
or
http://www.in.gov/dnr/fishwild/lare/lare_reports.html

For more information about participating in landowner conservation programs contact:

Soil and Water Conservation District Offices:

Whitley Co SWCD: 260-244-6266 ext 3

Huntington Co SWCD: 219-356-6816 ext 3

Allen Co SWCD: 260-484-5848 ext 3

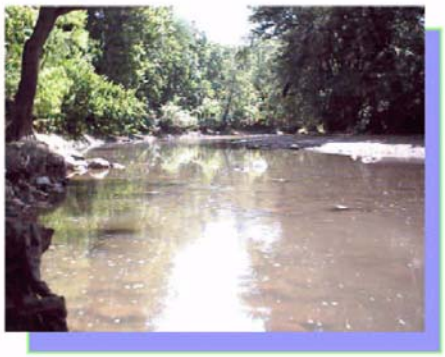
To report a spill or environmental emergency:
Call 1-888-233-7745

To report a wetland violation or concern:
Call 1-800-451-6027 ext. 24464

For stormwater or erosion control concerns:
Contact your regional IDEM Stormwater Specialist:
Rob Beck at 317-234-5028 or
Email: **rbeck@idem.in.gov**

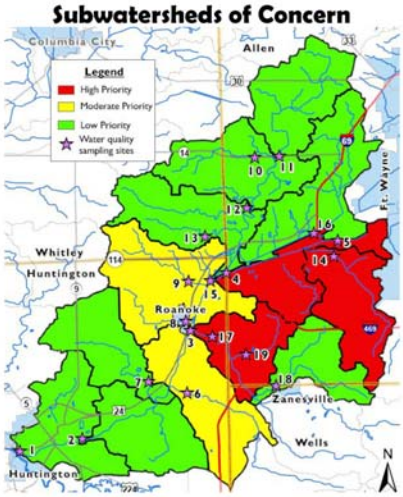
LITTLE RIVER WATERSHED

WHAT YOU SHOULD KNOW...
HOW YOU CAN HELP



The Little River Watershed is located in Northeast Indiana and spans approximately 141,034 acres.

Subwatersheds of Concern



Primary Pollutants in the Little River

The primary pollutant of concern in the Little River Watershed is sediment. Many of the aquatic insects collected during sampling are organisms that are tolerant of degraded habitats and poor water quality. Sediment is a major concern to an aquatic system since it reduces the amount of light that reaches the bottom of a stream and it can clog gills of aquatic animals.

Other important pollutants of concern in the Little River Watershed are nutrients. The two nutrients regularly sampled for when assessing stream health are nitrogen and phosphorus. These nutrients increase algal blooms and decrease stream oxygen.

Pollution Loads

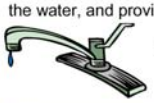
Sediment loads within the Little River Watershed average nearly 32,000 tons per year.

Nitrogen loads within the Little River Watershed average nearly 600 tons per year.

Phosphorus loads average approximately 140 tons per year in the Little River Watershed.

WHAT CAN YOU DO TO HELP KEEP THE LITTLE RIVER HEALTHY?

Restore or create wetlands in areas that are naturally wet. Wetlands attract a diverse array of wildlife, filter nutrients from the water, and provide downstream flood protection.

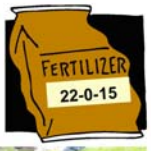


Conserve and reuse water wisely.

Add vegetative filter strips along ditches or streams instead of farming or mowing right up to the edge. Filter strips remove pollutants like sediment, bacteria, and chemicals and help to stabilize eroding banks.

Avoid creating goose-friendly pond habitats. Plant native species that grow taller than 12 inches along pond edges. Do not feed the geese!

Use less lawn fertilizer or only use phosphorus-free fertilizers. Look for products with a middle number of "0".



Direct downspouts into a rain garden instead of out into the street. Plant native trees, shrubs and perennials that filter pollutants and reduce runoff.

Fence livestock out of streams and ditches and set up alternative watering sources.

Photographs of all study sites

site 1

site 2

site 3

site 4

site 5

site 6

site 7

site 8

site 9

site 10

site 11

site 12

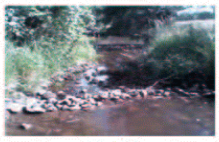
site 13

site 14

site 15

site 16

site 17


site 18

site 19