VFC Index - Watershed (Plan)

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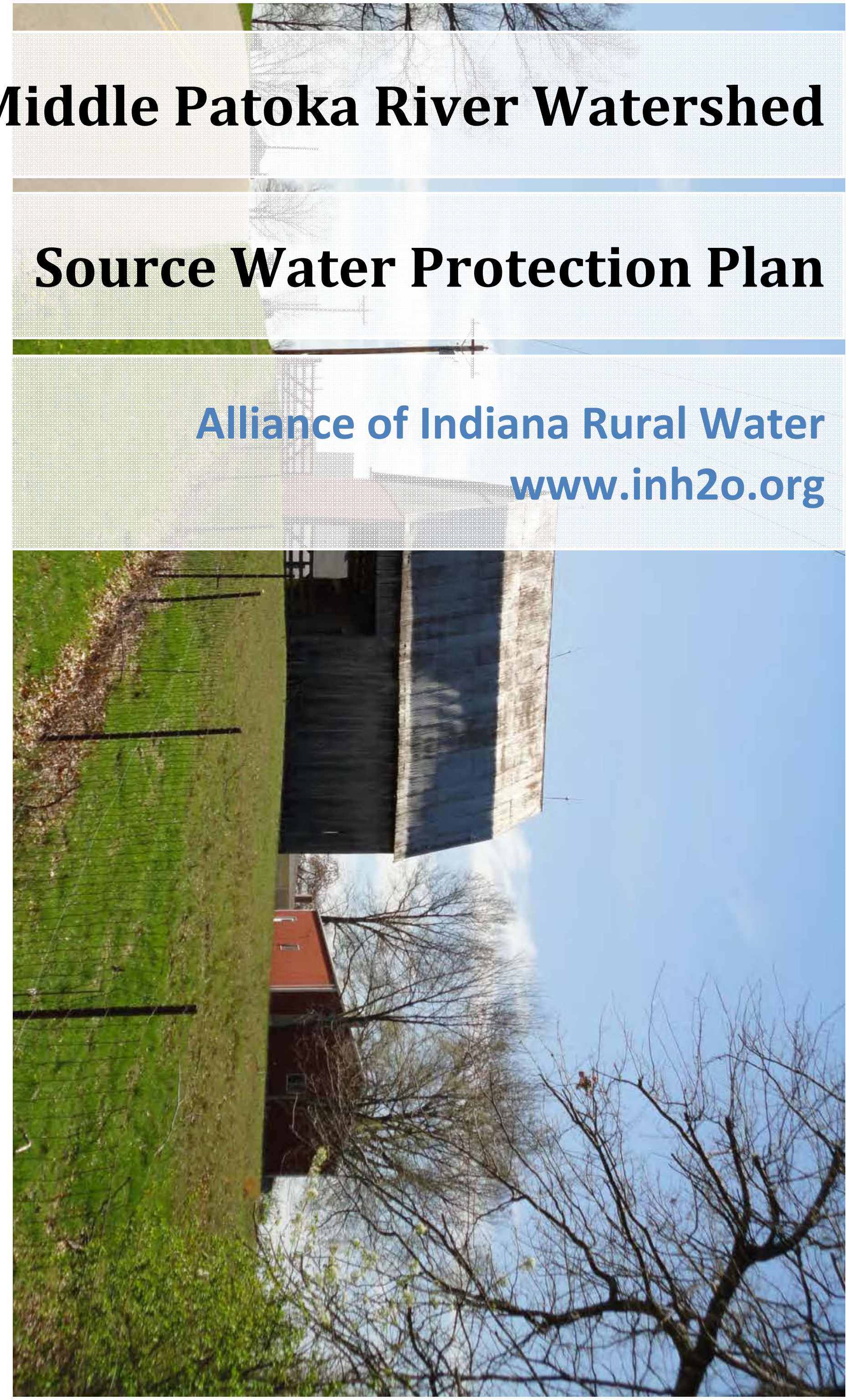
Middle Patoka River Watershed

Source Water Protection Plan

Alliance of Indiana Rural Water

www.inh2o.org



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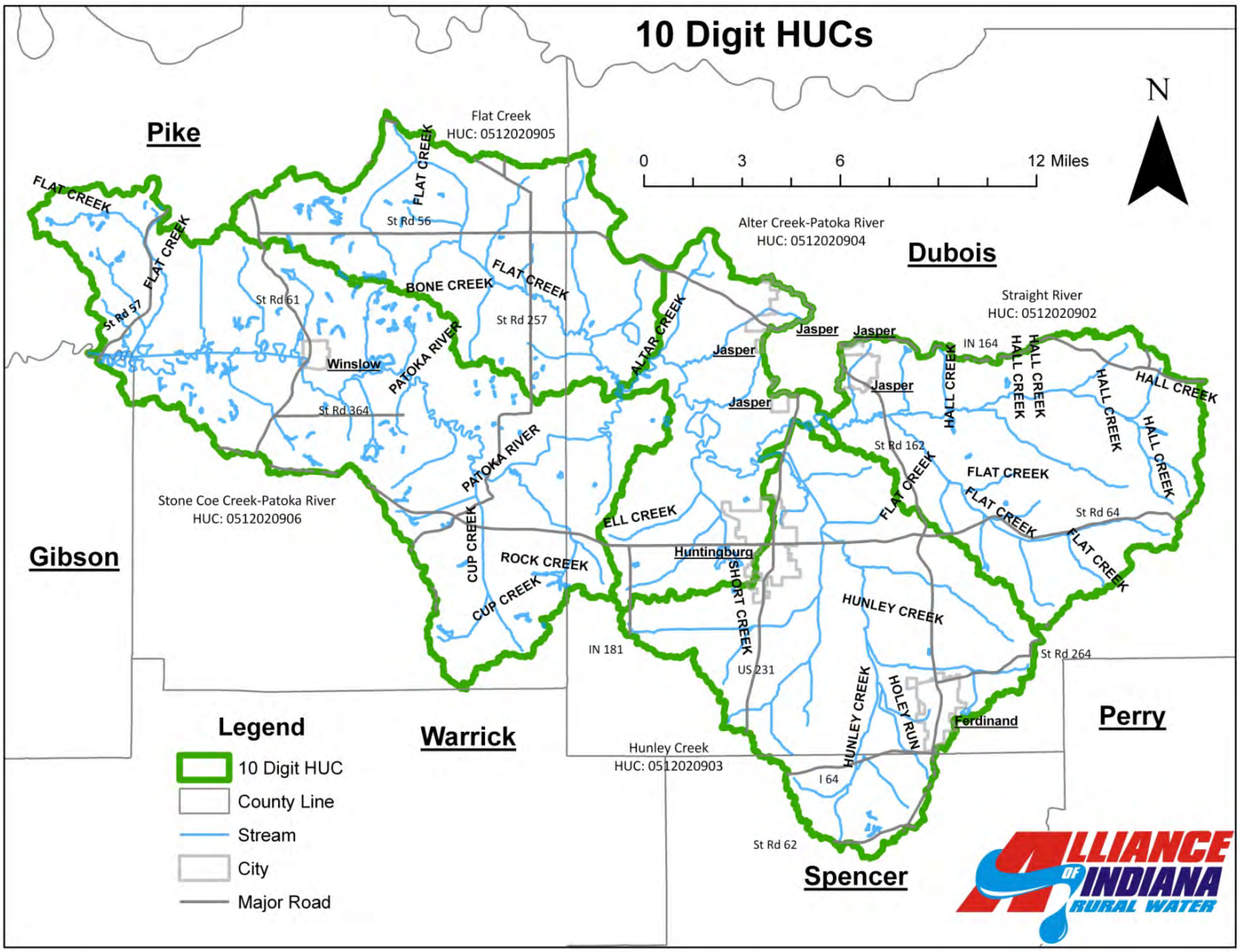
Introduction

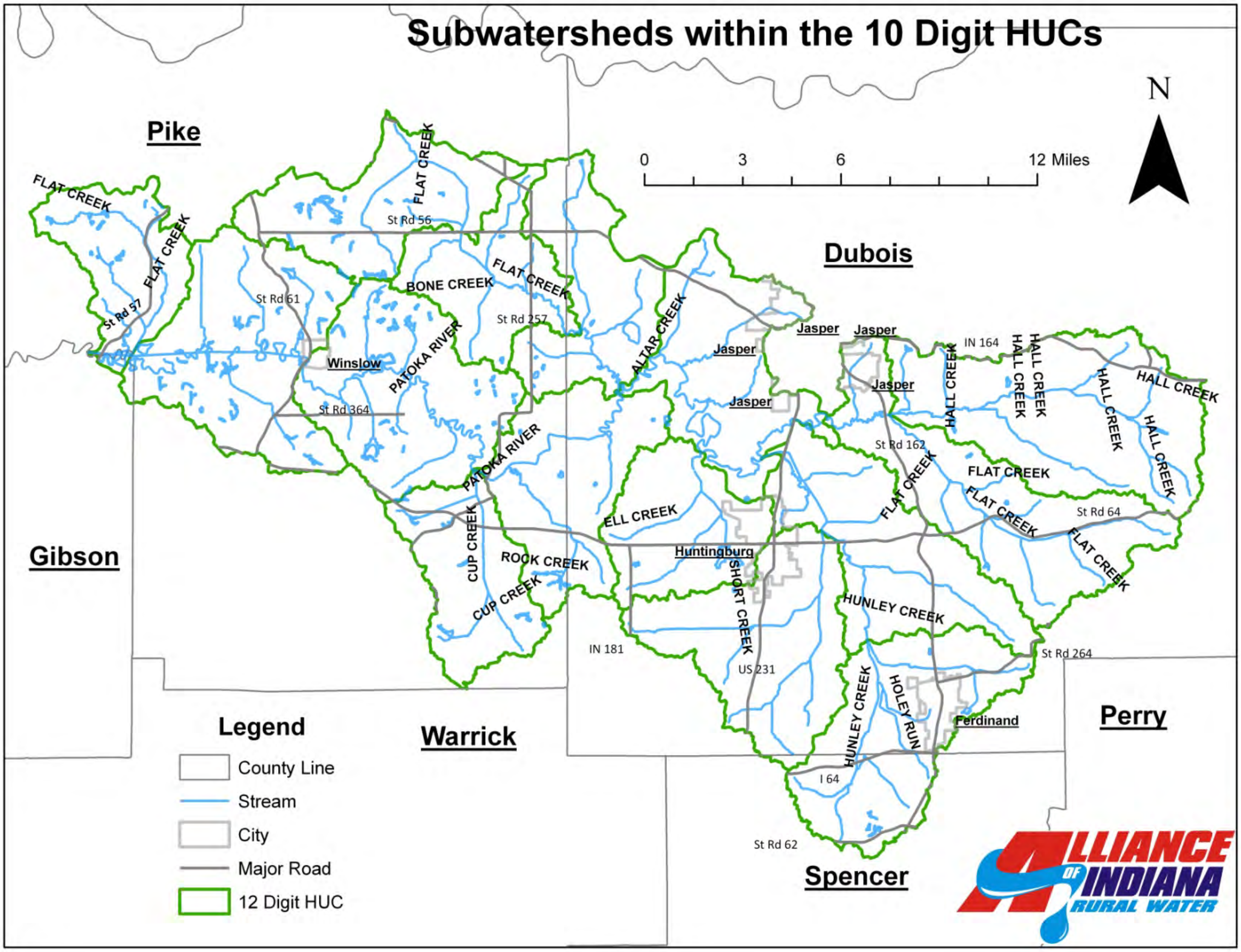
A watershed is all the land that drains to a particular body of water. For identification purposes, every watershed has been assigned a Hydrologic Unit Code (HUC) by the United States Geological Survey. The fewer digits in a HUC, the larger the watershed. The Middle Patoka River Watershed (MPRW) covers 236,706 acres in Dubois, Gibson, Pike, and Spencer Counties in southwest Indiana. Watersheds can be quite large—the Mississippi River Watershed for example—or quite small. The MPRW is made up of five watersheds that each has a 10 digit HUC[1]. Within the 10 digit HUCs are even smaller subwatersheds and each of these has a 12 digit HUC.

Map 1: 10 Digit HUCs



[1] Alter Creek-Patoka River HUC 0512020904 extends to Orange County (not shown on Map 1). The part not shown was included in a watershed plan done by the Dubois County Soil and Water Conservation District. More information about that plan is in Section 2.6.

Map 2: Subwatersheds within the 10 Digit HUCs



The main purpose of this plan is to outline goals and objectives designed to reduce runoff pollution from reaching the Patoka River and its tributaries. Runoff is generated when storm water flows off farm fields, feedlots, parking lots, roofs, and roads. Oils, bacteria, fertilizers, sediment, and other pollutants sitting on these surfaces get washed off by storm water and enter the streams. These pollutants are deposited by normal everyday activities like lawn and garden maintenance, livestock production, agricultural practices, and construction. The storm water carrying these pollutants can alter the temperature of the stream, damage aquatic habitat, and add sediment to the stream flow by scouring the channel and banks. Sometimes storm water is even considered a pollutant that harms a watershed's health.

This Source Water Protection Plan (SWPP) was written to meet the requirements of a watershed management plan (WMP) as defined by the Indiana Department of Environmental Management's (IDEM) Section 319 Grant Program. Meeting IDEM standards allows stakeholders to apply for State grant money to improve the watershed. The differences between a source water plan and a watershed plan are minimal; the former includes information about drinking water sources while the latter may not. The creation of this plan is not government mandated and participation is voluntary. The Alliance of Indiana Rural Water wrote this plan anticipating the community will embrace it and choose to implement its goals.

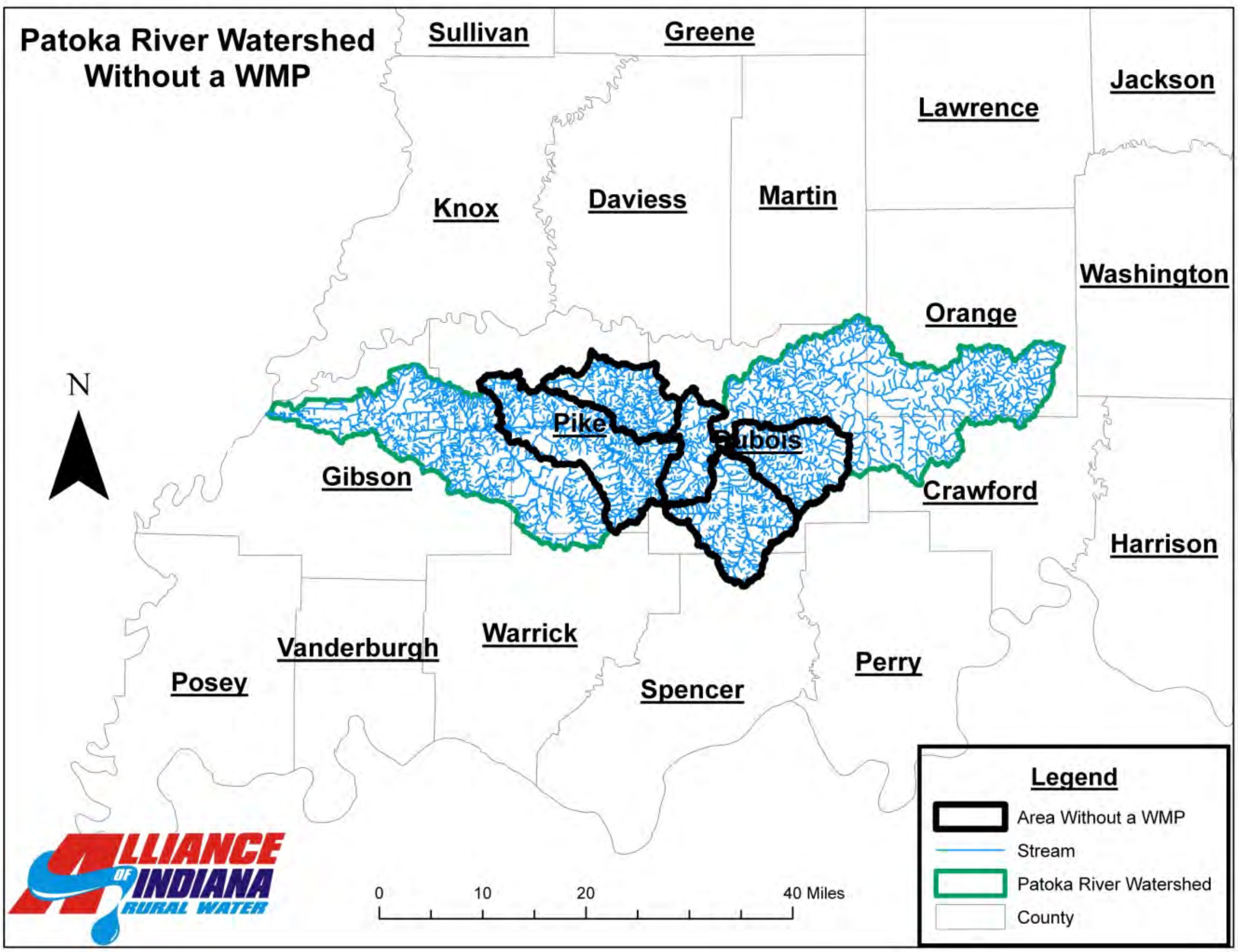
Chapter 1: Beginning the Project

1.1 Reasons for Initiating the Project

The Alliance of Indiana Rural Water is a nonprofit that assists Indiana's rural wastewater and drinking water utilities in providing excellent service to their customers and in complying with all state and federal rules. The Alliance provides training, on-site assistance, and wellhead/source water planning assistance. The Town of Winslow contacted the Alliance with the initial idea for a Patoka River Watershed project. In Indiana, utilities using groundwater as a drinking water source are required to have a plan to protect the area around their wells from contamination. Winslow, whose source of drinking water is the Patoka River, has no such requirement but still had an interest in protecting their source of drinking water. The Patoka River also serves as Jasper's drinking water source. The communities of Ferdinand and Huntingburg receive water from Patoka Lake. Huntingburg also has a small reservoir that can provide drinking water. Together these four communities provide drinking water for nearly 22,000 people.

The Alliance suggested a SWPP to Winslow. A SWPP uses a thorough review of water quality and landuse data to define problems and then outlines goals and objectives to address those problems and improve and protect water quality. SWPPs are voluntary, as is landowner support and participation of the goals and objectives.

Map 3: Patoka River Watershed Without a Watershed Plan

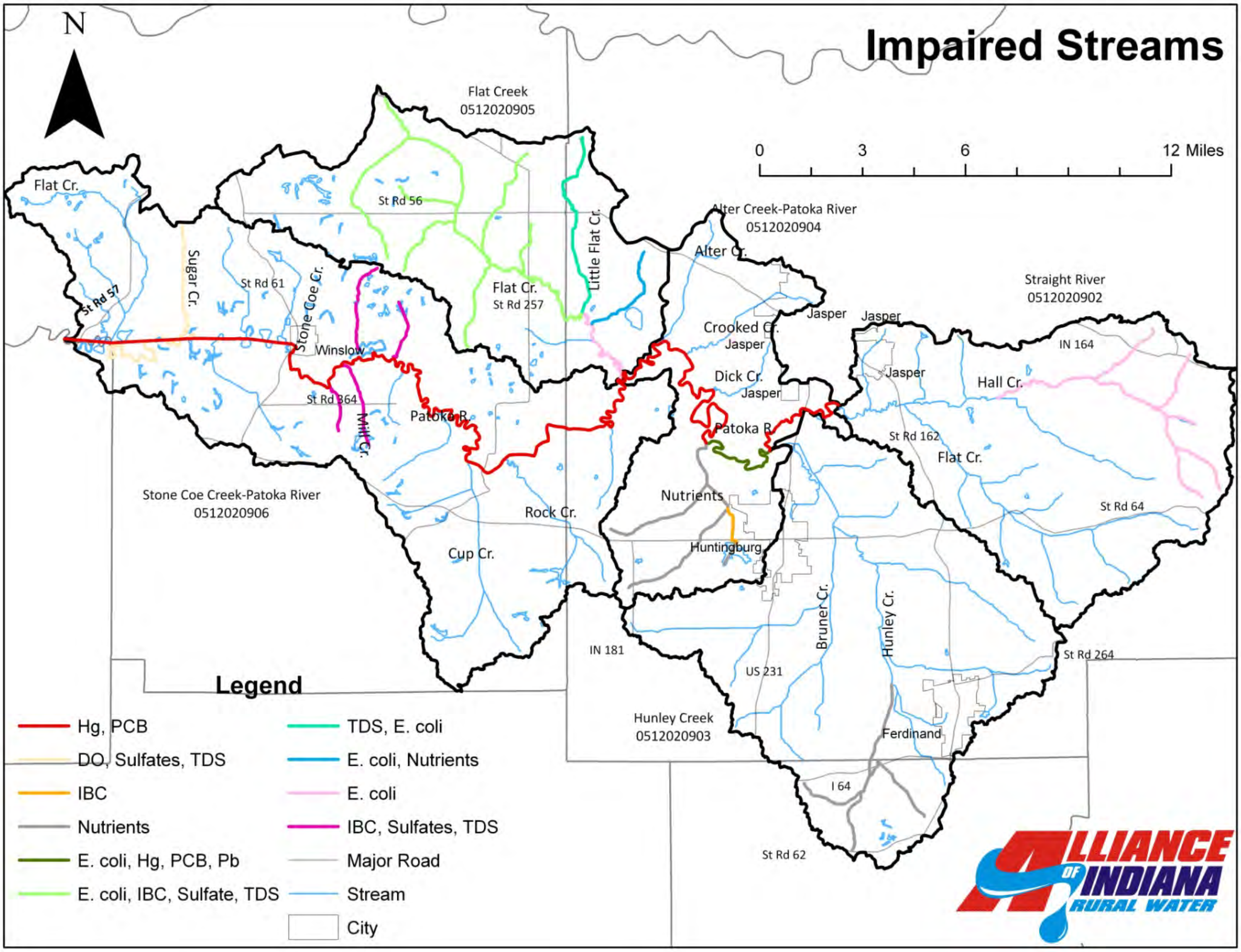


After meeting with Winslow, the Alliance and IDEM met with local governments and natural resource agencies to see if there was any other local interest in doing a SWPP. Interest was high, in fact Dubois and Pike Soil and Water Conservation Districts

(SWCD) had been thinking about applying for a grant for a similar project. Two thirds of the Patoka River Watershed is already covered by plans, so all parties agreed that the remaining portion would make a good project area (Map 3).

This area—dubbed The Middle Patoka River Watershed— has several streams that do not meet state water quality standards (Map 4), which was another reason to complete the SWPP. The Alliance of Indiana Rural Water would lead the project but depend on local partners to provide information about the area, serve on the steering committee, and assist with education and outreach.

Map 4: Impaired Streams (Source: IDEM 2008 303(d) List)



Impairments are determined by water quality testing done by IDEM and are explained in Figure 1. In determining impairments, IDEM assigns an Assessment Unit ID to sampled stream segments. Appendix A lists the impaired Assessment Units in the MPRW. Impairments were taken from IDEM's 2008 303(d) list.

Figure 1: Explanation of Impairments

Impairment	Explanation
Nutrients	In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events. • Total Phosphorus: One/more measurements >0.3 mg/l • Nitrogen (measured as NO3 + NO2) -- One/more measurements >10.0 mg/l • Dissolved Oxygen (DO) -- Measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/l or values >12.0 mg/l • pH measurements -- Measurements above the water quality standard of 9.0 or measurements that are consistently at/close to the standard, in the range of 8.7- 9.0 • Algal Conditions -- Algae are described as "excessive" based on field observations by trained staff.[2]
Dissolved Oxygen (DO)	The dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. Fish need at least three to five mg/L of DO. Indiana Water Quality Standard: Min: 4.0 mg/L Max: 12.0 mg/L
Sulfates	Sulfate criterion depends on ranges of hardness (in mg/l as CaCO3) or chloride (in mg/l) or both—for more details see 327 IAC 2-1-6 (5). Sulfate comes from the breakdown of sulfur minerals in rocks and soils. Sources include mines, coal combustion, and wastewater treatment plants.
Total Dissolved Solids (TDS)	Total Dissolved Solids (often abbreviated TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in: molecular, ionized or micro-granular (colloidal sol) suspended form. Generally the operational definition is that the solids must be small enough to survive filtration through a sieve the size of two micrometer. TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. Primary sources for TDS in receiving waters are agricultural and residential runoff, leaching of soil contamination and discharge from industrial or sewage treatment plants. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient runoff, general storm water runoff and runoff from snowy climates where road de-icing salts are applied.
Impaired Biotic Communities (IBC)	Aquatic invertebrates live in the bottom parts of our waters. They make good indicators of watershed health because they live in the water for all or most of their lives, stay in areas suitable for their survival and differ in their tolerance to amount and types of pollution.[3] An IBC listing implies that the population of invertebrates is not as diverse as it could be.
Mercury (Hg)	> 0.3 mg/kg in fish tissue Mercury is a metal linked to human development disorders.
Polychlorinated biphenyls (PCB)	> 0.02 mg/kg in fish tissue PCBs are man-made compounds commonly used in electrical components. They are tied to carcinogenic and non-carcinogenic impacts.
Lead (Pb)	Indiana Water Quality Standard: 50 µg/L Lead is a metal linked to human development disorders.
E. coli	E. coli is one member of a group of bacteria that comprise the fecal coliform bacteria and is used as an indicator organism to identify the potential for the presence of pathogenic organisms in a water sample. Pathogenic organisms can present a threat to human health by causing a variety of serious diseases, including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses.[4] Indiana Water Quality Standard: Shall not exceed 125 colony forming units (CFU) per 100 ml as a geometric mean based on not less than 5 samples equally spaced over a 30 day period nor exceed 235 per 100 ml in any 1 sample in a 30 day period

[2] From IDEM's CALM, supplied by IDEM's Selena Medrano via email 5.9.11
[3] Salt Creek Watershed Management Plan: 2008 Save the Dunes Conservation Fund.
http://www.savedunes.org/water_program/water_program/Salt%20Creek/Salt%20Creek%20.html
[4] ibid

1.2 The Steering Committee

Representatives from municipalities, agencies, and the public who were interested in helping with this project and determining the problems, goals, and objectives, etc. outlined in the SWPP volunteered their time to serve on the Steering Committee (Figure 2).

Figure 2: Middle Patoka River Watershed Steering Committee

Name	Affiliation
Judi Brown	Dubois County SWCD
Erica Burkemper	Dubois County SWCD
Jeanne Melchior	Watershed Resident
Heath Hamilton	Patoka River National Wildlife Refuge
Gordon Barnett	Watershed Resident
Shawn Werner	Dubois County Health Department
Todd Williams	Winslow Utility Superintendant
Toby Days	Alliance of Indiana Rural Water
Sky Schelle	Alliance of Indiana Rural Water and Project Coordinator

1.3 Stakeholder Concerns

In order to introduce the project to the public and gather public concerns about the watershed, project partners held four public meetings in February and March 2011. The meetings' purpose was to introduce the project and its goals and to gather concerns the public has about the watershed. The concerns, listed in the order they were gathered, are in Figure 2.

Figure 3: Concerns from February/March 2011, Public Meetings

Where are log jams and what can be done to reduce their occurrence
Acid Mine Drainage is a problem in lots of streams
Acid Mine Drainage solutions don't work. The limestone gets oxidized too quickly.
Enforcement of sediment control at construction sites is difficult due to budget constraints
Livestock have free access to the streams
Land applied manure is running off into the creeks
Illegal trash dumping south of 56 is a problem
Hobby farms dump dead livestock in streams
Poorly operated septic systems are a problem
Is it safe to come in contact with the water?
Private well owners need resources for water testing
Small animal farms don't fall under any regulation and are a pollution source
Impact of the Farbest Turkey Processing Plant on water quality
Cattle owners need education on the reasons to keep animals out of the streams
Channelization leads to log jams
Army Corps' Patoka River model doesn't take into account flow from agricultural tiles
Need to increase no-till
Where are stream buffer strips needed?
Need to increase cover crop plantings
Landowners channelize streams on their property and cut trees off banks
Water quality education needs to focus on reaching children
What influence does storm water have
Influence of Combined Sewer Overflows
Runoff from residential land is a problem
Influence of de-icing agents on water quality

Can alternative uses of poultry waste be found
Is there an influence of urban and rural pesticide and fertilizer use on water quality?
Air pollution is a problem in the watershed; particularly mercury deposits from the air
Are there pharmaceuticals in the public drinking water supply?
Adults need watershed education
Is farm waste (nutrients and bacteria) moving across the land and onto Jeffers Nature Preserve?
Landuse development needs to be sustainable
The Corps installed 13 flood control features (dams with detention behind them). What is the current status of each one?
Public needs to understand that a utility's cost to supply safe drinking water is increasing and the cost of water will increase as well
Bow fishermen hunt invasive species year round. DNR tells them to dump catch back in river rather than putting them on bank
Tires, engine blocks, and other large items are sometimes dumped in streams
Air Gas dumps a lime solution into South Fork of Patoka River. It's not being agitated and just coats the rocks.
In Winslow, log jam along RR bridge is cut loose by RR company and allowed to flow downstream

Chapter 2: Watershed Inventory Part 1

2. 1 Introduction to Watershed Inventory Part 1

The purpose of the Watershed Inventory is to gather information about the concerns. For example, the Alliance used aerial photographs to search for areas of poorly buffered stream banks. Still other data was collected by a windshield survey of the watershed, online research, and through phone calls and meetings. Existing water quality data and modeled data was also analyzed (see Chapter 3). Once all the data was collected, the steering committee studied it to determine which of the concerns they would focus on (see Chapter 5 for more information on those decisions).

Part 1 of the Watershed Inventory presents data on the scale of the entire watershed. Part 2 (Chapter 3) of the Watershed Inventory takes a more focused look at the 10 digit HUCs and data that is specific to them.

2.2 Geology/Topography

Except for a small part of the northwest edge, the project area was not covered by glaciers. The absence of the grinding and eroding ice sheet preserved a rolling topography (Plate 1) but also left the area without the thick soils deposited elsewhere in the state by receding glaciers. The maximum topsoil depth is 100 or 50 feet, depending on if you are in or outside the floodplain of the Patoka River. Across the watershed, sedimentary layers of sandstone, shale, and limestone lie beneath the topsoil. The limestone does not have any karst characteristics. The sandstone acts as an aquifer, although there are no community drinking water wells tapping into it. Each town in the watershed uses the Patoka Lake (which is outside the watershed) or the Patoka River as a drinking water source. The watershed experiences great elevation differences relative to one's proximity to the Patoka River.

Plate 1: Rolling Hills

The eastside of the MPRW, in Dubois County, has steep slopes and broad terraces. Moving south and southwest, the watershed is dominated by nearly level to very steep uplands. Within Dubois

County, the elevation in the watershed falls from 810 to 430 feet above sea level. Eastern Pike County makes up the middle part of the project area and has steep slopes, some greater than 20%. As the Patoka River continues west, the topography levels off, although there are still some hilly areas. The elevation at the western edge of the watershed is 222 feet above sea level.

Within the sedimentary layers, especially in the southwestern part of the watershed, lies coal. The area has a long coal mining history and currently supports both surface and underground mining. Mining can have many negative impacts on water quality. When water, whether running off mining waste on the surface or leaching underground, chemically reacts with coal, it turns acidic. Known as Acid Mine Drainage (AMD) this polluted water can harm aquatic life and stream chemistry. Mining contributes other runoff problems as well. Water leaving mines may carry heavy metals and sediment disturbed by the mining process. Sediment runoff is especially a concern at surface mines, which are exposed to precipitation and lack the vegetative cover and topsoil to infiltrate, filter, or slow down runoff. Mining is also a contributing factor to sulfate pollution. Map 4 shows sulfate impaired streams across historically or currently mined land within the MPRW.

Since 1977's Surface Mining Control and Reclamation Act, companies are required to reclaim the land they mine and return it to a state that protects water quality and human safety. However, the long history of mining prior to 1977 left potentially dangerous legacies like highwalls (an unstable cut made as part of surface mining), old equipment and buildings, subsidence (due to underground mining), exposed mining refuse (sometimes known as gob piles) and abandoned mine entrances. The Indiana Department of Natural Resources' (DNR) Abandoned Mine Land (AML) program works to restore sites impacted by pre-1977 mining. To become eligible for the AML program, a property's problems must be a result of pre-1977 mining. There are a few exceptions with underground mines, because many areas have both pre and post-1977 underground mining, and it is often hard to tell whether subsidence is caused by the older or newer mining operations. There are also some eligible sites that fall within an interim period, after the law was passed, but before the Restoration Program began in Indiana. Typically, landowners will call and report suspected AML problems, and DNR will investigate the sites and determine eligibility. Since August 2010, DNR has spent $89,255.39 reclaiming 15 sites in Dubois County and $28,683,645.03 reclaiming 92 sites in Pike County. Working with Laura Montgrain, a DNR employee, the Alliance learned that spent AML grant funds *must reflect the following priorities in the order stated:*

(1)(A) the protection of public health, safety, and property from extreme danger of adverse effects of coal mining practices;
(B) the restoration of land and water resources and the environment that --
(i) have been degraded by the adverse effects of coal mining practices; and
(ii) are adjacent to a site that has been or will be remediated under subparagraph (A);
(2)(A) the protection of public health and safety from adverse effects of coal mining practices;
(B) the restoration of land and water resources and the environment that --
(i) have been degraded by the adverse effects of coal mining practices; and
(ii) are adjacent to a site that has been or will be remediated under subparagraph (A); and
(3) the restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices including measures for the conservation and development of soil, water (excluding channelization), woodland, fish and wildlife, recreation resources, and agricultural productivity.

