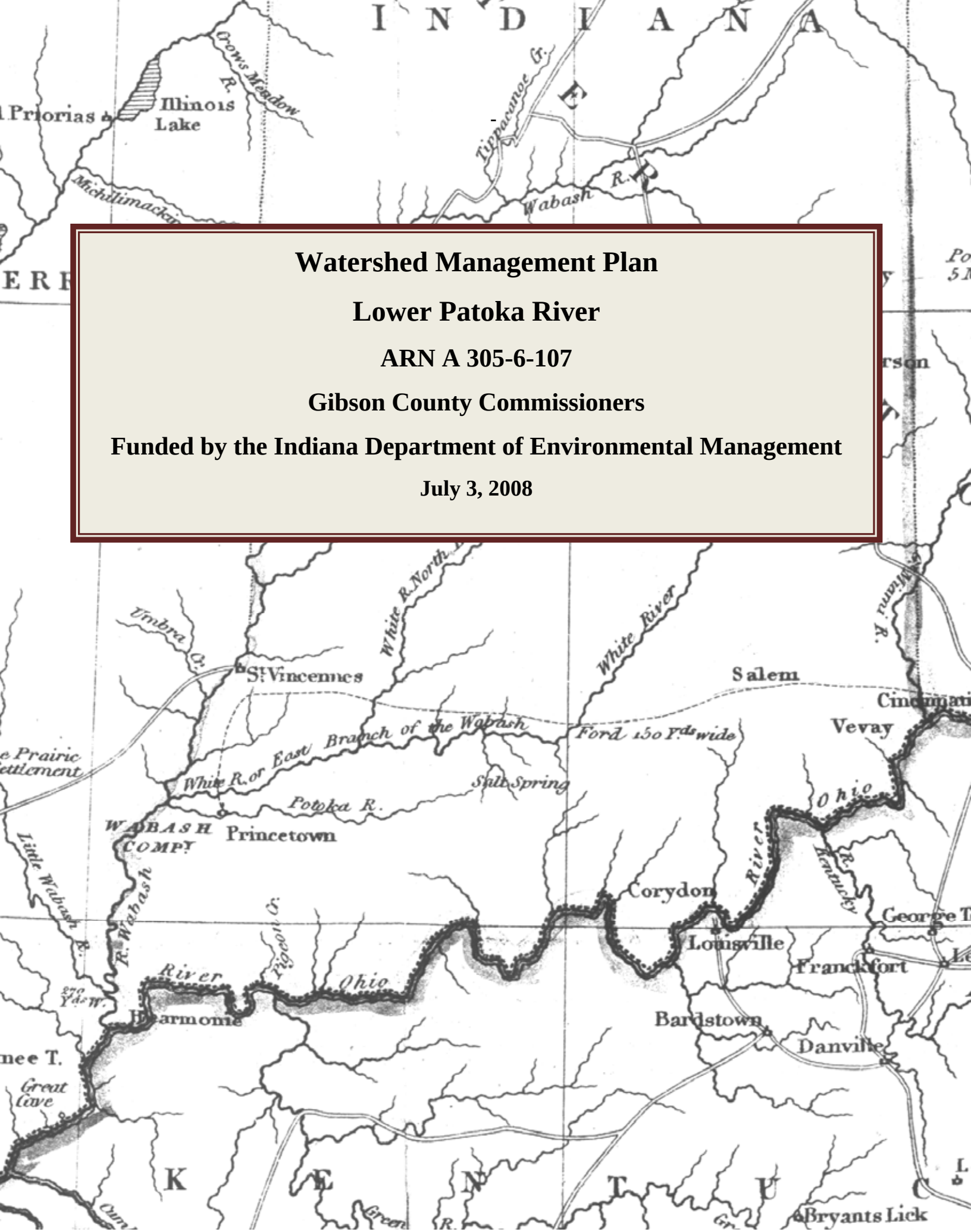

Watershed Management Plan

Lower Patoka River

ARN A 305-6-107

Gibson County Commissioners

Funded by the Indiana Department of Environmental Management

July 3, 2008

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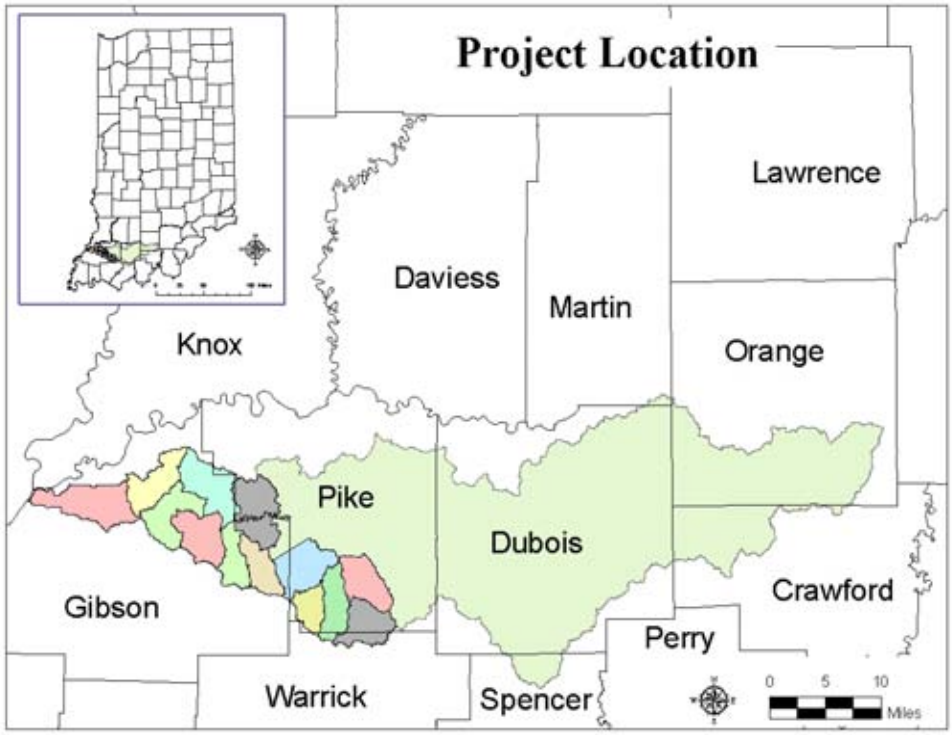
1. INTRODUCTION

1.1 Project Initiation. The Gibson County, Indiana Commissioners received a 205j grant from the Indiana Department of Environmental Management to develop a Preliminary Engineering Report (PER) for wastewater for the entire County, and a Watershed Management Plan (WMP) for the Lower Patoka River watershed. A citizens group has formed a coalition to concentrate on the Patoka Lake watershed. The Four River Resource Conservation and Development Area (RC&D) – U.S. Department of Agriculture is working with the Dubois County Soil and Water Conservation District to address the Patoka from Patoka Lake to the city of Jasper. The Four Rivers RC&D (http://www.fourriversrcd.org/) is also exploring the possibility of attacking the Patoka from Jasper to this project area.

This portion of the project will develop a Watershed Management Plan. The Project area consists of the Patoka River and the South Fork, Patoka River (Hydrologic Unit Code [HUC] 05120209080 at 86,689 acres and 05120209070 at 48,823 acres). There are 13 sub-watersheds in the project area.

1.2 Project Location. The project area is located in far southwest Indiana in Gibson, Pike, and Warrick Counties. Figure 1 below shows the location of the project, and Appendixes A and B provided in a larger format gives more detail. The Patoka River (Pa Toe Kah: an Indian word meaning “log on bottom”) begins in Orange County and winds its way approximately 138 miles (222 kilometers) to where it enters the Wabash River at Mt. Carmel, Illinois, immediately downstream of the confluence of the Wabash and White Rivers.

Figure 1-1
Project Location



1.3 Background. This project differs from most projects, in that a grant was secured from the Indiana Department of Environmental Management to prepare a PER and WMP, then the organization to manage the project was put into place. The Gibson County Soil and Water Conservation District coordinates the project with oversight by the County Commissioners. Indiana 15 Regional Planning Commission (www.ind15rpc.org) was contracted to provide a Watershed Coordinator and to compile a Watershed Management Plan for submittal to IDEM.

1.4 Steering Committee Structure and Members. The initial meeting was held at the Princeton Public Library on August 28, 2006 with eleven participants. A group of citizens volunteered to form a steering committee developed a vision of ***a healthier environment with better water quality for drinking, recreation, and wildlife in the Lower Patoka River watershed***.

Their mission of ***working towards a healthier environment with measurable successes by improving the water quality of the Lower Patoka River watershed through technical, financial, and educational resources and events*** will be the basis for realizing their vision.

The steering committee is a partnership with not only individual citizens, but federal, state, and local agencies contributing as well.

Four Rivers Resource Conservation and Development Area – U. S. Department of Agriculture
Gibson County Commissioners
Gibson County Council
Gibson County Health Department
Gibson County Soil and Water Conservation District
Gibson County Solid Waste Management District
Gibson County Surveyor
Patoka River National Wildlife Refuge and Management Area – Department of the Interior
Pike County Soil and Water Conservation District
Sugar Ridge Fish and Wildlife Area – Indiana Department of Natural Resources

The project began with volunteers signing up for the various officers to make the project a success, but almost immediately began to experience organizational problems. The President stopped participating, and getting a cohesive group for each meeting was extremely difficult. The project limped along for a few months with key personnel working to overcome the lack of participation. However, a solid steering committee was in place by August 28th and they provided input, support, and recommendations to the Watershed Coordinator to complete the plan.

1.5 Initial Concerns.

On November 14, 2006 a public meeting was held at the Oakland City Public Library. Ken Eck of the Indiana State Department of Agriculture facilitated the part of the meeting where concerns were discussed. Citizens were solicited to provide a list of their concerns.

The initial list of water quality concerns were pared down with items 1 through 5 below being those that were within the ability of the steering committee to accomplish. Large amounts of animal waste were not considered a major threat since IDEM and IDNR regulate confined animal feeding operations. The derivative problems associated with animal waste such as E. coli are incorporated into the other concerns.

Constructing ponds and lakes, it was decided, will have to be integrated into a much larger political program.

1. Sedimentation and Erosion
2. Trash/Illegal Dumping/Animal Remains
3. Coal Mining
4. Septic Systems
5. Oil and Gas Wells
6. Animal Waste (Main Channel)
7. Water Retention Public Access – Public lakes, etc.

2. DESCRIPTION OF THE WATERSHED

2.1 Geography

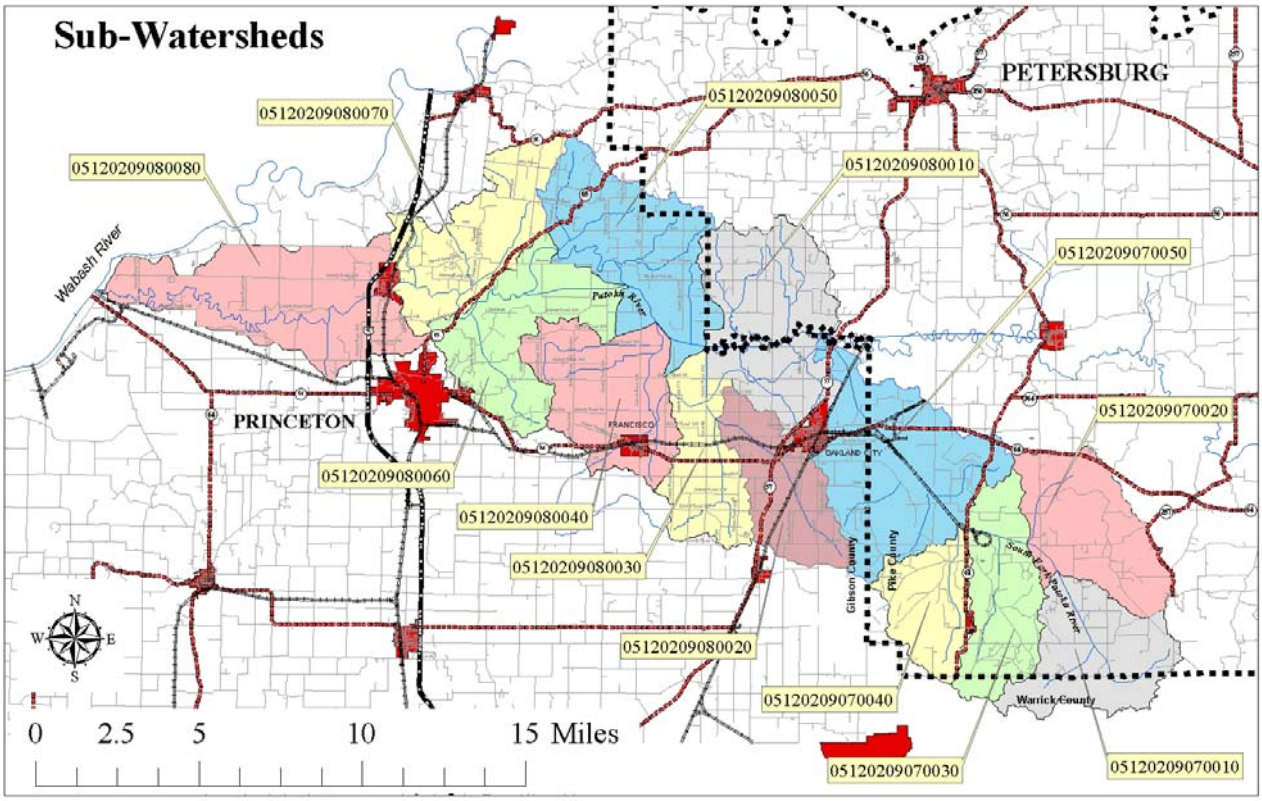
The project area is located in the *Wabash Lowland* physiographic region, which averages about 500 feet above sea level. The Patoka River begins in Orange County in the Hoosier National Forest near the settlement of Valeene at some 600 feet in elevation. On its westward 138 mile trip to the Wabash River, it fills Patoka Lake, which is both a flood control project as well as a source of drinking water for approximately 4,500 customers in eight counties. The river skirts Crawford County, passes through Dubois and Pike Counties and meets the Wabash River in Gibson County at 300 feet elevation. Portions of the river in Pike and Gibson Counties were dredged and straightened in an attempt to reduce flooding (See Appendixes A and B).

The South Fork headwaters are in far northern Warrick County at approximately 550’ elevation and flows northwesterly some 17 miles where it enters the main stem near the Pike – Gibson line (See Appendixes A and B).

2.2 Sub-Watersheds

There are thirteen 14-digit Hydrologic Unit Code (HUC) sub-watersheds in the project area. The South Fork Patoka River has 5 sub-watersheds and enters the main channel of the Patoka River near the Gibson – Pike lines. Figure 2-1 is provided to show the various sub-watersheds.

Figure 2-1
Sub Watersheds



HUC	Name	Acres
05120209070010	South Fork Patoka River - Headwaters	9358.8
05120209070020	South Fork Patoka River – Houchins Ditch	9664.2
05120209070030	South Fork Patoka River - Spurgeon	8489.3
05120209070040	South Fork Patoka River - Honey Creek	5840.2
05120209070050	South Fork Patoka River - Wheeler/Lick Creeks	15470.5

The main branch of the Patoka River in the project area has eight sub-watersheds:

05120209080010	Patoka River - Robinson/Big Creeks	13244.0
05120209080020	Patoka River - East Fork Keg Creek	7467.6
05120209080030	Patoka River - West Fork Keg Creek	6884.9
05120209080040	Patoka River - Lost Creek	10635.3
05120209080050	Patoka River - Yellow/Goose Creeks	12736.9
05120209080060	Patoka River - Houchins Cutoff/Indian Creek	10515.1
05120209080070	Patoka River - Trippet Ditch	10147.0
05120209080080	Patoka River - Patoka to Wabash R	15058.7

2.3 Physical Description

2.3.1 Geologic History. Relatively nonresistant siltstone and shale of Pennsylvanian age is the dominant rock type. In places, a thin layer of glacial materials blankets the bedrock, but the glacial tills are too thin to have a noticeable effect on the land forms.
The varied topography of Indiana is a legacy of active glaciation and the inexorable forces of running water acting through geologic time to erode and shape both soil and rock. The physiography of Indiana has left its mark on nearly every facet of cultural development from the course of trails followed by the earliest occupants of the state to the location and trend of modern highways, power lines, and the placement of reservoirs. (See Appendix C)

While there are some remnant effects of glaciers from the Illinoian and Pre-Illinoian Stages, the area was not affected during the latest Wisconsin Stage (Pleistocene Epoch).

The bedrock in the southwest part of the state is mostly shale, sandstone, limestone and coal of the Pennsylvanian System, which is covered in most areas by older glacial soils and residual soils, with some large lakebed clay deposits. Almost all of the southwest part of the state has a surface layer of silty wind-blown loess.

2.3.2 Topography. Throughout most of southwest Indiana, the bedrock system dips gently to the southwest at an average of one-half degree into a large structural depression called the *Illinois Basin*. This means that rocks exposed at a given locality would be found buried beneath 30 feet of younger rock just one mile southwest of the outcrop.

The project area is composed of three zones. The South Fork sub-watershed has rolling hills, row crops in the lower areas, and has been severely impacted by strip mining. The main channel and some tributaries have some rolling hills, but flattens out with less relief. Closer to the mouth at the Wabash River, the area is very flat with an extensive flood plain (See Appendix C).

2.3.3 Soils

There are eleven major soil units in the project area as delineated by the Natural Resources Conservation Service – U.S. Department of Agriculture (See Appendix D).

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. The USLE will be discussed in more detail in Benchmarks. Figure 3 lists the predominant soil types in the project area and various characteristics.

Table 1-1
Soils

Soil Unit	Drainage	Water Movement	Hydric Soils	Poor Septics	Erosion Factor
Alford-Sylvan-Iona	Well	Mod-High		Alford	.43/.43/.43
Bloomfield-Princeton-Ayrshire	Excessive	High			.10/.24/.28
Dubois–Otwell-Peoga	Poor	Low	Peoga		.55/.55/.55
Fairpoint-Bethesda-Zanesville	Well	High			.49/.37/.55
Hosmer-Zanesville-Stendal	Well	Low		Hosmer	.55/.55/.43
Lyles-Patton-Henshaw	Poor	Mod-High	Lyles, Patton		.10/.24/.43
Nolin-Haymond-Petrolia	Well	Mod-High	Petrolia		.43/.43/.37
Reesville-Ragsdale-Uniontown	Poor	Mod-High	Ragsdale		.43/.32/.49
Stendal-Bonnie-Birds	Poor	Mod-High	Bonnie, Birds		.43/.43/.43
ZanesvilleWellston-Gilpin	Well	Mod-High			.55/.49/.32
Zipp-Vincennes-Evansville	Poor	Low	Evansville, Vincennes, Zipp		.24/.24/.43

By using Figure 3 and Appendix D, one can correlate those soils that are more susceptible to erosion regardless of land use activities. Appendix C also shows those soils with slopes that are highly erodible as well. It is obvious that much of the project area has highly erodible lands.

Timber harvesting in the project area is done on “wood lot” basis rather than large areas of clear cutting (See Appendix B). Logging activities can cause erosion of all types of soils regardless of the composition and slope. Likewise, construction methods require monitoring to ensure soils do not leave a construction site.

2.3.4 Hydrology: The drainage in the project area, as well as the general area, is very much a product of human activities since settlers arrived in the area. The entire South Fork was dredged to drain low lying areas for agriculture and flood control and is referred to as the William Shy Drainage Ditch. Likewise, portions of the main Channel of the Patoka were dredged as well. One significant example is the Houchins Cutoff/Indiana Creek in sub-watershed 05120209080060 (See Appendixes B and C).

Channeling streams can reduce local flooding, but may exacerbate erosion and flooding down-stream due to increased velocity. The Lower Patoka Conservancy District was organized to address flooding in the lower portions of the Patoka River and its tributaries. The District covers the Patoka River from the Gibson - Pike line to the Wabash River. The District is empowered to remove obstructions but is prohibited from excavation in the channel. Never-the-less, the Patoka River National Wildlife Refuge is exploring some stream channel restoration in order to replace lost/degraded wetland habitat.

While the area in the western part of the project area near the confluence of the Patoka, Wabash, and White Rivers is prone to flooding, portions of the Patoka and South Fork have extensive flood plains as well. The Patoka River National Wildlife Refuge and Management Area was established in the area to take advantage of these prime bottomland hardwood forests. Bottomland hardwood forests are outstanding tools in reducing downstream flooding while providing uptake of excess nutrients among other things.

The Patoka River National Wildlife Refuge Manager has determined that flooding in the Oatsville Bottoms in the Robinson/Big Creeks Sub-Watershed occurs when the USGS in-stream gage north of Princeton (http://water.usgs.gov/waterwatch) reaches 12.8 feet.

Even though high-water helps to re-charge aquifers, flooding can be problematic. Sheet erosion is a major source of soil loss, petroleum by-products washed from road ways goes directly into the water, and trash and debris may wash into the streams as well. Flooded residences present a myriad of threats from septic systems, petroleum products, hazardous substances, dead livestock/pets, and other materials.

Figure 4 shows a typical flood event that occurs throughout the low lying areas of the project area on a re-occurring basis.

Figure 2-2- Patoka River in the Oatsville Bottoms

Picture courtesy of the Patoka River National Wildlife Refuge and Management Area
3/13/06

Because mounting scrutiny is being given to preserving and restoring wetland areas, permits for dredging are becoming increasingly difficult to obtain. Construction permits often times require that mitigation areas be developed to offset the loss of wetlands and forests.

For example, the new Interstate 69 mitigation rations of 3 to 1 were agreed upon by the Indiana Department of Transportation for forest areas. Ratios of 3 or 4 to 1 for various types of bottomland forests are part of a Memorandum of Understanding for offsetting loss of habitat when construction begins on the new Interstate. INDOT has agreed to bridging over the Refuge to minimize the impact of the highway. But, the end result will be an increase in prime flood abating, nutrient up-taking, erosion lowering bottomland hardwood forests in the area.

Since surface mining totally removes all surface features, while post mining activities have the potential to strongly impact water flow. Until deep-rooted grasses, crops, and trees are restored, runoff poses a major threat. This topic will be discussed in more detail in Section 2.4 – Land Use.

Another example of the concerns relative to large amounts of water is the Multi-Hazard Mitigation Plan (MHMP) submitted by Gibson County to the Federal Emergency Management Agency for approval. The MHMP is a "sustained action to reduce or eliminate long-term risk to human life and property from hazards."

The Gibson County Emergency Management Director organized a team and developed a list of potential disasters and developed a risk index. The index is 4 –Highly likely, 3 – Likely, 2 – Possible, 1 – Unlikely. The Calculated Priority Risk Index rated flooding at the top with tornados/straight line winds ahead of earthquakes, thunderstorms/hail, winter storms, transportation hazardous material release, land subsidence, and drought.

The plan goes on to examine the historical flooding around the County and points out that the National Climatic Data Center (NCDC) database reported 82 flood events in Gibson County since 1950 and of particular note were the extensive floods in 2002 and 2005.

As discussed above, flooded dwellings present a particular set of problems. The Multi-Hazard Mitigation Plan lists several actions to include enforcing County Flood Plain ordinances, updating Flood Way maps, and purchasing Repetitive Loss Structures. Once structures are removed due to repetitive loss, the area will be returned back to it natural state.

Pike County will be developing a Mitigation Plan as well with the assistance of a grant from the Indiana Department of Homeland Security.

These Multi-Hazard Mitigation Plans are more tools that should be used to assist in maintaining water quality in the project area.

2.3.5 Endangered Species: Human activities in the area, with the resultant impact on the environment, have had a very negative impact on the flora and fauna. The Indiana Department of Natural Resources lists some 48 endangered animals, 29 vascular plants, and four natural communities in Gibson County. Pike County has 35 animals, 18 vascular plants, and three natural communities on the endangered species list (See Appendix I).

The Patoka River National Wildlife Refuge and Management Area was established to take advantage of the bottomland hardwood forests along the Patoka River in Gibson and Pike Counties. However, a chronic lack of funding has hampered the Refuge from purchasing all of the property desired. While all purchases of private property are from "willing sellers," the lack of funding is providing an opportunity for private entities to purchase theses areas - and in some cases log them.

The U.S. Fish and Wildlife Service has conducted extensive studies in the region that catalogues the impact on the aquatic environment. Appendix H is a short report that reveals the impact on fish in the Patoka River and tributaries. The author has provided a synopsis thus:

A biological investigation of fish assemblages in the Patoka River drainage found that biological diversity of the system has remained stable during the last century; however, an alarming trend has been observed with declines in the biological integrity of the system. Biological integrity is defined as "the ability to support and maintain a balanced, integrated, adaptive assemblage of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats of the region". The sampling of 66 streams in the Patoka watershed found that index of biotic integrity scores improved significantly between 1992 and 2002 for degraded sites that had either no aquatic life or were severely impaired from acid mine drainage runoff, but high quality or least-impacted sites also showed a concomitant decline to "fair" levels of biological integrity. This suggests more efforts are needed to restore and protect "high quality" habitats and water quality of upstream drainage area in order to achieve future improvements in biological integrity and restoration of biological diversity.

The Committee's vision of *a healthier environment with better water quality for drinking, recreation, and wildlife in the Lower Patoka River watershed* is partially in response to the expanding list of endangered species.

2.4 Land use:

2.4.1 Mining. Coal was discovered in Pike County in 1860 and remains one of the areas major industries.

When mining activities in the project area are discussed, they fall into two very distinct groups of Historical and Current.

2.4.1.1 Historical Mining Activities:

The United States government enacted the Surface Mining Control and Reclamation Act (SMCRA) in 1977, which imposed strict reclamation guidelines during and after mining operations. Prior to 1977 there were very little formal reclamation guidelines. Land was mined, which resulted in total devastation of the area, and frequently abandoned without any restoration - Abandoned Mine Lands (AML).

Acid Mine Drainage (AMD) is caused by oxidation of pyrites during and after mining operations. AMD typically has a pH so low it is comparable to vinegar or battery acid. Obviously, nothing can live in this environment.

During dry periods, the AMD collets in pools and then flushes out after a heavy precipitation event. The result is that the entire 17 mile length of the South Fork was a dead zone for many years with no fish or amphibians.

Therefore, the AMD degrading the water quality of the area is generally from pre 1977 mining activities.

The SMCRA imposes an extraction fee on each ton of coal mined, with that money being used to address AMD/AML problems throughout the United States.

From 1996 until 2002, the Patoka South Fork Watershed Steering Committee attacked the AMD problem in the South Fork Patoka River sub-watershed (See Appendix F).

The Division of Reclamation (DOR), Indiana Department of Natural Resources is the state agency which implements the SMCRA in Indiana. The DOR helped fund the South Fork Steering Committee, which acted as a catalyst to catalogue, qualify, quantify, and remediate the AMD in the project area. Additional funds came directly from the Office of Surface Mining, U.S. Department of the Interior, which is the federal agency implementing the SMCRA. It should be understood that reclamation work is extremely expensive. Projects can range from several thousands of dollars to several million.

The South Fork Steering Committee received a Section 319 Grant from the Indiana Department of Environmental Management (IDEM) to provide for a Watershed Coordinator and water sampling. Don Corbett, a hydrologist from Indiana University, conducted water quality investigations in the region from 1965 through 1968. Appendix F has historical data from Corbett that pre-dates the South Fork Steering Committee, but is included for historical reference.

With the assistance of local, state, and federal agencies, the majority of AMD was eliminated when the South Fork Steering Committee adjourned for the last time on December 4, 2004 because they had accomplished as much as a grass roots organization could be expected to do.

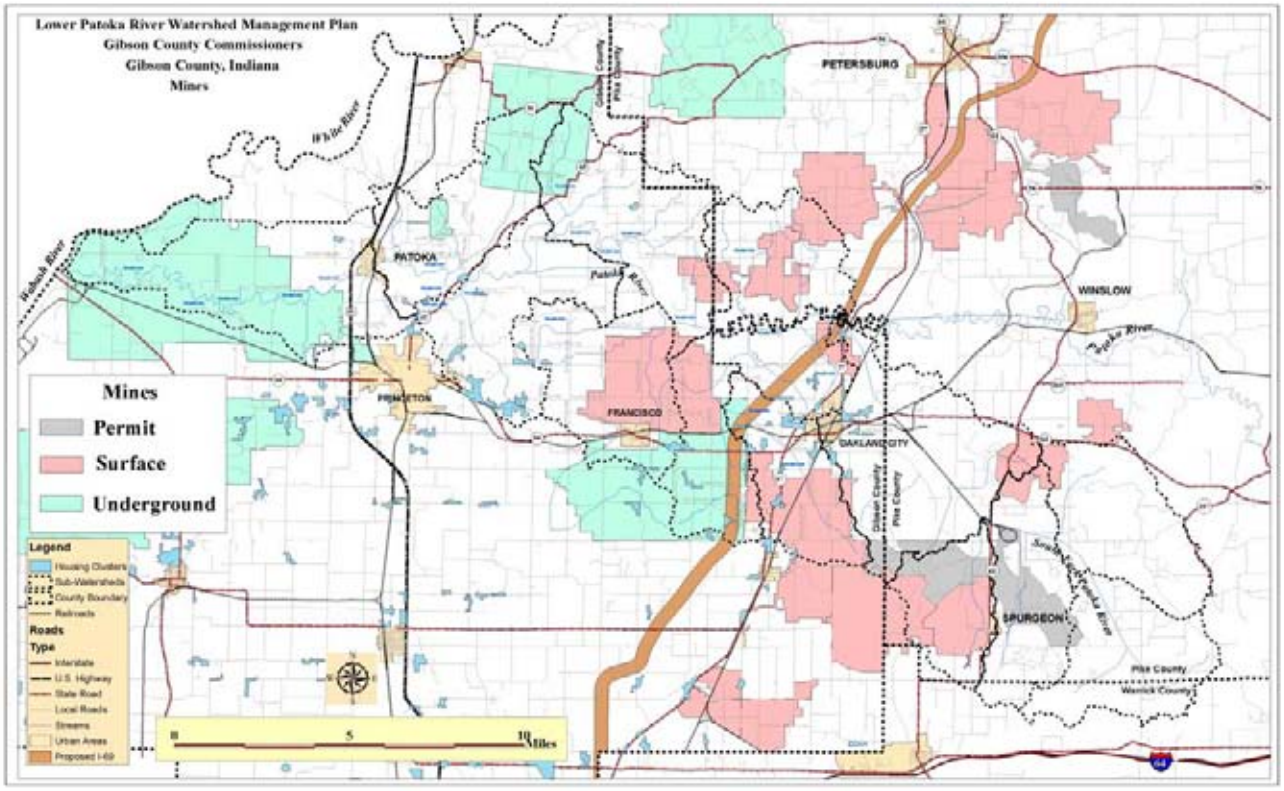
However, two major sources of AMD remain. The headwaters of the South Fork originate on the Pike-Warrick County lines, where there is severe degradation (See Appendix G). Another site is the Durham Ditch drainage that was addressed, but still has severe contamination See Appendix A and B. The DOR spent approximately $1.2 million in 2006 for reclamation at the headwaters, and is currently spending another $1.2 million to complete the project. The Durham Ditch problem is still being studied, and should be addressed in the not too distant future. Never-the-less, with the elimination of the AMD at the headwaters, one of the last of two major sources of contamination will be eliminated.