So in very general terms, we have to address the human safety hazards before we can address the environmental hazards, unless the environmental hazards are adjacent to a human safety hazard or are addressed in conjunction with a human safety hazard.[5]

Because of mining's long history, problem areas exist across Pike County. DNR defines a problem area as *geographic areas that contain AML features such as highwalls, subsidence, exposed Coal Refuse, etc. Problem area boundaries are drawn in accordance with federal rules, so the actual area that is reclaimed by our program often differs from the problem area boundaries that are*

[5] Email from DNR's Laura Montgrain 5.13.2011

shown on the attached map. In fact, for any given area, the actual reclaimed area is often smaller than the area enclosed in the problem area boundary.[6]

Map 5 was shared with the Alliance by Ms. Montgrain and shows existing DNR AML Problem Areas.

Map 5: DNR Map of AML Problem Areas

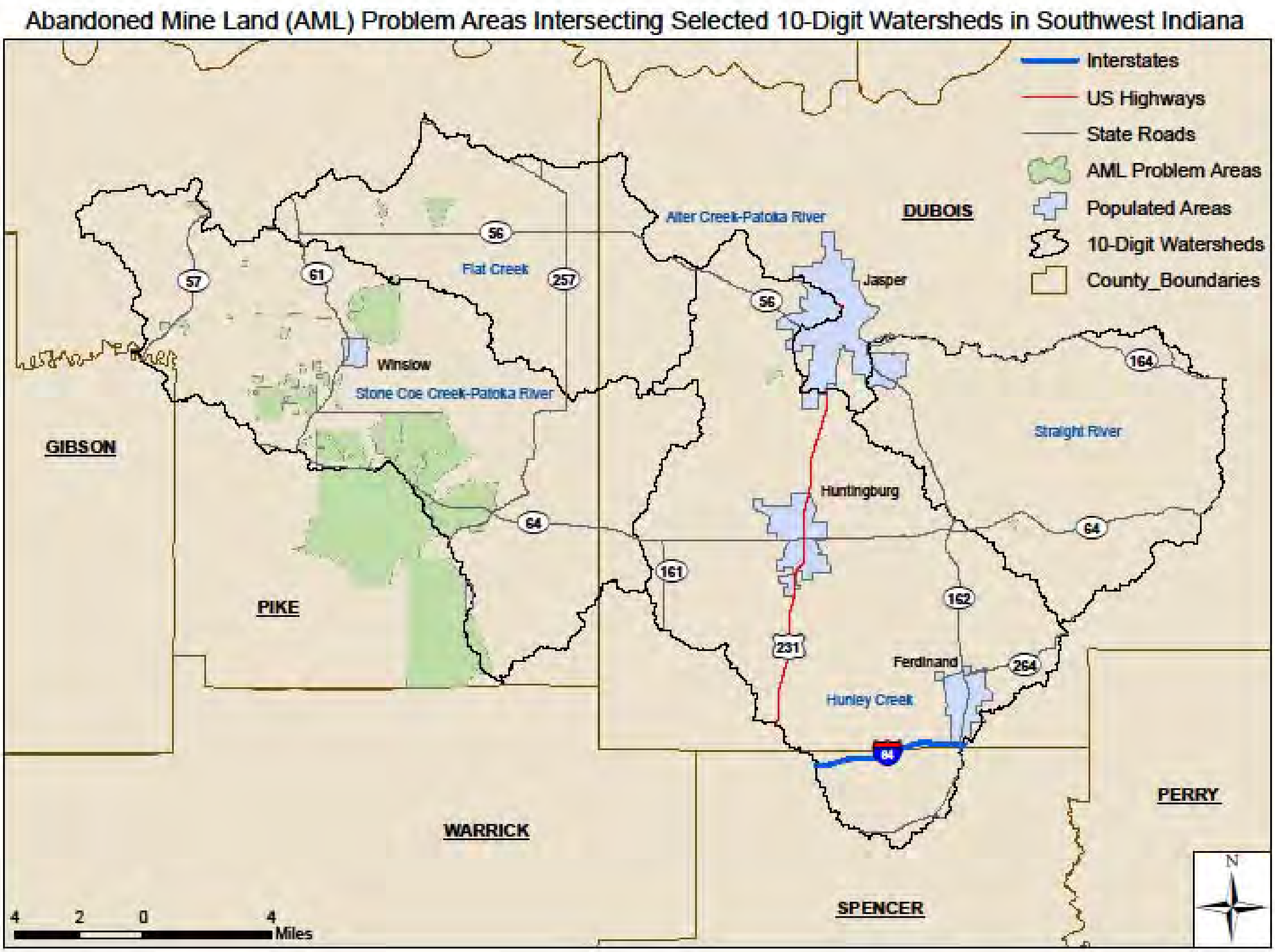


Plate 2 shows the location of active coal mining permits in and around the project area. Plate 2 and Maps 4-6 offer a good visual description of how widespread mining has been across the project area. Pike SWCD and Pike Natural Resource Conservation Service (NRCS) report that old surface mines are reopening to extract deeper coal seams, so mining will continue to impact the Middle Patoka Watershed.

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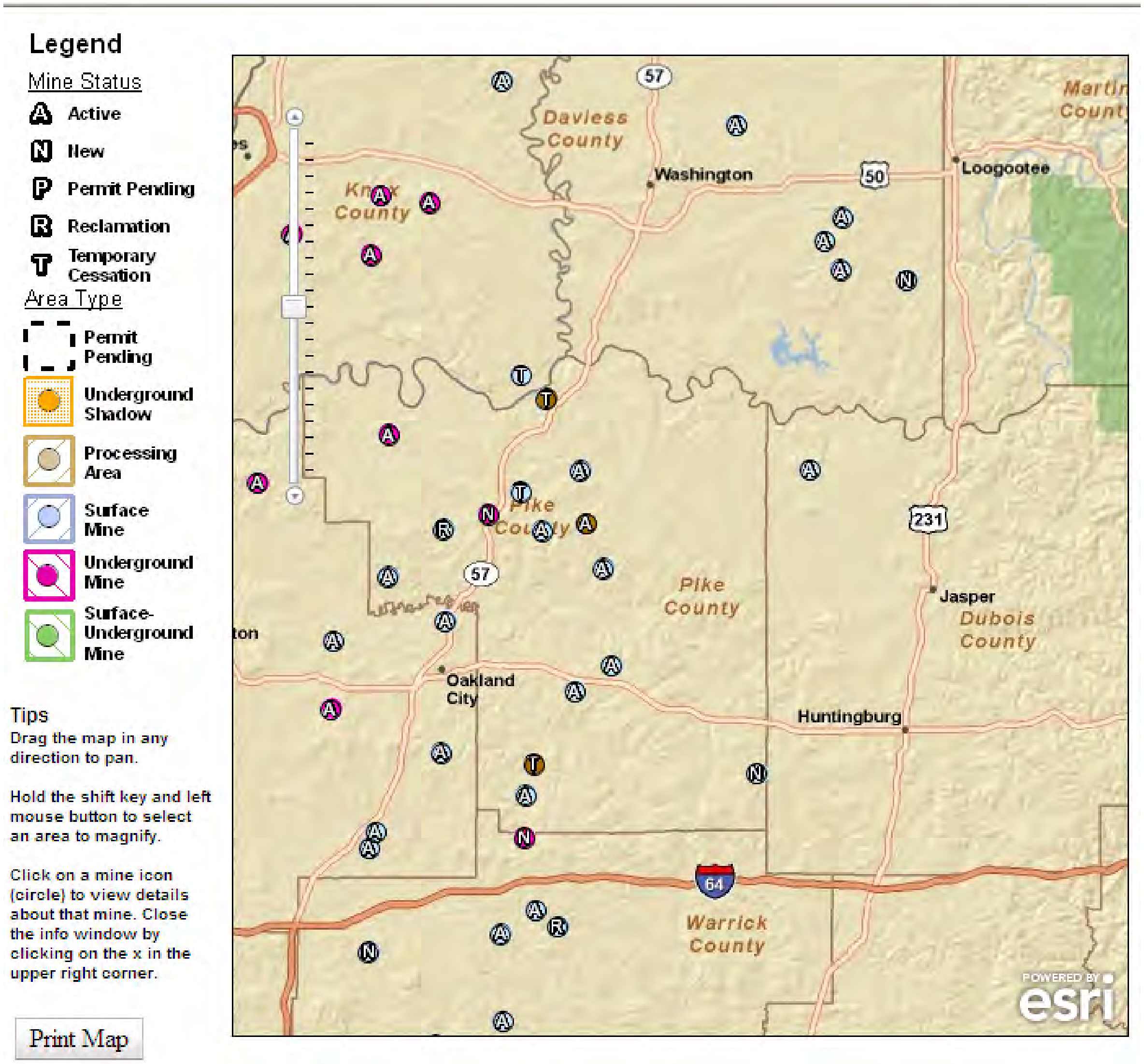
[6] Email from DNR's Laura Montgrain 2.7.2011

Plate 2: Active Coal Mining Permits in and Around the Project Area (Indiana DNR March 2011)

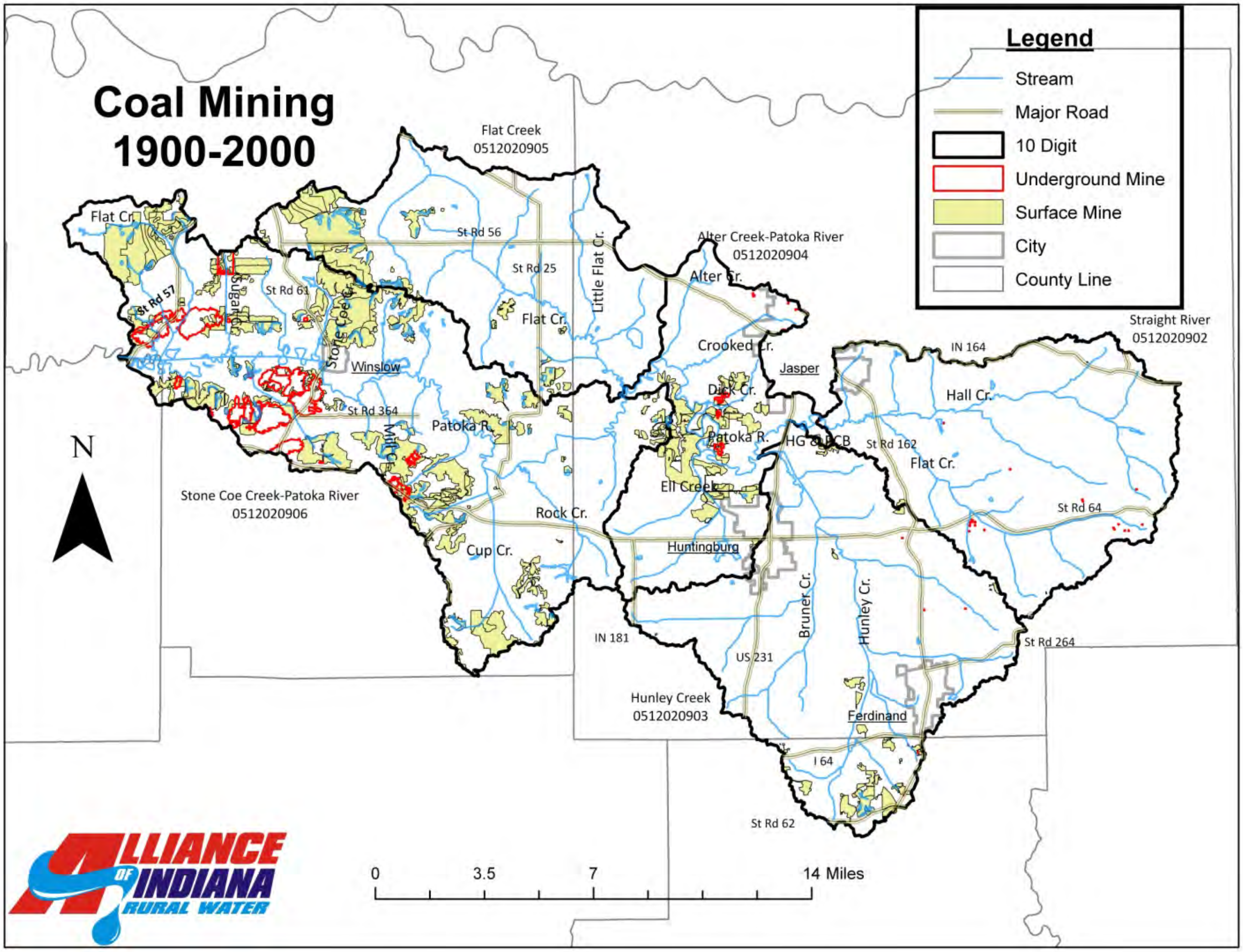


The public has concerns regarding the process of AMD treatment. As explained, most AMD sites are restored by DNR. A common practice in Indiana and elsewhere uses limestone to neutralize the acid. As was noted by members of the public though, when the calcium carbonate of the limestone reacts with acid, iron oxides precipitate out of the water and coat the limestone. This coating eventually 'seals' the limestone and diminishes its ability to further neutralize AMD.

Plate 3: AMD Treatment Site

Steve Herbert, Assistant Director of DNR's Restoration Section in the Division of Reclamation told the Alliance "that armoring of limestone is an issue we [DNR] deal with, but our value judgment on its' use is site specific and with the knowledge that the effectiveness may diminish with time." DNR does use other practices. In selecting the best practice for a site, Mr. Herbert reports that DNR "consider[s] issues other than cost or effectiveness. One of the growing issues we are dealing with currently is cost of future maintenance on passive systems. O&M [Operation and Maintenance] costs can significantly change the techniques we select for a site."[7]

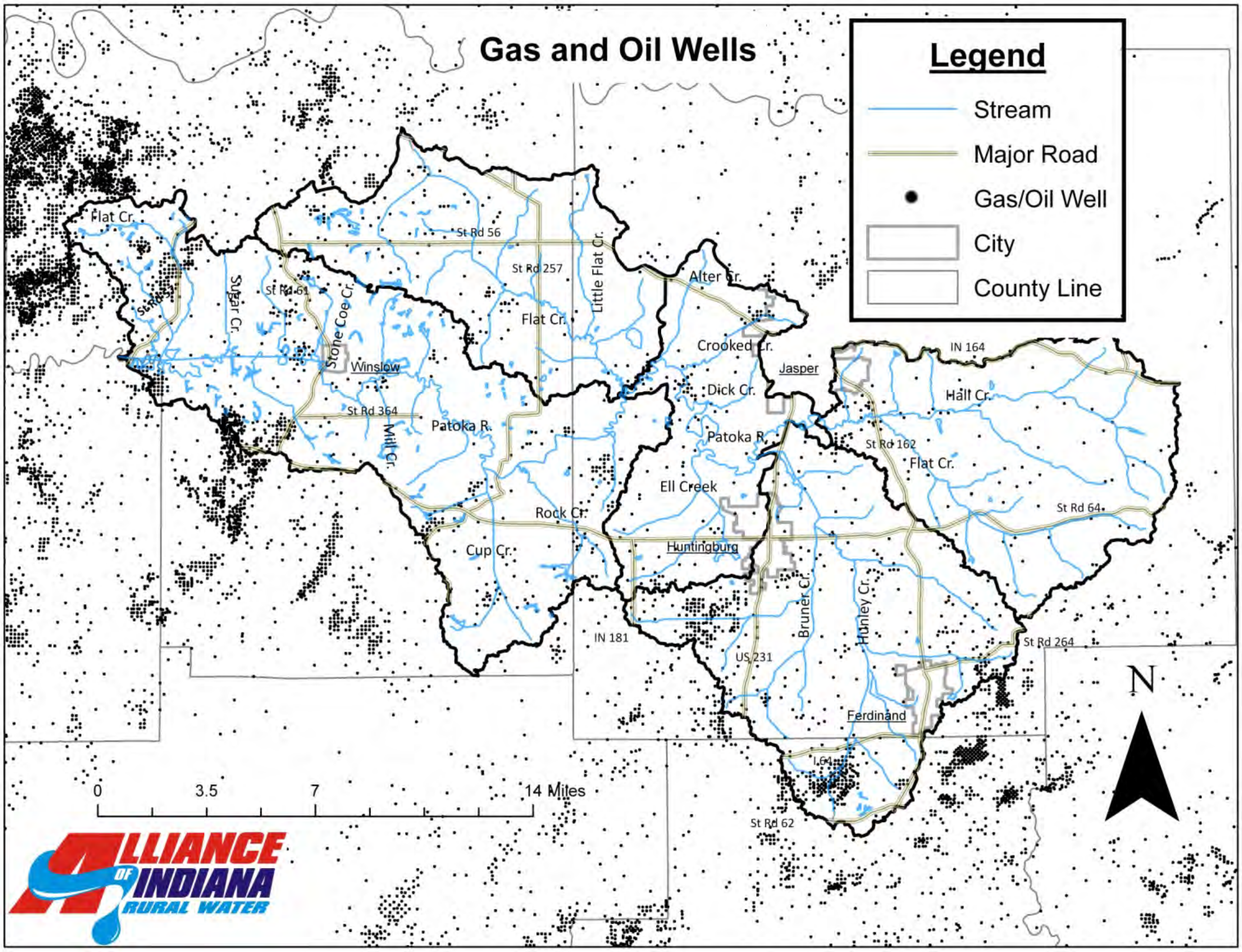
Map 6: Coal Mining 1900-2000



The project area, along with southwestern Indiana in general, is also relatively rich in oil and natural gas. The gas and oil fields are part of the Illinois Basin, which extends into Illinois and western Kentucky. In Indiana, the basin consists predominately of sandstone reservoirs generally between 1,000 to 3,000 feet deep. Map 7 shows the distribution of gas and oil wells in and around the project area.

[7] Email from DNR's Steve Herbert March 7, 2011

Map 7: Gas and Oil Wells



2.3 Hydrology

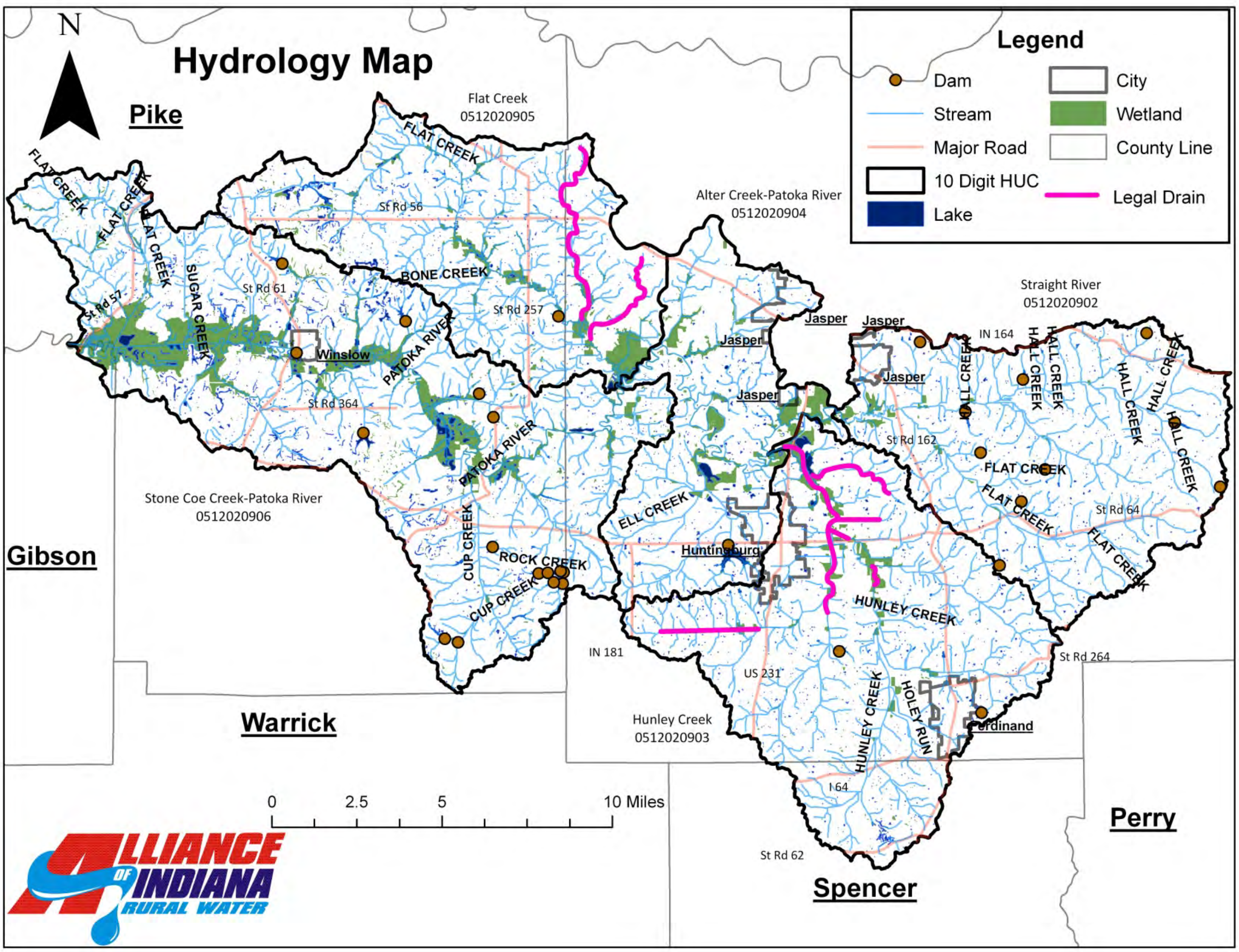
2.3.1: Hydrologic Features

The MPRW has 1,084 miles of streams and up to 30 square miles of wetlands (based on National Wetland Inventory). Determining the true amount of wetlands has proven difficult because the three sources of wetland data all give different results. The NRCS Soil Survey data says that 4.5% of the watershed's soils have the hydric soils necessary to support wetlands. According to the National Wetland Inventory (NWI)—a United States Fish and Wildlife Service program that inventories and maps the nation's wetlands—8.1% of the watershed is covered by wetlands. NWI inventory is made through observing aerial photography and is subject to errors. The final data, USGS Land Cover data, says that only 0.64% of the watershed is wetland. Field work would be necessary to determine the true amount of wetlands.

In addition to streams and wetland, the watershed's row crop land is drained by ditches, which include approximately 22 miles of legal drains. The watershed also has 3,562 lakes totaling more than 5 square miles (see Map 8). Many of these lakes are old mining pits. The largest use of the area's water is for drinking water. Throughout the watershed, small private groundwater wells supply drinking water. The only exceptions are Winslow, Ferdinand, Jasper, and Huntingburg. Winslow and Jasper draw from the Patoka River and Ferdinand and Huntingburg are supplied by the Patoka Lake. Huntingburg also has a small reservoir available for drinking water. Because of the decentralized use of ground water, its safety is not actively monitored. Residents interested in well testing (a topic brought up at the public meetings) are usually referred to the Health Departments. Gibson County refers people to Microbac Laboratories, Inc in Evansville, a private lab that can do testing.

Another drinking water concern mentioned by the public is whether pharmaceuticals are in the water. Pharmaceuticals are rarely absorbed 100% by the human body, so small quantities enter the sanitary sewer systems. Wastewater utilities are not required to test or filter for pharmaceuticals, so the pharmaceuticals that come in with the wastewater are sometimes still present in the clean water that leaves the plant and withdrawn downstream for drinking water. Definitive research about the impact of pharmaceuticals in drinking water is absent. However, it is known that traces of pharmaceuticals have never been detected anywhere near what a 'dose' of the drug actually is. Concerns like this one, as well as ever tightening monitoring and pollutant removal requirements from the government, put a strain on local utilities. The public wants cheap drinking water, and while the MPRW seemingly has a large supply, there are factors influencing the consumer's price per gallon that most don't take into consideration. These include the overhead costs of running a utility, sampling and reporting costs, filtration and disinfection costs, repair and upgrading of infrastructure, and staff salary and benefits.

Map 8: Hydrology Map



2.3.2: Recreation

The area's largest recreational area is the Patoka River National Wildlife Refuge (Section 2.5). The refuge is a tourist and recreational draw on the west side of the watershed and contains a large amount of wetlands. The Patoka River is not very deep or fast flowing, so it doesn't draw a lot of recreational users besides fishing.

Plate 4: Winslow Public Access Point

Fishing is widespread and there are boat launches in each town and spread across the watershed. Several people at the public meetings mentioned canoeing along the Patoka, but there are no canoe liveries in the watershed. The Town of Jasper does have a kayak club. At a public meeting, a fisherman said that when he uses a bow to fish for invasive fish, DNR has instructed him to put his kills back in the stream rather than leave them onshore. This seemed like a strange practice since it adds nutrient pollution to the stream. From DNR's website, the Alliance learned that suckers, carp, gar, bowfin, buffalo and shad may be taken year round with a bow. There are no bag limits for these fish. Fish must not be mutilated and returned to the water unless the fish is lawfully used as bait. Fish parts, including entrails, must not be discarded into any state waters, but should be disposed of in a sanitary manner that does not pollute the water or become detrimental to public health or comfort.[8]

2.3.3: Log Jams

The word 'Patoka' is Native American and literally means 'logs on bottom', so we know that the river has a long history of collecting downed trees. Log jams can inhibit recreation on the Patoka River. They also increase erosion by redirecting the water's energy into stream banks. The Patoka River Conservancy District is responsible for 88 miles of the Patoka within the project area. The District surveys that entire stretch every few years for jams, but primarily depends on citizens to let them know where log jams are. Specific log jam sites are mapped in Chapter 3. Tax revenue from landowners in the floodplain allows the District to do preventative maintenance, including tree removal from banks. DNR has policies guiding the removal of log jams and classifies jams into 5 conditions:

Condition 1 – A single log located either in or across the waterway channel.

Condition 2 - Two or more logs in or across the channel. The accumulated logs are interlocked, but there is no sediment build-up or debris collecting in the channel at site

Condition 3 – Two or more logs in or across the channel. The accumulated logs are interlocked and sediment and debris have begun to collect on the jam. There is still water movement through the logjam.

Condition 4 – Two or more logs in or across the channel. The accumulated logs are interlocked and sediment and debris have compacted into the logjam. There is no water movement through the logjam. The logjam acts as dam, holding back water within the channel; water movement is now through the overbank areas rather than the channel.

Condition 5 – Logjam is located on a waterway within an area providing significant environmental benefit or within a critical area for fish spawning.

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8 http://www.in.gov/dnr/fishwild/5870.htm#sort 5.13.11

Depending on the condition of the log jam, a landowner interested in removing it may have to apply for a permit. More information is available at DNR's website.[9] Unsurprisingly, many landowners will remove log jams without working with DNR. Recently, the owner of a railroad bridge in Winslow used heavy equipment to free a jam lodged against the bridge supports and then let the material float downstream where it potentially could cause another jam. Though log jams were found as part of this study, they were all on small tributary streams and not of significant size.

Plate 5: Typical Log Jam

2.3.4: Channel Modifications

West of Winslow, the Patoka River was straightened in the early 1920s, so there's a long history of channel modification in the watershed.

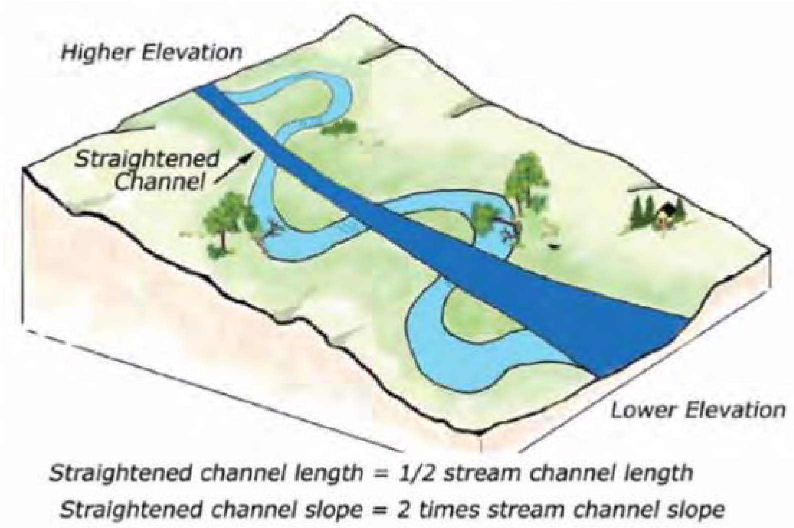
Plate 6: Channelized Patoka River

The public was concerned about the impact of artificially widened or straighten stream channels and removing vegetation from the banks. Often these practices are common on legal drains, although the Alliance noticed them in every part of the watershed. Channel straightening is sometimes proposed to address flooding or erosion problems. The premise is that a straight, smooth channel moves the water through faster, so less spills out onto the floodplain. Erosion problems are addressed by moving the main flow away from the eroding bank, which is frequently located on the outside of a bend. It's often thought that straightening provides a wide and fast path for water to move downstream and reduces the likelihood of log jams and sediment build up that might increase flooding. This assumption is usually only true if significant resources are available to maintain the channel. The reality of how straightened—also known as channelized—streams behave is very complicated.

Although straightening or relocating a stream may provide relief at a specific location, it drastically alters the stream flow characteristics and may cause additional problems both upstream and downstream of the project site. This is because the channel-straightening project tends to focuses on one stream function—water transport—without adequately accounting for other functions, such as energy dissipation and sediment transport. Straight streams tend to shoot water like a fire hose. When the bends and curves (meanders) are removed, the stream continues to drop the same elevation, but over a shorter linear distance. This increases the slope of the channel, which in turn increases the stream's velocity and energy.

[9] http://www.in.gov/dnr/files/wa-LogjamDebrisRemovalFAQs.pdf 5.6.11

Plate 7: Length of Straightened Vs. Natural Channel



[10] Remember that the meanders, riffles, pools, and floodplains of a natural stream channel provide resistance that dissipates the stream's energy. Without these features, the stream has more energy to use eroding its bed and banks. Often, the stream will cut into its bed, causing large steep eroding slopes. Trees on those slopes will eventually fall into the stream. The erosion process will continue until the stream can reach the equilibrium that was present prior to channelization. If landowners remove bank vegetation, this erosion only occurs more quickly.

Plate 8: Erosion along Straightened Stream

One solution to the increased erosion potential of a straightened stream is to protect the bed and banks with rock or concrete. This smooth, hard channel enables the water to speed through even faster, taking its energy with it. Downstream areas will have higher peak flows, because the water gets there faster, which may increase flooding problems. In addition, downstream areas will be subject to increased erosion, unless the project incorporates sufficient energy dissipation structures. Years later, the stream may still be eroding its bed and/or banks in an effort to restore a stable channel length and slope. Channelizing is therefore not a recommended method as it overlooks many important stream functions and typically creates more problems than it solves.[11]

2.3.5: Flood Control

Two other hydrologic concerns discussed at the public meetings were the status and location of 13 flood control dams thought to be spread across the watershed and how long it had been since the Army Corps of Engineers had updated their flow model for the Patoka River. Repeated attempts by the Alliance to learn about the flow model failed. As for the dams, the public suspected the Corps built them in the 1960s and wanted to know where they were located and if they had been maintained. DNR data shows 29 dams in the MPRW (Map 8). Most of the dams must be on private property, because very few were observed during the Alliance's windshield survey. The Corps was asked about the 13 dams mentioned at the public meetings, but wasn't familiar with them and said they weren't Corps constructed. It is unclear if some of the dams within the DNR database are the flood control dams the public had questions about.

[10] http://www.catskillstreams.org/pdfs/instreamtablepdfs/Channelizing.pdf 8.30.11
[11] Adapted from http://www.catskillstreams.org/pdfs/instreamtablepdfs/Channelizing.pdf 5.9.11

2.3.6: Streambank Erosion

Near the end of the project, a member of the steering committee asked the Alliance whether sediment from streambank erosion could be a significant source of the watershed's overall sediment load. Since streambank erosion was not brought up as a public concern, its distribution was not noted during the windshield survey and a precise estimate of its sediment contribution is unknown. Anecdotal evidence from the survey shows that while some streams in the watershed have stable banks, many do not, however data needed to pinpoint bank erosion to specific locations was not collected. Several factors can cause bank instability.

- Changing a stream's slope by moving, dredging, or straightening it alters bank stability. Increases in slope add energy to moving water and makes it easier for stream channels to erode.
- Additional flow above and beyond what the stream historically has transported will cause bank erosion. The increased flow, whether from urban areas or field tiles, erodes a channel wide enough to accommodate it.
- Disconnecting a stream from its floodplain increases channel erosion. Wet weather flows move more quickly and carry more energy than dry weather flows. When flood water can move out of its channel it slows down and loses some of its erosive force. Ditches and other channelized streams often are so deep that wet weather flows can't leave the channel, so their energy is directed solely on the stream banks and channel.