The end result of the campaign against AMD is that after many years of the pH being too low for aquatic life, the pH is now high enough to support a thriving aquatic community.

2.4.1.2 Current Mining Activities:

All current mining activities in the State are strictly controlled by the Division of Reclamation – Indiana Department of Natural resources. Never-the-less, problems can, and do, occur. The project area continues to see a rapid expansion of coal mining. Surface and underground mines are routinely being opened around the project area. Figure 5 below shows the extensive amount of current mining activity in the area.

Figure 2-3
Current Mining Activities



Section 2.3.2 (Topography) points out that there is a dip to the southwest in the bedrock of the area. The result of this is that while surface mines are more prevalent to the northeast, the cost of removing the overburden necessitates the employment of underground mines further to the southwest.

Even though reclamation guidelines dictate procedures to prevent the deterioration of the watershed, vigilance is required to ensure that the guidelines are in fact being followed. Reclaimed land is extremely vulnerable to erosion. The erosion not only contributes to sedimentation in the streams, but exposes pyretic materials, which can cause AMD.

Figure 2-4
Erosion and Exposed Acid Mine Drainage
in the Vicinity of Robinson/Big Creeks

Picture courtesy of the Patoka River National Wildlife Refuge and Management Area - 11/2/07

2.4.2: Urban and Industrial Land Use:

The identity of the project area is changing with agriculture giving way to manufacturing and increased mining, although mining in Gibson and Pike Counties has been a mainstay for over a century.

This development has resulted in a population growth that puts pressures on the environment. Incorporated towns, housing clusters, and individual homes all pose threats such as septic systems, trash dumping, fuel leaks, and non-permitted excavation in sensitive areas such as wetlands and floodplains. Construction on Interstate 69 has just begun. Development along the entire corridor from Evansville to Indianapolis will undoubtedly increase. Appendixes A and B shows that the Interstate will particularly impact the project area.

2.4.2.1 Industry:

Major employers in the area contribute to a vibrant economy. However, each type of industry poses a different kind of threat to the environment. Power generation, for example, is a source of mercury. IDEM has issued fish consumption advisories throughout the State due to mercury contamination. The Patoka River has a "Group 3" advisory for carp and catfish. A Group 3 advisory suggests that citizens "Limit to one meal per month (12 meals per year) for adult males and females. Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 do not eat."

Two power plants operate in Petersburg, and the Duke electrical generating station on the Wabash River is reported to be the third largest in the country. (See Appendixes A and B)

Toyota Motor Manufacturing Indiana Incorporated opened an automobile assembly plant near Princeton in 1997 that is a magnet for companies that supply parts. Princeton, in turn, has seen an increase in the area's population.

2.4.2.2 Septics:

Appendixes A and B show the distribution of development in the project area. Other than Francisco and Oakland City, there are no waste water treatment facilities in the watershed. Individual homes, housing clusters, and the entire town of Patoka rely on septic systems. Improperly installed and maintained septic systems pose serious threats to water quality. Again, development along Interstate 69 will pose additional concerns.

2.4.2.3 Wastewater:

A rapidly expanding industrial base is continuing to apply pressure to the waste water treating facilities in the area. As part of this IDEM project, the Gibson County Commissioners had Neikirk Engineering develop a Regional Wastewater Infrastructure Plan. The plan is a comprehensive plan that assesses the current wastewater infrastructure needs, calculates the future needs of the county, and outlines wastewater collection and treatment solutions. The plan will help this committee to develop a plan to promote public health and protect the environment.

The Infrastructure Plan reports that the septic systems in the vicinity of the Town of Patoka do not work well due to a high water table in the area. The reports confirmed reports of raw sewage flowing into open ditches. The Plan also reports that the Oakland City waste water facility is "under-designed for heavy flows that occur during storm events."

The report goes on to say “that in the past 2 years the inflows exceeded the plant’s maximum design capacity a total of 52 days.” The Francisco plant is only five years old and in good shape.

2.4.2.4 Demographics:

Figure 7 shows that by the year 2040, approximately 23% of Gibson County residents and 24% of Pike County residents will be over the age of 65. Less than half of the residents in each county will be contributing towards a stable household income. Retired residents are generally on a fixed income, which will limit their ability to install and maintain a properly operating septic system, or contribute towards maintaining viable urban waste water systems. This will continue to be a major threat to the watershed for years to come.

Table 2-1
Demographics

	2040						
	Total	**Pre-School 0-4**	**School Age 5-19**	**College Age 20-24**	**Young Adult 25-44**	**Older Adult 45-64**	**Seniors 65+**
Gibson	33,566	2,039	6,410	1,769	7,850	7,763	7,735
Pike	13,557	839	2,513	647	3,139	3,156	3,263

Data source: Indiana Business Research Center

2.4.2.5 Construction:

The IDEM website discusses construction related activities thus - Any "project site owner" engaged in construction-related activities (meaning any manmade change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting, and grading) that disturb one (1) or more acres of land may be required to obtain a "Rule 5" storm water runoff permit under 327 IAC 15-5 from the IDEM Office of Water Quality.

The cumulative effect of the expanding mining, industrial, power generation, and urban sectors will pose challenges for environmental managers for years to come.

2.4.3 Forestry:

2.4.3.1 Current Situation:

There are very few, if any, isolated areas of Indiana forestland where trees have never been cut. Most of these areas are thought of as small treasures and are preserved in state parks and nature preserves.

The project area does not have any extensive forested areas. Rather there are "wood lots," riparian zones, and some public wildlife areas Appendix B shows the distribution of timbered lands in the project area.

Sugar Ridge Fish and Wildlife Area and Pike State Forest – Indiana Department of Natural Resources have several non-contiguous parcels in the area that are managed for timber harvest as well as wildlife and recreational activities. Some of these parcels are located directly up-stream of the project area, and have a direct influence on water quality such as that of the Patoka River National Wildlife Refuge.

Conservation groups, private citizens, State, and Federal agencies all realize the importance of the remaining forests, rivers, and wetlands in the area and have undertaken projects to **C**onserve, **P**rotect, and **R**estore these valuable assets.(See Appendixes A and B).

2.4.3.2 Outlook:

Forests are vital ecosystems that provide for maintaining riparian zones, carbon sequestration, and stabilizing hillsides. Bottomland hardwood forests have a tremendous positive effect on down-stream flooding, nutrient uptake, and aquifer recharging.

According to the Indiana Department of Natural Resources Cooperative Forest Management Section, Indiana's forests face significant threats to their sustainability, including the following key threats.

- The lack of management or inappropriate management of forest resources.
- Inappropriate development of forestland, and public policies that encourage or accelerate forest losses.
- Inadequate incentives to retain forests, restore forests, and manage forests for the goods and services needed.
- Inadequate public understanding of the economic potential and proper management of Indiana's forests.
- Invasive plant and animal species, which threaten forest health and productivity.
- Inadequate coordination of public and private efforts to address the sustainability of Indiana's forests.
- Short and long term accessibility of forest owner assistance programs, and resource management incentives.
- The high cost of owning and managing forests as a long term investment.
- The turnover rate in land ownership is expected to swell and threaten forest sustainability.

All of the items listed above are relevant concerns of the Steering Committee members because they realize that the project area is a microcosm of the State in general. The concerns are relevant because of the direct link between trees and their effect on water quality.

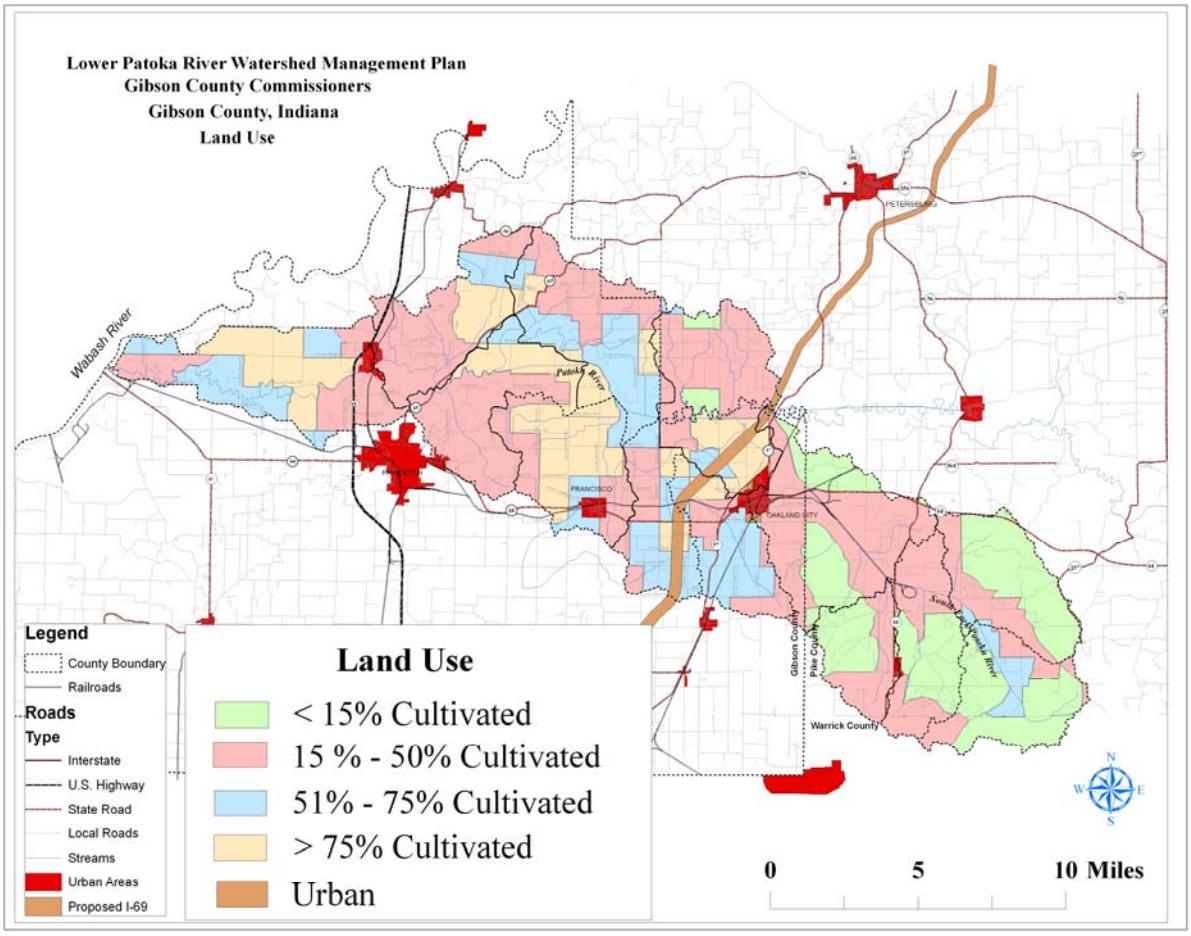
The Natural Resources Conservation Service – U.S. Department of Agriculture implements various programs under the federal Farm Bill. The 2008 Farm Bill has many programs to **C**onserve, **P**rotect, and **R**estore the environment.

Additionally, the State of Indiana can provide land owners with an incredible amount of assistance. The State Division of Forestry website at http://www.in.gov/dnr/forestry/ presents information on subjects such as "Private Landowners Assistance" and "Licensed Timber Buyers."

2.4.4 Agriculture:

While the region is becoming increasingly industrialized, the majority of the project area is still heavily farmed. Most sub-watersheds range from 15 to 75% cultivation. Figure 7 and Appendix B show the agriculture patterns in the project area.

Figure 2-5
Agricultural Land Use



The increased number of ethanol plants in the region has resulted in an overwhelming demand for corn. Historic high prices for corn have some land owners maximizing the yield on every acre of their land. Unfortunately, highly erodable soils, riparian zones, and forested areas are being farmed as well. Areas that may be more suitable for pasture, or forests, require aggressive use of techniques to reduce, or eliminate, erosion and run-off from pesticides and excess nutrients. Conservation tillage methods can substantially reduce sheet and gully erosion.

A layer of mulch will help prevent the germination of many weed seeds, while reducing the need for cultivation or the use of herbicides. Mulches also help moderate the soil temperature and retain moisture during dry weather. Mulches protect the soil from the impact of raindrops that can cause crusting. Crusting can prevent the germination of seedlings.

Conservation tillage: Any tillage and planting system in which at least 30 percent of the soil surface is covered by plant residue after planting to reduce soil erosion by water; or where soil erosion by wind is the primary concern of at least 1,000 pounds per acre of flat small grain residue equivalent are on the surface during the critical erosion period.

Conventional Tillage: Tillage types that leave less than 15 percent residue cover after planting, or less than 500 pounds per acre of small grain residue equivalent throughout the critical wind erosion period. Generally involves plowing or intensive tillage.

Reduced Tillage: Tillage types that leave 15-30 percent residue cover after planting or 500 to 1,000 pounds per acre of small grain residue equivalent throughout the critical wind erosion period.

Source – Natural Resources Conservation Service

Table 2-2

2007 Transect Surveys – All Crops – Total Acres by Tillage Type

Watershed	No-till	Mulch-till	Reduced-till	Convention	N/A	Unknown	Total
Gibson County	10931	1410	10225	15162	705	3879	**42312**
Pike County	8510	1654	4642	4835	2128	0	**21469**

Source: Kenneth Eck - Indiana State Department of Agriculture

As an example of agricultural practices, the data for the South Fork shows about 45% of the area falls in the <15% cultivated category, which is because of extensive mining in the area over many years and the presence of the Patoka River National Wildlife Refuge and Sugar Ridge Fish and Wildlife Area.

Some 36% of the area falls in the 15-50% cultivated range – With some 48,823 acres there about 17,576 acres are in the 15-50% range.

Approximately 4% is in the 51-75% range, which means 1,953 acres are in this category.

Table 4 below shows the results of combining the tillage methods and cultivation percentages.

Table 2-3
Tillage

Sub-Watershed	No-till	Mulch -till	Reduced -till	Conv.	N/A	Unk.	Total Acres
East Fork Keg 15 -50%	780	90	720	1,080	30	300	3,000
East Fork Keg 51 - 75%	949	110	876	1,314	36	360	3,650
East Fork Keg < 75%	221	26	204	306	9	85	850
Houchins Cutoff 15 -50%	1,950	225	1,800	2,700	75	750	7,500
Houchins Cutoff 51 - 75%	130	15	120	180	5	50	500
Houchins Cutoff < 75%	650	75	600	900	25	250	2,500
Lost Creek 15 - 50%	910	105	840	1,260	35	350	3,500
Lost Creek 51 - 75%	420	49	388	580	16	162	1,615
Lost Creek > 75%	1,430	165	1,320	1,980	55	550	5,500
Patoka to Wabash 15 - 50%	1,014	117	936	1,404	39	390	3900
Patoka to Wabash 51 - 75%	1,560	180	1,440	2,160	60	600	6000
Patoka to Wabash >75%	1,352	156	1,248	1,872	52	520	5,200
Robinson/Big Creek 15 - 50%	450	52	415	623	17	173	1,730
Robinson/Big Creek 51 - 75%	2,067	239	1,908	2,862	80	795	7,950
Robinson/Big Creek > 75%	832	96	768	1,152	32	320	3,200
South Fork 15 - 50%	7,030	1,230	3,867	3,867	1,582	0	17,576
South Fork 51 - 75%	781	137	430	430	176	0	1953
South Fork >75%	0	0	0	0	0	0	0
Trippet 15 - 50%	1,768	204	1,632	2,448	68	680	6,800
Trippet 51 - 75%	400	46	370	555	16	154	1,541
Trippet > 75%	520	60	480	720	20	200	2,000

West Fork Keg 15 - 50%	598	69	552	828	23	230	2,300
West Fork Keg 51 - 75%	950	110	876	1,314	37	365	3,650
West Fork Keg > 75%	260	30	240	360	10	100	1,000
Yellow/Goose 15 - 50%	1,300	150	1,200	1,800	50	500	5000
Yellow/Goose 51 - 75%	1,716	198	1,584	2,376	66	660	6,600
Yellow/Goose > 75%	286	33	264	396	11	110	1,100
Total	**30,324**	**3,967**	**25,078**	**35,467**	**2,625**	**8,654**	**106,115**

The data from Table 2-3 above will be referred to in the following sections of this plan, for example, to correlate sources of sediment and for setting goals.

2.4.5 Oil and Natural Gas:

2.4.5.1. As gas and oil production quickly declined in the Trenton Field in northern Indiana, new discoveries were being made in the southwestern part of the state known as the Illinois Basin. Production from fields in Vigo and Pike Counties was rapidly followed by new discoveries in Sullivan and Gibson Counties. Unlike the single field of northern Indiana that produced from a single reservoir, these new discoveries produce from many smaller fields and a variety of different reservoirs at different depths. Also, unlike the Trenton Field, the Illinois Basin fields produce mostly oil, not gas. Soon all the counties located in the southwestern part of the state were contributing to oil production. Production peaked in 1956 at over 12 million barrels for the year. Since that time both the numbers of holes drilled and the production for the state have declined. In 1997, Indiana produced just less than 2.5 million barrels of oil and 526 million cubic feet of gas.

2.4.5.2. The Division of Oil and Gas administers Indiana's oil and gas statutes (IC 14-37 and IC 14-38), which regulate petroleum exploration and production operations including: well spacing, exploration, permitting, drilling, completion, production, and abandonment operations; underground injection of fluids for enhanced oil recovery or for production fluid disposal; and the underground storage of natural gas or other petroleum products in underground formations.

The Orphaned and Abandoned Sites Program reviews abandoned well sites for inclusion in a statewide list of sites qualifying for state closure action. The program manages projects for well closure and site remediation work on improperly abandoned oil and gas production facilities. Funding for the program is provided through annual well fees paid by Indiana operators, civil penalty assessments, and forfeited bonds

2.4.5.3. The Southwest Indiana Brine Coalition (SWIBC) was formed in 1998 by citizens concerned by the impacts of oil extraction-especially the problem of the saltwater by-product upon land and water resources. Partnering with the Four River Resource Conservation and Development Area enabled the SWIBC to obtain grant monies from the Indiana Department of Environmental Management and Indiana Department of Natural Resources- Division of Oil and Gas. These funds have allowed the SWIBC to hire a full-time Coordinator, who has been identifying oil well brine contamination in a seven-county area since 1999. Restoration of brine damaged areas has been accomplished through cost-sharing with the landowners.

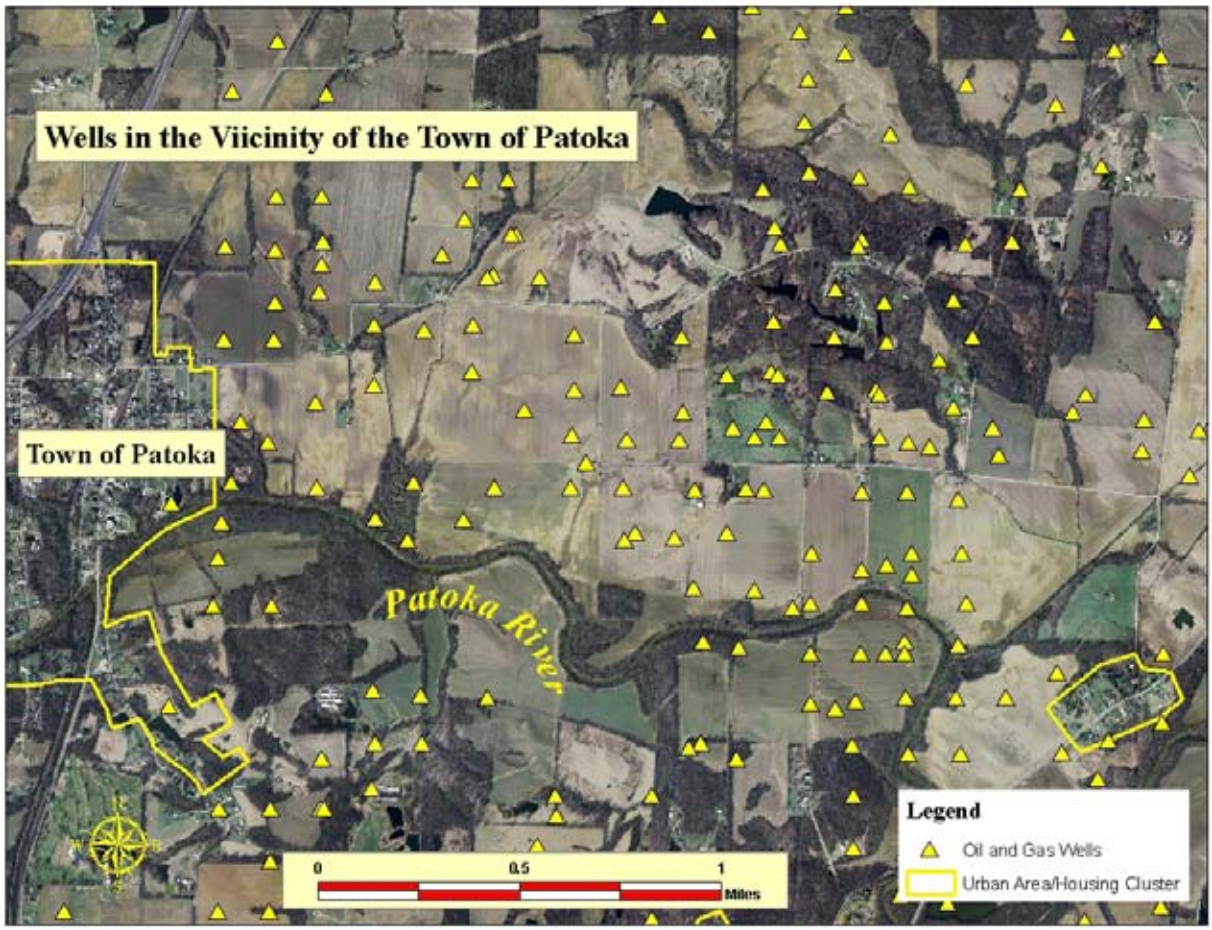
The SWIBC has identified eight sites in the project area in Gibson County, and six sites in the project area in Pike County (See Appendixes A and B). Saltwater (Brine) renders the soil sterile, which can lead to erosion. Brine sites on hillsides can have a devastating effect as erosion goes unchecked. Besides the obvious effects of erosion, brine also diminishes water quality.

Figure 2-6 – Brine Damaged Soils Can lead to Excessive Erosion

Photo Courtesy of Southwest Indiana Brine Coalition

As this part of the State became the major petroleum producer, with a small amount of associated natural gas, a huge number of wells were drilled. Many of these wells were never cataloged and many have since been abandoned. Therefore, a map of the project area would show a massive number of wells, and would not be functional. However, a small portion of the Houchins Cutoff/Indian Creek Sub-watershed is provided here as an example of the number of wells and their location to water sources.

Figure 2-7
Well Location Example



2.4.6 The Patoka River National Wildlife Refuge and Management Area (PRNWRMA) was established in 1994 and is one of the most significant bottomland hardwood forests remaining in the state. The refuge supports over 380 species of wildlife, including the threatened bald eagle and endangered Indiana Bat.

The Refuge will consist of 6,970 acres of National Wildlife Refuge and 15,847 acres of Management Area; this differentiation is necessary to avoid conflicts with the Surface Mining Control and Reclamation Act and the area's surface coal mining industry. A river corridor project will encompass 30 miles of the Patoka River and 19 miles of oxbows with a total of 12,700 acres of existing wetlands.

Even though the Refuge was established to take advantage of the bottomland hardwood forests along the Patoka River in Gibson and Pike Counties, a chronic lack of funding has hampered the Refuge from purchasing all of the property desired. While all purchases of property are from "willing sellers," the lack of funding is providing an opportunity for private entities to purchase theses areas - and in some cases log them.

The Refuge is preparing a Comprehensive Conservation Plan that will guide management of the Refuge and Management Area for the next 15 years, but will be reviewed periodically to meet new circumstances. The plan has three goals directed to habitat, wildlife, and people. The vision of the Refuge states “The Patoka River National Wildlife Refuge and Management Area restores, protects and manages a diverse bottomland hardwood forest eco-system and associated habitats …” The plan goes on to list some projects such as studying the feasibility of reconnecting an oxbow to the river and of constructing a series of ridge and swale wetland complexes within the floodplain, and planting them with bottom-land hardwood trees.

Having the floodplain restored and protected is an exciting plan that the Steering Committee supports to help reduce flooding, trap sediment, and for recharging groundwater aquifers.

2.4.7 Sugar Ridge Fish and Wildlife Area

Sugar Ridge Fish & Wildlife Area is unique in that much of the land has been strip-mined. Sugar Ridge is made up of six separate areas, totaling approximately 8,100 acres. The strip-mined land features about 100 pits and lakes, along with rows of overburden from the mining operation. The land that has not been mined is mostly rough and rolling

A large part of Areas I, II and III was once leased from Amax Coal Company. The leasing began in 1964 and continued until 1980 when most of the land was donated to the Division of Fish and Wildlife. Currently, only Area VI is still leased through Gray Farms, Inc.

Most revenues used in land acquisition, development, operation and maintenance of Sugar Ridge are derived from the sale of hunting, fishing and trapping licenses. Funds are also received from the federal Pittman-Robertson and Dingell-Johnson programs to aid fish and wildlife restoration. These funds are derived from taxes levied on sport hunting and fishing equipment.

3. ESTABLISHING BENCHMARKS:

Committee members originally compiled a list of concerns that would be the basis for developing this watershed management plan:

- Sedimentation and Erosion – Erosion from fields, ditches, and excavation sites
- Trash/Illegal Dumping/Animal Remains – Dump sites and trash dumped in streams and along roads
- Coal Mining – Erosion and acid mine drainage from old and current mine lands
- Septic Systems – Isolated homes, housing clusters, and urban waste water systems
- Oil and Gas Wells – Oil and brine spills and broken lines
- Animal Waste (Main Channel) – Confined animal feeding operations
- Water Retention Public Access – Retention/detention basins, cover plants, and combined sewer outflow

Citizens were solicited to provide a list of their concerns. The initial list of water quality concerns were pared down with items 1 through 5 being those that were within the ability of the steering committee to accomplish. Large amounts of animal waste from local operations were not considered a major threat since IDEM and IDNR regulate confined animal feeding operations. However, resultant constituents of animal waste such as E. coli, and nitrogen from isolated activities as well as manure hauled in are incorporated into other aspects of this plan. Constructing ponds and lakes and combined sewer outflow are beyond the scope of the project, so it was decided they will have to be integrated into a much larger political program.

"Windshield Surveys," water quality data, and data mining were used to gather sufficient data to qualify and quantify these concerns.

Volunteers and the Watershed Coordinator drove around the project area and conducted windshield surveys in order to get a first-hand look of where the good and bad are located. Additionally, aerial photography was used to evaluate areas where there was a lack of access. The findings of the windshield surveys and the data mining are evaluated in this section.

Appendix E graphically shows the location of the stressors such as dump sites that were visually observed during the surveys. Table 3-1 below lists the problems in a tabular form.

Table 3-1
Table of Concerns

Concern	Source	Location
Elevated levels of suspended solids	Lack of Conservation Tillage methods	Widespread around the project area: see Figure 2-5
	Improper excavation techniques	Temporary isolated sites around the project area Roadside ditches- several in the Patoka to Wabash and Houchins Cutoff/Indian Creek area
	Livestock access to streams, pasture	Goose Creek, Houchins Cutoff, Lost Creek, and Trippet areas
	Timber harvesting practices	Isolated woodlots around the project area
	Mining	New mines in the Lost Creek and Robinson/Big Creek areas: See Figure 2-3
Illegal dumping	Construction materials and household furniture/appliances at remote locations Household trash dumped off bridges Large objects used to help stabilize eroding banks	2 Sites – Robinson/Big Creeks 2 Sites – Wheel/Lick Creeks 1 Site – Houchins Cutoff 3 Sites – Patoka to Wabash 2 Sites – South Fork
Acid Mine Drainage	Mining activities	Potentially at all mining activities, Durham Ditch in the South Fork is the worst
Elevated levels of E. coli	Improper/inadequate septic system	Housing clusters in Keg Creek – East Fork & West Fork, Lost Creek, Houchins Cutoff/Indian Creek, & Trippet
	No/inadequate waste water treatment plants	Oakland City & Patoka
	Livestock in streams	Goose Creek, Houchins Cutoff, Lost Creek, and Trippet areas
	Manure spreading/ stockpiling	Temporary isolated sites around the project area

Oil and brine contamination	Broken feeder lines, inadequate berms, brine spills	Houchins Cutoff, Keg Creeks - East Fork & West Fork, Patoka to Wabash, Robinson/Big Creek, Trippet, Yellow/Goose Creeks

Section 4 will detail the causes of these problems and stressors, Section 5 will discuss the sources, and Section 6 will evaluate the critical areas.