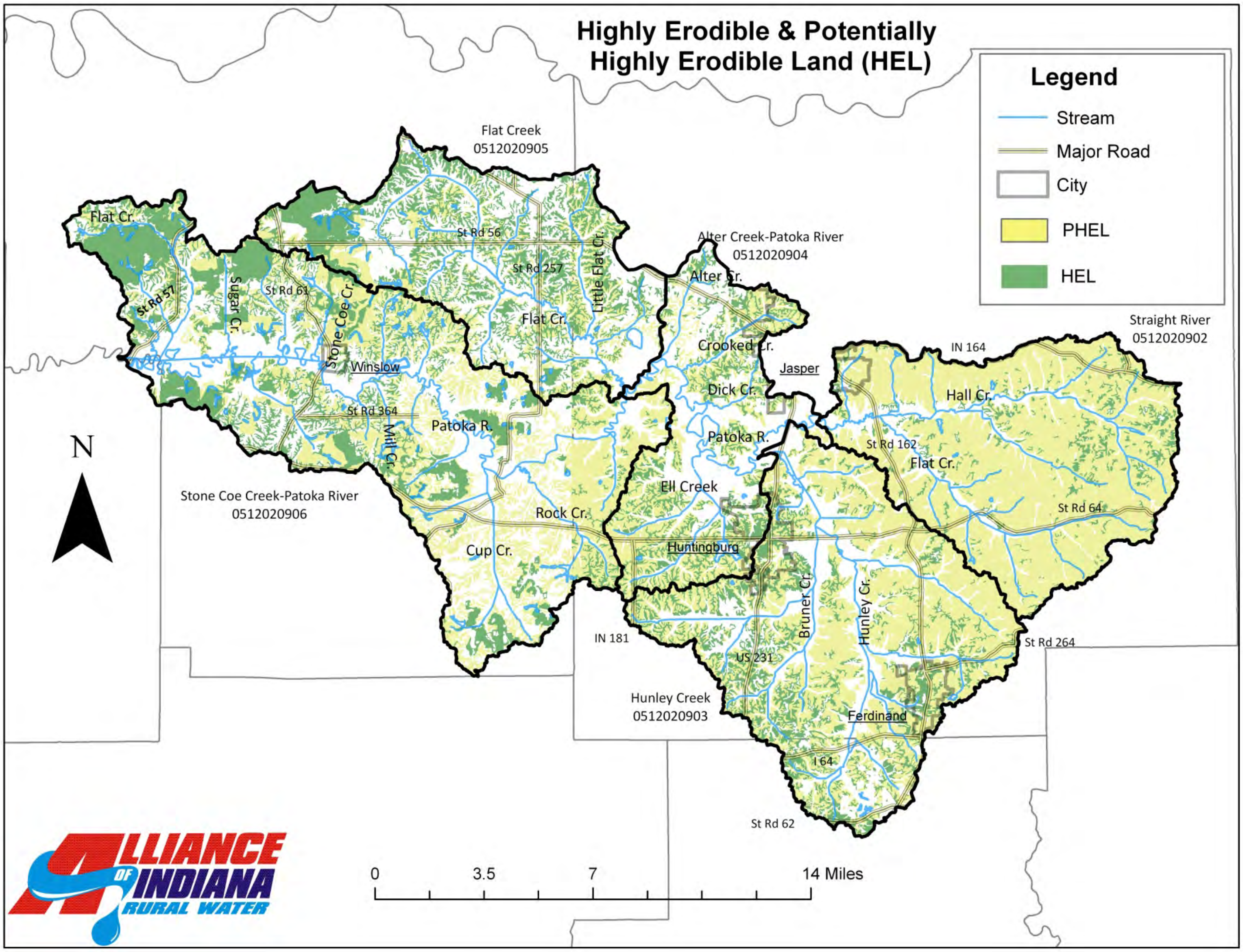
2.4 Highly erodible soil, hydric soil, and septic system suitability

2.4.1: Highly Erodible Soil

Soil characteristics can potentially impact a watershed's water quality. Eroding soils, for instance contribute sediment and nutrients attached to that sediment to local streams. The Natural Resources Conservation Service (NRCS) maintains a list of highly erodible soil units for each county based upon the potential of soil units to erode from the land. The classification is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. Potentially highly erodible soils may or may not be highly erodible depending upon factors such as slope steepness and length. A field investigation would be necessary to determine whether or not potentially highly erodible lands are in fact highly erodible.[12] Approximately 58% of the Middle Patoka River Watershed is classified as highly erodible land (HEL) or potentially highly erodible land (PHEL) (Map 9). The non erodible soils are primarily along the streams and within the floodplains.

[12] HEL and Septic Suitability text adapted from the Salt Creek Watershed Management Plan

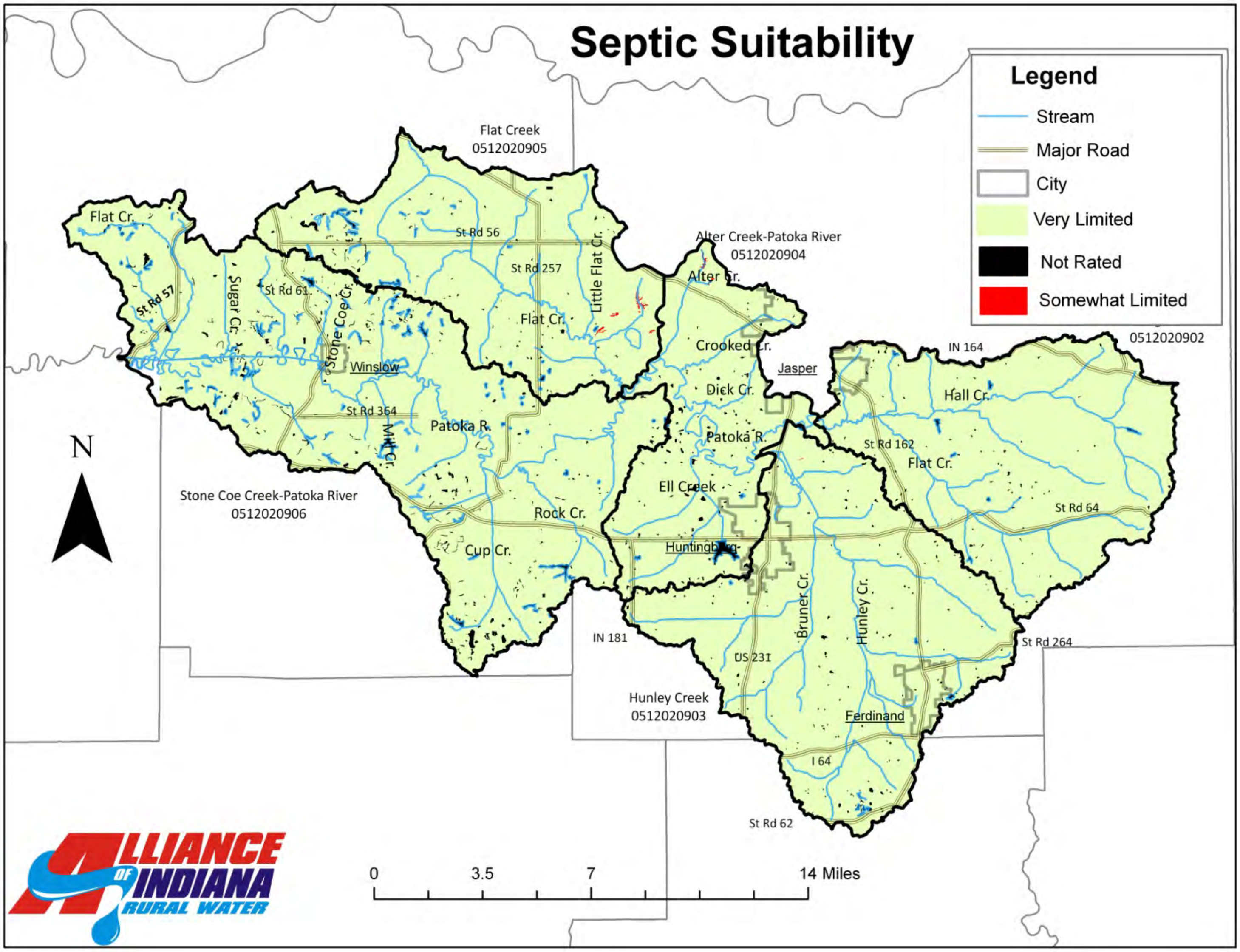
Map 9: HEL and PHEL



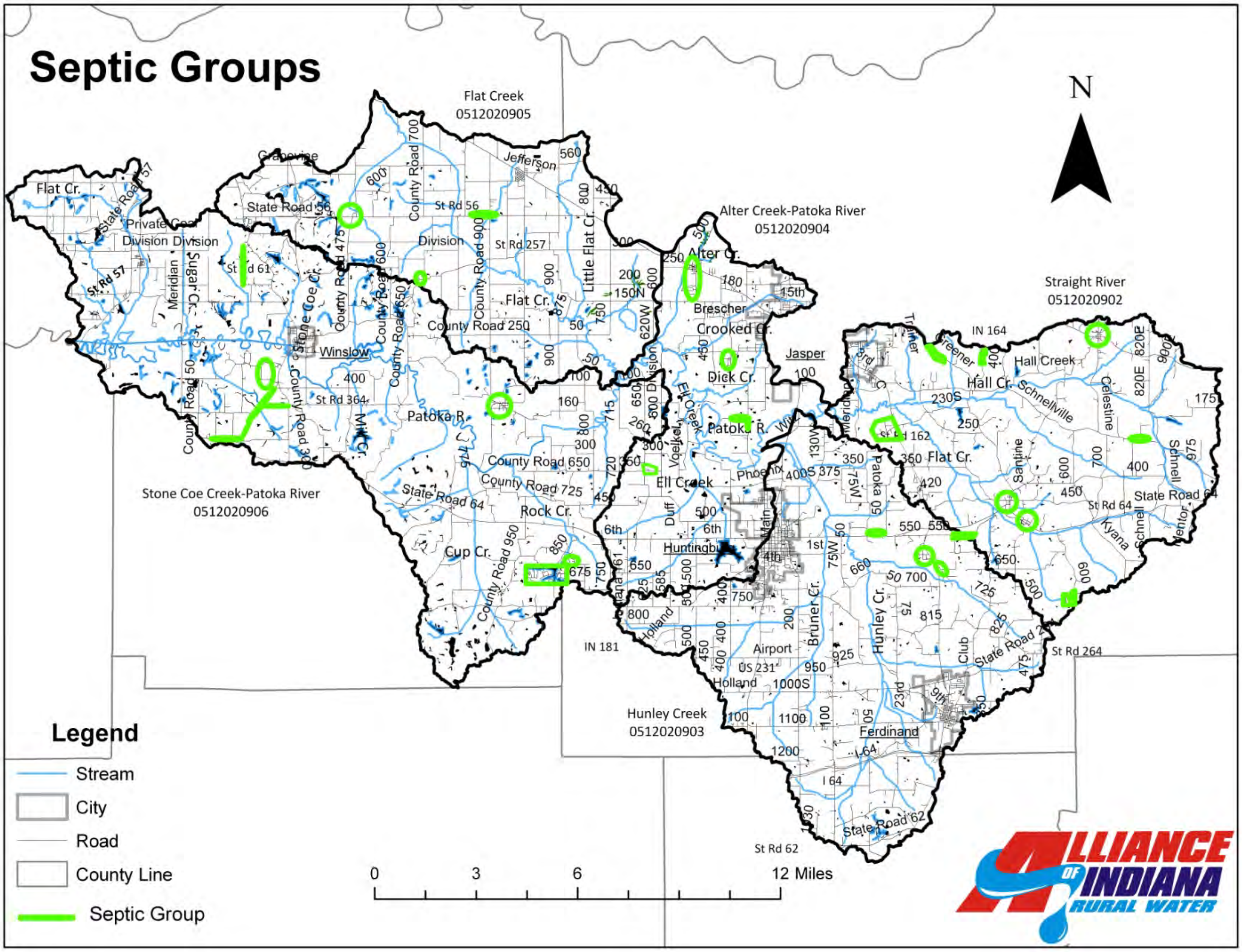
2.4.2: Soils Suitable for Septic Systems

Onsite sewage disposal (septic) systems are designed for the purpose of wastewater treatment. For optimal functionality, the systems must be properly engineered and installed, located in suitable soils, and receive routine maintenance. Systems that are not regularly maintained, have outdated or inefficient designs, or are installed in inappropriate soils often result in septic failure. Only 1.6% of the soils in the MPRW are unrated for septic suitability. 98.3% of the soils are rated very limited for septic suitability and the remaining rated somewhat limited (Map 10). Discharge of effluent associated with failing septic systems can introduce pathogens, parasites, bacteria, and viruses, which can cause disease through body contact or ingestion of contaminated water. E. coli and other pathogens pose a particular threat when sewage pools on soil or migrates to recreational waters. The towns in the MPRW are the only areas not on septics. During a windshield survey, the Alliance mapped groups of septic systems. A group was defined as at least 10 homes and/or businesses within a quarter mile squared area. Map 11 shows the septic groups.

Map 10: Septic Suitability



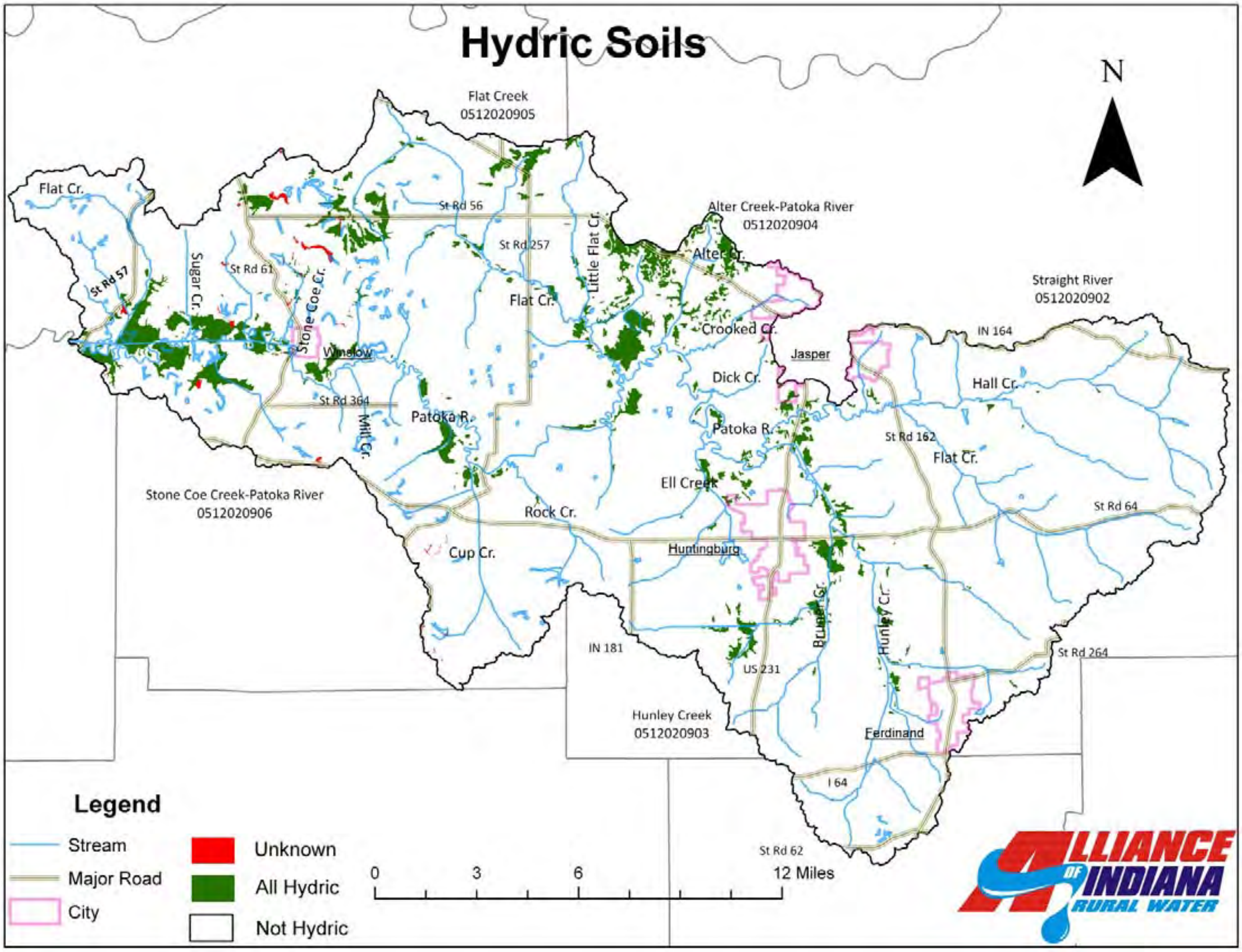
Map 11: Septic Groups



2.4.3: Hydric Soils

A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils support the growth and regeneration of water tolerant vegetation and are associated with wetlands. Wetlands play an important role in reducing regional flooding, providing wildlife habitat, recharging groundwater, and filtering sediment, nutrients, and other pollutants. According to the NRCS Soil Survey, only 4.5% of the soils in the MPRW are hydric (Map 12).

Map 12: Hydric Soils



2.4.4: Agricultural Field Practices

Cropland takes up nearly 40% of the land in the Middle Patoka Watershed and if properly managed runoff pollution from those fields can be minimized. Cropland field runoff can include sediment, fertilizers, and herbicides and pesticides. An important row crop best management practice (BMP) is no-till. No-till is a farming system where the seeds are directly deposited into untilled soil which has retained the previous crop residues. Some of the environmental benefits of no-till such as erosion control, improvement of water quality, and increased water infiltration leading to reduced flood hazard will come into effect only after several years of continuous, uninterrupted application. Traditionally, no-till has been more successful with soybeans than corn, but new technologies are making no-till corn a better option for farmers. Figure 4 shows no-till as a percentage of all row crop fields in each of the Middle Patoka's four counties.

Figure 4: 2009 Purdue Extension No-Till Information

County	% Corn Acreage in No-Till	% Soybeans Acreage in No-Till
Dubois	41%	68%
Gibson	10%	59%
Pike	10%	51%
Spencer	52%	70%

A second important BMP are cover crops. Cover crops are grasses, legumes or small grains grown between regular grain crop production periods for the purpose of protecting and improving the soil. The most common cover crops in Indiana are fall-seeded cereals, such as rye or wheat, and fall-seeded annual ryegrass. Advantages of using cover crops include water and wind erosion control, improved soil tilth, and improved crop yield.[13] Used together, cover crops and no-till can provide improved yields, soil health, and environmental benefits. Within the watershed, NRCS reports that cover crops work best with soybeans and generally speaking are already on steeper slopes. More incentives are needed to encourage farmers to try cover crops. NRCS suggested to the Alliance that both no-till and cover crops could be increased if someone could do one-on-one education with the farmers throughout the growing season.

A final field practice common in the watershed are drainage tiles.

Plate 9: Field Tile Emptying into Stream

Tiles are long linear pipes buried under fields to collect water and channel it into nearby streams or ditches so fields don't become oversaturated. While tiles make large scale agriculture possible, the flow they add to streams can increase erosion and flooding. Water from tiles can also contain concentrations of whatever fertilizer, herbicide, or pesticide was recently applied to the farm field. Field tiles were observed across the MPRW.

2.5 Landuse in the Watershed

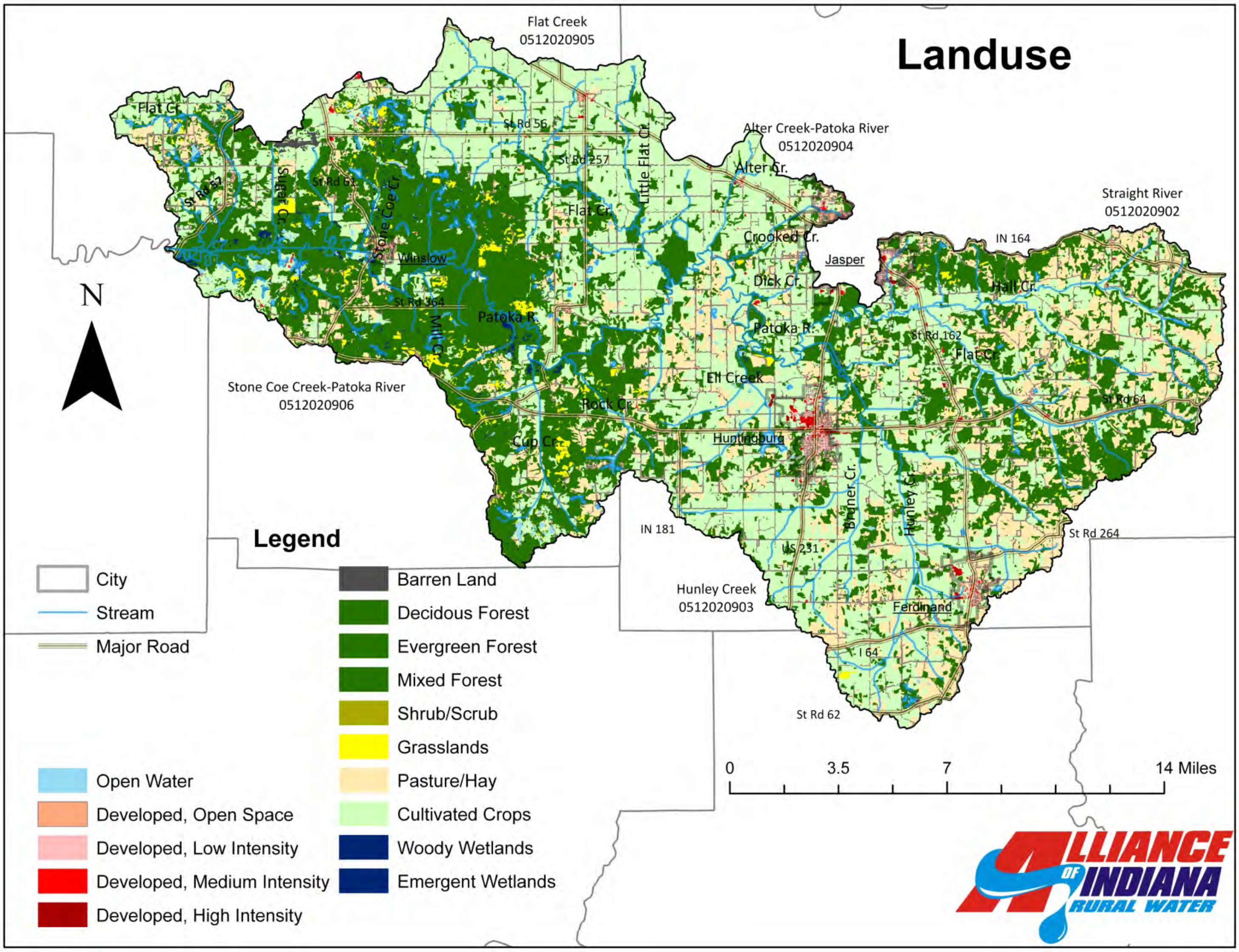
Figure 5 lists each landuse as a percentage of the entire Middle Patoka River Watershed. Map 13 shows those landuses.

Figure 5: Landuse in The MPRW

Landuse	Percentage of Watershed	Acres
Open Water	1%	2,373
Developed Open Space	5.7%	13,575
Developed Low Intensity	0.77%	1,821
Developed Medium Intensity	0.27%	643
Developed High Intensity	0.15%	357
Barren Land	0.12%	296
Deciduous Forest	36%	84,436
Evergreen Forest	1.8%	4,322
Mixed Forest	0.01%	36
Shrub/Scrub	0.05%	123
Grasslands	1.2%	3,036
Pasture/Hay	14%	32,416
Cultivated Crops	39%	92,063
Woody Wetlands	0.37%	897
Emergent Wetlands	0.27%	653

[13] http://www.agry.purdue.edu/ext/forages/publications/ay247.htm 5.31.2011

Map 13: Landuse



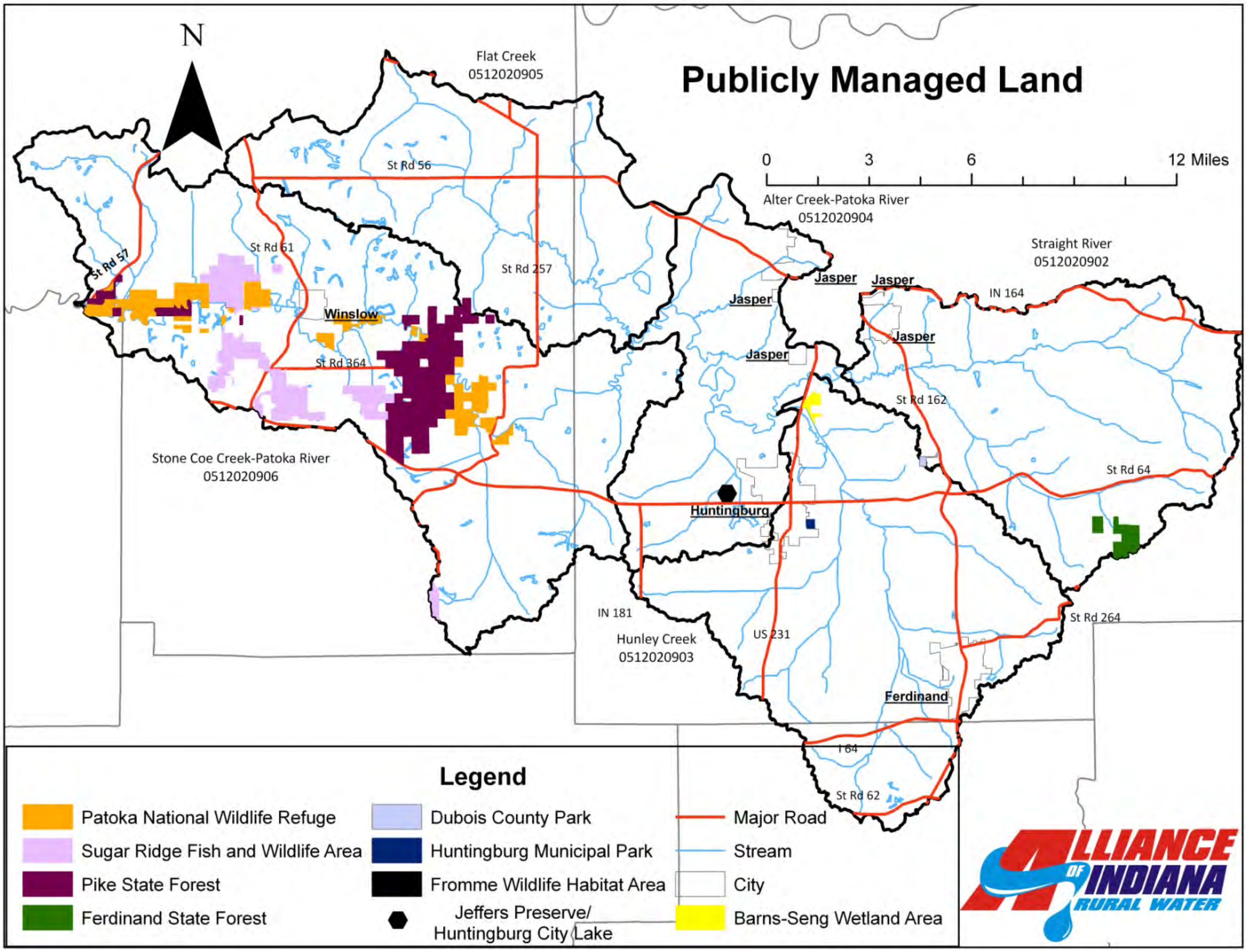
2.5.1: Managed Lands

Publicly managed land lies throughout the watershed, but is concentrated in Pike County (Map 14).

- Ferdinand State Forest has camping, fishing, boating, swimming, picnicking, hiking trail, and mountain bike trails. 7792 acres of the forest are in the MPRW. According to DNR records, which go back 3 years, timber harvesting was last done in 2009.
- Dubois County Park is 44 acres, has a 3 acre stocked lake, a campground, tennis courts, basketball courts, a playground, and wetlands area with paved trails.
- Pike State Forest covers 4796 acres in the watershed and offers camping. DNR does not have records of timber harvesting in the forest.
- Sugar Ridge Fish and Wildlife Area is 8562 acres of strip mined land that features scores of lakes (DNR says some may be dead from AMD) and rows of overburden from the mining operations. Fishing, hunting, wildlife watching, and target ranges are open to the public. Mining rights are still owned by the mining companies, so occasionally mining will occur. It's only in those circumstances that timber harvesting occurs since the trees will be destroyed anyway.
- Barnes-Seng is a 150 acre wetland conservation area operated by DNR.
- Huntingburg Municipal Park is 40 acres.

- Huntingburg Country Club (not on Map 14) is a 9 hole Golf Course.
- Jasper Country Club (not on Map 14) is a 9 hole Golf Course.
- Patoka River National Wildlife Refuge and Wildlife Management Area is 5193 acres. The refuge has a goal of continued growth and wetland restoration through the purchase of available lands.
- Jeffers Nature Preserve was donated to the Huntingburg Foundation. Hiking trails are being planned for the site.
- Huntingburg City Lake is 180 acres with public access and a hiking trail. The lake is directly south of Jeffers Preserve.

Map 14: Publicly Managed Land



2.5.2: Air Quality

Air quality in the watershed was a public concern brought up in the initial project meetings. IDEM says that Dubois County and Washington Township in Pike County do not meet attainment for the Annual Particulate Matter (2.5 microns or less) air quality standard. Particulate matter is a complex mixture of extremely small particles and liquid droplets made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.[14] There are two power plants north of the project area and several to the south along the Ohio River. Jasper is considering retrofitting a decommissioned plant to burn bio-mass for energy production.

2.5.3: Deicing Agents

A member of the public asked the Alliance to research the impact deicing agents may have on local water quality. Pike County puts sand down on the roads. Jasper puts salt and salt brine down. They also use beet juice. Huntingburg only uses salt and are considering experimenting with sprays, but need more garage space for the equipment. Ferdinand uses salt and in areas without storm drains will occasionally use sand. Dubois County uses sand, salt and cinders. Definitely saying that any of these agents does or does not impact water quality is difficult without targeted water testing (which was not a part of this project). IDEM has not listed any of the watershed's streams as impaired for chlorides, which is an indicator of salt. However, some streams are impaired for Total Dissolved Solids (TDS), a pollutant associated with de-icing salts. TDS also has several other sources though.

2.5.4: Livestock Production

Across the watershed, livestock are produced by small hobby farmers and large agribusiness Confined Feeding Operations (CFO). CFOs are facilities with at least 300 cattle, 600 swine, 600 sheep, or 30,000 fowl. There are 58 CFOs in the watershed (see Watershed Inventory Part 2); 50 of which are in Dubois County. Because of the large amounts of manure generated at CFOs, they are a pollution risk. Using IDEM's Virtual File Cabinet (http://12.186.81.89/Pages/Public/Search.aspx), the Alliance checked the most recent inspection reports for CFOs in the MPRW. No compliance issues were discovered. Local SWCDs and NRCS report that the majority of the watershed's CFOs raise some type of poultry. There are many public concerns surrounding livestock production. The first is what can be done with the excess poultry manure from the CFOs. Within the watershed, Dubois County has the most chickens and turkeys. According to Dubois County NRCS, the county produces enough manure to satisfy 100% of the nitrogen and 50% of the phosphorus and potash needed to fertilize row crops. Despite this, the use of commercial fertilizer is still high. NRCS attributes this to the difficulty of measuring nitrogen in manure and the hard to break tradition of buying commercial fertilizer. Pike County NRCS reports that in-county manure production can't satisfy cropland fertilizer needs. Challenges exist for finding suitable uses for all the manure generated in the watershed and ways to store it so precipitation doesn't create nutrient and bacteria rich runoff.

Plate 10: Runoff from Uncovered Manure

A study from the Chesapeake Bay Watershed—an area rich with CFOs—suggests several uses for excess manure.

- Land Application as Crop Fertilizer
- Pelletizing
- Composting
- Land Application for Forest Production
- Cogeneration

As mentioned above, NRCS, in partnership with SWCDs, work to promote responsible manure application on farm fields. The Alliance contacted Doug Brown, State Forest Manager with DNR, to ask about the feasibility of using manure as a forest fertilizer and got the

[14] http://www.epa.gov/air/particlepollution/ 5.9.11

following reply:

While we could see some possible benefits in some locations, there are too many concerns about equipment access, recreation conflicts, water quality and environmental impacts. A better option may be some of the reclaimed strip mine areas that are often nutrient poor and more accessible to equipment.[15]

Across the MPRW are hobby farms—small farms maintained without the expectation of being the primary source of income. During the windshield survey, it was difficult to discern a hobby farm from a small animal farm. According to the steering committee, hobby farms are not concentrated in any one part of the watershed nor is there evidence that they are dominated by any one type of animal. The illegal dumping of dead animals from hobby farms is a public concern. Dumping in or near surface water can potentially pollute that water, and groundwater, with bacteria, viruses, and nutrients. During this project, a member of the public contacted the Alliance of Indiana Rural Water about an animal dump site south of Winslow near a mining pit on DNR land.

Plate 11: Animal Carcasses

DNR said they lacked the resources to clean it up, so the Alliance contacted the County Health Departments in the project area to learn who else might clean up such sites. The County Health Departments all said that the responsibility lies with the landowner. The County would handle county land, DNR must do DNR land, etc. The Highway departments will dispose of what's dumped in their jurisdiction. Pike County Board of Health did say that if a site posed a clear human health risk, they would work with the landowner to get it cleaned up.

The future of livestock production is closely tied to corn prices. If corn prices remain high, livestock production's landuse may decrease as farming on marginal lands increases. Conversely, if corn decreases, as it may if ethanol subsidies are cut, livestock may be a more economical option for owners of marginal lands.

2.5.5: Construction Concerns

In Indiana, any landowner (farming is exempt) disturbing 5 or more acres of land must apply for a storm water management plan permit (known as a Rule 5 Permit). This permit outlines how the landowner will keep sediment onsite during construction. Within Jasper, any disturbance of 1 acre or more must be permitted (known as a Rule 13 Permit). More specific information about these permits is at http://www.in.gov/idem/4867.htm .

[15] Email 5.12.11 From Doug Brown, DNR

Plate 12: Construction Site Erosion

Whether resources exist to diligently monitor construction sites is a public concern. Oversight of storm water permits falls onto the county SWCDs, except in Jasper, where the city has jurisdiction. Pike County SWCD has a part time staffer who covers 2 other county's construction site monitoring. The expansion of I-69 and US 231, and future development along those routes, promise to increase demand for Rule 5 oversight.

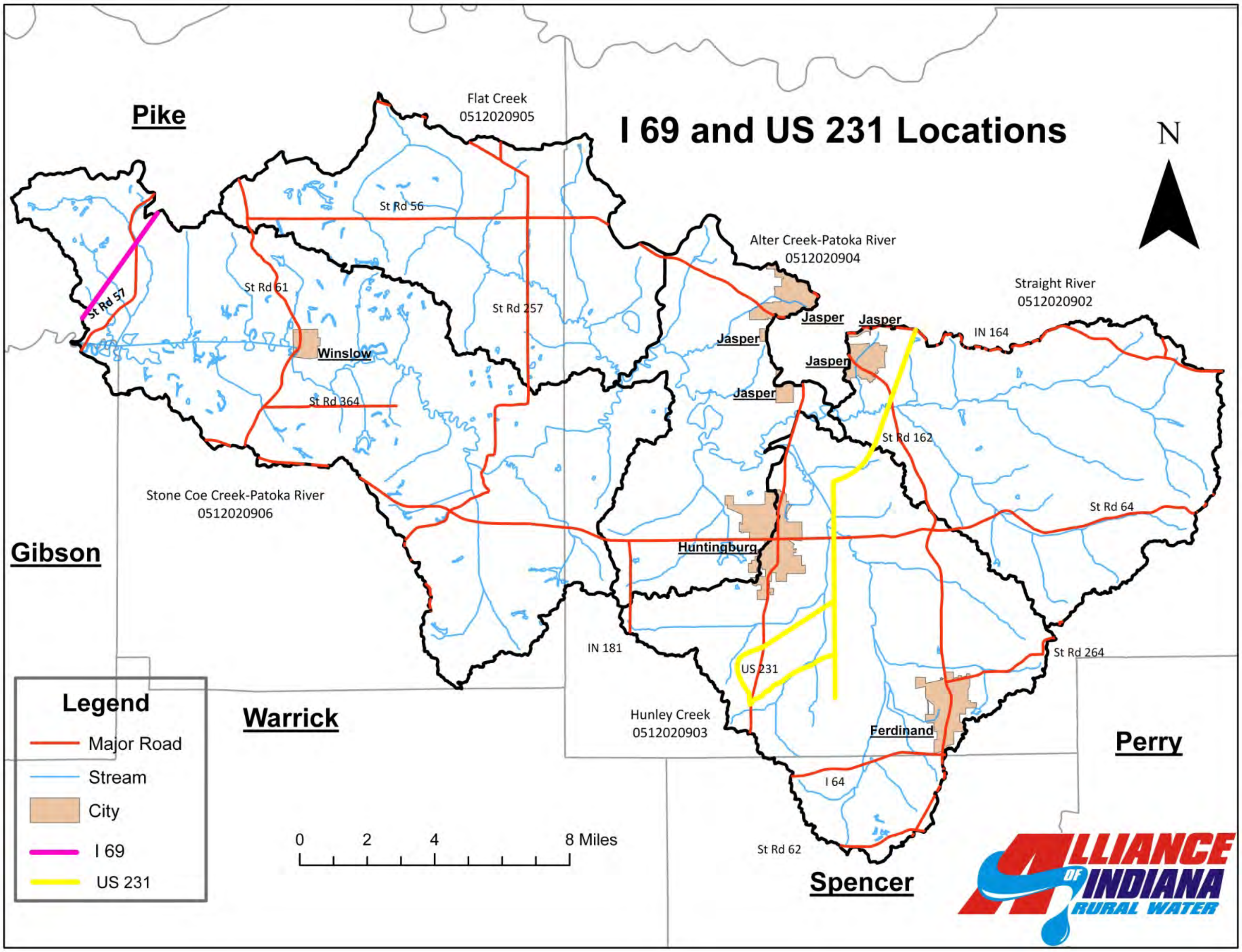
I 69 will influence a small portion of the watershed and won't include any interchanges (see Map 15). The project is still in the design stages. From the Indiana Department of Transportation (INDOT) website, the Alliance learned that:

INDOT is *now preparing six separate Tier 2* [Environmental Impact Statements] *EISs for I-69 between Evansville and Indianapolis. The Tier 2 EISs will determine the alignment, interchange locations and design characteristics of I-69 within the selected corridor, as well as develop more detailed mitigation measures…. it is anticipated that the actual right-of-way needed for I-69 will be between 240 and 470 feet wide, as compared with the 2000 foot width for the corridor. After a Tier 2* (Right of Decision) *ROD is issued for a section, the project will proceed into the design phase. The design phase will conclude with the preparation of construction plans and documents for that Tier 2 section. During the design phase, permit applications will occur. Toward the end of or after the design phase, land acquisition will occur. Following land acquisition, the construction phases will ensue. It is anticipated that each Tier 2 section will be divided into multiple parts for construction contracts.*[16]

Construction on the new US 231 in Dubois County will start in 2013. INDOT is currently planning a new road construction project that would re-route US 231 around Huntingburg and Jasper as well as enlarge the thoroughfare from a two-lane to a divided four-lane limited access highway. The bypass is scheduled to be completed in 2014.[17]

[16] http://www.i69indyevn.org/tier2overview.html
[17] http://www.dcadc.org/initiatives/US231.cfm

Map 15: I 69 and US 231 Locations



The construction and increased urban footprint in the watershed concerns some members of the public. Each of the counties' or towns' long term plans cites sustainable development as a goal. However, such goals are sometimes set aside in pursuit of short term economic gains; especially if sustainable development principles are not written into municipal codes or ordinances. An example of a popular sustainable development principle is Low Impact Development (LID). LID is an approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs. LID still allows land to be developed, but in a cost-effective manner that helps mitigate potential environmental impacts.[18]

Across the watershed, only 6.9% of the land is developed. Numerous studies have shown that watershed health begins to decline once development covers 10% of a watershed. As that 10% threshold approaches, the need for LID and other best practices becomes more important. Landuse does tell us that urban runoff pollution sources do exist. Urban areas are hotspots for fertilizer/pesticide use and other common urban pollutants and because of their impervious surfaces have less storm water infiltration and more runoff than other areas. The increased runoff creates a need for storm water ponds, ditches, and other

[18] http://www.huduser.org/publications/pdf/practlowimpctdevel.pdf 5.31.2011

infrastructure that conveys water. More information about urban pollution sources is in the second part of the Watershed Inventory.

2.6 Other planning efforts in the watershed

Many city, state, and private organizations' mission and interests overlap with the MPRW. Below is a brief synopsis of each of those organizations and how their long-term goals may impact the watershed. Of particular interest to the public was what organizations did public education about water quality. Besides the SWCDs doing education at the county fairs, no one organization seems to have public education as a high priority. A map showing planning entities jurisdiction is below.

Indiana Department of Environmental Management

The Indiana Department of Environmental Management (IDEM) is mandated through the Clean Water Act to assess the State's surface water quality and list those bodies of water that don't meet state water quality standards. This list, called the 303(d) list after the specific section of the Clean Water Act that describes it, includes several streams in the MPRW. Information about the impaired streams is in Section 1.2 and the Watershed Inventory Part 2. In 2012, IDEM is scheduled to do a Total Maximum Daily Load (TMDL) report for E. coli and nutrients in the Patoka River Watershed. The TMDL will provide information about pollutant sources and the maximum amount (or load) of E. coli and nutrients the Patoka River can receive and still meet water quality standards.

Indiana 15 Regional Planning Commission[19]

Indiana 15 Regional Planning Commission is a multi-county governmental agency as enabled by Indiana Code 36-7-7. Throughout its 25 years of service, Indiana 15 has been involved with a multitude of community and economic development projects bringing millions of dollars into the regional economy. Many of Indiana 15's objectives overlap with the purpose and goals of this project.

- Identify existing industrial sites that have been abandoned and target them for beneficial reuse.
- Utilize basic planning, coordination and organization needed to initiate and sustain sound
- development.
- Develop and promote the tourism industry in the region.
- Promote and support programs and projects that provide every resident of the region with
- safe, clean, potable water.
- Ensure that all residents have access to safe, clean, and affordable wastewater treatment
- systems.
- Identify affordable alternative wastewater treatment for communities that cannot afford
- traditional treatment methods.
- Develop and support programs and projects that utilize the area's abundant water and
- timber resources while protecting them from pollution.
- Create and support programs and projects that enhance the marketability of the district's
- mineral resources, such as coal, oil, and timber without harm to the environment.

Indiana 15 also has two projects connected to watershed management they'd like to implement.

- The construction of additional storage impoundments around the Huntingburg wastewater treatment plant to create additional storage during wet weather flow.
- Update Winslow's comprehensive plan with extra emphases on park and recreation.

[19] All information from http://www.ind15rpc.org/ 5.10.11

Patoka River Conservancy District

The District is responsible for 88 stream miles of the Patoka River. The entire 88 miles are surveyed every few years for log jams, but the District primarily depends on citizens to let them know where jams are. The District does preventative maintenance every year, which includes tree removal from banks. Taxes from landowners in the floodplain pay for the maintenance work.

Town of Winslow 2008 Master Plan

Several items in the Master Plan relate to watershed management and the issues facing the MPRW.

Goal 3, Objective 2, Strategy 4: Strengthen the Community-Wide Clean-Up Program by thorough promotion, drop-off points for large items, volunteers to help the elderly and disabled, recycling options, and a plan to manage hazardous chemicals, such as oils, paints, and solvents.

Goal 3, Objective 6, Strategy 2: Promote the use of the Winslow Sports Park and Riverside Park as an Outdoor Education Lab to teach students about nature, the environment, and horticulture.

Goal 6, Objective 2, Strategy 1: Develop a regular series of informative fliers on existing land use and property maintenance issues that can be added to the local utility bill mailings.

Goal 6, Objective 2, Strategy 3: Develop an Eco Club for local residents to explore the natural environment and amenities, develop educational programs focusing on the environment, plan recreational activities, and promote the ongoing protection of environmentally-sensitive areas.

Goal 6, Objective 2, Strategy 4: Pursue Brownfields Grants for Phase I Environmental Remediation of contaminated properties by utilizing a list of locally-known or possible Brownfield areas within the Town of Winslow to encourage the re-use of abandoned, un-used, or vacant properties within the community.

Goal 6, Objective 2, Strategy 5: Collaborate with the Indiana Department of Natural Resources (DNR) - Division of Reclamation to identify potential re-use of previously-mined properties within the Winslow Area for future development or recreational use.

Goal 6, Objective 2, Strategy 6: Identify ways to preserve the water quality, existing wildlife, and habitat of the Patoka River and its minor tributaries in the Winslow Area to ensure that the community can support the existing opportunity to develop an Outdoor Recreation & Adventure Tourism niche market in the Town of Winslow.

Patoka 2000

Patoka 2000 is a committee of the Jasper Chamber of Commerce dedicated to trees, beautification, and other quality of life initiatives in Jasper. In 2011, the committee had Earth Week Activities, an Arbor Day Celebration, a River Clean Up day, and a Tree Care Workshop.

Jasper Municipal Separate Storm Sewer System (MS4) Program

An MS4 is a conveyance or system of conveyances (sewers, roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) designed to move storm water off the land. The extra water flow associated with storm water, as well as the sediment in that water, contributes to the degradation of streams and rivers. US EPA has mandated that certain urban areas (including Jasper) manage their MS4s to reduce this degradation. The MS4 program has six requirements.

1. Public education and outreach;

2. Public participation/involvement;

3. Illicit discharge, detection and elimination;

4. Construction site runoff control;

5. Post-construction site runoff control; and

6. Pollution prevention/good housekeeping.

Jasper Comprehensive Plan 2010

Several items in the Comprehensive Plan relate to watershed management and the issues facing the MPRW.

Natural Systems Section

Goal 2, Objective 1: Strengthen policies and ordinances that encourage sensitive development that retains the pastoral character and responds to the natural terrain. Policies could include limiting the removal of woodlands and wetlands, reducing sporadic residential development on agricultural lands, and discouraging development on steep slopes.

Goal 2, Objective 2: Develop a public awareness and educational campaign regarding the benefits of surrounding natural systems. Set aside land in environmentally sensitive areas for limited public use or access, appropriate recreational uses, and preservation. The Patoka River or Buffalo Flats Nature Preserve could serve as "outdoor classrooms" for local schools. Utilization of these natural features as teaching tools and communicate to both students and citizens the interconnectedness of the built environment, local waterways, and natural systems.

Goal 2, Objective 4: Provide incentives and encourage conservation subdivision development permits contextually sensitive growth that also preserve views, resources or natural features, and even incorporates these features as amenities.

Goal 3, Objective 1: Jasper residents recognize the Patoka River is an important community amenity. Protect and enhance this riparian corridor by buffering development, promoting "River Friendly Farming" practices, and discouraging inappropriate industrial uses along the river in order to protect water quality, wildlife habitat and its intrinsic aesthetic value.

Goal 3, Objective 2: Review proposals for development and structures in floodplains that may restrict the natural function(s) along waterways. Maintain floodways and associated floodplains as natural spaces primarily for flood control, water quality management, and groundwater recharge. Development should be well-buffered in the vicinity of these sensitive areas.

Goal 3, Objective 3: Consider opportunities to restore riparian areas adjacent to river and stream corridors by removing abandoned and neglected structures and working with property owners to ensure that bank stabilization, water quality and aesthetics are not diminished by commercial or industrial activities.

Goal 3, Objective 4: Continue to encourage public awareness of water quality by providing identification on roadways at waterway crossings and stenciling or applying decals at drainage inlets with the message "Drains to the Patoka River".

Goal 3, Objective 5: Coordinate with the county health department to monitor existing septic systems near the end of their useful life to determine the need to connect to nearby sanitary sewer. Consider technologies such as pop-up's that allow a property owner to monitor the condition of their septic system.

Goal 3, Objective 6: As an "MS4" community, the City has a number of measures in place to address storm water runoff. The City should promote or strengthen incentives for "Best Management Practices" or green infrastructure such as vegetated swales, shared detention facilities and pervious pavement to contain storm water on-site. To increase filtration and groundwater recharge, consider reducing maximum lot coverage requirements for new development in environmentally sensitive areas, or encourage restricting the percentage of allowable impervious surface to reduce storm water runoff.

Goal 3, Objective 7: Beaver Lake serves as Jasper's emergency secondary source of drinking water. City officials should partner with Dubois County officials, the Dubois County Health Department and property owners surrounding the lake to ensure future development does not impair the water quality of Beaver Lake.

Goal 4, Objective 2: Jasper's exploration of converting the existing (coal burning) power plant to burn bio-fuels is indicative of the city's commitment to investigate cutting-edge technology to power the city. The City should continue discussions with its wholesale energy provider and other stakeholders to explore cost-effective and sustainable methods for producing and delivering electricity to Jasper residents.

Goal 4, Objective 3: Trees are important aesthetically, but also aid in the breakdown of certain air pollutants. Support the Chamber of Commerce's effort to designate Jasper as a "Tree City". Commit to maintaining and replacing the aging urban forest within the public right-of-way and/or on municipally-owned properties. Provide educational workshops for residents regarding the proper planting, maintenance and general care of trees in the city.

Goal 4, Objective 4: Encourage sustainable site development and building practices. Public buildings and large-scale commercial developments can set an example with appropriate site selection, design and development practices that minimize grading and retain existing natural features. Natural landscapes provide valuable services such as climate regulation, clean air and water, and improved quality of life.

Parks, Recreation, and Open Space Section

Goal 1, Objective 6: Explore opportunities to incorporate sustainable, or "green" design principles as an integral part of future development. Innovative site design features could include the incorporation of storm water detention facilities as amenities rather than simply storm water infrastructure. In addition, conservation design principles would allow for preserving open space or other natural features as part of future development.

Town of Ferdinand Comprehensive Plan 2007

Several items in the Comprehensive Plan relate to watershed management and the issues facing the MPRW.

Goal 8, Objective 1: Promote carefully-planned growth by establishing prioritized areas where future development will be encouraged.

Goal 8, Objective 2: Promote a balance of strategic future development and agricultural land conservation to maintain the existing character of the Ferdinand Area.

Goal 8, Objective 3: Promote compact community growth and the efficient use of land resources by encouraging quality development, redevelopment, and revitalization in areas served by existing infrastructure, including the area around the Interstate 64 and SR 162 interchange (Exit 63).

Goal 8, Objective 4: Encourage carefully-planned growth by conserving natural features and environmentally-sensitive land, including the existing floodplain areas north and west of Ferdinand.

Huntingburg Master Plan 2007

Several items in the Master Plan relate to watershed management and the issues facing the MPRW.

Goal 2: Community Character

- Preserve rural character by balancing development and AG landuse and by building upon the area's natural features to enhance that development
- Enhance appearance by planting trees and providing for other landscape improvements

Goal 7: Land Use #3

- Promote the efficient use of land resources and existing infrastructure by encouraging compact development and the redevelopment of underutilized or vacant properties within the Huntingburg Community.
- Consider the conservation of natural resources and protection of environmentally-sensitive land during the review of new development proposals and infrastructure expansions.

Major Recommendations

- Maintain a high level of scrutiny when addressing potential developments within or near floodplain areas, wetland areas or bodies of water
- Floodplains limit growth in town, so consider Balanced Growth or infill.

Pike County Comprehensive Plan 2009

Pike County does not have any zoning regulations. Priorities from the Comprehensive Plan include:

Continue economic development

- Locations for future land use opportunities are along the I69 corridor, north and east of Winslow, and around Otwell.

Enhance the natural features of the county through appropriate protection.

- Conserve prime farmland and forest land where possible
- Use appropriate construction measures on steep slopes
- Protect floodplains and wetlands through BMPs for erosion and sediment control and dedication of drainage and conservation easements
- Protect significant wildlife habitat through voluntary dedication or easements and voluntary acquisition by non-profit entities

Goal 3 and 5 of the Plan have strategies that pertain to the MPRW Project.

Goal 3: Environmental

- Restrict development in the 100 year floodplain by prohibiting new or expanded structures except when no increase in flood elevation and velocity will result and when the area of floodwater storage will not be reduced.
- Avoid alterations or significant modifications to natural stream channels unless flooding is reduced, any increase in erosion or flood velocity will not affect other areas, and only minor impacts will occur to wetlands or endangerered species.

- Use best management practices for erosion and sedimentation control during and after site preparation
- Buffer streams and lakes to prevent water quality degradation
- Protect, to the extent possible, areas of endangered species, wetlands, public parks, unique natural areas and other areas with significant natural features
- Restrict the density and site grading on land with natural slopes of 10% to 20% and prohibit urban development on natural terrain slopes greater than 20%.
- Restrict development on sites with wetlands such that wetlands are avoided or replaced at a ratio comparable to the quality of the wetland being lost.

Goal 5: Utilities:

- Encourage the water systems in the county to consider expansion of their water filtration and distribution systems to ensure the systems are adequate for existing businesses and residences and provides capacity to accommodate anticipated future development.
- Ensure that all communities and new developments in Pike County have appropriate natural or man-made drainage systems to adequately accommodate storm water flows.

Dubois County Master Plan: 2009

The only areas in Dubois County with zoning are the communities of Jasper, Huntingburg, and Ferdinand. Broad recommendations from the Master Plan include:

1. Expand water and sanitary sewer areas

2. Conserve prime farmland and forest land

3. Protect floodplains and wetlands through BMPs and conservation easements

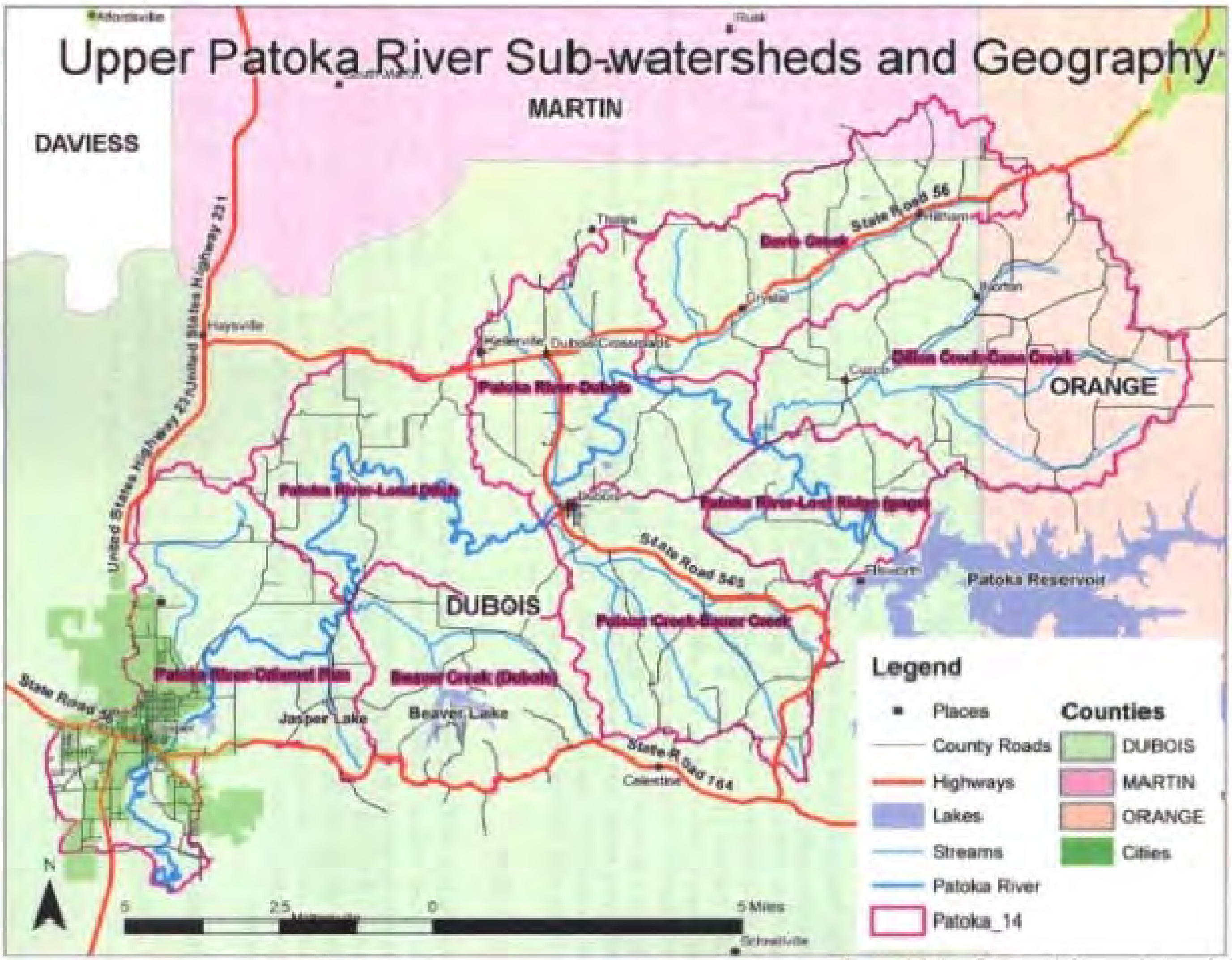
4. Protect most significant wildlife habitats through voluntary easements

Specific objectives that pertain to the MPRW Project are:

- Prohibit any new development involving on-site sewage treatment systems (septic tanks with lateral field, holding pits, etc.) within and adjacent to incorporated areas with the exception of industrial pretreatment facilities.
- Examine financial assistance programs for any low-and moderate-income households on septic systems to connect to a centralized sewer system.
- Develop a countywide strategy to ensure all residents have access to an environmentally sound and economical sewage treatment system.
- Explore the management structures, capital costs and financing mechanisms associated with the improvement of natural and man-made drainage systems to adequately accommodate storm water flows.
- Restrict development in the 100 year floodplain by prohibiting new or expanded structures except when no increase in flood elevation and velocity will result and when the area of floodwater storage will not be reduced.
- Avoid alterations or significant modifications to natural stream channels unless flooding is reduced, any increase in erosion or flood velocity will not affect other areas, and only minor impacts will occur to wetlands or endangered species.
- Use best management practices for erosion and sedimentation control during and after site preparation
- Buffer streams and lakes to prevent water quality degradation

This watershed project was initiated through a partnership between the Dubois SWCD and Four Rivers RC&D. The area was chosen because it's the source of drinking water for the City of Jasper, there were concerns about overspreading of livestock manure, expansion of the Patoka Lake Water District's service into the area would encourage development, and because soil conditions increase the chance of runoff pollution. A map from the plan shows that the project area is northeast of the MPRW and feeds into it at Jasper (Map 16). No implementation of this plan has been done yet.

Map 16: Upper Patoka River Watershed



Water quality testing during the project showed high levels of E. coli, Dissolved Oxygen, pH, Nitrate, Total Phosphorus, Total Suspended Solids, and Ammonia Nitrogen. All pollution from the Upper Patoka Watershed enters the Middle Patoka Watershed—another reminder that 'we all live downstream'. The recommended actions (Figure 6) from the Upper Patoka

Watershed Plan show that many of the same needs from the Middle Patoka Watershed exist upstream as well. In addition to the Upper Patoka Watershed Plan, a SWPP exists for the Patoka Lake Watershed, which feeds into the Upper Patoka and ultimately the Middle Patoka. Patoka Lake is a reservoir that supplies drinking water for several southern Indiana counties. The plan was written by the Alliance in 2005 and is available at http://plrws.net/storage/Patoka_Lake_SWP_Short_Version.pdf .

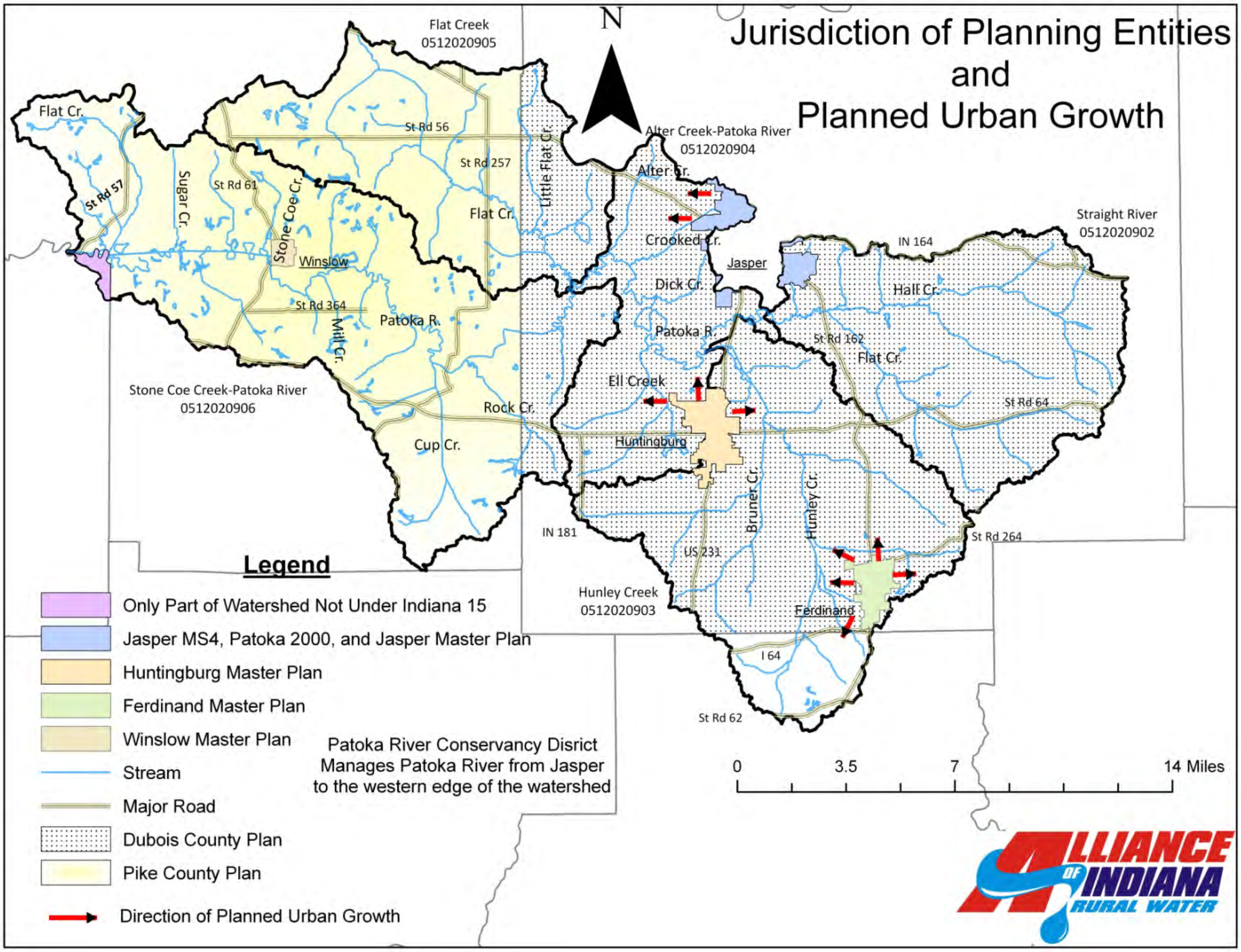
Figure 6: Upper Patoka Watershed Action Register

Sub-watershed	Recommended BMPs	Amounts	Estimated load reductions
Patoka River – Dubois	Change to no-till farming on HEL fields	3 fields (60 acres)	1281 pounds/year N
			639 pounds/year P
			744 tons/year sediment
	Nutrient management planning on no-till fields	10 fields (200 acres)	Variable N
			Variable P
	Filter Strips on un-buffered fields	4 fields (7.9 acres of filter strips)	1528 pounds/year N
			820 pounds/year P
			1528 tons/year sediment
Patoka River – Long Ditch	Change to no-till farming on HEL fields	8 fields (160 acres)	3416 pounds/year N
			1704 pounds/year P
			1984 tons/year sediment
	Filter Strips on un-buffered fields	7 fields (5.1 acres of filter strips)	6104 pounds/year N
			3269 pounds/year P
			1704 tons/year sediment
Beaver Creek	Grazing plan, cattle exclusion, watering systems, & watering pad	3 pastures (10 acres affected)*	177 pounds/year N
			87 pounds/year P
			103 tons/year sediment
	Change to no-till farming on HEL fields	4 fields (68 acres)	1476 pounds/year N
			736 pounds/year P
			856 tons/year sediment
	Filter strips on un-buffered fields	4 fields (2.6 acres of filter strips)	1804 pounds/year N
			723 pounds/year P
			902 tons/year sediment
	Nutrient management planning on no-till fields	4 fields (68 acres)	Variable
			Variable
Patoka River-Calumet Run	Filter strips on un-buffered fields	4 fields (100 acres)	1564 pounds/year N
			836 pounds/year P
			782 tons/year sediment
	Change to no-till farming on HEL fields	2 fields (34 acres)	144 pounds/year N
			78 pounds/year P
			84 tons/year sediment
Polson-Bauer Creek	Filter Strips on un-buffered fields	1 field (1.1 acre of filter strip)	172 pounds/year N
			92 pounds/year P
			74 tons/year sediment
Davis Creek	Filter Strips on un-buffered fields	1 field (1.5 acre of filter strip)	237 pounds/year N
			127 pounds/year P
			103 tons/year sediment

** This measure also satisfies reductions needed for the pathogen problem*

Table 7.1.1: Recommended BMPs and locations

Map 17: Jurisdiction of Planning Entities and Planned Urban Growth



2.7 Threatened and endangered plants and animals

The Indiana Department of Natural Resources maintains a County Endangered, Threatened and Rare Species List. The list for the counties in the MPRW is in Appendix B. While these listed species historically thrived in Pike, Dubois, Spencer, and Gibson counties and presumably the MPRW, urbanization, deforestation, farming, mining, and a myriad of other environmental changes may preclude all species from fully recovering. Many types of mussels, for instance, are pollution intolerant, and area streams, with their many pollution sources, temperature fluctuations, and storm water influences, may never be able to fully support a wide variety of mussel species again.