3.1 Suspended Solids and Nutrients

3.1.1 Turbidity

Turbidity and Transparency: Turbid water is cloudier, and is caused by suspended matter including clay, silt, organic matter, and algae.

Transparency measures the scattering of light, The scattering of light decreases photosynthesis which means organisms in the water receive no light and water temperature increases due to light absorption.

Turbidity can be measured in Nephelometer Turbidity Units (NTU's). Ranges for NTUs are 0 – 173; the Indiana average is 36. IDEM measures suspended solids in milligrams per liter (mg/l). There is no way to correlate NTUs and mg/ls and there is no State standard for total suspended solids but the State target is 30 mg/l.
NTUs are easier for field personnel to measure. Therefore, the watershed group will work with NTUs, and supplement their data with IDEM findings.

3.1.2 Nitrogen-Ammonia

Nitrogen occurs in water as nitrate (NO3), nitrite (NO2), and ammonia (NH3). It enters the water from human and animal waste, decomposing organic matter, and runoff.

Nitrogen works with phosphorus to increase algae growth and cause eutrophication.

Nitrogen can come from manure, such as treatment lagoons and over-fertilized fields. Because nitrogen is the most abundant nutrient in commercial fertilizers, runoff from agriculture, golf courses, and lawns is high in nitrogen, especially if it rains soon after application.

According to the Indiana Department of Natural Resources *Hoosier Riverwatch Training Manual*, "Sewers are the #1 source of nitrates in Indiana's surface water."

While there is no State limit for Nitrogen, 1 mg/l is the target concentration for surface waters.

3.1.3 Phosphorus

Most fresh water has naturally low phosphate levels, and this limits algal growth. If excessive phosphates enter surface water, it can support rapid algal growth. When the algae die, their decomposition by bacteria uses up oxygen and may produce odors and algal toxins.

While phosphorus occurs naturally in soil, sediments from soil erosion and runoff are often a significant source of phosphorus. Additionally, they may enter the stream via bank erosion or runoff from forestry, agriculture, and urban lands.

Phosphorus can come from manure sources, such as treatment lagoons, over fertilized agricultural fields, or waterfowl. Urban sources may include storm drains, parking lot and road runoff, construction sites, and inadequately treated wastewater.

Even though Indiana does not have a standard for phosphorus, .3 mg/l is the target concentration for surface waters.

3.1.4 IDEM Sampling – Appendixes A and F show IDEM sampling sites and those sites that are above State targets. Appendix E shows the sites related to other threats in the watershed.

Table 3-2
IDEM Water Sampling Data

Location	Sub-Watershed	Date	TSS (mg/l) Target 30 mg/l	Nitrogen (mg/l Target 1 mg/l	Phosphorus (mg/l) Target .3 mg/l
WPA070-0004	South Fork - Headwaters	05/16/2001	27	<0.100	<0.300
		07/25/2001	**30**	<0.100	<0.300
		09/18/2001	6	<0.100	<0.300
WPA070-0005	South Fork Honey Creek	05/16/2001	25	<0.100	0.058
		07/31/2001	15	<0.100	0.046
		07/31/2001	13	<0.100	0.046
		09/18/2001	<4	<0.100	0.051
WPA070-0006	South Fork - Spurgeon	05/15/2001	23	0.170	<0.030
		07/24/2001	28	0.540	<0.030
		09/18/2001	<4	0.240	<0.030
WPA070-0007	Wheeler/Lick Creeks	05/09/2001	**34**	<0.100	0.059
		07/31/2001	25	0.220	0.150
		09/18/2001	<4	<0.100	0.086
WPA070-0008	South Fork Headwaters	05/16/2001	27	0.170	0.043
		07/24/2001	26	<0.100	0.039
		09/18/2001	<4	<0.100	0.030
WPA070-0015	South Fork Headwaters	05/31/2006	15	0.159	<0.060
		07/31/2006	<10	**1.560**	0.210
		10/12/2006	15.2	0.350	0.060

WPA070-0017	South Fork Honey Creek	05/31/2006	13	<0.100	0.177
WPA070-0018	South Fork - Spurgeon	05/30/2006	26	<0.100	<0.060
		08/01/2006	<10	<0.100	<0.060
		08/01/2006	11	0.269	**0.697**
		10/11/2006	17.6	<0.100	<0.060
WPA070-0019	South Fork – Houchins Ditch	05/30/2006	<10	0.109	<0.060
		08/01/2006	<10	<0.100	<0.060
		10/12/2006	<10	<0.100	<0.060
WPA080-0013	Robinson/Big Creeks	05/09/2001	17	<0.100	<0.030
WPA080-0014	Houchins Cutoff/ Indian Creek	05/08/2001	19	**2.300**	0.240
		08/23/2001	**42**	**1.300**	0.190
		08/23/2001	**87**	**1.300**	0.220
		09/25/2001	11	**2.700**	<0.030
WPA080-0015	Trippet Ditch	05/08/2001	**100**	< 0.100	0.260
		08/15/2001	**84**	< 0.100	0.180
		09/25/2001	**42**	< 0.100	0.210
WPA080-0016	Patoka to Wabash	05/08/2001	**90**	< 0.100	0.210
		08/15/2001	**90**	< 0.100	0.190
		09/25/2001	**43**	< 0.100	0.180
WPA080-0017	Robinson/Big Creeks	05/15/2001	**86**	< 0.100	0.230
		08/08/2001	29	< 0.100	0.170
		09/26/2001	**33**	< 0.100	0.220
WPA080-0018	Yellow/Goose Creeks	05/08/2001	12	<0.100	0.054
		08/08/2001	4	<0.100	0.074
		09/25/2001	<4	<0.100	0.037
WPA080-0019	Yellow/Goose Creeks	08/08/2001	**73**	<0.100	0.160
		08/15/2001	**75**	<0.100	0.210
		09/26/2001	**41**	<0.100	0.200
WPA080-0020	Houchins Cutoff/ Indian Creek	05/08/2001	9	<0.100	0.036
		08/08/2001	9	<0.100	<0.030
		09/26/2001	<4	<0.100	<0.030
WPA080-0021	Patoka to Wabash	05/08/2001	**99**	<0.100	0.240
		08/14/2001	**94**	<0.100	0.200
		09/25/2001	**36**	<0.100	0.200
WPA080-0024	Yellow/Goose Creeks	05/08/2001	**87**	<0.100	0.280
WPA080-0041	Robinson/Big Creeks	05/30/2006	**374**	0.137	**0.437**
		07/31/2006	<10	0.169	0.098
		10/1020/06	<5	<0.100	0.060
WPA080-0042	Patoka to Wabash	06/12/2006	**64**	<0.100	0.116
		08/15/2006	**104**	<0.100	0.164
		11/13/2006	**78**	<0.100	0.092
WPA080-0045	Patoka to Wabash	06/12/2006	**65**	<0.100	0.153
		08/17/2006	**156**	<0.100	0.171
		11/13/2006	**79**	<0.100	<0.050

WPA080-0047	Trippet Ditch	06/12/2006	**81**	<0.100	0.212
		08/16/2006	**147**	<0.100	0.155
		11/13/2006	**68**	<0.100	0.108
WPA080-0048	East Fork Keg	05/30/2006	**38**	0.468	<0.060
		07/31/2006	20	0.123	0.127
		10/10/2006	<5	0.161	0.085
		10/10/2006	13.6	0.163	0.135

Indicates above State Target

3.1.5 Soil and water Conservation District Sampling

Personnel from the Gibson County Soil and Water Conservation District have collected water quality data using a field kit in conjunction with the Hoosier Riverwatch program administered by the Indiana Department of Natural Resources. Data for all volunteer monitoring sites can be accessed at the Hoosier Riverwatch website at http://www.hoosierriverwatch.com. Guidelines and statistics can be found in the Volunteer Monitoring Guide.

As mentioned in Section 3-1, NTU's will be the target units, since it is much easier for watershed members to calculate. As IDEM continues to sample, that data will be incorporated for reference purposes.

SWCD members conducted sampling on nine occasions. Turbidity was at or above the State average of 36 NTUs 33% of the time. As the project advances, routine collection of data will provide a clearer picture with season/climatic variations as well as other constituents such as nitrogen, phosphorous, and E. coli. Current data shows that 1/3 of the time the targets are not being met for NTUs.

Table 3-3
SWCD Water Sampling Data

Location	Date	(NTUs) Target 36 NTUs	Nitrate (mg/l) Target 36 mg/l	Nitrite (mg/l) Target 36 mg/l	Orthophosphate (mg/l) Target .3 mg/l
Dongola Bridge	07/30/2007	**37**	4.5	0.65	0.2
Historical Bridge	07/24/2006	**50**	2.2		0.3
	10/30/2006	25	2.2	0.495	0.3
	05/21/2007	**32**	2.2	4.950	0.2
	07/24/2006	**60**	2.2		**0.4**
Houchins Ditch	10/30/2006	25	2.2	0	0.3
	11/08/2006	30			
	05/21/2007	15	8.8	0.99	0.3

Indicates above State Target

3.1.6 Summation:

Table 3-4 represents the results of the IDEM data for those sites where that portion of the watershed can be isolated, when extrapolated against flow data from the USGS in-stream gage in the Patoka River north of Princeton. This data will be used is the following sections for decision making purposes.

Table 3-4
Baseline Data for Total Suspended Solids, Nitrogen, and Phosphorous

The South Fork sub-watershed used for this calculation is about 45,112 acres or about 8.18% of the total Patoka River watershed of 551,000 acres

IDEM site WPA70-0007 (Wheeler/Lick Creeks)

Total Suspended Solids				Nitrogen	Phosphorous
Date	**mg/l Target 30 mg/l**	**Discharge cf/s**	**Loss – Tons/ ac year**	**mg/l Target 1 mg/l**	**mg/l Target .3 mg/l**
5/9/2001	34	74	.0045	<0.10	.059
7/31/2001	25	651	.0001	.22	.150
9/18/2001	<4	91	.0001	<0.10	.086
Average	**21**	**272**	**.0031**	**.14**	**.096**

The portion of East Fork – Keg Creek sub-watershed used for this calculation is about 6,785 acres or about 1.23% of the total Patoka River watershed of 551,000 acres

IDEM site WPA80-0008

Total Suspended Solids				Nitrogen	Phosphorous
5/30/2006	38.0	1920	.1060	-	-
7/31/2006	20.0	273	.0001	-	-
10/10/2006	13.6	353	.0001	-	-
Average	**24**	**848**	**.0354**	-	-

The portion of Robinson/Big Creek sub-watershed used for this calculation is about 935 acres or about 0.17% of the total Patoka River watershed of 551,000 acres

IDEM site WPA80-0013

Total Suspended Solids				Nitrogen	Phosphorous
5/9/2001	17.0	74	212	<0.10	<0.030
Average	**17.0**	**74**	**212**	**<0.10**	<0.030

The portion of the Yellow/Goose Creek sub-watershed used for this calculation is about 3,000 acres or about 0.54% of the total Patoka River watershed of 551,000 acres

IDEM site WPA80-0018

	Total Suspended Solids			Nitrogen	Phosphorous
5/8/2001	12	79	49	.320	0.054
8/8/2001	4	79	16	.320	0.074
9/25/2001	4	73	15	.140	0.037
Average	**7**	**77**	**27**	**.260**	**0.055**

Indian Creek in the Houchins Cutoff/Indian Creek sub-watershed is approximately 5,340 acres or about 0.99% of the total Patoka River watershed of 551,000 acres

IDEM site WPA08-0020 is near the mouth of Indian Creek

	Total Suspended Solids			Nitrogen	Phosphorous
05/08/2001	9.0	79	2.6	<0.10	0.036
08/08/2001	9.0	58	1.9	<0.10	<0.030
09/26/2001	<4	84	1.2	<0.10	<0.030
Average	**7**	**74**	**2**	**<0.10**	**.0320**

3.2. Illegal Dumping

Dumping poses a threat to the environment because toxic substances are often times disposed of along with solid waste. Oil, petroleum solvents, and other chemicals can have a devastating effect on the aquatic community. Additionally, plastics, wire, and twine can entangle amphibians and mammals such as beavers and cause them to drown.

Volunteers conducted windshield surveys of each sub-watershed and catalogued ten illegal dump sites. (See Appendixes A and E) The ten sites at bridges and other isolated spots are routinely used to dispose of dead animals, trash and construction materials. The steering committee feels that dumped items are one of the most severe threats to water quality.

3.3 Acid Mine Drainage

pH – power of hydrogen – pH expresses the activity of the hydrogen ions in water. The relative concentration of hydrogen and hydroxide ions determines whether a solution is acidic or basic. The pH level is an important measure of water quality because aquatic organisms are sensitive to pH, especially during reproduction. 6.0 – 9.0 is the optimum range for reproducing organisms.

The data in Appendix G shows that before a concentrated effort was begun to address the abandoned mine lands in the South Fork Watershed, the pH was generally so low it would support very little aquatic life. For example, in 1965 at the site on State Road 61 the average pH was 3.2 and in 1966 it was 3.5. By 2001 the average was 7.3 and in 2002 it was 7.5.

3.4 E. coli

E. coli is a specific species of fecal coliform bacteria used in Indiana's state water quality standards. Some strains of E. coli can lead to illness in humans. Fecal coliform bacteria are found in the feces of warm-blooded animals, including humans, livestock, and waterfowl. These bacteria are naturally present in the digestive tracts of animals (all birds and mammals), but are rare or absent in unpolluted waters. Fecal coliform bacteria typically enter water via combined sewer overflows, poor septic systems, and runoff from agricultural feedlots. The bacteria can enter the body through the mouth, nose, ears, eyes, or cuts in the skin. The Patoka River in Gibson and Pike Counties has been on the 303d list for E. coli for several years and will continue to be on the 2008 list.

3.4.1 Gibson County Waste Water Preliminary Engineering Report: Neikirk Engineering has prepared a *Regional Wastewater Infrastructure Plan* as part of this grant from IDEM. The Plan comprehensively assesses the current wastewater infrastructure needs, calculates the future needs of the county, and outlines wastewater collection and treatment solutions. The Plan should help to promote public health and protect the environment.