2.8 Relationships between watershed characteristics discussed in Part 1 of the Watershed Inventory

Many items discussed in Part 1 of the Watershed Inventory relate to one another and offer stakeholders in the MPRW clues about where pollution is coming from and ideas on possible partnerships and projects that may improve the watershed.

- The need to enforce sediment control at construction sites will increase in the future once I69 and US231 are built (Map 15). The area surrounding these new roads are Highly Erodible Land (HEL) and Potentially Highly Erodible Land (PHEL), further illustrating the need for strong Rule 5 enforcement. City master plans also highlight urban areas that are slated for future growth (Map 17)

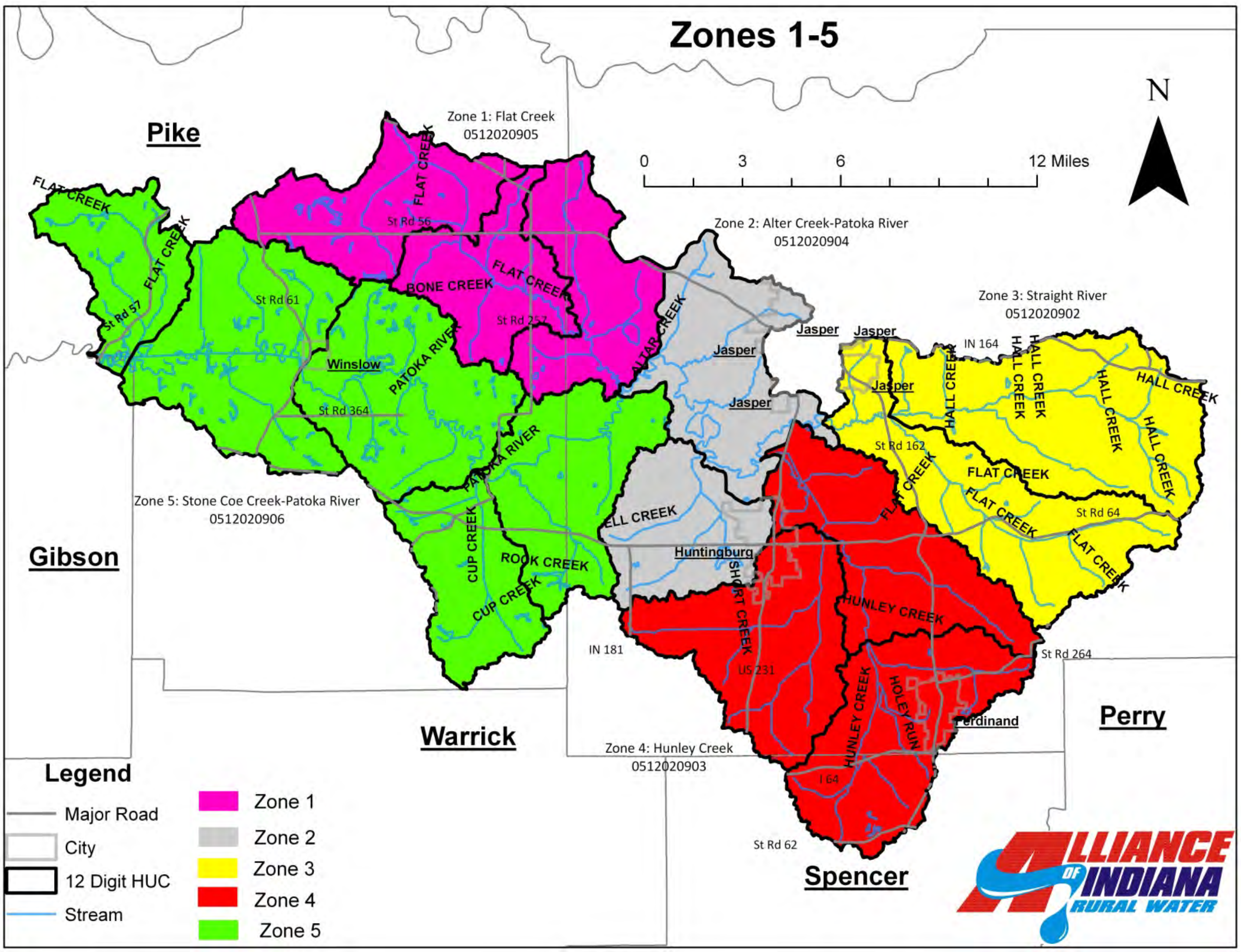
- Across the watershed, row crops are farmed on HEL. Increased use of BMPs like no-till and cover crops can reduce soil erosion.
- The public is concerned about runoff from residential and agricultural lands, hobby farm practices, sediment control at construction sites, and the spreading of poultry manure. Each issue can be addressed by BMPs, however BMPs are costly. A less expensive solution is to educate the public about each issue, its potential impact on water quality, and how they can help manage their land to benefit the entire watershed. The public sees the need for more widespread education.
- Mining occurs in the western part of the watershed, and there are signs that it will increase in the future. Mined lands must be returned to their pre-mining state. Using poultry manure to fertilize the reclaimed land may be a good alternative to spreading the manure on farm fields.
- Sulfate impairments and DNR's map of AMD Problem Areas show that mining is contributing to poor water quality in the western half of the watershed.
- Virtually all of the watershed's soils are very limited for septic systems. New development will spring up along the newly completed I69 and US231. This development should be tied into sewers or properly sited to ensure the septic systems work properly.
- There are numerous nutrient pollution sources in the MPRW. These include failing septics, farm fields, manure from livestock operations, and eroding sediment.

Chapter 3: Watershed Inventory Part 2

3. 1 Introduction to Watershed Inventory Part 2

The MPRW has Five 10 Digit HUCs. The Indiana Department of Environmental Management recommends dividing the watershed into zones as a way to provide a more detailed narrative of the data. Within the 10 Digit HUCs are smaller 12 Digit HUCs. Each 10 Digit HUC has been chosen as a zone (Map 18). Thus there are 5 zones in the MPRW. Stretching over parts of four counties, the MPRW is quite large. The second part of the Watershed Inventory has information on water quality, biological, and landuse data specific to the five zones of the watershed.

Map 18: Zones 1-5



3.2: Data and Targets

Water quality data was not gathered specifically for this study. This decision was primarily because of constraints in the project budget. Water quality data from other groups, taken over the last decade, does exist, but for the most part was not used for four reasons:

- Data sets were not collected across the entire watershed, making comparisons of water quality across the project area impossible.
- Data sets were not collected with the same methodologies.
- Very little of the data was collected over a time frame greater than 6 months and often at a frequency of only 1-3 samples.
- The data sets were not taken concurrently. Often years separated different studies.

Water quality data for this plan comes from IDEM's Impaired Streams List (Map 19), Syngenta sampling of atrazine, and models using the Spreadsheet Tool for Estimating Pollutant Load (STEPL). Figure 7 has information about parameters of water quality concerns identified by the public and the steering committee.

Figure 7: Water Quality Parameters Discussed in this Plan

Parameter	Background	Typical Sources	Sampled By	Frequency	Standard/Target
Atrazine	Atrazine is a white, crystalline solid organic compound widely used for control of broadleaf and grassy weeds. Effective in 1993, its uses were greatly restricted. Some people who drink water containing atrazine well in excess of the maximum contaminant level (MCL) for many years could experience problems with their cardiovascular system or reproductive difficulties.[20]	Applied to farm fields.	Syngenta	Atrazine was sampled twice a month except during April, May, and June when it was sampled every week. Winslow sampling was from April 2003 through December 2010. Jasper sampling was April 2003 through April 2009, but not done in the MPRW.	Concentrations of atrazine and its degradates in raw water below an average of 37.5 ppb over a 90-day period ensures protection of pregnant women and all others, and concentrations of atrazine in finished water that do not exceed 3 ppb as an annual average to protect consumers from longer term chronic effects.[21]

[20] http://water.epa.gov/drink/contaminants/basicinformation/atrazine.cfm#one 5.31.2011
[21] http://www.epa.gov/opp00001/reregistration/atrazine/atrazine_update.htm 5.16.11

Parameter	Background	Typical Sources	Sampled By	Frequency	Standard/Target
E. coli	E. coli is one member of a group of bacteria that comprise the fecal coliform bacteria and is used as an indicator organism to identify the potential for the presence of pathogenic organisms in a water sample. Pathogenic organisms can present a threat to human health by causing a variety of serious diseases, including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses.	Septic systems, wildlife waste, livestock	IDEM	5 times over the course of a month at 72 sites. Sites were visited between 2000 and 2010.	Indiana Water Quality Standard: Shall not exceed 125 cfu per 100 ml as a geometric mean based on not less than 5 samples equally spaced over a 30 day period nor exceed 235 cfu per 100 ml in any 1 sample in a 30 day period
Nutrients	Nutrients commonly refers to nitrogen and phosphorus. Both are needed for plant life to thrive, but in excess, especially phosphorus, can disrupt water chemistry.	Septic systems, wildlife waste, livestock manure, lawn fertilizers, sewage treatment plants	IDEM	94 sites spread across the 2001, 2006, and 2007 sampling seasons. Between 1 and 4 samples were taken at each site.	In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events. • Total Phosphorus: One/more measurements >0.3 mg/l • Nitrogen (measured as NO3 + NO2) -- One/more measurements >10.0 mg/l • Dissolved Oxygen (DO) -- Measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0- 5.0 mg/l or values >12.0 mg/l • pH measurements -- Measurements above the water quality standard of 9.0 or measurements that are

					consistently at/close to the standard, in the range of 8.7-9.0 Algal Conditions -- Algae are described as "excessive" based on field observations by trained staff.
Parameter	**Background**	**Typical Sources**	**Sampled By**	**Frequency**	**Standard/Target**
Dissolved Oxygen	The dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms.	Organic waste: septic systems, livestock manure	IDEM	99 sites spread across the 2001, 2006, and 2007 sampling seasons. Between 1 and 12 samples were taken at each site.	Fish need at least three to five mg/L of DO. Indiana Water Quality Standard: Min: 4.0 mg/L Max: 12.0 mg/L
Sulfates	Sulfate comes from the breakdown of sulfur minerals in rocks and soils.	Sources include mines, coal combustion, and wastewater treatment plants.	IDEM	92 sites spread across the 2001, 2006, and 2007 sampling seasons. Between 1 and 4 samples were taken at each site.	Sulfate criterion depends on ranges of hardness (in mg/l as CaCO3) or chloride (in mg/l) or both—for more details see 327 IAC 2-1-6 (5).
Total Dissolved Solids	Total Dissolved Solids (often abbreviated TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in: molecular, ionized or micro-granular (colloidal sol) suspended form. Generally the operational definition is that the solids must be small enough to survive filtration through a sieve the size of two micrometer. TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants.	Primary sources for TDS in receiving waters are agricultural and residential runoff, leaching of soil contamination and discharge from industrial or sewage treatment plants. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient runoff, general storm water runoff and	IDEM	85 sites spread across the 2001, 2006, and 2007 sampling seasons. Between 1 and 4 samples were taken at each site.	Total dissolved solids, were evaluated for the exceedance(s) of Indiana's WQS for point of water intake and the number of times the exceedance(s) occurred. For any single pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements. A TDS impairment is defined as more than one exceedance of the acute or chronic criteria for human health within a three-year period.

		runoff from snowy climates where road de-icing salts are applied.			
Parameter	**Background**	**Typical Sources**	**Sampled By**	**Frequency**	**Standard/Target**
Impaired Biotic Communities (IBC)[22]	Aquatic invertebrates and fish make good indicators of watershed health because they live in the water for all or most of their lives, stay in areas suitable for their survival and differ in their tolerance to amount and types of pollution. An IBC listing implies that these populations are not as diverse as they could be. The Qualitative Habitat Evaluation Index (QHEI) is an index designed to evaluate the lotic habitat quality important to aquatic communities and is used in conjunction with Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) and/or Fish Commuity (IBI) data to evaluate the role that habitat plays in waterbodies where IBC have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. A higher QHEI score represents a more diverse habitat for colonization of aquatic organisms. For streams where the macroinvertebrate and/or fish community (mIBI and/or IBI) scores indicate IBC, QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities or if there may be other stressors/pollutants causing the IBC.	Source of IBC can be water temperature, siltation, and low DO	IDEM	35 sites spread across the 1996, 2001, and 2006 sampling seasons. 1 sample was taken at every site.[23]	Not Supporting Biotic Communities: QHEI total score of <51 indicates poor habitat. • mIBI <1.8 (for samples collected with an artificial substrate sampler) • mIBI <2.2 (for samples collected using kick methods) IBI <36
Mercury	Mercury is a metal linked to human development disorders.	Mercury is naturally occurring, but is also emitted from coal fired power plants	IDEM	70 sites spread across the 2001, 2006, and 2007 sampling seasons. Between 1 and 12	> 0.3 mg/kg in fish tissue

[22] Adopted from IDEM's Consolidated Assessment Listing Methodology: http://www.in.gov/idem/nps/files/watersheds_methodology_calm.pdf 11.7.11

[23] Davis, Todd E. November 4, 2011. [Personal Communication]. Located at: Indiana Department of Environmental Management (IDEM), Assessment Information Management System (AIMS) Database, Indianapolis, Indiana.

				samples were taken at each site.	
Parameter	**Background**	**Typical Sources**	**Sampled By**	**Frequency**	**Standard/Target**
Polychlorinated biphenyls (PCBs)	PCBs are man-made compounds commonly used in electrical components. They are tied to carcinogenic and non-carcinogenic impacts.	PCBs are man-made compounds commonly used in electrical components. They are no longer used.	IDEM	4 sites during the 2001 sampling seasons. Approximately 12 samples taken at each site.	> 0.02 mg/kg in fish tissue
Lead	Lead is a metal linked to human development disorders.	Lead commonly comes from industrial practices.	IDEM	92 sites spread across the 2001, 2006, and 2007 sampling seasons. Approximately 12 samples taken at each site.	Indiana Water Quality Standard: 50 µg/L
Biological Oxygen Demand (BOD)	The amount of oxygen taken up by microorganisms that decompose organic waste matter in water. A high BOD indicates the presence of a large number of microorganisms, which suggests a high level of pollution.	Organic waste: Urban storm water, septic systems, wildlife/pet waste.	Not sampled. Runoff modeled by STEPL. See 3.2.1 for STEPL informati on.	STEPL run in May, 2011.	Without stream flow data, STEPL cannot provide a target.
Sediment	All particles suspended and dissolved in water.	Sediment from erosion and urban storm water, as well as organic matter and trash.	Not sampled. Runoff modeled by STEPL.	STEPL run in May, 2011.	Without stream flow data, STEPL cannot provide a target.
Total Nitrogen	There are three forms of nitrogen that are commonly measured in water bodies: ammonia, nitrates and nitrites. Total nitrogen is the sum of total kjeldahl nitrogen (organic and reduced nitrogen), ammonia, and nitrate-nitrite.[24]	Wastewater treatment plants, runoff from fertilized lawns and croplands, failing septic systems, runoff from animal manure and storage areas, and	Not sampled. Runoff modeled by STEPL.	STEPL run in May, 2011.	Without stream flow data, STEPL cannot provide a target.

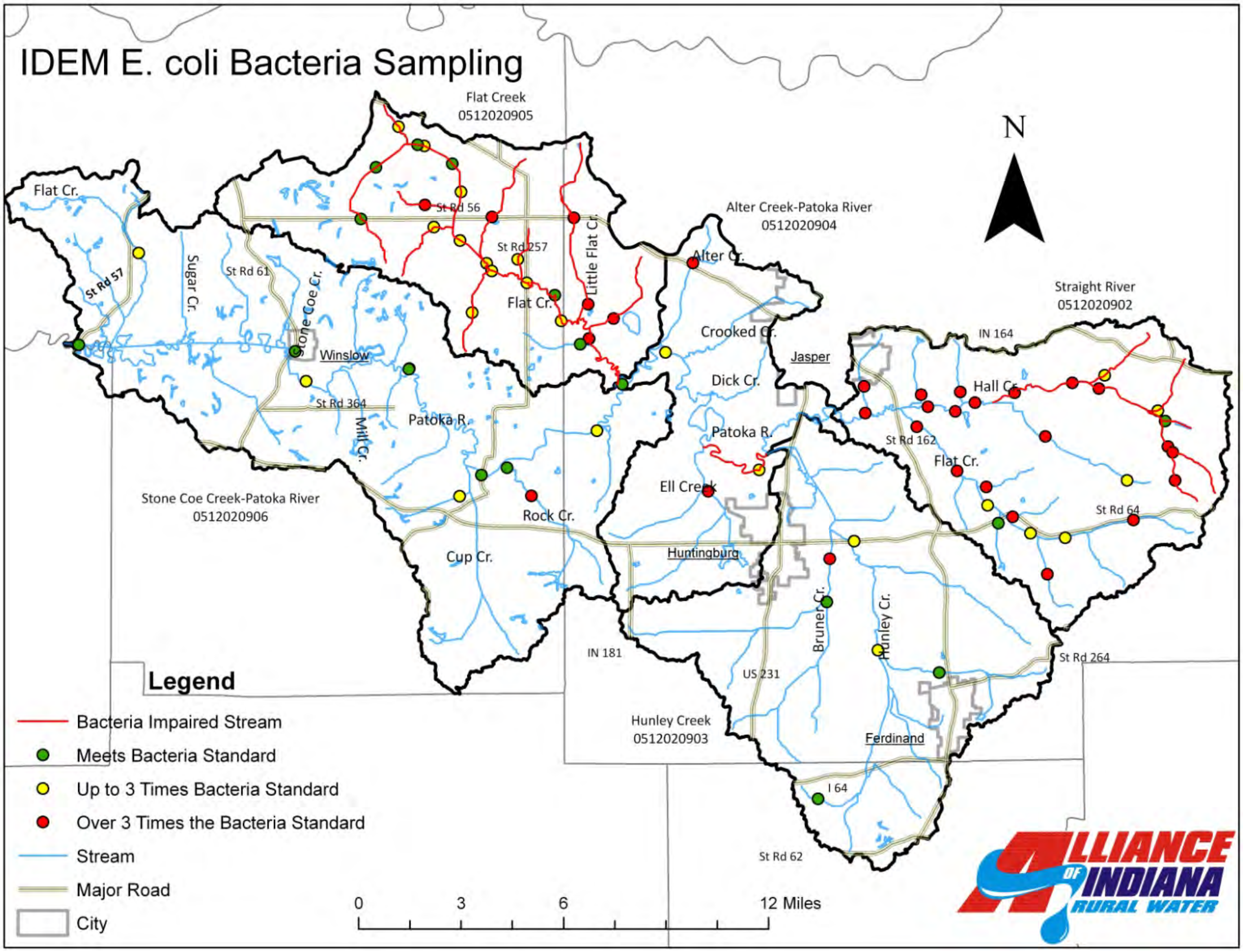
[24] http://www.epa.gov/region9/water/tribal/pdf/cwa-reporting/Total-Nitrogen.pdf 5.31.2011

		industrial discharges.[25]			
Parameter	**Background**	**Typical Sources**	**Sampled By**	**Frequency**	**Standard/Target**
Total Phosphorus	A measure of both dissolved and particulate forms of phosphorus	Wastewater treatment plants, septic systems, wildlife/pet waste, and lawn fertilizers	Not sampled. Runoff modeled by STEPL.	STEPL run in May, 2011.	Without stream flow data, STEPL cannot provide a target.

Members of the steering committee were concerned about the distribution of E. coli across the watershed and asked for that data to be mapped (Map 19). Sampling sites for the other parameters listed in Figure 7 are mapped in Sections 3.3, 3.4, 3.5, 3.6, and 3.7.

[25] Ibid.

Map 19: IDEM E. coli Bacteria Sampling



3.2.1 STEPL Model

In the absence of a water quality sampling program, the Alliance turned to a USEPA approved computer model called the Spreadsheet Tool for Estimating Pollutant Load (STEPL) to estimate the amount of runoff pollution in the watershed. Though STEPL is a model, it does take real world data like soil type, annual rain fall, land use, number of septics, and type of farm animals into account. Using STEPL, loads of nitrogen, phosphorus, Biological Oxygen Demand (BOD), and sediment runoff pollution per acre per year in each of the 12 digit HUCs were calculated (Figure 8). Those calculations gave a watershed-wide high and low value of each pollutant per acre per year. The range between those high and low values was divided into three equal parts, which provides a relative way to compare pollutant runoff across different HUCs (Figure 8). Maps 20-23 show the STEPL results.

Figure 8: Raw STEPL Data

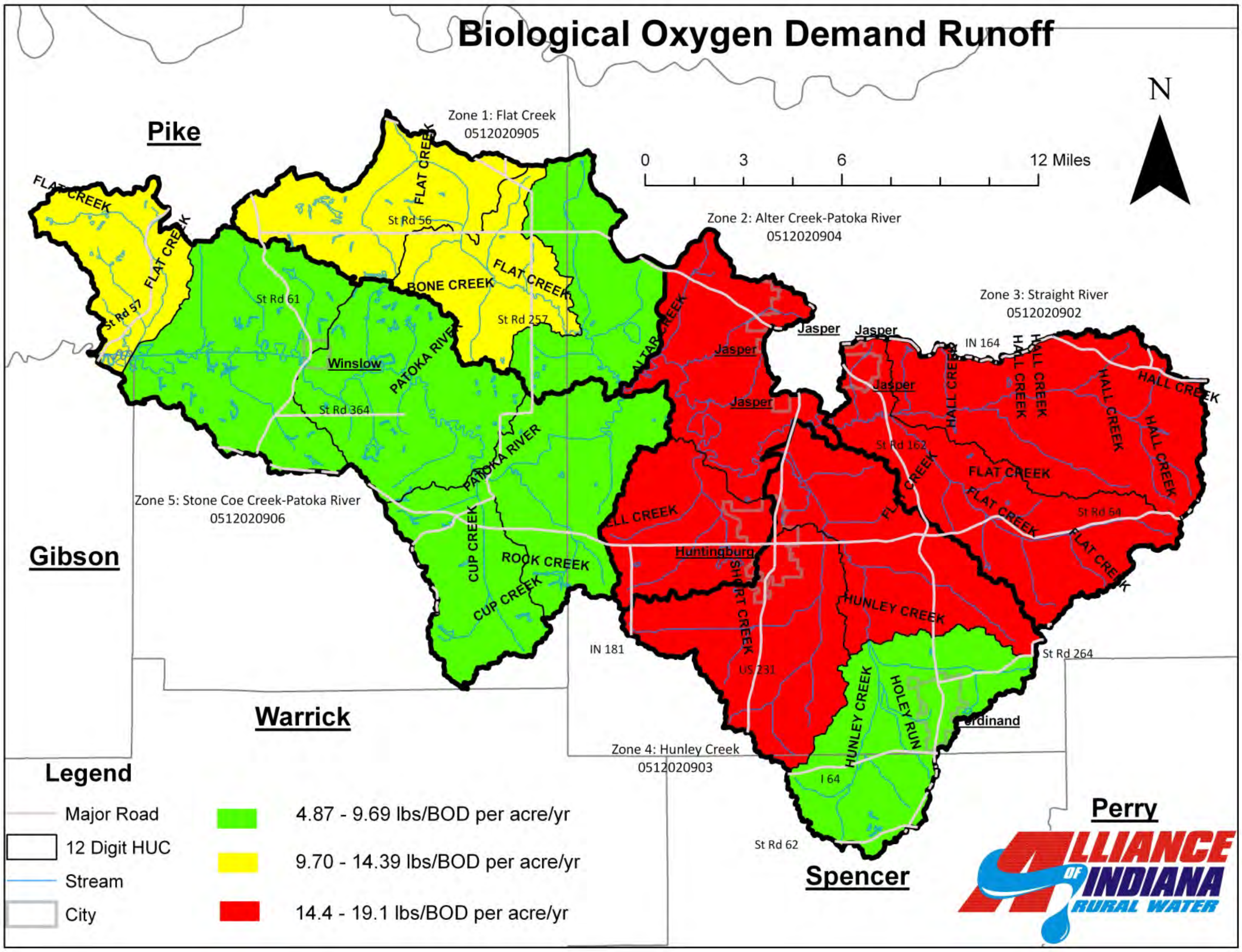
	Nitrogen Runoff lbs/acre/yr	Phosphorus Runoff lbs/acre/yr	BOD Runoff lbs/acre/yr	Sediment Runoff t/acre/yr
Zone 1				
headwaters flat	7.9	1.6	11.3	0.4
Bone/Flat Creek	8.1	1.8	13.8	0.4
Little Flat Creek	2.73	0.72	5.85	0.15
Zone 2				
Ell Creek	11.5	2.34	19.1	0.4
Crooked Creek	11.5	2.22	16.7	0.41
Zone 3				
Hall Creek	9.23	1.66	15	0.21
Rickland/Flat	8.87	1.65	14.8	0.2
Zone 4				
Green/Hunley	5.6	1.01	8.6	0.18
Bruner Creek	11.6	2.21	17.1	0.41
Indian/Hunley	9.9	1.94	16	0.28
Zone 5				
Flat Creek	6.6	1.4	12.6	0.3
Sugar Creek	3.6	0.75	6.63	0.13
Mill Creek	2.38	0.54	4.87	0.07
Rock Creek	2.61	0.61	5.57	0.11
Cup Creek	4.1	0.9	8.5	0.1

As described in 3.2.1 and Figure 8, Green=Low Runoff, Yellow=Medium Runoff, and Red=High Runoff

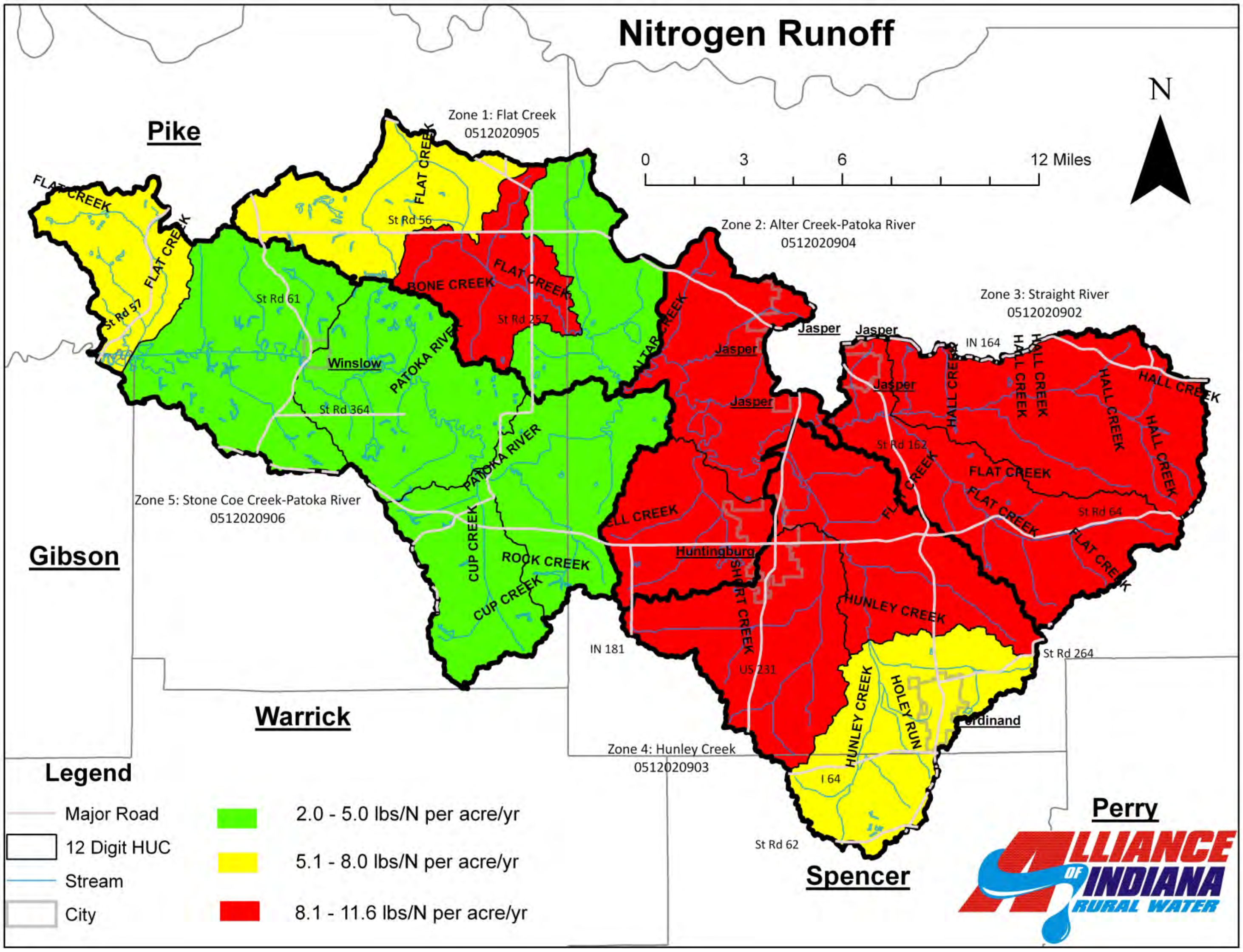
Figure 9: Values Used to Compare STEPL Runoff

Parameter	Low Runoff	Medium Runoff	High Runoff
BOD	4.87-9.69 lbs/acre/year	9.70-14.39 lbs/acre/year	14.4-19.1 lbs/acre/year
Nitrogen	2.0-5.0 lbs/acre/year	5.1-8.0 lbs/acre/year	8.1-11.6 lbs/acre/year
Phosphorus	0.54-1.14 lbs/acre/year	1.15-1.74 lbs/acre/year	1.75-2.34 lbs/acre/year
Sediment	140-380 lbs/acre/year	381-620 lbs/acre/year	621-880 lbs/acre/year

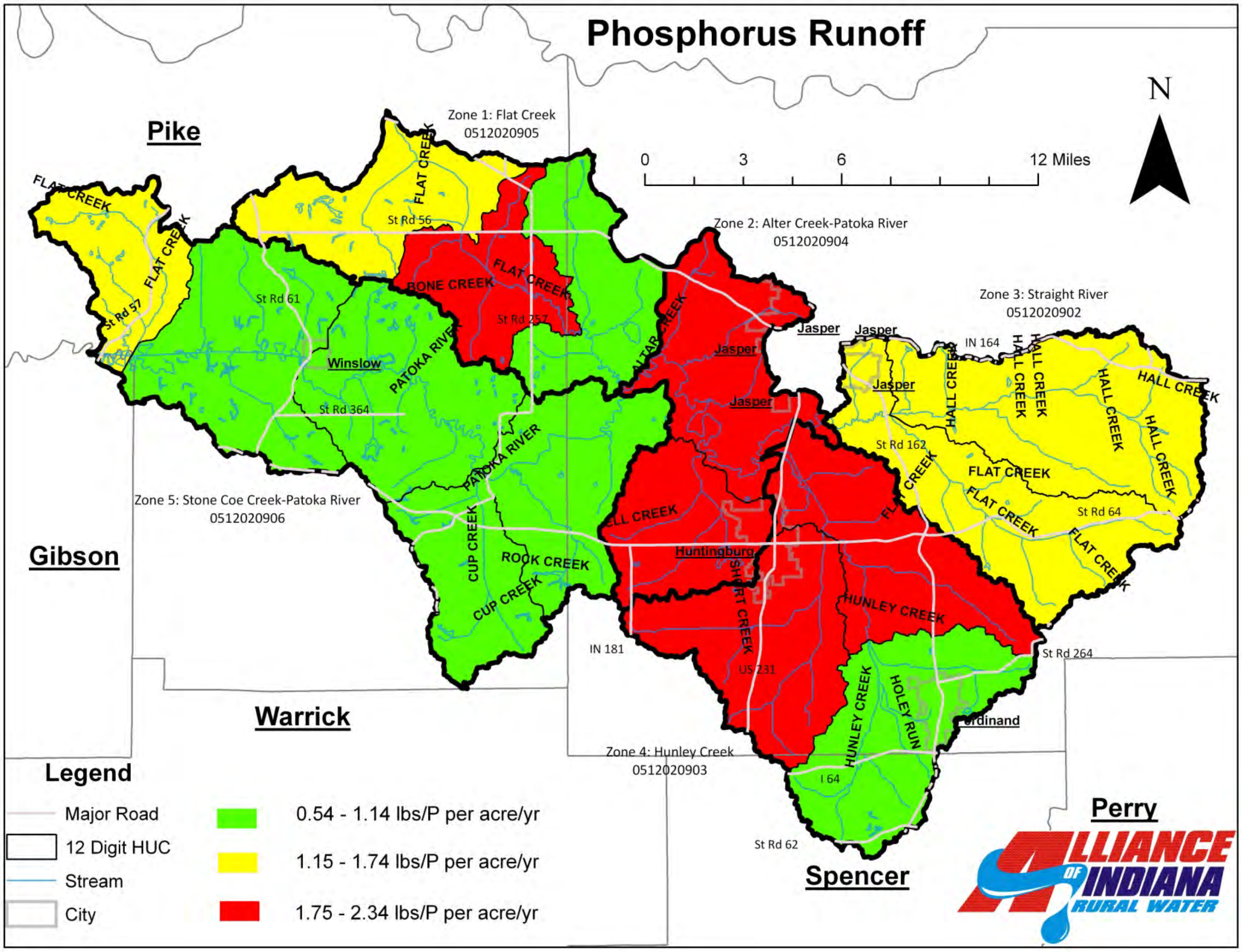
Map 20: BOD Runoff



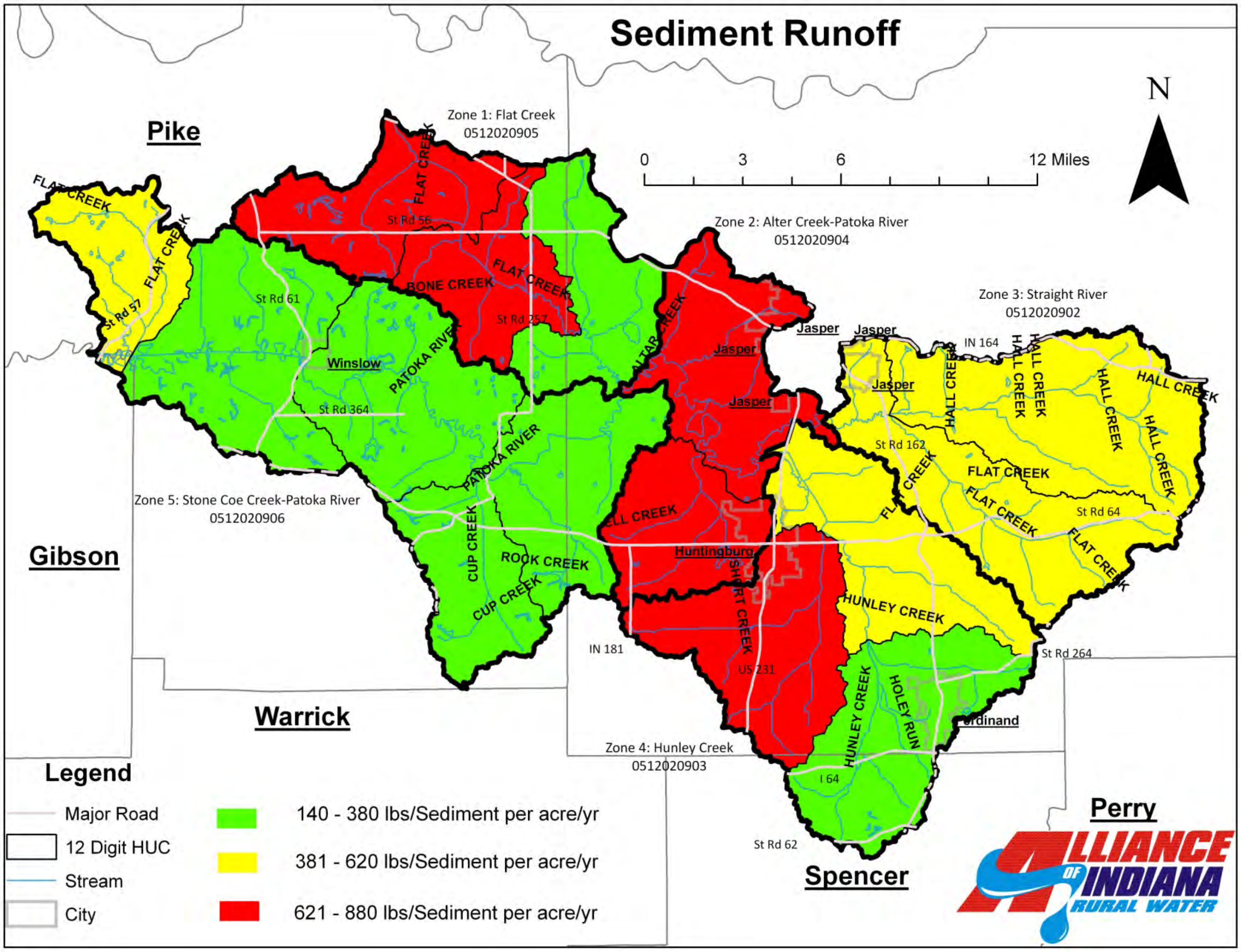
Map 21: Nitrogen Runoff



Map 22: Phosphorus Runoff



Map 23: Sediment Runoff



3.2.2 Windshield and Desktop Surveys

During March and April, 2011, the Alliance conducted a windshield survey to gather information about some of the public concerns. A windshield survey is done by driving an area and taking note of what is seen on the landscape. Each 12 Digit HUC was surveyed and the location of trash dumping, farm field erosion, animal access to a stream, AMD, log jams, and areas of septic groups were mapped. Animal access to a stream was defined as any area where it was obvious that livestock animals enter the water; animals didn't have to be present for the site to be mapped. Some of the animal access sites may also be hobby farms; but in general this study was unable to differentiate a hobby farm from an animal farm that did not meet the definition of a CFO. A septic group was defined as a group of at least 10 homes or businesses outside of a municipal sewer system and all within a squared quarter mile. On average it took 4 hours to survey each HUC, and at least 75% of the watershed's roads were driven. Hall Creek and Richland-Flat Creek Watersheds were surveyed last. Garlic mustard was out in the fields, making it difficult to know if every area of erosion was visible.

The Alliance also did a desktop survey of stream buffers. A buffer is the vegetation on a stream's bank. This vegetation helps secure the bank against erosion and filters sediment, nutrients, and other pollutants that runoff the land towards the stream. The best buffers will have trees that also shade the stream and help regulate its water temperature. However, in an agricultural watershed like the Middle Patoka River, tree buffers are very rare. For this project, a 'Good' buffer was defined as 20 feet or more of grass/trees. A buffer 'Needing Improvement' was 10-19 feet of grass/trees, and a 'Poor' buffer was anything less than 10 feet wide. Streams which showed up on the State's computer file of streams, but couldn't be located on Google Earth were also mapped. The buffer maps were made by locating a stream on Google Earth and using the measuring tool to determine the buffer type. Often a stretch of stream had several different buffer types, so the type with the biggest ratio with respect to the whole stretch was used. A stream buffer survey of a watershed this size is very uncommon. Users of these maps should keep three things in mind.

- Differentiating between a grass buffer and other types of vegetation, such as crops, was sometimes difficult.
- Just because a buffer was labeled as 'Good', doesn't mean that pollutant sources such as cattle or chemical spreaders couldn't impact the stream.
- The buffer maps should be field verified before any resource management decisions are made.

210.5 miles of stream buffer (19.06%) in the MPRW were rated as either Needing Improvement or Poor. If you only consider Zones 1-4—because Zone 5 is nearly entirely forested and its results skew the data—197.17 miles of stream buffer (27.3%) were rated as either Needing Improvement or Poor.

Plate 13: Grass Buffer

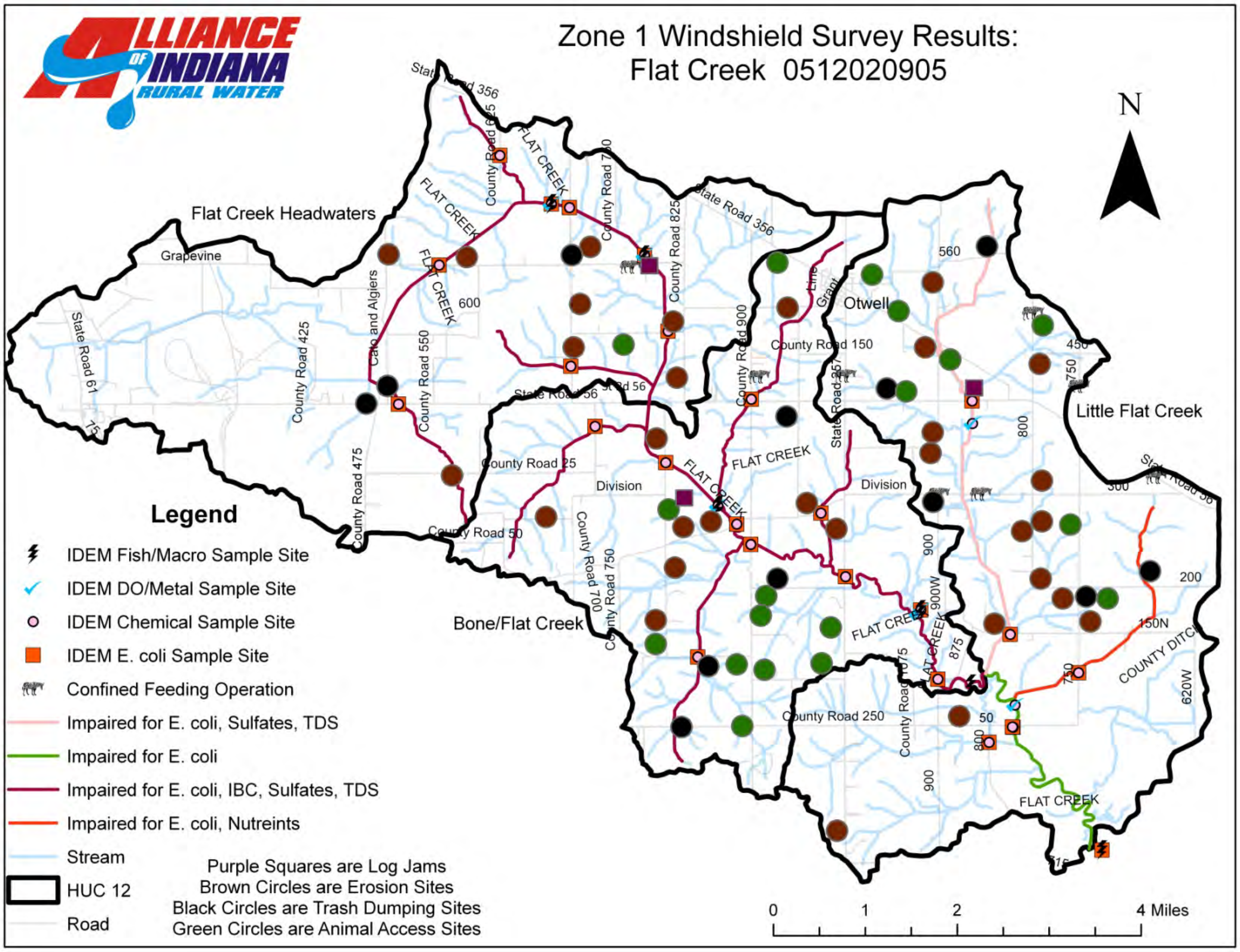
Plate 14: Tree Buffer

The windshield and desktop surveys were done to give the steering committee as much on the ground data to use in their decision making as possible. While the maps do pinpoint the general location of areas needing improvement, they were not made to single out any one landowner. Rather, taken alongside the STEPL results, the windshield survey and buffer maps can help direct education or cost-share opportunities to areas of the watershed where they are most needed.

<u>3.3: Zone 1</u>

Zone 1 is the 10 Digit HUC Flat Creek (0512020905). The zone has three 12 Digit HUCs within it. From west to east, they are Flat Creek Headwaters, Bone/Flat Creek, and Little Flat Creek. The small village of Otwell sits in the northern part of Zone 1 at the intersection of St. Rd. 257 and St. Rd. 356. The windshield survey for Zone 1 was done on March 8, 9, and 15, 2011.

Map 24: Zone 1 Windshield Survey



3.3.1: Zone 1 Water Quality Information

The data shows that E. coli, Sulfates, Total Dissolved Solids, Nutrients, Sediment, Nitrogen, and Phosphorus are water quality issues in Zone 1.

Zone 1 water quality information comes from STEPL modeling and IDEM's impaired list of waterbodies. IDEM's data shows very few nutrient problems: across the zone, only one nitrogen sample and 3 phosphorus samples exceeded the water quality target (see Figure 7 for list of targets). One stream segment in Little Flat Creek subwatershed is listed as impaired for nutrients. Each subwatershed had exceedances of the DO standard, but no impairments were declared. Flat Creek and its major tributaries are all impaired for E. coli (Map 19). 23 IDEM bacteria sites are in Zone 1. 26% of the sites meet the bacteria standard, 48% exceed the standard by up to three times the limit, and 26% exceed the water quality standard by over 3 times. Other water quality impairments in Flat Creek Headwaters and Bone/Flat Creek subwatersheds include sulfates, and TDS. A common source of sulfates is mining which occurs north of St. Rd. 56. The TDS likely comes from the agricultural land in Zone 1. In addition to nutrients, Little Flat Creek subwatershed is impaired for E. coli and TDS.

Noteworthy STEPL results include the high nitrogen and phosphorus runoff in Bone/Flat Creek subwatershed and the medium nitrogen and phosphorus runoff in Flat Creek Headwaters subwatershed. STEPL also showed medium Biological Oxygen Demand (BOD) runoff, and high sediment runoff in Flat Creek Headwaters and Bone Flat Creek subwatersheds. Organic pollution sources like septic systems and animal waste cause BOD. Nutrients are an organic pollution, so a link may exist between the BOD and the nutrients runoff results. The nutrient phosphorus binds easily to sediment, so the high sediment runoff likely helps contribute phosphorus to the streams too.

3.3.2: Zone 1 Macroinvertebrate/Fish Information

All of the main stems and major tributaries in Flat Creek Headwaters and Bone/Flat Creek subwatersheds are impaired for biotic communities (IBC). Biotic communities refer to fish and benthic macroinvertebrates— animals lacking backbones (invertebrate), which can be seen with the naked eye (macro), and live part of their lives on or in the bottom (benthos) of a body of water.

Plate 15: Benthic Macroinvertebrates

There are many advantages of using benthic macroinvertebrates to assess the quality of a stream. The benthic macroinvertebrates are good indicators of localized conditions, as many of the animals have limited migration patterns. Most species have a complex life cycle of one year or more. Sensitive life stages will respond quickly to stress; the overall community will respond more slowly. Robust macroinvertebrate populations need a streambed with areas of rocks and gravel to thrive. Eroded sediment deposited on the stream-bed can smother bottom-dwelling communities and alter habitat by filling in holes and depressions. Suspended solids can reduce light penetration and therefore limit photosynthesis, with consequences for macroinvertebrate diversity and numbers.[26]

The STEPL loading may help explain the IBC. High sediment runoff corresponds to the same areas impaired for impaired biotic communities. Organic pollution also causes IBC, and Flat Creek Headwaters and Bone/Flat Creek subwatersheds had medium levels of BOD runoff.

3.3.3: Zone 1 Landuse Information

Zone 1 is relatively flat on the west side and the relief generally increases as one moves east. Surface mining occurs on the west side of Zone 1. On the east side, Little Flat Creek and one of its tributaries are legal drains.

[26] http://www.mchd.com/wq/html/macroinvertebrate.htm 6.3.2011

Plate 16: Dredging a Ditch

Zone 1's largest landuses are cultivated crops and forest. Runoff from forestry practices is not a public concern, and the

Plate 17: Field Erosion in Zone 1

windshield survey only found two logging site in the entire watershed (Zone 1 and Zone 5). However, both sites lacked any erosion control.

Plate 18: Zone 1 Logging Site

Depending on how it's managed, crop land contributes sediment, nutrients, and storm water runoff. Eight CFOs are in Zone 1 and while no permit compliance issues were found, manure spread from those facilities on agricultural fields may contribute to the nutrient and TDS impairments. In the headwaters, near St. Rd. 61 along St. Rd. 56 there is reclaimed mine land and existing mines. The intersection of St. Rds. 61 and 56 also has Pike County High School. Besides the high school, the only other large urban area is the village of Otwell in Little Flat Creek subwatershed. Otwell's citizens use private wells for drinking water. The village has a lagoon system for their wastewater. Three septic groups were found in Zone 1 (Map 11)

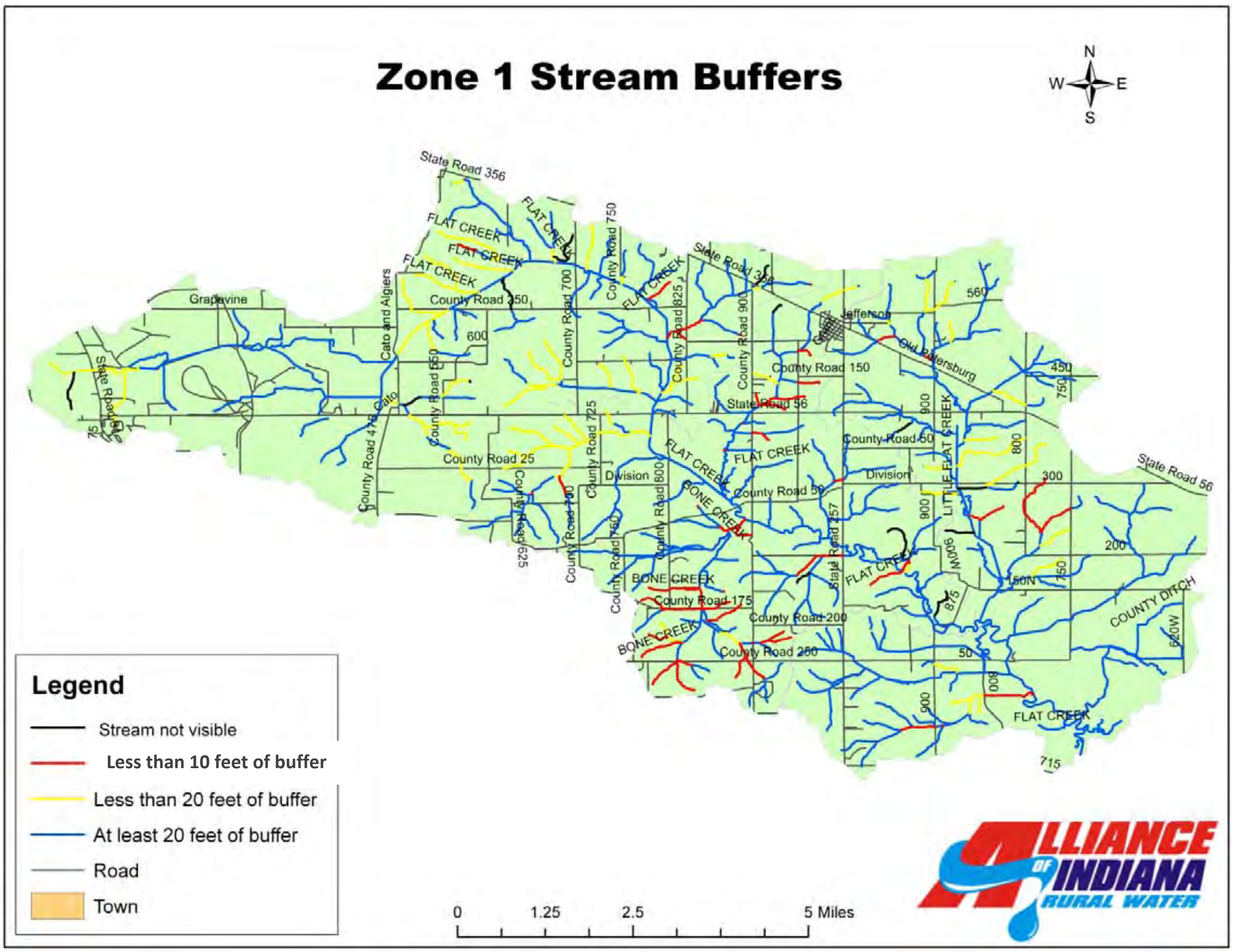
Windshield survey results for Zone 1 are in Figure 9.

Figure 10: Zone 1 Windshield Survey Results

Windshield Survey Discovery	Number in Zone 1	Number per 10,000 acres (Zone 1 has 26,125 acres)
Erosion Site	31	8.2
Trash Dumping Site	12	3.1
Animal Access to Stream Site	18	4.7
AMD Site	0	0
Log Jam Site	3	.79

Bone/Flat Creek subwatershed had the highest number of animal access sites and the second highest number of erosion sites in Zone 1. That subwatershed also has high sediment and nutrient runoff. Landuse shows that Zone 1 has forests bordering many of its major streams and some of their headwaters. Within Zone 1, Bone/Flat Creek has the greatest number of poor buffers and Flat Creek Headwaters the greatest numbers of buffers needing improvement. Generally speaking, the presence of farmland creates a buffer that is less than 20 feet in width. Overall, Zone 1 has 50.42 miles of stream buffers (26.5% of the total stream miles) rated as either Needing Improvement or Poor.

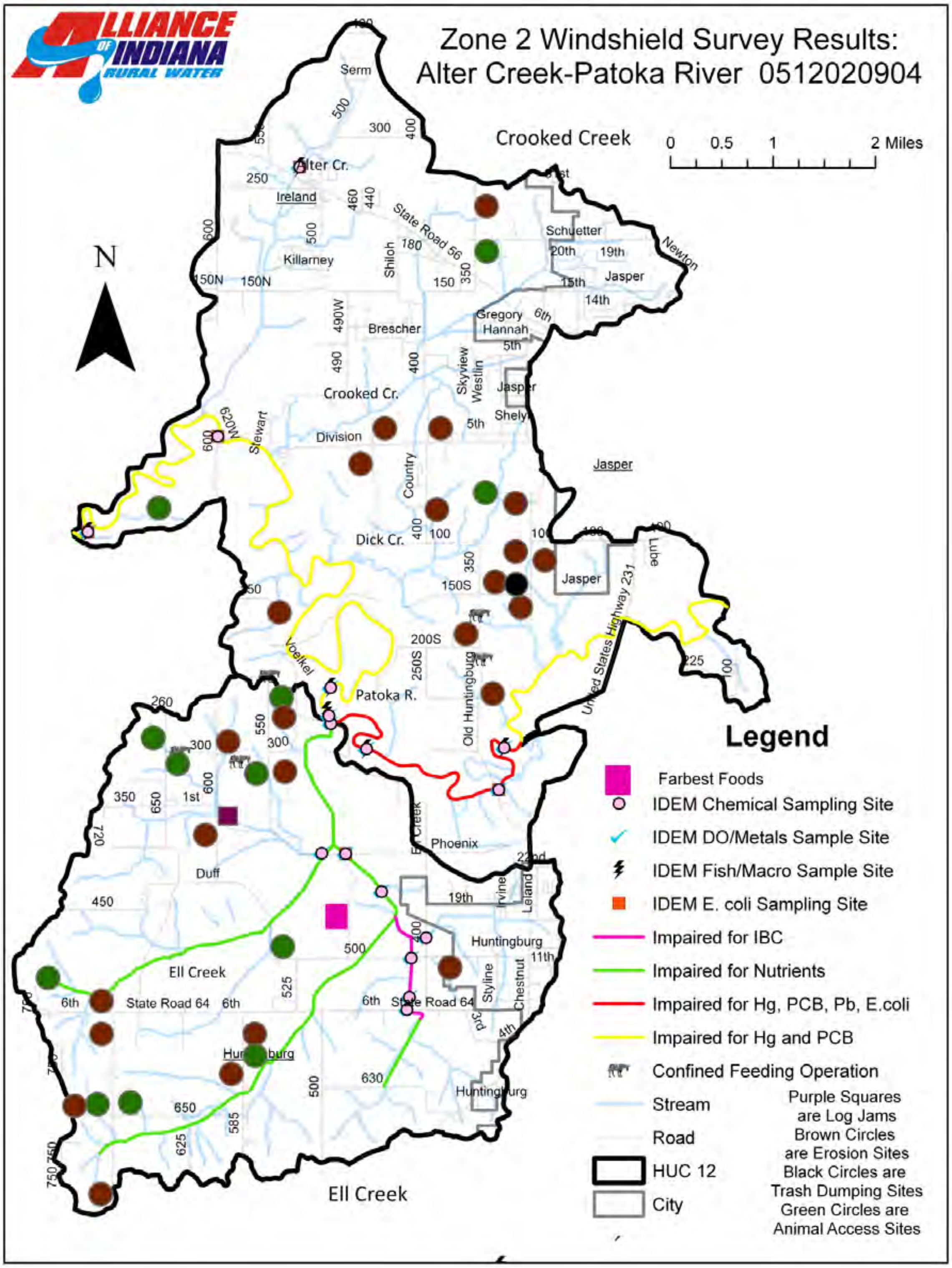
Map 25: Zone 1 Stream Buffers



3.4: Zone 2

Zone 2 is the 10 Digit HUC Alter Creek-Patoka River (0512020904). The zone has two 12 Digit HUCs within it. From north to south they are Crooked Creek and Ell Creek. The small village of Ireland sits in the northern part of Zone 2. Parts of Jasper and Huntingburg are also in this Zone. The windshield survey for Zone 2 was done on March 29 and 30 and April 19 and 26, 2011.

Map 26: Zone 2 Windshield Survey Results



3.4.1: Water Quality Information

The data shows that Hg, PCB, Pb, E. coli, BOD, Sediment, Nitrogen, and Phosphorus are water quality issues in Zone 2.

Zone 2 water quality information comes from STEPL modeling, IDEM's impaired list of waterbodies, and Syngenta's atrazine sampling, which was taken just outside of the project area but discussed here because it relates to the drinking water of the Middle Patoka River Watershed. IDEM's data shows 22 phosphorus samples in Crooked Creek subwatershed that exceed the standard. However, these are not coupled with nitrogen exceedances, so no streams were impaired for nutrients. At the lower end of Crooked Creek subwatershed a sampling station sits at a segment that's impaired for IBC (see Map of Zone 2). At this site, DO exceeded the water quality standard 22 times, however an impairment was not declared because the exceedances were not close enough together and did not constitute a large enough percentage of all the samples taken[27]. All of the Patoka River in southern Crooked Creek subwatershed is impaired for Hg and PCB in fish tissue. A stretch is also impaired for Pb and E. coli. The Pb and PCBs likely are legacy pollutants from Jasper's industrial past. Mercury (Hg) can also be a legacy pollutant, but is also associated with coal fired power plants. Five IDEM bacteria sites are in Zone 2. One of them meets water quality standards, two have bacteria counts up to 3 times the standard, and two have counts over 3 times the standard. In Ell Creek subwatershed, the main stem and the three main tributaries are impaired for nutrients. All of the STEPL parameters have high runoff. The atrazine sampling represents data from upstream of the MPRW. No violations were found, so atrazine is not a concern for Jasper Water customers.

3.4.2: Macroinvertebrate/Fish Information

The only IBC stream in Zone 2 is a 1,300 foot long outlet of Huntingburg City Lake that flows to Ell Creek. The outlet is a poorly buffered ditch that runs through farm fields, so its IBC impairment is not a surprise.

3.4.3: Landuse

The middle of Zone 2 has a history of surface mining and a small amount of underground mining. Zone 2's largest current landuses are cultivated crops, pasture, and forest. There are five CFOs in Zone 2 and none had permit compliance issues. The Zone also has urban landuse. All of the urban areas in Zone 2 contribute runoff pollution. These include bacteria, nutrients, and storm water. Typical urban sources are residential and commercial lawns, storm water ponds, and impervious surfaces. Storm water ponds collect polluted runoff from impervious parking lots and roofs and slowly release it into nearby streams. They are hot spots for urban pollution and offer good opportunities to improve water quality.

The Village of Ireland and the northwest part of Jasper are in Crooked Creek subwatershed. Jasper's origins can be traced back to where the current Jasper City Mill now stands along the Patoka River. The river was important to Jasper's early settlement and served as a means of transportation for goods and services and as a source of water power for grist mills. Today, the city is the largest urban area in Dubois County, although most of the city is not within the boundaries of the MPRW. However, the part of Jasper expected to grow the most is in the watershed, as is Jasper Country Club's golf course. The windshield survey found three storm water ponds in the part of Jasper that overlaps with the project area: Jasper High

[27] As explained in IDEM, Consolidated Assessment Listing Methodology. Page B-3 http://www.in.gov/idem/nps/files/watersheds_methodology_calm.pdf

Plate 19: Example Storm water Pond

School, St. Charles Medical Plaza (next to Jasper High School) and The Church of Jesus Christ of Latter Day Saints (across the street from the High School).

The northwest part of Huntingburg is in Ell Creek subwatershed (Zone 4 also has part of Huntingburg in it). The city has two connections with the Patoka Lake Regional Water District to augment the city lake as the primary water source. Since the city lake is a drinking water source, it's protected by conservation district zoning. In 2003 the water division completed an 8.5 million dollar State Revolving Loan Fund (SRF) water project that included the construction of a state-of-the-art water treatment facility, over two miles of new and replacement water mains, plus an additional 750,000 gallon Water Storage Tank for improved fire protection and pressure. The water system for the City of Huntingburg has maintained the best rating possible (Class 5 Rating) for a community of its size with the ISO (Insurance Services Office). Huntingburg has a nine hole golf course in Zone 2, and its area of expected growth, the northwest corner of town, is also in Zone 2. The windshield survey found three storm water ponds in Huntingburg: Memorial Health Care Center and the Wellness Center (both on the north side of town along US 231) and Southridge High School. The north side of town has approximately 1 mile of several large drainage ditches along US 231 that collect storm water.

Plate 20: Ditches along US 231

Urban areas also have point sources of pollution. A point source is a factory or industry that is permitted to discharge a certain amount of wastewater into local streams. The only point source that was a public concern is Farbest Foods Inc. outside of

Huntingburg. Farbest processes turkeys and members of the public were concerned that their lagoon was being used as a settling pond for the turkey blood and then emptied into a nearby tributary. The Alliance visited the plant and spoke on the phone with Farbest Food Inc.'s President. The lagoon is part of the plant's wastewater treatment facility. While the concern about blood being discharged to a tributary is incorrect, Farbest has had some violations in their discharge permit. According to IDEM and USEPA, their permit is in noncompliance for violations in the amounts of ammonia, Carbonaceous Biochemical Oxygen Demand, E. coli, Total Suspended Solids, and oil and gas discharged between June 2006 and May 2009. Farbest is currently spending $5.5 million to upgrade their wastewater treatment plant as part of their compliance agreement with IDEM.

Four septic groups were found in Zone 2 (Map 11).

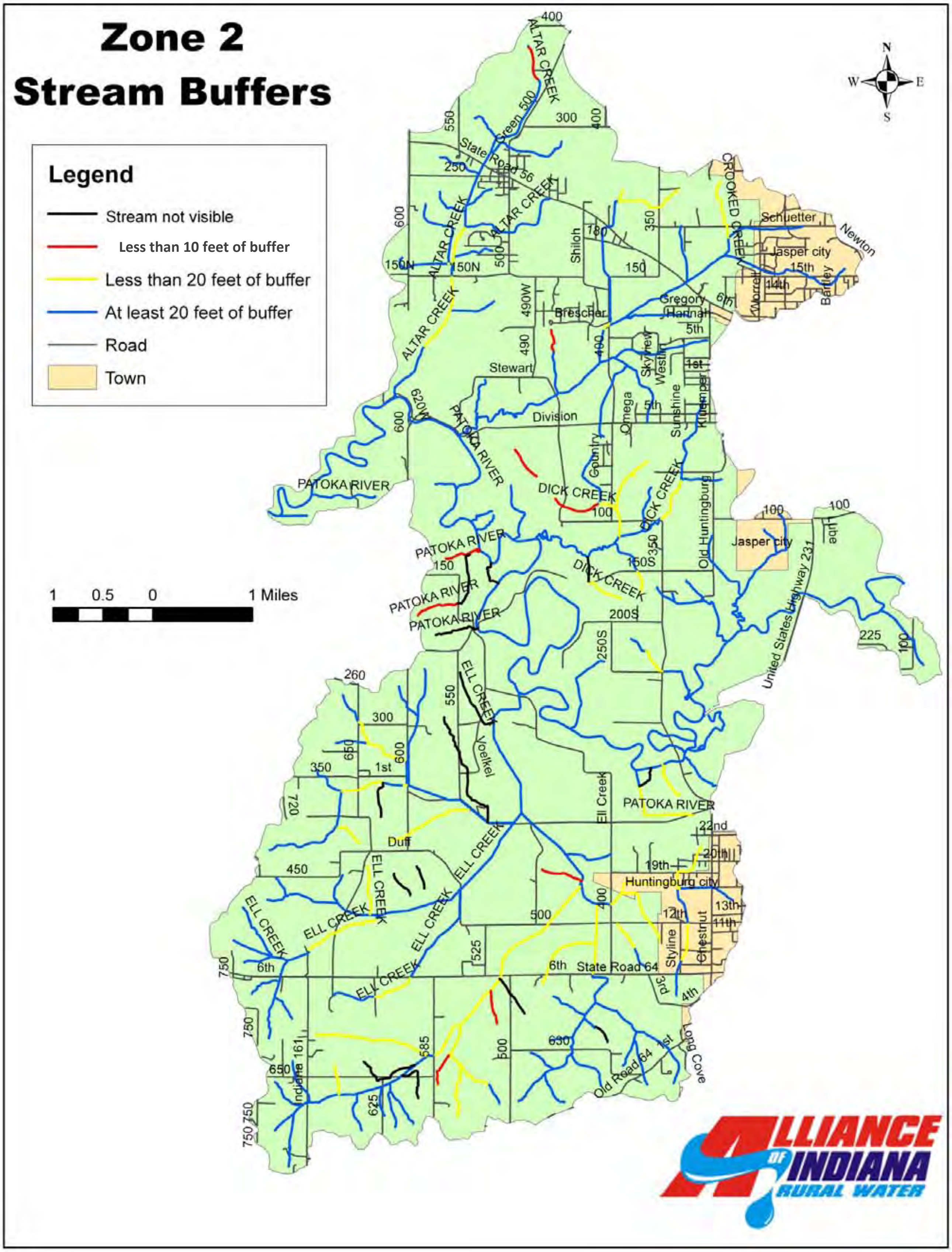
The windshield survey results show that the number of erosion and animal access sites per 10,000 acres is not very different between Zones 1 and 2 (Figure 10). Compared with the entire watershed, Zone 2 has the highest number of erosion sites per 10,000 acre. These may explain the IBC and nutrient impairments and high STEPL runoff totals.