3.4.2 IDEM Sampling (See Appendix F for water quality data index).

Table 3-5
IDEM Water Sampling Data for E. coli

Location	Sub-Watershed	Date	Concentration in cfu/100 ml
WPA070-0012	South Fork Wheeler/Lick Creeks	04/24/2001	43.5
		05/01/2001	8.4
		05/08/2001	35.9
		05/15/2001	18.3
		05/22/2001	84.5
WPA070-0015	South Fork Headwaters	07/12/2006	214.3
		07/19/2006	980.4
		07/26/2006	83.6
		08/02/2006	<1
		08/09/2006	37.9
WPA070-0017	South Fork Honey Creek	07/12/2006	>24,200
		07/19/2006	>2,420
		07/26/2006	488.4
		08/02/2006	>2420
		08/09/2006	2,419.2
WPA070-0018	South Fork Spurgeon	07/12/2006	1,413.6
		07/19/2006	157.6
		07/26/2006	260.2
		08/02/2006	328.2

		08/09/2006	365.4
WPA070-0019	South Fork Houchins Ditch	07/12/2006	>24,200
		07/19/2006	209.8
		07/26/2006	172.2
		07/26/2006	98.6

WPA080-0002	Houchins Cutoff/Indian Creek	04/24/2001	870.4
		05/01/2001	41.9
		05/08/2001	53.7
		05/15/2001	45.7
		05/22/2001	547.5
		07/10/2006	27.8
WPA080-0008	East Fork Keg Creek	04/24/2001	1,416.6
		05/01/2001	57.3
		05/08/2001	866.4
		05/15/2001	133.3
		05/22/2001	1,299.65
WPA080-0035	Yellow/Goose Creeks	04/24/2001	210.5
		04/24/2001	2,419.2
		05/01/2001	101.7
		05/08/2001	206.3
		05/22/2001	1,046.21
WPA080-0036	Patoka to Wabash	05/08/2001	101.7
		05/08/2001	127.4
		05/15/2001	96
		05/22/2001	579.4
WPA080-0041	Robinson/Big Creeks	07/10/2006	27.5
		07/17/2006	155.3
		07/24/2006	1,119.9
		07/31/2006	8.5
		08/07/2006	304.4
		08/07/2006	461.1
WPA080-0042	Patoka to Wabash	07/10/2006	248.9
		07/17/2006	517.2
		07/24/2006	155.3
		07/31/2006	117.8
		08/07/2006	365.4

WPA080-0045	Patoka to Wabash	07/10/2006	613.1
		07/17/2006	517.2
		07/24/2006	107.6
		07/31/2006	88.4
		08/07/2006	121.1
WPA080-0047	Houchins Cutoff/Indian Creek	07/10/2006	488.4
		07/17/2006	298.7
		07/24/2006	109.5
		07/31/2006	77.6
		08/07/2006	43.7
WPA080-0048	East Fork Keg Creek	07/10/2006	686.7
		07/17/2006	920.8
		07/24/2006	290.9
		07/31/2006	613.1
		08/07/2006	579.4
WPA080-0051	Lost Creek	07/17/2006	48.7
		07/24/2006	137.4
		07/31/2006	64.4
		08/07/2006	13.4

IDEM visited the area in 2001 and 2006 and tested 74 samples in the project area for E. coli. Of the samples, 46 were above the State limit of 235 cfu/100ml single sample or 125 cfu/100ml geometric mean over 5 days.

It must be understood that each sample was a “snapshot” at that moment. A comprehensive testing program for each sub-watershed will allow the Committee to better grasp what is truly happening in that area.

Never the less, some disturbing patterns can be detected: Sites 17 and 18 in the South Fork were always “off the scale.” Site 19 was above limits 3 out of four times, and site 15 was above two out of five times.

In the rest of the watershed, sites 8, 35, 41, 42, 45, and 48 were generally well in excess of limits. Without the ability to conduct intense investigations, it would be imprudent to speculate on any particular sources. Some sites are down stream of housing clusters/urban areas while some are in isolated areas. Some sites are in tributaries and some are in the main channel.

Having the ability to monitor above the confluence of the South Fork, each sub-watershed, and at the mouth should, over a period of time, reveal where, when, and how E. coli is getting into the streams.

3.5 Oil Wells and Brine:

Saltwater (brine) renders the soil sterile, which can lead to erosion due to a lack of cover crops. Brine sites on hillsides can have a devastating effect as erosion goes unchecked. Besides the obvious effects of erosion, brine can also diminish water quality, while small amounts of petroleum can easily render large quantities of water undrinkable. Petroleum products also have a devastating effect on fish, birds and mammals.

The 12 sites surveyed by the Southwest Indiana Brine Coalition (SWIBC) are ¼ to 1acre,with the foremost danger being from erosion due to sterility of the soil. Drinking water is at minimal risk as large amounts of salt are not present.

There is neither a comprehensive program for rating oil well operations, nor is there a readily accessible database of violations with which to establish benchmark levels. While the Division of Oil and Gas oversees the program, individual operators and land owners are the first line of defense when it come to ensuring wells, and their associated equipment, are properly operating. Agencies like the Division of Oil and Gas and the SWIBC, unfortunately, arrive on the scene after a problem has already occurred. Even still, the Committee feels that this is a concern that needs to be an integral part of this plan.

4. IDENTIFYING PROBLEMS CAUSES, AND STRESSORS:

A group of dedicated volunteers reviewed all of the data, and known or suspected problems were distilled down to arrive at a list of items that this plan is capable of addressing.

Table 4-1

Problem Statement	Cause	Extent/Critical Areas
Elevated levels of suspended solids clogs ditches, exacerbates flooding, and scatters light, which decreases photosynthesis; heavy loads also can carry nutrients	Ag: HELs (Critical Areas)	Lost Creek, Houchins Cutoff, Robinson/Big Creek, Trippet, Yellow/Goose
	Steep un-vegetated ditches (Critical Areas)	Roadside ditches- several in the Patoka to Wabash and Houchins Cutoff/Indian Creek area
	Excavation	Temporary isolated sites around the project area Roadside ditches- several in the Patoka to Wabash and Houchins Cutoff/Indian Creek area
	Mined lands (Critical Areas)	New mines in the Lost Creek and Robinson/Big Creek areas:
	Brine damaged sites	3 – East Fork 2 – Houchins Ditch 1 – Lost Creek 1 – Robinson/Big Creek 2 - Trippet 2 – Wheeler Creek 1 – Margin of Wheeler Creek
	Livestock (Critical Areas)	Goose Creek, Houchins Cutoff, Lost Creek, and Trippet areas
	Logged forested areas	Isolated woodlots around the project area

Nutrients (Nitrogen and Phosphorous)	Urban: storm drains, parking lots, road runoff, construction sites, inadequately treated wastewater, septic tank effluent, and lawn fertilizer. Agricultural: manure sources such as treatment lagoons, over-fertilized fields Waterfowl.	Sites in the main stem of the Patoka River show elevated levels
Illegal dumping of trash and animal carcasses contaminates the water with petrochemicals, carcinogens, and dangerous materials	Citizens dump trash and animal carcasses alongside of, and in, tributaries and the main channel of the Patoka River	2 Sites – Robinson/Big Creeks 2 Sites – Wheeler/Lick Creeks 1 Site – Houchins Cutoff 3 Sites – Patoka to Wabash 2 Sites – South Fork
Acid Mine Drainage (AMD). Oxidation of pyrites during and after mining operations creates acidic water with low pH	Abandoned mine lands Newly mined lands (Critical Areas) Underground mine "gob" piles	South Fork: Durham Ditch and isolated pockets Each surface mine 2 underground mines
Elevated levels of E. coli. E. coli can lead to illness in humans	Livestock in streams (Critical Areas) Septic systems at individual homes and housing clusters (Critical Areas) Waste water treatment plants	Goose Creek, Houchins Cutoff, Lost Creek, and Trippet areas Housing clusters in Keg Creek – East Fork & West Fork, Lost Creek, Houchins Cutoff/Indian Creek, & Trippet Community of Spurgeon Oakland City and Patoka
Oil and brine contamination renders water undrinkable and injures fish, birds, and mammals.	Oil wells - broken feeder lines, inadequate berms, brine spills (Critical Areas)	Intermittent sites in the Patoka to Wabash, Houchins Cutoff/Indian Creek, and Trippet area

5. IDENTIFYING SOURCES:

5.1 Suspended Solids:

5.1.1 Agriculture

Of the some 135,000 acres in the project area, about 90% have tillage that ranges from 15% to more than 75%. While there are many other activities that contribute to erosion, the sheer quantity of agriculture in the project area means that agriculture is the foremost source (See Figure 2.5).

Table 5-1

Average USLE Soil Loss (in tons/acre) for 2007 fields with Indicated Tillage system

Watershed	No-till	Mulch-till	Reduced-till	Convention	N/A	Average
Gibson County	5.8	6.5	11.8	8.4	4.1	**8.4**
Pike County	4.4	4.8	11.2	14.8	0.1	**8.8**
Average	**5.1**	**5.7**	**11.5**	**11.6**	**2.1**	**8.6**

The Indiana Department of Agriculture cannot break the data down by current Hydrologic Unit Code
These are averaged across soil types and slope

Table 5-2

2007 Transect Surveys – All Crops – Total Acres by Tillage Type

Watershed	No-till	Mulch-till	Reduced-till	Convention	N/A	Unknown	Total
Gibson County	10931	1410	10225	15162	705	3879	**42312**
Pike County	8510	1654	4642	4835	2128	0	**21469**

What do the tables above tell us?

30% of the acres surveyed by the ISDA are No-till and lose about 99,149 total tons of soil per year
5% are Mulch-till and lose about 17,464 total tons of soil per year
23% are Reduced-till and lose about 170,959 total tons of soil per year
31% are Conventional-till and lose about 231,965 total tons of soil per year
5% are Not applicable and lose about 5,949 total tons of soil per year
6% are Unknown

While Reduced-till and Conventional tillage are about 54% of the acres, their combined loss is closer to 77% of the total tons lost each year.

Figure 5-1
Activities such as farming, logging, construction, ditch cleaning, and general excavation can lead to elevated levels of suspended solids.

Figure 5-2
The results of constructing and maintaining a grass waterway

5.1.2 Mining

Surface mining is more pronounced in the north and east part of the project area, but underground mines dot the area as well.

Near Mt. Olympus in the far north part of the Trippett Ditch – Goose/Yellow Creeks sub-watersheds is an underground mine that has ceased operations. While the site still has a responsible party, the fact that the site may fall into disrepair is of deep concern to Committee members.

5.1.3 Timber Harvesting

As discussed in Sect 2.4.3, the project area does not have large tracts of forested lands, but rather "wood lots", riparian zones etc. throughout the project area that are periodically logged. If loggers use high-impact equipment, especially during wet weather, rutting may occur, which will lead to severe erosion (See Appendix B). Steep uplands require particular attention since they are highly susceptible to erosion.
The Action Register in Section 7 lists activities to assist landowners regarding good stewardship of their forested lands.

5.1.4 Excavation

From time-to-time, construction activities are undertaken to construct buildings, clean ditches, or to clear fields of obstructions – including riparian zones. While many of these activities are of short duration, on-going measures to maximize discharge of ditches, for example, are counter productive to reducing erosion. Table 3-1 shows that there are several roadside ditches in the Patoka to Wabash and Houchins Cutoff/Indian Creek sub-watersheds that are deep, steep sided, and lack vegetation.

5.1.5 Livestock

Access to streams often-times leads to riparian zone destruction and therefore stream bank erosion. Unless animals are fenced from streams and provided alternate watering systems, they will seek water and a cool place during hot weather. The Goose Creek, Houchins Cutoff, Lost Creek, and Trippet areas have locations where exclusion needs to be addressed.

5.2. Nutrients

Table 3-4 shows those sites that were "isolated" from the main stem of the Patoka River. Because these sites are not affected by up-stream activities, the data reflects local conditions rather than everything above the project area.

Remarkably, no sites exceeded the target levels. One site, 70-0015, exceeded the target on July 31, 2006. However, the Division of Reclamation – IDNR was conducting reclamation of abandoned mine lands at the site during that time, which may well explain this anomaly.

5.3. Illegal Dumping

Citizens dump animal carcasses, trash, construction materials, and household appliances around the watershed rather than properly disposing of them. There are ten "significant" dump sites identified by committee members as part of this project.

The Patoka South Fork Watershed Steering Committee, a grass roots organization, conducts twice-yearly trash collection projects on the lower three miles of the South Fork. The sweeps are done as part of the Adopt-A-River program through the IDNR. The group often times finds large items other than "litter" such as tires, televisions, riding lawn mowers, and hot water heaters.

Figure 5-3
Typical bridge dump site

Figure 5-4
Patoka South Fork Volunteers

The main channel of the Patoka River has several kitchen appliances, among other things, that have migrated down stream from where they were disposed of. Both Gibson and Pike Counties have comprehensive solid waste management districts.

5.4. Acid Mine Drainage

The entire South Fork sub-watershed was once the most impacted stream in Indiana due to AMD. While reclamation efforts have addressed the most egregious sites, the Division of Reclamation continues to address some of the remaining spots in the sub-watershed. Never-the-less, recent mining elsewhere has the potential to create AMD due to failed reclamation practices and runoff from waste piles at underground mines.

5.5. E. coli

Septic systems and waste water treatment plants pose the vast majority of threats in the project area. The Town of Patoka has no waste water treatment plant and Oakland City is in dire need of upgrades. These two areas will be the focus of waste treatment for some time. City and County officials are acutely aware of the problem and have made these priority areas.

As mentioned before in Section 2.4.2.3 Wastewater, the Oakland City wastewater facility exceeded the maximum design capacity a total of 52 days in two years. And while there are no readily available reports of E. coli violations, it can be assumed that if raw sewage is present then E. coli in harmful levels may well be present.

IDEM sampling site WPA070-0017 may be influenced by the small community of Spurgeon, as there are no other readily identifiable sources nearby. Spurgeon town leaders are exploring the feasibility of constructing a community-wide waste water treatment facility.

Permitted Confined Animal Feeding Operations in the project vicinity are not numerous and are overseen by IDEM, but smaller producers that do not require a permit abound throughout the area.

The region is dotted with families that may have a few horses or cows, to several hundred hogs or chickens.

Even though the number of livestock with direct access to streams is not considered extensive, exclusion from streams is yet another way to reduce the threat to streams. Additionally, the failure to proper manage/store manure can have a severe impact on water quality.

Consideration must be given by landowners to implementing a comprehensive Nutrient Management Plan that takes into account the type and amount of manure, the composition/slope of the soils, and environmental aspects such as filter strips and grass waterways.

Site WPA070-0018 is situated downstream from the confluence of a tributary that has some animal feeding operations and consistently had high readings from IDEM.

5.6. Oil Wells and Brine Damaged Sites

There is no way to identify a particular area for identifying problem wells since a well may be performing satisfactorily one moment and the next develop a leak or a pipe may rupture. There are so many wells, both logged and un-logged, in the area that it is impossible to develop a cataloguing and monitoring system with current resources. A vigorous approach needs to be taken by the Committee to develop an atmosphere where operators and owners actively strive for a superior manner of conducting operations. Appendixes A and B shows the brine sites that the Southwest Indiana Brine Coalition has inventoried.

Figure 5-5
Poorly maintained oil wells are a danger to water quality

Figure 5-6
Leaking oil wells are constant threats

Figure 5-7
An example of a broken oil well line

6. IDENTIFYING CRITICAL AREAS:

Wanting to set priorities for each goal so that a multi-faceted approach could be taken, the Steering Committee identified critical areas **and priorities based on the water quality data collected by IDEM and the SWCD, windshield surveys, and anecdotal knowledge**.

Although the entire project area has critical areas for each constituent, three sub-watersheds (Houchins Cutoff/Indian Creek – Trippet - Yellow/Goose Creeks) were selected for intense focus as the priority area. Measures will be undertaken to address the concerns in this area, and evaluated to see what is working, and how to improve activities. Subsequent areas should benefit by what is learned in this initial phase. For instance, repetitive sampling should reveal a pattern that establishes a solid base-line of water quality data and show seasonal patterns, while outreach activities are being conducted to educate landowners.