Figure 11: Zone 2 Windshield Survey Results

Windshield Survey Discovery	Number in Zone 2	Number per 10,000 acres (Zone 2 has 28,334 acres)
Erosion Site	24	8.6
Trash Dumping Site	1	.35
Animal Access to Stream Site	16	4.3
AMD Site	0	0
Log Jam Site	1	.35

The southern part of Zone 2 has a large section of buffers needing improvement within the area of Huntingburg's growth. In the north, Jasper's identified area of growth overlaps with a small number of stream buffers needing improvement. The rest of the marked buffers on Map 27 run through farmland and are likely impacted by that landuse. Overall, Zone 2 has 23.68 miles of stream buffers (18.2% of the total stream miles) rated as either Needing Improvement of Poor.

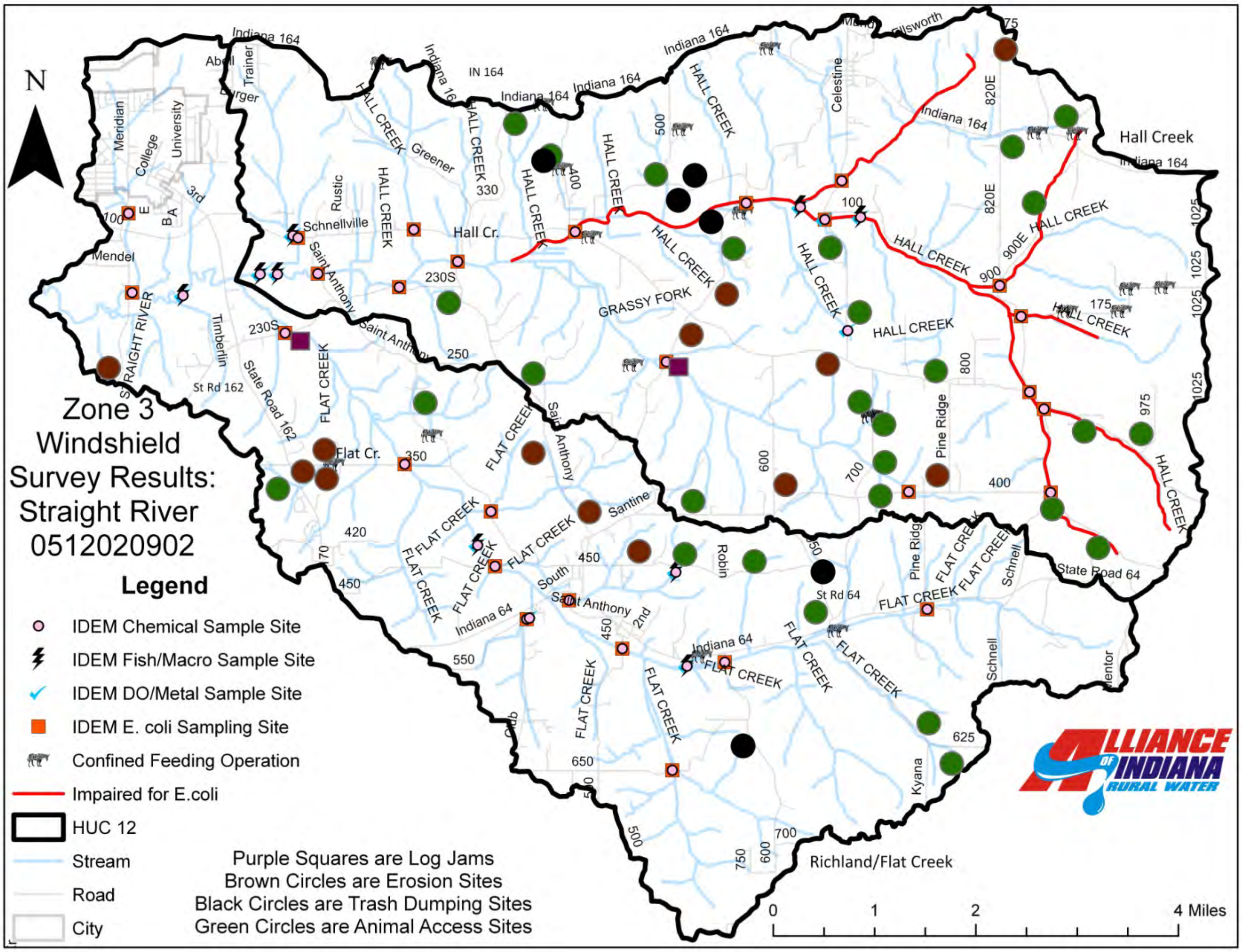
Map 27: Zone 2 Stream Buffers



3.5: Zone 3

Zone 3 is the 10 Digit HUC Straight River (0512020904). The zone has two 12 Digit HUCs within it. From north to south they are Hall Creek and Richland/Flat Creek. A portion of eastern Jasper sits in the northwest part of Zone 3. The windshield survey for Zone 3 was done on April 26 and 27, 2011.

Map 28: Zone 3 Windshield Survey



3.5.1: Water Quality Information

The data shows that E. coli, BOD, and Nitrogen are water quality issues in Zone 3.

Zone 3 water quality information comes from STEPL modeling and IDEM's impaired list of waterbodies. IDEM's data shows no nutrient impairments and only three phosphorus samples that exceeded the target. No nitrogen samples exceeded the target. Hall Creek and Richland/Flat Creek subwatersheds had four and five exceedances of the DO water quality standard, but these did not lead to an impairment. The only impairment in Zone 3 is bacteria in Hall Creek and four of its tributaries. IDEM has 28 bacteria sampling points in Zone 3. Two meet the bacteria water quality standard. Six are up to 3 times the bacteria standard and the rest are over 3 times the bacteria standard. Zone 3 sediment and phosphorus runoff is medium. Nitrogen and BOD runoff is high. There are seven macroinvertebrate/fish sample points in Zone 3, but no impairments to report.

3.5.2 Landuse Information

Zone 3's largest landuses are forest, cultivated crops, and pastureland. There are 16 CFOs in Zone 3 and none had permit compliance issues. As noted, part of Jasper occupies a small corner of the

Plate 21: Zone 3 Landscape

Zone. As the new US 231 is built, development is expected to occur on the east side of Jasper in Zone 3. Generally speaking, Zone 3 is part of the headwaters of the MPRW and its eastern portions have the hills and slopes one would expect in a headwaters region.   Most of the observed farming was in the flat floodplains, which may explain the fewer number of erosion sites compared to other Zones. Erosion may have also been hidden by the garlic mustard that was prevalent during the windshield survey. Throughout the windshield survey, the Alliance had to negotiate regional flooding. In Zone 3, floodplains received a layer of sediment as the water receded and this may also have hidden erosion.

Plate 22: Flood deposits on Field

Plate 23: Flooding

The windshield survey passed Schnellville Conservation Club, which has an earthen dam and spillway in the headwaters of Hall Creek. This perhaps is one of the dams the public was curious about. While driving, the Alliance also passed the part of Ferdinand State Forest that's in Zone 3. The forest, like nearly all of Zone 3, has Potentially Highly Erodible Land.

Plate 24: Schnellville Conservation Club Dam

Eight septic groups were found in Zone 3 (Map 11).

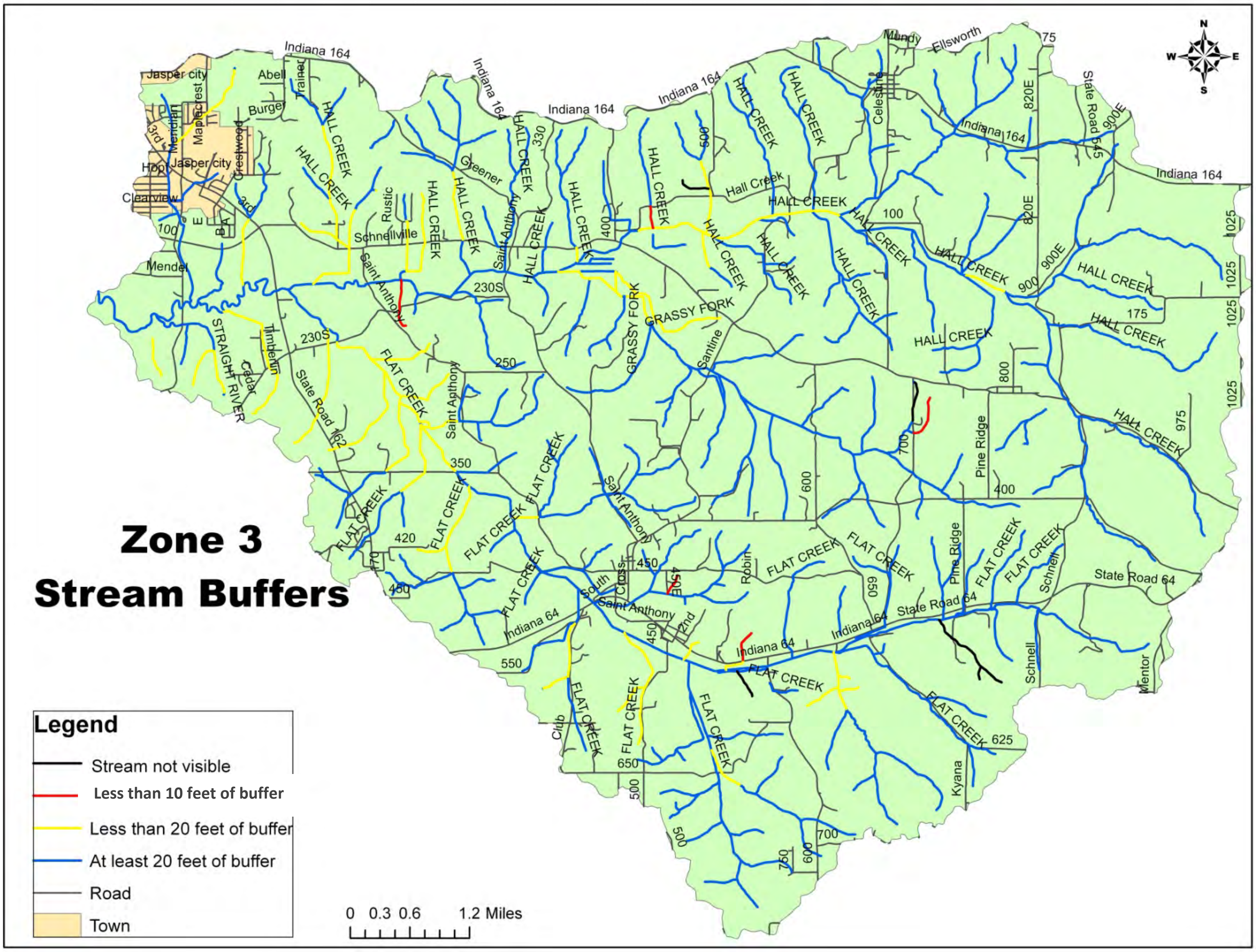
Figure 11 has other Zone 3 windshield survey data. Zone 3 has an E. coli impairment and ranks first amongst the five zones in number of animal access points per 10,000 acres.

Figure 12: Zone 3 Windshield Survey Results

Windshield Survey Discovery	Number in Zone 3	Number per 10,000 acres (Zone 3 has 42,960 acres)
Erosion Site	12	3.0
Trash Dumping Site	6	1.15
Animal Access to Stream Site	28	6.4
AMD Site	0	0
Log Jam Site	1	0.46

The eastern parts of Zone 3, which make up part of the Middle Patoka's headwaters, have good buffers due to the large forests. Just south of the junction with Hall Creek, a large section of Flat Creek and its tributaries have buffers that need improvement but other than this area the Zone is typically well buffered. This area of Flat Creek's buffers may need improvement because the area in general has been influenced by Jasper's growth; incidentally, just to the south in Zone 4 is an area of urban sprawl/growth. Overall, Zone 3 has 32.24 miles of stream buffers (17.7% of the total stream miles) rated as either Needing Improvement or Poor.

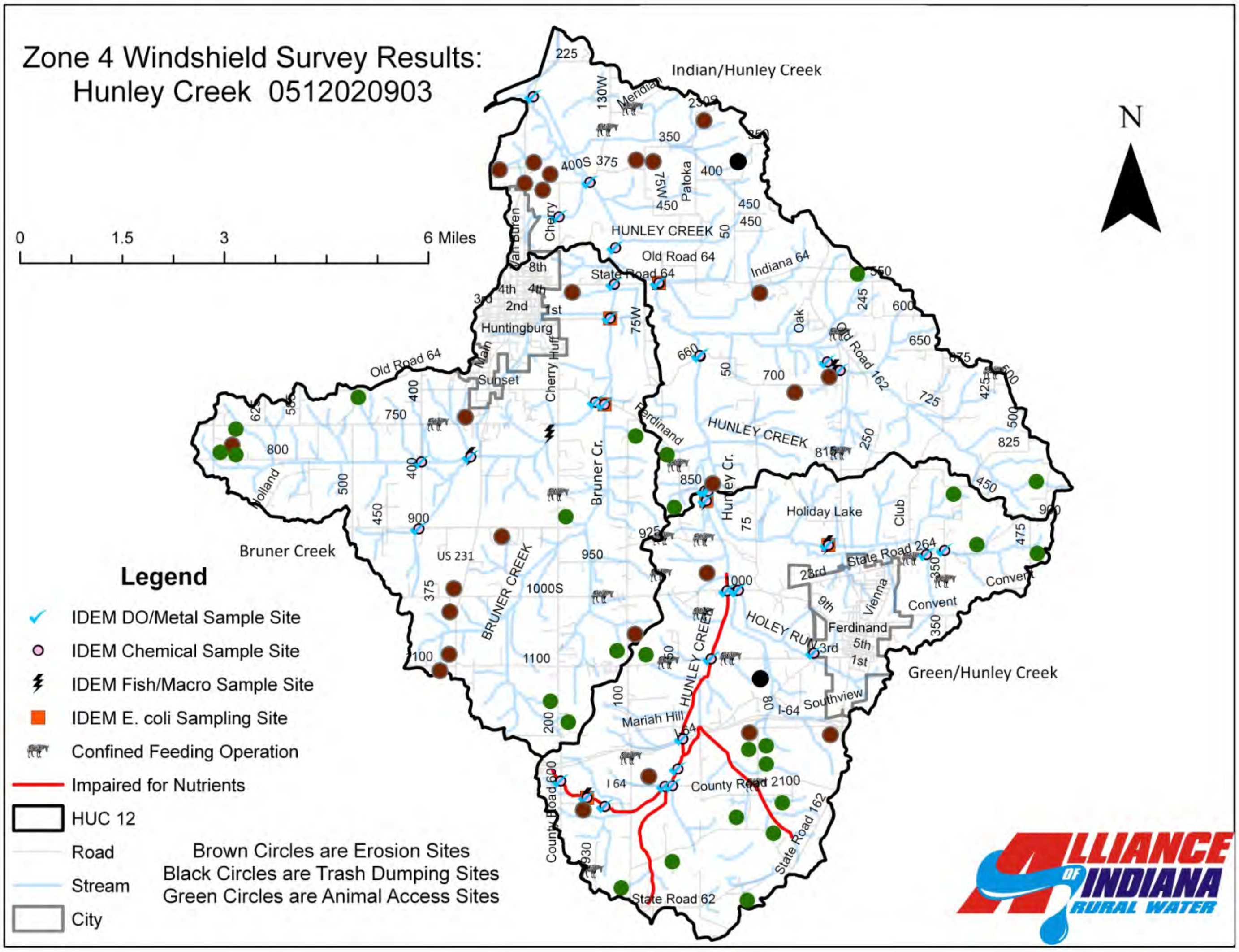
Map 29: Zone 3 Stream Buffers



3.6: Zone 4

Zone 4 is the 10 Digit HUC Hunley Creek (0512020903). The zone has three 12 Digit HUCs within it. From north to south they are Indian/Hunley Creek, Bruner Creek, and Green/Hunley Creek. The eastern part of Huntingburg and all of Ferdinand sit in Zone 4. The windshield survey for Zone 4 was done on March 18 and 23 and April 28, 2011.

Map 30: Zone 4 Windshield Survey



3.6.1: Water Quality Information

The data shows that E. coli, Nutrients, BOD, Sediment, Nitrogen, and Phosphorus are water quality issues in Zone 4.

Zone 4 water quality information comes from STEPL modeling and IDEM's impaired list of waterbodies. IDEM's data show that 19 DO exceedances of the water quality standard across Green/Hunley Creek subwatershed. That same subwatershed has a nutrient impairment and the DO levels may be influenced by those high nutrient samples. Six bacteria sampling sites are in Zone 4. Three meet the standard, two are up to 3 times the bacteria standard, and 1 is over 3 times the bacteria standard. Although these exceedences in the bacteria standard exist, IDEM has not yet added the streams to the list of impaired waterbodies. STEPL shows that Bruner Creek subwatershed has high runoff for all four parameters. Indian/Hunley Creek subwatershed has high runoff for all parameters except sediment, which has medium runoff. Green/Hunley Creek subwatershed has medium nitrogen runoff and impairments for nutrients. Sediment, phosphorus, and BOD runoff is low. There are 11 macroinvertebrate/fish sample sites in Zone 4 but no IBC impairments to report.

3.6.2: Landuse Information

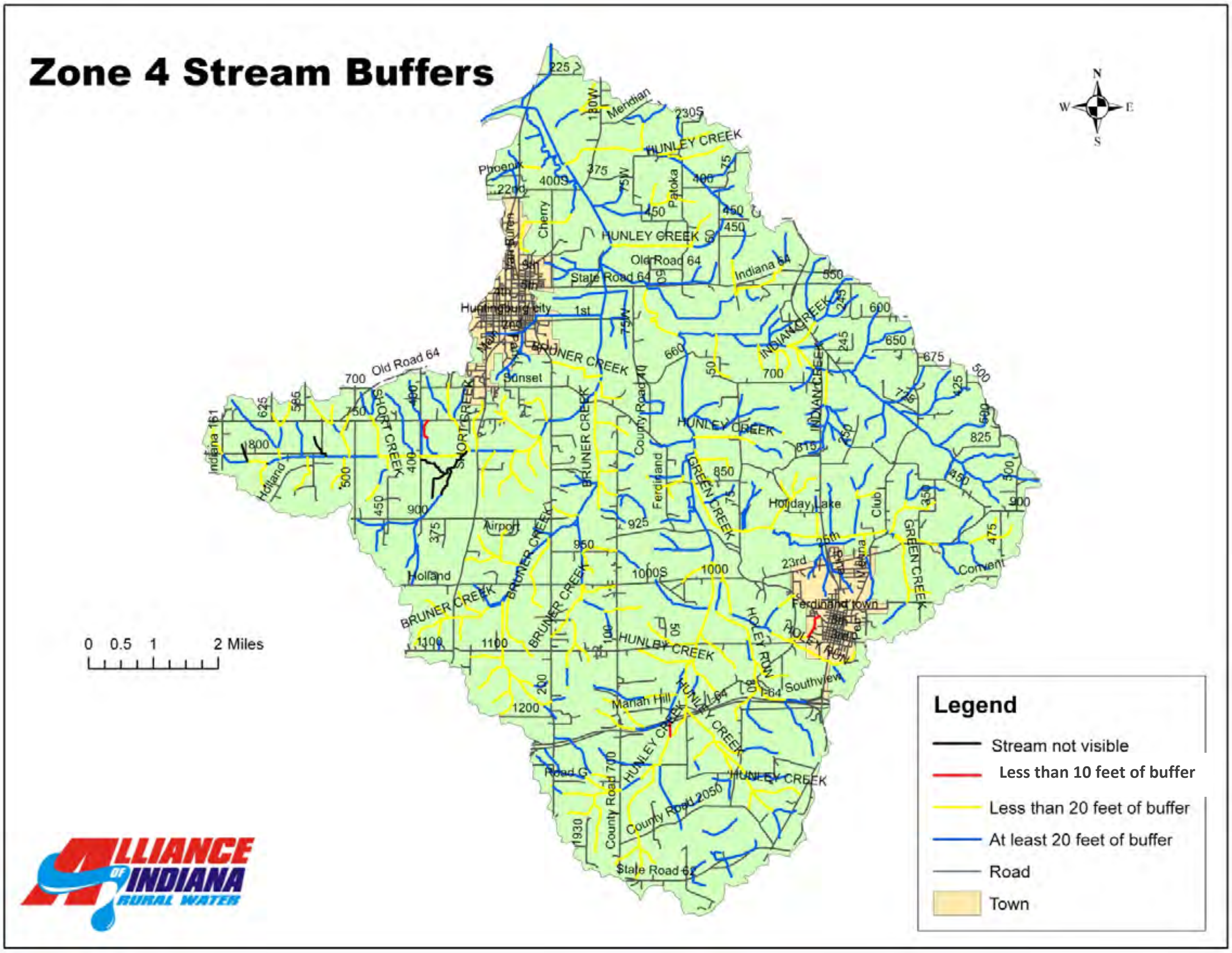
Cultivated crops, forest, and pasture are Zone 4's largest landuses. There are 18 CFOs in Zone 4 and none had permit compliance issues. The Zone also has the largest amount of urban land of all the zones and the urban sources discussed in section 2.5.5 obviously relate to Zone 4 too. Historically, Zone 4 had surface mining in the south around Ferdinand. Now that land has been restored or is being restored. Indian/Hunley Creek subwatershed has upscale suburbs of Jasper and Huntingburg spread across it. Impending landuse changes include future development along the new US 231 route and the growth of Ferdinand. Ferdinand provides drinking water (from Patoka Lake) and sewer services to its citizens. Ferdinand's master plan outlines growth in all areas of the town. Ferdinand asked the Alliance to suggest some water quality improvement projects on or near the city parks. That report is in Appendix C. The windshield survey found two storm water ponds in Ferdinand: The YMCA and the Library. A new retail area is springing up on the town's south side near the exit for I64. The area has large roadside drainage ditches like those in Huntingburg. These ditches would provide opportunities to install BMPs that would cleanse and infiltrate storm water.
Six septic groups were found in Zone 4 (Map 11)

Figure 13: Zone 4 Windshield Survey Results

Windshield Survey Discovery	Number in Zone 4	Number per 10,000 acres (Zone 4 has 42,126 acres)
Erosion Site	27	4.9
Trash Dumping Site	2	.38
Animal Access to Stream Site	26	4.9
AMD Site	0	0
Log Jam Site	0	0

Zone 4's buffers generally are dictated by landuse. The Indian/Hunley Creek subwatershed has the fewest buffer issues in the Zone and the largest amount of forests. The rest of the Zone is dominated by buffers that need improvement. These buffers border streams running through some of the flattest farmland in the entire watershed. Overall, Zone 4 has 90.83 miles of stream buffers (40.4% of the total stream miles) rated as either Needing Improvement or Poor.

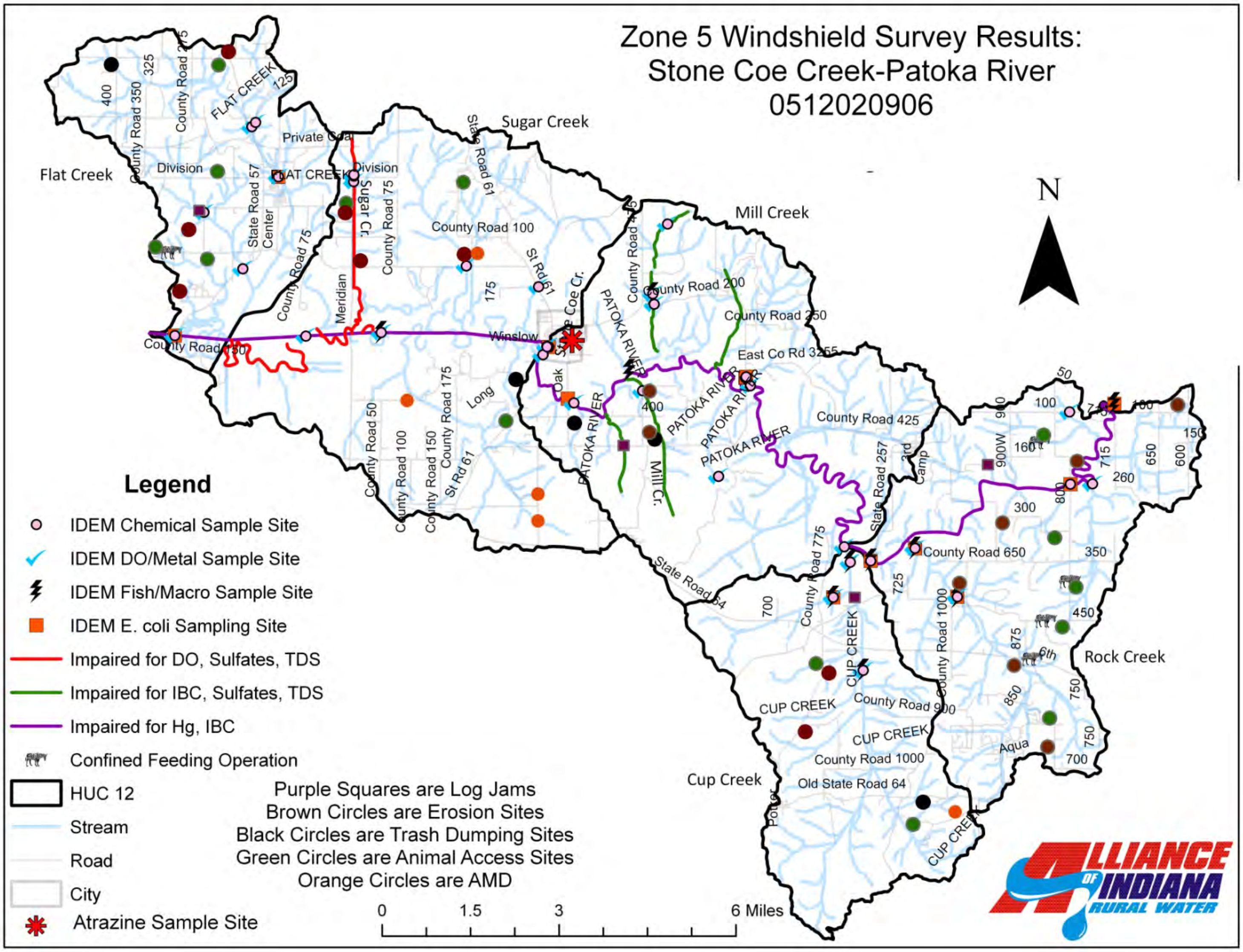
Map 31: Zone 4 Stream Buffers



3.7: Zone 5

Zone 5 is the 10 Digit HUC Stone Coe Creek-Patoka River (0512020906). The zone has five 12 Digit HUCs within it. From west to east they are Flat Creek, Sugar Creek, Mill Creek, Cup Creek, and Rock Creek. Winslow is the only urban area in Zone 5. The windshield survey for Zone 5 was done on March 30 and April 8, 9, and 19, 2011.

Map 32: Zone 5 Windshield Survey



3.7.1 Water Quality Information

The data shows that Hg, Sulfates, TDS, E. coli and DO are water quality issues in Zone 5.

Zone 5 water quality information comes from STEPL, Syngenta's atrazine sampling, and IDEM's list of impaired waterbodies. There are not nutrient impairments in Zone 5, but Mill Creek and Flat Creek subwatersheds did have seven and 11 phosphorus samples exceed the target respectively. Within Zone 5, Flat Creek subwatershed had the most DO exceedances with 17. These did not lead to an impairment and may be related to the phosphorus exceedances in the same subwatershed. The entire Patoka River in Zone 5 is impaired for Hg and PCB. Four tributaries to the Patoka River in Mill Creek subwatershed are impaired for IBC, sulfates, and TDS. Sugar Creek subwatershed has DO, sulfates, and TDS impairments. IDEM has 10 bacteria sampling sites in Zone 5. Five of the sites meet the bacteria standard, four are up to three times the standard, and one is over three times the standard. Zone 5 has the lowest runoff totals of the entire Middle Patoka River Watershed. Flat Creek has medium runoff for all four parameters. The rest of the Zone's runoff was low for all of the parameters. The atrazine sampling showed no violations, so atrazine is not a concern for Winslow Water customers.

3.7.2 Macroinvertebrate/Fish Information

In Zone 5, the entire Patoka River as well as four streams in the Mill Creek subwatershed are impaired for biotic communities. A variety of potential reasons for this impairment exist, so pinpointing the exact one is difficult. West of Winslow the Patoka is channelized, which can be a stressor on biotic communities. The windshield survey, steering committee, and DNR identified several mining problem areas in Sugar Creek and Mill Creek subwatersheds, and those may be a contributing factor as well. The eastern edge of Zone 5 has more farming and erosion sites than the rest of the Zone, and of course continuing to the east are areas dominated by row crops and pastures; the sediment load from the other Zones may be another factor in the poor biotic communities.

3.7.3 Landuse Information

Zone 5's largest landuses are forest, cultivated crops, and pasture. The Zone has the greatest concentration of wetlands in the MPRW and nearly all of the publicly managed land. Patoka National Wildlife Refuge, Sugar Ridge Fish and Wildlife Area, and Pike State Forest are all in Zone 5.

Plate 25: Typical Landscape in Zone 5

The predominance of managed land and forested areas help Zone 5 have the lowest pollutant runoff rates of the entire project area. Winslow is the largest urban area in Zone 5. Winslow asked the Alliance to suggest some water quality improvement projects. That report is in Appendix C. Much of the land around Winslow is forested. The town draws its drinking water from the Patoka River and its interest in protecting that source was the impetus for this project. Within the MPRW, every subwatershed except Zone 5's Flat Creek and Sugar Creek is upstream of Winslow and impacts the town's source of drinking water. Phosphorus from upstream is of particular concern to Winslow. 66% of the subwatersheds upstream of Winslow have medium or high phosphorus runoff. Some of those streams are also impaired for nutrients. The largest phosphorus sources likely are urban runoff, wastewater treatment facilities, and failing septic systems.

The sulfate impairments in Zone 5 point to mining. The windshield survey found more evidence of mining and past mining in Zone 5 than anywhere else in the watershed. This included reclaimed land and streams with AMD. It was reported to the Alliance that Augusta Lake and the surrounding area in Mill Creek subwatershed had several AMD sources. A division of Air Gas was dumping lime into Augusta Lake to neutralize the acid, but this remediation has ceased. The public tells the Alliance that the AMD sites found during the windshield survey don't do justice to the scope of the problem. This likely is true since the windshield survey was only able to observe what was visible from the roads. In considering the scope of the AMD problem, remember that DNR has identified problem areas in Sugar Creek and Mill Creek subwatersheds.

Plate 26: Reclaimed Mine Land

Plate 27: Acid Mine Drainage in Stream

Other than evidence of mining, the windshield survey did not find as many pollution sources in Zone 5 as in the other zones. The amount of forested land obviously explains this. While logging was not listed as a public concern, evidence of poor logging practices like lack of erosion control and poorly maintained access roads were noted when discovered during the windshield survey. However, as explained above, only two such sites were found in the entire watershed. One was in Zone 5. While forested land is one of the largest landuses in the watershed, there isn't evidence that it's a large contributor to runoff pollution.