The three priority sub-watersheds identified are representative of the wide range of threats to water quality. The Committee identified this priority area due to:

- Agriculture is 15% to 75%
- Increasing surface mined lands
- An underground mine
- A channelized stream
- A small urban area
- Several housing clusters
- Extensive roadside ditches
- Highly erodible soils
- Isolated areas with livestock in streams

Appendix E is a graphic picture of the areas that have been identified as critical due to the qualified and quantified criteria, while Table 6-1 below shows the data in an indexed form. The priorities were established by consensus after reviewing and analyzing all available data.

Table 6-1
Critical areas

Stressor	Sources	Critical Areas	Priority
Total Suspended Solids	Ag tillage methods Reclaimed surface mine lands Unprotected roadside ditches Underground mine refuse pile Inappropriate excavation & logging Livestock in streams	Houchins Cutoff/Indian Creek – Trippet – Yellow/Goose Creeks Newly mined lands Underground mines Excavation sites and logging areas Livestock enclosures	1 2 3 4 5

Illegal Dumping	Bridges Eroding stream bank stabilizing Remote locations	Bridge at 875W Bridge at 400W Bridge at 75S (South Fork) Dump Site 250N at 450W Dump Site 150N at 1100E	1 2 3 4 5
Acid Mine Drainage	Entire South Fork Sub-watershed Newly mined lands Underground mines	Durham Ditch Newly mined lands Underground mines	1 2 3
E. coli	Waste water treatment plants Individual septic systems Livestock in streams	Patoka and Oakland City Housing Clusters: East Fork & West Fork of Keg Creek, Lost Creek, Houchins Cutoff/Indian Creek, and Trippet Ditch. Honey Creek Livestock-scattered enclosures	1 2 3
Oil and Gas	Petroleum spills Open oil pits Brine spills	Entire Patoka to Wabash sub-watershed Entire Patoka to Wabash sub-watershed Current brine sites	1 2 3

6.1 Total Suspended Solids: Excessive erosion originates from several sources. Agriculture is the premiere sources due to the sheer amount of area under cultivation. Additionally, cumulative effects from excavation, mining, and livestock contribute to degrading water quality.

6.2 Illegal Dumping: Dumping is a problem throughout the project area. Sites are invariably in remote areas where unloading is quick and easy. The sites selected represent some of the more egregious sites and were prioritized by the Committee by the amount of trash and their effect on the environment.

6.3 Acid Mine Drainage: The entire South Fork area has a legacy of abandoned mine lands, which are the foremost sources of AMD. Durham Ditch is one of the largest remnants of these lands and has been identified as the next priority to be addressed by the Division of Reclamation – IDNR in its on-going reclamation efforts.

6.4 E. Coli: Patoka and Oakland City have been identified in the Preliminary Engineering Report as having severe problems in both quality and quantity. Housing clusters pose a threat as well, but are more distributed around the area. Additionally, isolated pastures exist where livestock is permitted direst access to streams, or there are insufficient filtering areas between the pasture and streams.

The center portion of the project area has the two urban areas and most of the housing clusters in East Fork & West Fork of Keg Creek, Lost Creek, Houchins Cutoff/Indian Creek, and Trippet Ditch. However, with the exception of Honey Creek near Spurgeon, an examination of data does not seem to show a strong linkage between specific housing clusters or animal pens, and an IDEM sampling site that exceeded target levels.

6.5 Oil Wells: Due to the vast number of oil wells in the flood-prone Patoka to Wabash sub-watershed, spills can more readily contaminate the water during a flooding event. Since this area repeatedly experiences flooding pumps are often times placed on scaffolds to elevate them above the normal flood level. Should a discharge occur during a flood event, the contaminates will discharge directly into the water.

7. SETTING GOALS AND SELECTING INDICATORS:

7.1 Sediment Goal: Reduction of Total Suspended Solids to State target of 30 mg/l by Sub-watersheds

Location	Load Type	Amount
IDEM site WPA70-0007 (Wheeler/Lick Creeks) Average	Current Load	34 mg/l (.0031 Tons/Acre per Year)
	Target Load	30 mg/l (.0027 Tons/Acre per Year)
	Reduction Needed	12% (.0004 Tons/Acre per Year X 45,112 Acres = 18 Total Tons)
IDEM site WPA80-0008 (East Fork Keg Creek) Average	Current Load	38.0 mg/l (.0354 Tons/Acre per Year)
	Target Load	30 mg/l (.0280 Tons/Acre per Year)
	Reduction Needed	21% (.0074 Tons/Acre per Year X 6,785 Acres = 50 Total Tons)

Additional Information for the Sedimentation Goal: The priority area is East Fork & West Fork of Keg Creek, Lost Creek, Houchins Cutoff/Indian Creek, and Trippet Ditch. As experience is gained as to what is working and what is not, adjustments can be made to maximize the efforts and funds of the watershed group.
$120,000.00 will be budgeted for a Watershed Coordinator over three years
Section 3 lists the TSSs at the numerous IDEM collection sites located around the project area

Objective/ Management Measure	Load Reduction	# needed to reach target load	Action Item	Cost	Schedule	Indicators	Responsible Party (RP) and Technical Help (TH)
Hire a Watershed Coordinator	N/A	N/A	Find a qualified individual	$120,000 – over 3 years	First months of project	Coordinator is hired	RP = SWCD TH = IDEM (Section 319 with match)

Develop Water Quality Monitoring Program	N/A	N/A	Develop a QAPP	Cost built into Section 319 and cost share	First months of project	QAPP is approved by IDEM	RP = Watershed Group (WG) TH = SWCD, IDEM
			Implement water sampling program	$1,125.00	5 Sites annually throughout the project	Water quality database is developed	RP = Watershed Group (WG) TH = SWCD, IDEM, IDNR
Develop Public Outreach/ Education Program	N/A	N/A	Publish informational articles in newsletters, discuss at SWCD meetings, release public media articles Display at fairs, etc	$600.00	Duration of Grant	Articles published, programs presented, displays Number of people receiving information	RP = WG TH = SWCD, IDNR, NRCS
			Create displays for events like county fair, Science Sensation, & 4th Grade Farm Fair	$375.00	Annually - Duration of Grant	Displays created, number of people addressed	RP = WG TH = SWCD, IDNR, NRCS
			Establish a website	$450.00	First months of project	Website established	RP = WG
Slope/vegetate Roadside Ditches	70-0007-18 Total Tons Year 80-0008 50 Total Tons Year	7,826 Linear feet 10' high 21,739 Linear feet 10' high	Encourage county/state highway crews to change profile of ditches over five year period to 1½ to 1 slope	$19,565 ($3,913 Yr X 5 Years) $2.50 per Linear foot for 10' bank $54,348 ($10,870 Yr X 5 Years)	1,565 linear feet each year for 5 years 4,348 linear feet each year for 5 years	Miles of ditches with improved profiles	RP = WG County/state highway crews

Implement Reduced Tillage Practices	70-0007-18 Total Tons Year 80-0008 50 Total Tons Year	2 Acres 17 Acres	Promote cost share Convert to reduced-till as needed or until target levels are met	App $25 Ac Fed Gov – up to 90% cost share up to 2,500 Ac	Second month-continuous effort to convince owners to change to reduced till	Number of acres converted to lower till methods	RP = WG TH = SWCD, IDNR, NRCS
Add Buffer Strips	70-0007-18 Total Tons Year 80-0008 50 Total Tons Year	3 Ac 19 Ac	1 Ac filter strip = up to 90% reduction over tilled ground Add strips as needed or until target levels are met	$2,000.00	Annually: March – October; continuous through grant period and beyond	Number of filter strips	RP = WG TH = SWCD, IDNR, NRCS
Add Grass Waterways	70-0007-18 Total Tons Year 80-0008 50 Total Tons Year	3 Ac 19 Ac	Add strips as needed or until target levels are met Waterway 40' wide app. 1 ton of soil per year per 100' long	$6,500.00 40' X 100'	Annually: March – October; continuous through grant period and beyond	Number of waterways	RP = WG TH = SWCD, IDNR, NRCS
Add Water And Sediment Control Basins (WASCOBS)	Load reduction dependent on slope, tillage, soils, etc	1 Each	Add strips as needed or until target levels are met	± $3,500.00	Annually: March – October; continuous through grant period and beyond	Number of WASCOBS	RP = WG TH = SWCD, IDNR, NRCS
Restore/ Maintain Wetlands			Support funding for the Patoka River National Wildlife Refuge	$300.00	Annually - indefinitely	Area of wetlands is increased, wetlands being destroyed reduced	RP = WG TH = SWCD, elected officials, local, state, federal
			Construct wetlands	$2,000/$3,000 Ac	Annually-indefinitely	Wetlands constructed	RP = WG TH = National Wildlife Refuge, NRCS, IDNR,

7.2 Illegal Dumping Goal: Eliminate 5 Dump Sites

Inventory	Amount
Current Number	10
Target Number	5
Reduction Needed	5

Additional Information for the Illegal Dumping Goal: As listed in the Sedimentation Goal, a Watershed Coordinator will be hired to coordinate the implementation of the myriad aspects of this WMP.

$120,000.00 will be budgeted for implementation measures for the three year project

Objective/ Management Measure	Load Reduction	# needed to reach target load	Action Item	Cost	Schedule	Indicators	Responsible Party (RP) and Technical Help (TH)
Develop Public Outreach/ Education Program	N/A	N/A	Establish a website	Included in 7.1 above	First months of project	Website established	RP = Watershed Group (WG) TH = SWCD, IDEM- Section 319
			Publish informational articles in newsletters, discuss at SWCD meetings, release public media articles	Included in 7.1 above	Duration of Grant	Articles published, programs presented Number of people receiving information	RP = WG TH = SWCD – Ed. Coord & Solid Waste Dist.
			Create displays for events like county fair, Science Sensation, & 4th Grade Farm Fair	Included in 7.1 above	Annually - Duration of Grant then indefinitely	Displays presented	RP = WWG TH = SWCD – Ed. Coord

Develop Enforcement Program	N/A	N/A	Organize roving watches and video surveillance	$1,200.00 Camera = $500.00	Duration of Grant then ongoing indefinitely	Reduction in number of dump sites Reduction in amount of trash collected by volunteers, etc.	RP = WG TH = Sherriff's office, volunteers, county commissioners – ordinances Solid Waste Dist.
Eliminate Animal Carcasses Thrown Into Streams	Not Estimable	Part of cumulative effects of reduction measures	Educate Citizens Regarding Water quality issues via radio, TV, newspapers, etc.	$700.00	Duration of Grant 1-3 years-Spring	Reduction in animal carcasses found in streams	RP = WG) TH = SWCD, IDEM, IDNR, County Health Officer, State Health Dept., volunteers
Conduct Monitoring Program	N/A	N/A	Maintain inventory of dump sites; update inventory periodically	Included in 7.1 above	Duration of Grant 1-3 years-Summer; modify schedule per change in inventory	Database developed	RP = WG TH = SWCD, volunteers, Solid waste Dist.

7.3 Acid Mine Drainage Goal: Eliminate Acid Mine drainage

Load Type	Amount
Current Load	Not Estimable
Target Load	Not Estimable
Reduction Needed	Not Estimable

Additional Information for the Acid Mine drainage Goal:
$120,000.00 will be budgeted for a watershed Coordinator over three years

Objective/ Management Measure	Load Reduction	# needed to reach target load	Action Item	Cost	Schedule	Indicators	Responsible Party (RP) and Technical Help (TH)
Develop Water Quality Monitoring Program	N/A	N/A	Develop a QAPP	Included in 7.1 above	First months of project	QAPP is approved by IDEM	RP = Watershed Group (WG) TH = SWCD, IDEM
			Implement water sampling program	Included in 7.1 above	5 Sites annually Duration of Grant	Water quality database is developed	RP = Watershed Group (WG) TH = SWCD, IDEM, IDNR, OSM

7.4 E. coli Goal: Reduce E. coli concentrations to the State of Indiana standard for E. coli of 235cfu/100ml single sample or 125 cfu/100ml geometric mean over 5days.

Load Type	**Amount**
Current Load	Varies by sub-watershed
Target Load	235cfu/100ml single sample or 125 cfu/100ml geometric mean over 5days
Reduction Needed	Varies by sub-watershed

$120,000.00 will be budgeted for a Watershed Coordinator over three years
Section 3 lists the TSSs at the numerous IDEM collection sites located around the project area

Objective/ Management Measure	**Load Reduction**	**# needed to reach target load**	**Action Item**	**Cost**	**Schedule**	**Indicators**	**Responsible Party (RP) and Technical Help (TH)**
Develop Water Quality Monitoring Program	N/A	N/A	Develop a QAPP	Included in 7.1 above	First months of project	QAPP is approved by IDEM	RP = Watershed Group (WG) TH = SWCD, IDEM
			Implement water sampling program Agreement/contract with certified lab.	Included in 7.1 above	Monthly Duration of Grant	Water quality database is developed	RP = Watershed Group (WG) TH = SWCD, IDEM, IDNR, OSM
Encourage Development of county-wide Waste Water Treatment Networks	N/A	N/A	Encourage elected officials to pursue funding to address waste water facilities	Included in 7.1 above	Duration of Grant 1-3 years	Number of waste water systems installed/ enlarged	RP = WG) TH = SWCD, IDEM, IDNR, County Health Officer, State Health Dept.

Educate Homeowners Regarding Properly Operating Septic Systems	N/A	N/A	Distribute articles to newspapers, radio and TV spots, displays at fairs, etc	Included in 7.1 above	Duration of Grant 1-3 years; then ongoing indefinitely	Number of septic systems permitted, improved, inspected Number of people receiving information	RP = WG) TH = SWCD, IDEM, IDNR, County Health Officer, State Health Dept.
Exclude Livestock From Streams	Not Estimable	Part of cumulative effects of reduction measures	Educate livestock owners regarding water quality issues	Included in 7.1 above	Duration of Grant; ongoing indefinitely	Number of livestock exclusions, alternative watering systems installed	RP= WG TH = IDEM, SWCD, NRCS
Eliminate Animal Carcasses Thrown Into Streams	Not Estimable	Part of cumulative effects of reduction measures	Educate Citizens Regarding Water quality issues via news media	$500.00	Indefinitely	Reduction in animal carcasses found in streams	RP = WG) TH = SWCD, IDEM, IDNR, County Health Officer, State Health Dept., volunteers
Reduce Runoff from Livestock Areas and Lawns	Not Estimable	Part of cumulative effects of reduction measures	Promote nutrient management programs Educate citizens regarding nutrient management plans, waste storage/ disposal, buffers	$200.00	Indefinitely	Number of people receiving information	RP = WG) TH = SWCD, IDEM, IDNR, County Health Officer, State Health Dept., volunteers

7.5 Oil Well and Brine Goal: Eliminate Oil and Brine Damage.

Load Type	Amount
Current Load	Not Estimable
Target Load	Not Estimable
Reduction Needed	Not Estimable

$120,000.00 will be budgeted for a Watershed Coordinator over three years

Objective/ Management Measure	Load Reduction	# needed to reach target load	Action Item	Cost	Schedule	Indicators	Responsible Party (RP) and Technical Help (TH)
Inventory Brine Sites	N/A	N/A	Solicit land owners to report brine damaged sites, compile database	Included in 7.1 above	First months, then ongoing indefinitely	Number of people receiving information Number of sites identified	RP = Watershed Group (WG) TH = SWCD, IDNR, SWIBC, volunteers
Identify Substandard Wells/Sites	N/A	N/A	Conduct survey, Compile database Periodically update inventory	$375.00	First months, then ongoing indefinitely	Number of wells/sites identified Number of oil spills reported	RP = Watershed Group (WG) TH = SWCD, IDNR, SWIBC, RC&D, Oil and Gas Assoc, volunteers

8. CHOOSING MEASURES TO APPLY

Refer to the Action Register in Section 7, which is an all-inclusive list of goals, action items, indicators, etc. that will be the starting point for the following measures:

Steering Committee members worked many long and hard hours to analyze the information gathered during this project and to develop measures that are realistic in time, effort, and expenses. Committee members are in strong agreement that the foremost measure to apply is to have a **Watershed Coordinator** and an active steering committee. Depending on the scope of this project, an assistant may be needed as well. The Watershed Coordinator will be the foremost person in the project area to pull all of the disparate parts of this plan under one cohesive umbrella. It must be remembered that even though this project is administered by the Gibson County Commissioners, a significant part of the project area is in Pike County; with a tiny fraction in Warrick County.

Committee members feel that the Watershed Coordinator should be the foremost agent in directing activities ***towards a healthier environment with measurable successes by improving the water quality of the Lower Patoka River watershed through technical, financial, and educational resources and events.***

By having a full-time and well-trained Watershed Coordinator(s), the project area will have someone who can coordinate with private corporations, citizens, county governments, and state and federal agencies. Public awareness, finances, and coordination of efforts will maximize the benefits to the area. Many of the original concerns, as well as the final set of goals, are intertwined. Focusing on the "Big Picture" rather than each concern as a separate and distinct problem will yield maximum results.

Establishing a comprehensive water monitoring program must be **one of the foremost** priorities of the Committee. By "isolating" each sub-watershed with strategically placed monitoring points, the Committee will be better able to develop a long-term comprehensive picture of where threats/impairments are greatest.

Oakland City University could be a premier organization to enlist in developing a monitoring program. The University biology department worked with the Patoka South Fork Watershed Steering Committee during their initial period to help develop baseline data. Additionally, Vincennes University plans on building a regional campus near Ft. Branch and Indiana Vocational Technical College is opening a campus in Princeton. Both of the institutions should be contacted to see if they will have programs that can compliment this project.
Refer to the Action Register for a Matrix of Problems, Goals, Measures, and Indicators.

8.1 Suspended Solids and Nutrients

Table 8-1

Measure	Positive Impacts	Cost	Cost Share/ Return	Technical Help/ Program
Cover Crop	Reduce velocity Improve water infiltration Capture excess nutrients Reduce erosion to tolerable (T) level	Varies (App $100.00/Ac)	$22.50/Ac + Harvest straw (Total App. $147.00/Ac)	Conservation Tillage Program CRP, EQIP, CREP ISDA NRCS SWCD – Section 319
Tillage	Reduce velocity Improve water infiltration Capture excess nutrients Capture excess pesticides Reduce erosion to tolerable (T) level Reduce eutrophication	Varies (Minimal)	Max $14,000.00 each landowner	Conservation Tillage Program CRP, EQIP, CREP ISDA NRCS IDNR SWCD – Section 319
Filter Strip	Reduce velocity Improve water infiltration Capture excess nutrients Capture excess pesticides Stream bank stability Sediment settling Reduce eutrophication	Varies (App $120.00/Ac)	90% govt. cost share	Conservation Tillage Program CRP, EQIP, CREP, WRP ISDA NRCS SWCD – Section 319
Water And Sediment Control Basin (WASCoB)	Reduce velocity Trap sediment Reduce flooding Capture excess nutrients Capture excess pesticides Improves “farmability”	Varies (App $2,500)	90% govt. cost share	Conservation Tillage Program CRP, EQIP, CREP ISDA NRCS SWCD – Section 319

Waterways	Reduce velocity Trap sediment Reduce flooding Capture excess nutrients Capture excess pesticides Reduce eutrophication	Varies (App $6,500 40' X 100')	90% govt. cost share	Conservation Tillage Program CRP, EQIP, CREP ISDA NRCS SWCD – Section 319
Sediment Control Fences	Eliminate runoff from construction sites	Not estimable	Not estimable	IDEM – Rule 5 SWCD – Section 319
Ditch Maintenance	Vegetation reduces erosion, capture excess nutrients and excess pesticides Sloped banks reduce erosion	Built into county/state maintenance budgets	Not estimable	INDOT IDNR IDEM – Rule 5 SWCD – Section 319
Animal Exclusion from streams	Protect stream banks Eliminate erosion Reduce excess nutrients Reduce eutrophication	Not estimable	Not estimable	CRP, WRP ISDA NRCS SWCD – Section 319
Low Impact Forestry	Reduce erosion Reduce velocity Trap sediment Reduce flooding Capture excess nutrients Capture excess pesticides Reduce eutrophication	Not estimable	Not estimable	SWCD – Section 319 IDNR – Forestry IDEM – Rule 5

8.2 Illegal Dumping

Pike County Residents have two opportunities each year to dispose of large items at no cost and once each year to dispose of "special waste" at no cost. The local landfill has a spring event where large household items can be dropped off for free. In the fall they also have an event when citizens can also dispose of "special waste" such as tires, air conditioners, spray paint cans, etc.

Gibson County as well has programs where citizens can drop off large household items as well as special waste. Communities throughout Gibson County all have programs that help citizens with large items, special waste, and other items at no, or little, cost. Gibson County residents do not directly pay tipping fees. Because petrochemicals, animal carcasses, and carcinogens being dumped into the waterways can have devastating consequences on the environment, the Committee must aggressively coordinate activities to address the problem of dumping in the project area by developing a program to organize, institute, and enforce efforts to reduce, or eliminate, dumping.

- County solid waste boards to provide large item pick-up, drop-off, or disposal assistance
- Private citizens and citizens groups to help educate, patrol, and report offenders
- IDNR and U.S. Fish and Wildlife employees to patrol, observe, and report offenders
- Elected officials to implement this plan by establishing a Watershed Coordinator and being the focal point for activities
- A camera, or cameras, should be obtained by the sheriffs departments, IDNR, or Fish and Wildlife Service to assist in identifying offenders.
- No dumping signs and minimum fine signs.

Costs are distributed throughout the various programs and departments. Watershed Group funding for water quality monitoring and equipment are built into the Section 319 cost-share budget.

8.3 Acid Mine Drainage

The Committee must work with the IDNR – Division of Reclamation to ensure old mine lands are still being addressed in reclamation activities. Likewise, recently mined lands are susceptible to generating AMD if reclamation sites are not properly maintained.

Costs for reclamation are built into the operations of the mining operations while the Division of Reclamation – Indiana Department of Natural Resources is budgeted through the Surface Mining Control and Reclamation Act.

Watershed Group funding for water quality monitoring is built into the Section 319 cost-share budget.

8.4 E. coli

The Committee should coordinate with the county health officials, the State Board of Health, IDEM, county building inspectors, and lending institutions regarding:

Table 8-2

Measure	Positive Impact	Cost	Resource
New Septic Systems	Reduce safety hazards Reduce excess nutrients Reduce eutrophication	Not estimable	SWCD – Section 319 IDEM County Health Dept State Dept of Health Lending institutions
Maintain Septic Systems	Reduce safety hazards Reduce excess nutrients Reduce eutrophication	Not estimable	SWCD – Section 319 IDEM County Health Dept State Dept of Health
Monitor CAFOs	Reduce safety hazards Reduce excess nutrients Reduce eutrophication	Cost built into Section 319 and cost share	IDEM IDNR SWCD – Section 319
Waste Water Treatment Plants	Reduce safety hazards Reduce excess nutrients Reduce eutrophication	Not estimable	IDEM SWCD – Section 319 State – Rural and Community Affairs
Livestock Access to Streams	Reduce safety hazard Reduce excess nutrients Reduce eutrophication	Not estimable	IDEM IDNR SWCD – Section 319
Animal Carcasses In Streams	Reduce safety hazards	Not estimable	IDEM IDNR SWCD – Section 319
Runoff from Livestock Pens and Yards	Reduce safety hazards Reduce excess nutrients Reduce eutrophication	Not estimable	IDEM IDNR SWCD – Section 319

8.5 Oil and Natural Gas

Rather than be reactive, the Committee must have someone routinely travel around the project area and be proactive. The more people that are looking for problems, the less opportunity that a problem will have to go un-noticed for any extended period of time.

Additionally, the Committee should work with the Southwest Indiana Brine Coalition to address those brine problems that already exist and identify additional sites.

Costs are built into the operations of the petroleum operators while the Division of Oil and Gas – Indiana Department of Natural Resources is budgeted through the Oil and Gas Fund that is funded by Petroleum Severance Taxes.

Watershed Group funding for water quality monitoring is built into the Section 319 cost-share budget.

9. CALCULATING LOAD REDUCTIONS

Measuring load reductions is currently, and will be for some time, difficult because the project area is at the bottom of the watershed.

9.1 Total Suspended Solids (TSS) and Nutrients: The Committee can easily measure turbidity as NTUs. While NTUs do not give a "load" per se, they will provide a base from which to measure changes. IDEM can continue to do more extensive testing, which will determine loads by weight and volume.

The goal of a 30 mg/l of TSSs will initially have to be measured against current data, but future data will need to be collected from the proposed sites in each sub-watershed. In this manner, the effect of up-stream erosion can be excluded in analysis. An additional sampling site in the main channel up-stream of the confluence of the South Fork will contribute to assessing what is, and what is not, being generated in the project area.

Base line data developed in Table 3-4 shows that there are currently four sites in the project area where concentrations could be calculated based on sampling data, location of the sampling site, and extrapolated against local flow data. The data will have to be extrapolated for critical areas.

Table 3-4 shows that IDEM Site (07-0007), the farthest point downstream in the entire South Fork sub-watershed, had one of three samples exceed the target for TSS, while the average was below target levels. Likewise, all nutrients were within limits, no doubt due to dilution.

Site WPA80-0008 also exceeded targets levels one of three times, while the average was within parameters.

IDEM Site WPA80-0013 did not exceed target levels.

IDEM Site WPA80-0020 was consistently within target levels.

9.2 Illegal Dumping:

While there is no "load" per se, the goal of reducing the number of illegal dumps is very quantifiable. The Committee should have someone periodically tour the project area and assess the extent of dumping, while coordinating with volunteers, the sheriffs' departments, and solid waste departments.

The original reduction of 50% of the sites must be followed up by further elimination of sites as the project progresses. As new sites are identified, they should be added to the matrix for attention.

9.3 Acid Mine Drainage: No comprehensive base line data exists from which to develop a concentration reduction plan. However, by instituting an aggressive monitoring program, the Committee will be able to develop base line data and reduction plans for those tributaries that may be identified as suffering from low pH. Any new or reoccurring sources of AMD can be quickly identified and dealt with.

9.4 E. coli: Data collected to date does not indicate actual sources other than the suspected sources of the Towns of Oakland City, Patoka, and Spurgeon. Sites in the South Fork are attenuated by dilution by the time the South Fork nears the main stem at site WPA070-0012. Never the less, the following matrix lists the data for those sites that are not influenced by the main stem of the river.

Table **9-1**
E. coli Matrix For Those Sites Separated From the Main Stem

Site	Location	Average Per 100 CFU-mg/l	Percentage Reduction Required
WPA070-0012	SF – Wheeler/Lick Creeks (Cumulative SF)	38.1	Within Limits
WPA070-0015	SF - Headwaters	**263.0**	11
WPA070-0017	SF - Honey Creek	**6,389.0**	74
WAP070-0018	SF - Spurgeon	**505.0**	54
WAP070-0019	SF – Houchins Ditch	**6,170.0**	97
WPA080-0008	East Fork Keg Creek	**754.6**	69
WPA080-0035	Robinson/Big Creeks	**796.7**	70
WPA080-0041	Robinson/Big Creeks	**323.1**	37
WPA080-0048	East Fork Keg Creek	**618.18**	62
WPA080-0051	Lost Creek	168.6	Within Limits

9.5 Oil and Gas: There are no load reduction measures for this goal as there is no load and the extent of the problem is not fully known. However the goal is of great magnitude in achieving the group's vision.

10. IMPLEMENTING THE MEASURES

Successfully implementing this plan will require enormous effort on the part of the Watershed Group, and all parties concerned. The Steering Committee plans on submitting an application to IDEM for a Section 319 cost-share grant during the next grant cycle.

The 319 grant will enable for the hiring of a full-time Watershed Coordinator, who will be directly responsible for implementing the various aspects of the plan.

The threats to the watershed such as erosion, nutrients, oil and gas wells, trash, and acid mine drainage can be addressed in a coordinated manner rather than in competitive, disjointed, and non-productive activities. Working with the Interstate Oil & Gas Compact Commission, the Southwest Indiana Brine Coalition, and local, state, and federal agencies will reap huge rewards as efforts are combined towards a common goal.

A cost share program will be developed to assist those landowners that wish to undertake the programs discussed in this plan, while offsetting the costs of implementation.

Outreach events will allow landowners, and other citizens, to benefit from one-on-one interaction and receive immediate feed-back from personal contact.

Developing an education plan will allow for disseminating information to the citizens in the area regarding water quality issues. Public presentations, media blitzes, and displays at various activities will all contribute to keeping citizens informed.

Developing a water quality monitoring program will provide for comprehensive far-reaching decision making regarding programs, activities, and time lines.

The Action Register in Section 7 shows the various measures, timelines, and responsible parties needed to achieve the goals of the Watershed Group.

The Group has decided that a full-spectrum approach will be undertaken. All of the Best Management Practices (BMPs) discussed here-to-fore will begin to be applied once a Watershed Coordinator is in place.

Those sites sampled by IDEM will provide base-line data for those sub-basins. However the data will have to be extrapolated against those critical areas where there are no sampling sites.

Best Management Practices (BMPs) such as reduced tillage will begin to reveal their impacts after the first years of the project. As the program continues to gain momentum throughout the subsequent years, the true impact of the BMPs will definitely begin to show.

11. MONITORING INDICATORS

A water quality monitoring plan will be devised and implemented, which will determine the success of the activities undertaken. The Watershed Coordinator will maintain the database, conduct analyses, and make periodic reports to the Steering Committee.

Trash dumps will be monitored on an ongoing basis to gage the effect of the education, enforcement, and outreach programs, while oil wells and brine sites will addressed on a continuing basis.

From time-to-time, the various threat inventories will need to be up-dated and reviewed. Then, adjustments may need to be made to the schedule and the `approach to achieving the goals of the Watershed Group.

12. EVALUATING AND ADAPTING THE PLAN

The Gibson County SWCD is ultimately responsible for ensuring the success of this Watershed Management Plan.

The Committee will periodically evaluate the reports from the Watershed Coordinator and volunteers and make changes as necessary to address those areas in the watershed where additional efforts may be required.

References:

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