Plate 28: Logging Site in Zone 5

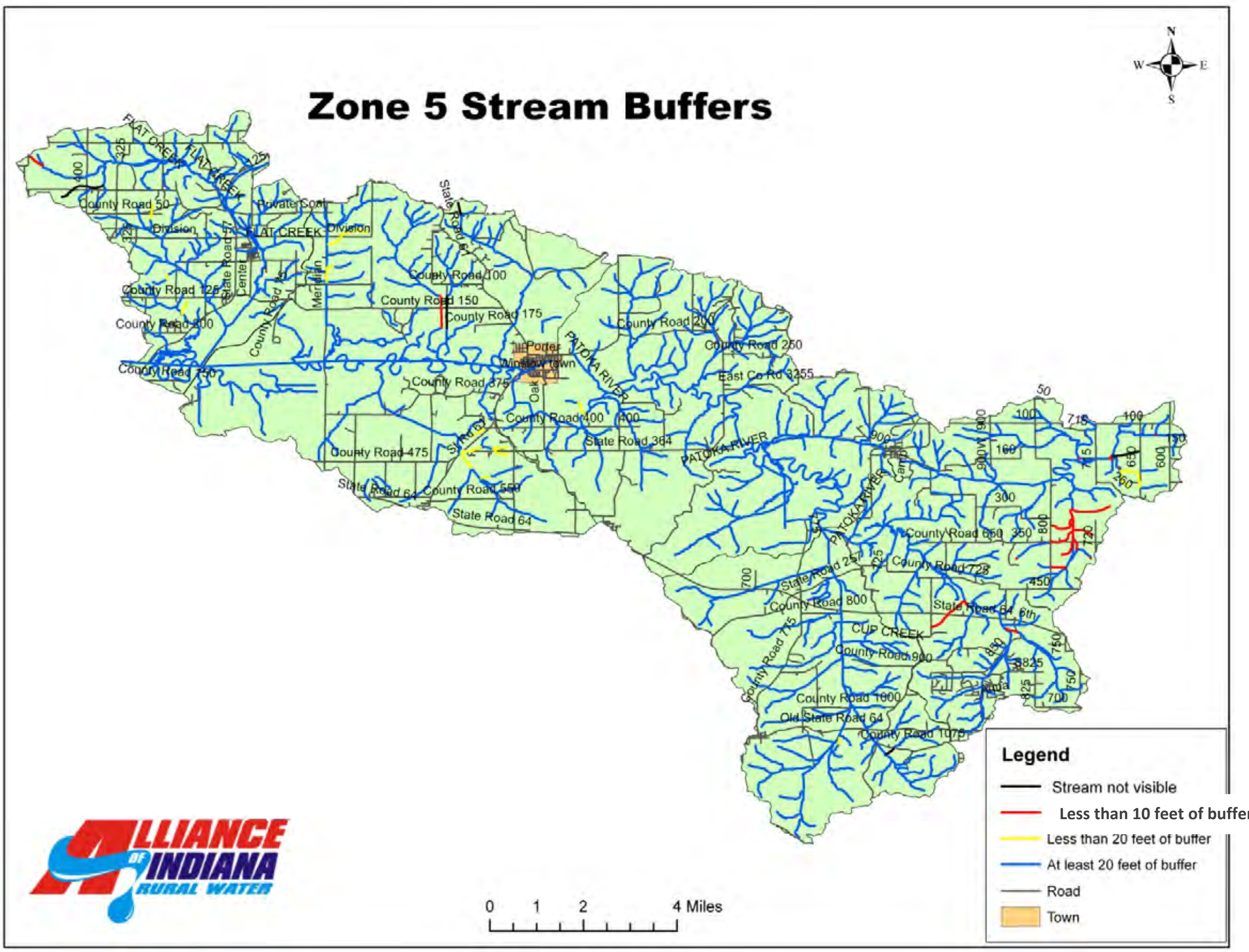
Zone 5 has four CFO and six septic groups. None of the CFOs had permit compliance issues. Widespread trash dumping was not found during the windshield survey, but employees at the Patoka Wildlife Refuge report that it's a real problem on their property. Not a week goes by, they said, that a large amount of waste is not found. They currently are working with IDEM and DNR to determine the proper steps for confronting known dumpers.

Figure 14: Zone 5 Windshield Survey Results

Windshield Survey Discovery	Number in Zone 5	Number per 10,000 acres (Zone 5 has 61,339 acres)
Erosion Site	16	2.1
Trash Dumping Site	5	.65
Cattle Access to Stream Site	14	1.8
AMD Site	5	.65
Log Jam Site	5	.65

By far, Zone 5 has the fewest numbers of problem buffers. In no small part is this due to the large forests that cover the area. The Zone 5 buffers needing work are found next to agricultural land. Overall, Zone 5 has 13.33 miles of stream buffers (3.4% of the total stream miles) rated as either Needing Improvement of Poor.

Map 33: Zone 5 Stream Buffers



4.1 Watershed Inventory Summary

Figure 15: Zones 1-5 Windshield Survey Results

Figure 14 ranks the windshield survey discoveries for the project area, with a ranking of '1' signifying the highest number discovered and '5' signifying the lowest number discovered.

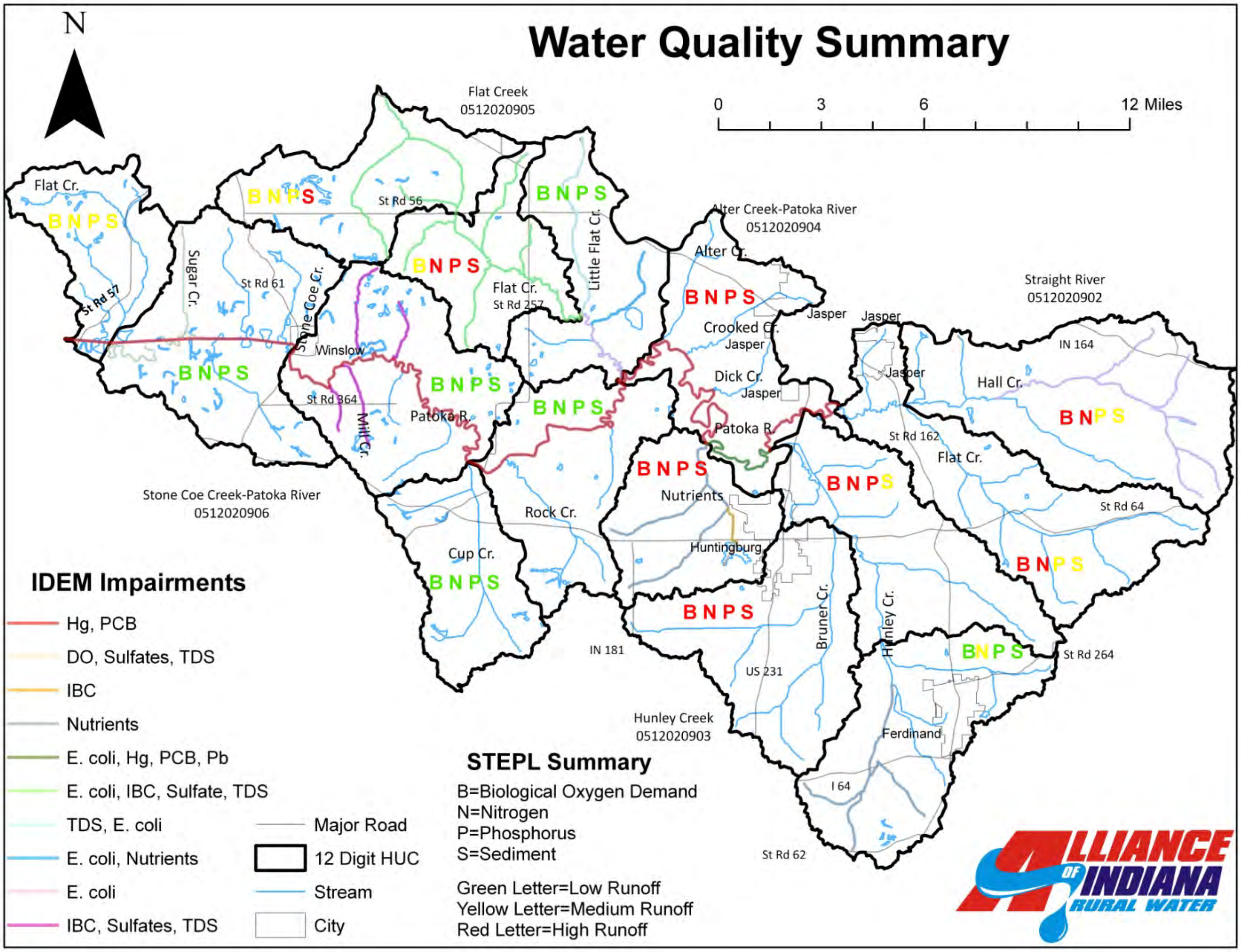
Zone	Windshield Survey Discovery	Ranking Amongst All Zones (based on numbers per 10,000 acre)
1	Erosion Site	2
	Trash Dumping Site	1
	Cattle Access to Stream Site	3
	AMD Site	5 (tied)
	Log Jam Site	1
2	Erosion Site	1
	Trash Dumping Site	5
	Cattle Access to Stream Site	4
	AMD Site	5 (tied)
	Log Jam Site	4
3	Erosion Site	4
	Trash Dumping Site	2
	Cattle Access to Stream Site	1
	AMD Site	5 (tied)
	Log Jam Site	2
4	Erosion Site	3
	Trash Dumping Site	2
	Cattle Access to Stream Site	2
	AMD Site	5 (tied)
	Log Jam Site	5
5	Erosion Site	5
	Trash Dumping Site	3
	Cattle Access to Stream Site	5
	AMD Site	1
	Log Jam Site	3

Zones 2, 1, and 4 ranked highest for erosion, which is not surprising since cultivated crops is the largest landuse across those three zones. NRCS said the eastern side of the watershed has the highest amount of livestock, and the survey bore that out; the two zones with the highest numbers of cattle access points were Zones 3 and 4. Zone 5 has the most active mining and the highest number of AMD sites located, as well as several sulfate impairments. The rankings for trash dumping and log jams are less reliable data. The windshield survey simply is not a great tool for identifying dumping or log jam sites. Dumping is unlikely to occur right by the road, so most sites would be hard to find from a car. Log jams can only be viewed if they are at stream crossings.

Conclusions on IDEM bacteria tests in the MPRW are hard to make. Sampling points show exceedances throughout the watershed, but IDEM has not decided if all those points will result in bacteria impaired streams. The data does show that across landuses, the bacteria standard is not being met. Individual sources of bacteria—septics, farm animals, CFOs, and farm fields—are across the watershed, so we must assume that the bacteria problem is as well. Unlike bacteria, many of the other IDEM data from the list of impaired streams is straightforward. Map 34 and the bullets below summarize the water quality results.

- The mercury, PCB, and lead pollution have sources in the watershed's industrial past. Airborne mercury is still likely being deposited by nearby coal fired power plants.
- Sulfate impairments are only on the western half of the watershed where coal mining was most active and occurs today.
- IBC occurs in Flat Creek and its tributaries in Zone 1 and four tributaries spread across Zones 2 and 5. Zone 1's sulfate and TDS impairments and lack of buffers may contribute to the IBC. Zone 2 is heavily farmed, the impaired stream's buffer needs improvement, STEPL estimated high sediment runoff, and the windshield survey showed the greatest concentration of erosion sites. Zone 5's IBC impaired streams flow through old mines that are impaired for sulfates and TDS.
- Nutrient impairments occur in Zones 1, 2, and 4. The nutrient phosphorus binds to soils; Zones 1, 2, and 4 ranked 2^{nd}, 1^{st}, and 3^{rd} respectively in number of erosion sites. The Zone 1 impairment is in a subwatershed with low nitrogen and phosphorus runoff, but there is a CFO directly north of the impaired stream's head. Nitrogen and phosphorus runoff is high in Zone 2 and nitrogen runoff is medium in the Zone 4 subwatershed with the nutrient impairment. BOD, an indicator of nutrient pollution, is high in Zone 2 and parts of Zone 4.
- The majority of TDS impairments are in Pike County. The county does not salt their roads, and given the landuse the next most likely source is agricultural runoff.

Map 34: Water Quality Summary



5.1 Analysis of Stakeholder Concerns

Using the data from the Watershed Inventory, the steering committee revisited the list of public concerns to decide which ones they want to focus on. Not every concern chosen to be addressed can receive attention right away.

Figure 16: Concerns Revisited

Concern	What Does Our Data Say about the Concern?	Is this Concern Something we want to Address?
Where are log jams and what can be done to reduce their occurrence	Windshield survey found 9 small log jams and the public and Conservancy District reports that large jams do occur regularly	Yes, through adult education
Acid Mine Drainage is a problem in lots of streams	5 AMD sites were found and IDEM data showed AMD evidence	Yes
Acid Mine Drainage solutions don't work. The limestone gets oxidized too quickly.	DNR confirmed that oxidation is a problem at some sites	Yes
Enforcement of sediment control at construction sites is difficult due to budget constraints	Confirmed by SWCDs	Yes
Livestock have free access to the streams	Windshield survey found 98 access sites	Yes
Land applied manure is running off into the creeks	NRCS says manure is applied 5-6 months out of the year. Exact locations not known.	Yes
Illegal trash dumping south of 56 is a problem	Windshield survey found 25 trash dumping sites spread across the watershed	Yes
Hobby farms dump dead livestock in streams	No evidence of dumping livestock found. Hobby farms not concentrated in any one area.	Yes, through adult education
Poorly operated septic systems are a problem	County Health Departments report that failure may be as high as 50%. Windshield survey found 25 septic groups.	Yes, through adult education
Is it safe to come in contact with the water (swim/wade etc)?	Some streams have bacteria levels exceeding safe limits	Yes
Private well owners need resources for water testing	County Health Departments refer people to private labs or Jasper Water Treatment Plant	No
Small animal farms don't fall under any regulation and are a pollution source	Small animal farms were seen across the watershed. Pollution sources include manure runoff and animal access to streams	Yes
Impact of the Farbest Turkey Processing Plant have on water quality	The plant has violated its water quality permit and is addressing those issues	No, IDEM has jurisdiction
Cattle owners need education on the reasons to keep animals out of the streams	Windshield survey found 98 access points	Yes
Channelization leads to log jams	Online research confirmed that channelization can be a cause of log jams	Yes, through adult education
Army Corps' Patoka River model doesn't take into account flow from agricultural tiles	Corps never responded to inquiry	No

<table>
<tr><th>Concern</th><th>What Does Our Data Say about the Concern?</th><th>Is this Concern Something we want to Address?</th></tr>
<tr><td>Need to increase no-till corn and soybeans</td><td>No Till as a % of row crop acreage<table><tr><th>County</th><th>Soybeans</th><th>Corn</th></tr><tr><td>Dubois</td><td>68</td><td>41</td></tr><tr><td>Gibson</td><td>59</td><td>10</td></tr><tr><td>Pike</td><td>51</td><td>10</td></tr><tr><td>Spencer</td><td>70</td><td>52</td></tr></table></td><td>Yes</td></tr>
<tr><td>Where are stream buffer strips needed?</td><td>19.06% of the buffers in the watershed are not large enough</td><td>Yes</td></tr>
<tr><td>Need to increase cover crop plantings</td><td>SWCDs report that cover crops could be used more widely</td><td>Yes</td></tr>
<tr><td>Landowners channelize streams on their property and cut trees off banks</td><td>Not widely seen as part of the windshield survey but could still be a problem</td><td>Yes, through adult education</td></tr>
<tr><td>Water quality education needs to focus on reaching children</td><td>No one in the watershed is focusing on this</td><td>Yes</td></tr>
<tr><td>What influence does storm water have</td><td>Storm water causes runoff from all landuses</td><td>Yes</td></tr>
<tr><td>Influence of Combined Sewer Overflows</td><td>There are none in the watershed</td><td>No</td></tr>
<tr><td>Runoff from residential land is a problem</td><td>Not enough data to differentiate residential runoff from other urban runoff</td><td>Yes</td></tr>
<tr><td>Influence of de-icing agents on water quality</td><td>Salt is not widely used. Sand is most common, but not thought to be applied enough to be a problem.</td><td>No</td></tr>
<tr><td>Can alternative uses of poultry waste be found</td><td>There are options besides land application. One suggestion is to use it on reclaimed mine land as fertilizer.</td><td>Yes</td></tr>
<tr><td>Is there an influence of urban and rural pesticide and fertilizer use on water quality</td><td>Atrazine data showed no problems. Nutrient (fertilizer) runoff is high in urban and rural areas.</td><td>Yes (nutrients)</td></tr>
<tr><td>Air pollution is a problem in the watershed; particularly mercury deposits from the air</td><td>Some streams are impaired for mercury, which commonly comes from air pollution</td><td>No, IDEM has jurisdiction over airborne pollutants</td></tr>
<tr><td>Are there pharmaceuticals in the public drinking water supply?</td><td>Samples from this watershed not available. Nationwide, no dose of any drug has ever been found in a drinking water sample</td><td>No</td></tr>
<tr><td>Adults need watershed education</td><td>Dubois County SWCD educates</td><td>Yes</td></tr>
<tr><td>Is farm waste (nutrients and bacteria) moving across the land and onto Jeffers Nature Preserve?</td><td>No data from this site, although a field inspection suggests it may occur</td><td>Not directly. We will focus on farm runoff</td></tr>
<tr><td>Landuse development needs to be sustainable</td><td>Sustainability was a goal in all the land use plans. Growth is planned to occur along US 231 extension, all around Ferdinand, and the northwest corner of Jasper.</td><td>Yes, through adult education</td></tr>
<tr><td>Current status of the 13 Corps 13 flood control features (dams with detention behind them)</td><td>Corps had no knowledge of these dams</td><td>No</td></tr>
</table>

Concern	What Does Our Data Say about the Concern?	Is this Concern Something we want to Address?
Public needs to understand that a utilities cost to supply safe drinking water is increasing and the cost of water will increase as well	No data gathered. Concern taken at face-value.	No, this is the responsibility of the utilities
Bow fishermen hunt invasive species year round. DNR tells them to dump catch back in river rather than putting them on bank	DNR rules say fish can't be returned to the water unless they are used as bait	No
Tires, engine blocks, and other large items are sometimes dumped in streams	Windshield survey found 25 trash dumping sites	Yes
Air Gas dumps a lime solution into South Fork of Patoka River. It's not being agitated and just coats the rocks.	This has occurred, but reportedly has stopped	No
In Winslow, log jam along RR bridge is cut loose by RR company and allowed to flow downstream	The railroad was not contacted	Yes, through adult education

5.2: Identify Problems, Causes, and Sources

Problems are concerns that the steering committee wants to focus on. The identification of problems is an important step towards setting project goals and was done by grouping similar concerns together and creating a problem statement that encompassed those concerns. Some concerns fit in more than one group, but that does not mean they are more important than other concerns. Some concerns have been reworded to include similar concerns or because data collection resolved ambiguity about them.

A Cause is an event, agent, or series of actions that produces a problem. Causes may include pollutants, social behaviors, etc. Some problems and causes might be identical. IDEM requires that potential causes of water quality problems be defined as a specific pollutant parameter, but secondary causes may also be identified.

A Source is an activity, material, or structure that results in a cause of runoff pollution. Sources should be described in enough detail to show the part of the watershed where they occur and, when applicable, what their magnitude is across the watershed. Sources were identified in the Watershed Inventory Parts One and Two. The figure below summarizes those findings, matching Problems and Causes with their corresponding Sources. IDEM does not require Sources for social problems like lack of education.

Figure 17: Relationship of Concerns, Problems, Causes, and Sources

Concerns	Problem	Potential Cause(s)	Potential Source(s)
Reduce log jams and properly remove existing ones The impacts of stream channelization Illegal Trash Dumping Hobby farms dumping dead livestock Poorly operated septic systems are a problem Safety of contacting stream water (swim/wade etc) Unregulated small animal farms are a pollution source Cattle need to be kept out of streams Need more water quality education for kids and adults Influence of storm water Runoff from residential land Need for alternative uses of poultry waste Landuse development needs to be sustainable	Public needs education on watershed health and how they can improve and protect it	N/A	N/A
Acid Mine Drainage is in the watershed's streams Some AMD solutions don't work over the long-term	AMD is polluting watershed streams	Sulfate impairments; windshield survey found streams with acid pollution	Abandoned mines and mining waste in Zone 5
Cattle need to be kept out of streams Unregulated small animal farms are a pollution source The impacts of stream channelization No-till needs to be increased Poorly buffered streams Cover crops need to be increased Influence of storm water	Sediment is polluting watershed streams	Sediment as measured by STEPL model	98 Cattle Access Sites 110 Erosion Sites New development in urban areas 58% of watershed is HEL or PHEL No-Till needs to be increased (see Figure 4) Runoff from developing areas: mainly the perimeters of Ferdinand, Huntingburg, and Jasper 22 miles of regulated drains 210.5 miles of stream buffers are < 20 ft.
Cattle need to be kept out of streams Unregulated small animal farms are a pollution source Hobby farms dumping dead livestock Land applied manure The impacts of stream channelization No-till needs to be increased Poorly buffered streams Cover crops need to be increased Influence of storm water Runoff from residential land Need for alternative uses of poultry waste	Nutrients (nitrogen and phosphorus) are polluting watershed streams	Nitrogen and phosphorus as measured by STEPL model	98 Cattle Access Sites 110 Erosion Sites 58% of watershed is HEL or PHEL No-Till needs to be increased (see Figure 4) Runoff from all urban areas 210.5 miles of stream buffers are < 20 ft. 58 CFOs Failing septic systems (25

Poorly operated septic systems are a problem			septic groups found)
Concerns	**Problem**	**Potential Cause(s)**	**Potential Source(s)**
Cattle need to be kept out of streams Unregulated small animal farms are a pollution source Hobby farms dumping dead livestock Land applied manure Influence of storm water Need for alternative uses of poultry waste Poorly operated septic systems are a problem	Bacteria levels in parts of the watershed exceed the water quality standard	E. coli bacteria	98 Cattle Access Sites 58% of watershed is HEL or PHEL No-Till needs to be increased (see Figure 4) Runoff from all urban areas Failing septic systems (25 septic groups found)

6.1: Loads for each Pollutant Identified as a Problem's Cause

A pollutant load is a measure of the amount of pollutant in the stream during a period of time. Examples include, pounds/week and tons/year. IDEM requires current loads for each pollution parameter listed as a problem's cause (E. coli, Sediment, Nitrogen, and Phosphorus). Target loads meeting the applicable water quality standard or benchmark are also required. In order to calculate a load, you need a measurement of stream flow (the amount of water in the stream) and the concentration of a pollutant from the stream. Milligrams per liter (mg/L) is an example of a concentration. The load is the product of flow (usually in cubic feet of water per second) and pollutant concentration and represents pollution from both point (factories, CSOs, septics, etc.) and nonpoint (runoff) sources. Since this project did not have a sampling program to provide flow or concentration data, calculating true loads would be difficult. Estimated loads for sediment, nitrogen, and phosphorus are taken from the STEPL and listed in Figure 17 for the entire watershed and for those subwatersheds with high runoff, as seen on Maps 20-23 and Map 34. AMD is a stated problem, but we lack the data needed to calculate a load. Luckily, through DNR, the windshield survey, and members of the steering committee, we know which subwatersheds have the largest AMD problems (see 7.2: Critical Areas) E. coli bacteria has very little mass, and can only be expressed as a concentration of colony forming units (cfu). E. coli is summarized by averaging the samples from IDEM's sampling program. On average, E. coli samples exceeding the 235 cfu/100 ml water quality standard need a 53% reduction to meet that standard. The entire watershed's E. coli load needs to decrease by 40%. On average, the high nitrogen subwatersheds need a 38% reduction to have a low STEPL value. On average, the high sediment subwatersheds need a 39% reduction to have a low STEPL value. On average, the high phosphorus subwatersheds need a 35% reduction to have a low STEPL value.[28]

Figure 18: Current Loads

Pollutant	Load for Entire Watershed	Cumulative load for the subwatersheds with high runoff	Average of samples exceeding water quality standard
Nitrogen (loads from STEPL)	1,689,237 lbs/yr	1,194,864 lbs/yr	N/A
Phosphorus (loads from STEPL)	335,164 lbs/yr	157,356 lbs/yr	N/A
Sediment (loads from STEPL)	58,348 tons/yr	26,719 tons/yr	N/A
E. coli (from IDEM)	392 cfu/100 ml (average per sample site)	N/A	498 cfu/100 ml

[28] Based on reducing runoff data from Figure 9 from the low end of 'High Runoff' to the high end of 'Low Runoff'. For example, reducing sediment runoff from 621 lbs/acre/year to 380 lbs/acre/year.

Target loads for nitrogen, phosphorus, and sediment are based on the average reduction needed for subwatersheds with high STEPL measured runoff to have low runoff. The E. coli target load is the single sample water quality standard.

Figure 19: Target Loads and Reductions Needed

Pollutant	Average Reduction Needed	Target Load	Load Reduction Needed
Nitrogen	38%	739,676 lbs/yr	455,188 lbs/yr
Phosphorus	35%	102,282 lbs/yr	55,074 lbs/yr
Sediment	39%	16,299 tons/yr	10,420 tons/yr
E. coli	40%	235 cfu/100 ml	E. coli loads cannot be calculated. The number of colony forming units would have to be decreased by 40% across the watershed to meet the water quality standard.

7.1: Goals and Indicators

Using the defined Problems as a starting point, the steering committee discussed the large-scale changes they'd like to see in the watershed. That discussion eventually led to six goals designed to improve and protect the water quality in the MPRW. See 8.1 for more information on achieving the goals. Each goal also includes an indicator. Indicators are measures that determine whether progress towards a goal is being made. Indicators can be administrative in nature (number of meetings held) or environmental (reduced pollutant loading).

These six goals represent the steering committee's long-term vision for how to improve water quality in the Middle Patoka River Watershed. However, not all of these goals, or the subwatersheds they describe, can be a first priority.

Goal 1: Promote, support, and involve the public in efforts that will improve the water quality of the MPRW. *Indicators will be the number and type of public participation events and opportunities as well as progress towards achieving goals 2-6.*

Goal 2: In the subwatersheds with high nitrogen runoff, reduce that pollutant by 455,188 lbs within 10 years. *The indicator will be modeling that factors nitrogen reductions from installed BMPs.*

Goal 3: In the subwatersheds with high phosphorus runoff, reduce that pollutant by 55,074 lbs within 10 years. *The indicator will be modeling that factors phosphorus reductions from installed BMPs.*

Goal 4: In the subwatersheds with high sediment runoff, reduce that pollutant by 16,299 tons within 5 years. *The indicator will be modeling that factors sediment reductions from installed BMPs.*

Goal 5: Within 25 years, reduce E. coli levels in the watershed so the water quality standard is achieved. *The indicator will be water quality sampling done by IDEM as part of their rotational basin sampling program.*

Goal 6: Within 3 years, begin to rehabilitate the AMD sites documented in the plan. *The indicator will be geographic and water quality data on acid mine drainage and work done at already known sites. Future IDEM sulfate sampling will also be an indicator.*

7.2: Critical Areas and BMPs/Measures

Critical Areas are defined in order to better direct resources to where they might best impact the MPRW. They were chosen based on an analysis of the watershed inventory data. The three Critical Areas chosen offer opportunity to reduce runoff sources in order to improve water quality and/or mitigate the impact of future sources in order to protect water quality. Not all of the subwatersheds described in the goals are listed as critical; this is because the Critical Areas will need to be reassessed and perhaps changed once the initial phase of project is completed and other phases are initiated. For the initial implementation phase of this project, three Critical Areas were chosen.

1. Bone/Flat Creek subwatershed in Zone 1, all of Zone 2, and Bruner Creek and Indian/Hunley Creek subwatersheds in Zone 4 are critical for E. coli, sediment, nitrogen, and phosphorus.

    Rational: This area has ten septic groups and has parts or all of the Zones the windshield survey ranked 1-3 for erosion sites and cattle access to the streams. This area has the greatest percentage of inadequate stream buffers in the entire watershed. These five subwatersheds also have high runoff of at least two pollutants (sediment, nitrogen, or phosphorus) and some of the most poorly buffered streams in the watershed. Many of the Best Management Practices used to address these problems will also address E. coli.

2. Urban areas within city boundaries and across the watershed as defined by the landuse map (low, medium, and high developed areas).

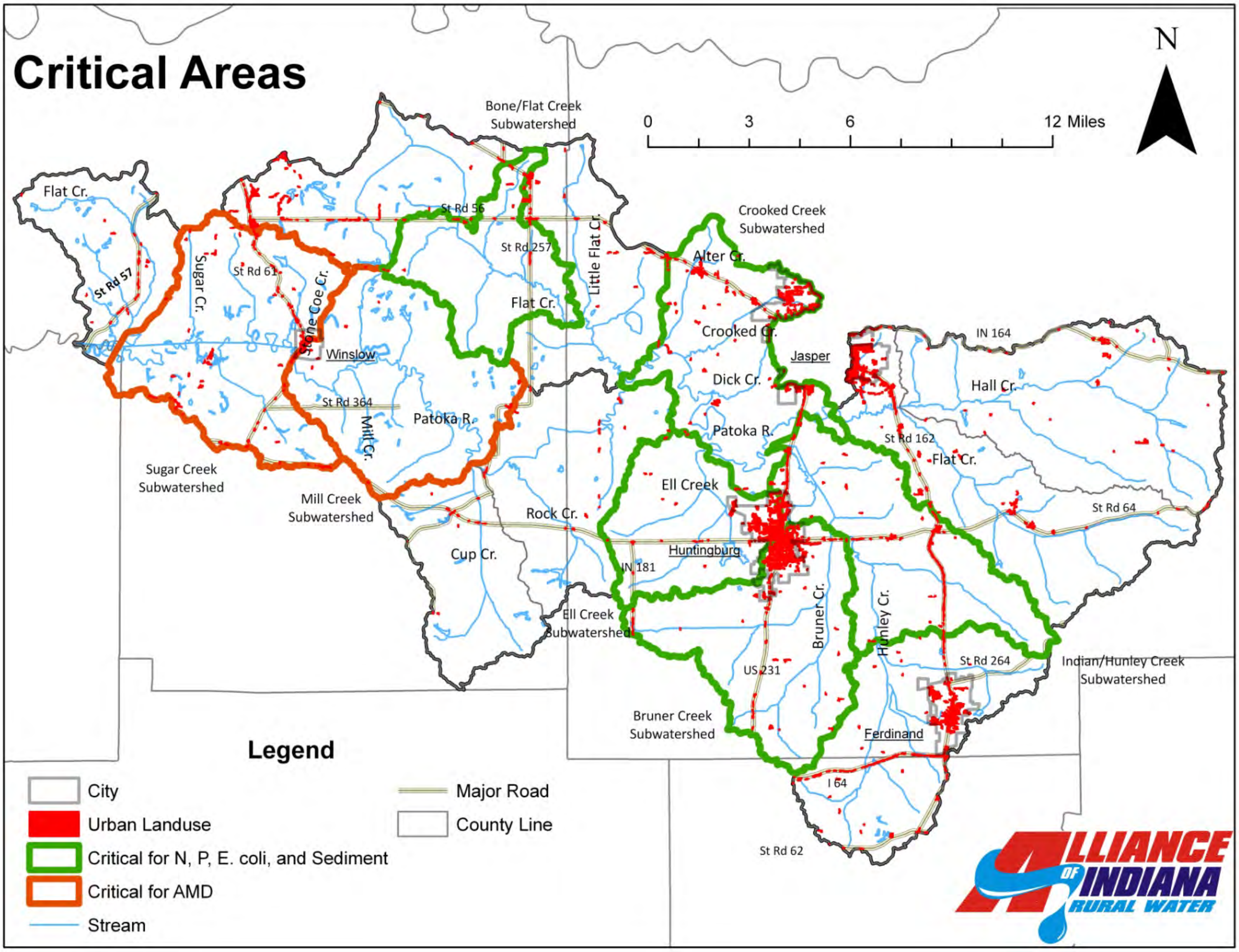
    Rational: Urban areas contribute polluted runoff and storm water that increases downstream flows; causing erosion and the addition of sediments and nutrients to the water. Buffers needing improvement were often found on urban peripheries where growth is expected to occur.

3. Sugar Creek and Mill Creek subwatersheds in Zone 5 are critical for remediation of acid mine drainage

    Rational: Four out of the five AMD sites found during the windshield survey were in Sugar Creek subwatershed. Members of the public, DNR, and the steering committee indicate that AMD is a problem in these subwatersheds.

Map 35 shows the critical areas.

Map 35: Critical Areas



In Figure 19, proposed Best Management Practices (BMPs) chosen by the steering committee are matched up with the appropriate Critical Area. These BMPs, along with educational objectives, are prioritized in Section 8.1. Using the Region V Model, a pollutant load model recommended by USEPA, and STEPL, an estimate of the number of BMPs needed to meet the goals were calculated. The models are only capable of estimating the number of practices needed to reach Goals 2, 3, and 4.

Figure 20: Critical Areas, BMPs/Measures, and Load Reductions

BMP	Estimated Sediment Load Reduction per Acre of BMP	Estimated Phosphorus Load Reduction per Acre of BMP	Estimated Nitrogen Load Reduction per Acre of BMP	Applicable Critical Area
Prescribed/Rotational Grazing	59.4 tons (274 acres needed to meet sediment goal)	29 lbs (1,899 acres needed to meet phosphorus goal)	56.9 lbs (7,986 acres needed to meet nitrogen goal)	Critical Area 1
Mulch Till	20.3 tons (802 acres needed to meet sediment goal)	8 lbs (6,884 acres needed to meet phosphorus goal)	16 lbs (28,449 acres needed to meet nitrogen goal)	Critical Area 1
Conservation Cover	46.9 tons (347 acres needed to meet sediment goal)	20.9 lbs (2,623 acres needed to meet phosphorus goal)	41 lbs (11,102 acres needed to meet nitrogen goal)	Critical Area 1
Cover/Green Manure	1.56 tons (10,420 acres needed to meet sediment goal)	1 lb (55,074 acres needed to meet phosphorus goal)	55,074 will meet 25% of N goal. Other practices are needed.	Critical Area 1
Critical Area Planting	46.9 tons (347 acres needed to meet sediment goal)	20.9 lbs (2,623 acres needed to meet phosphorus goal)	41 lbs (11,102 acres needed to meet nitrogen goal)	Critical Area 1
Filter Strip	4.38 tons (3,721 acres needed to meet sediment goal)	4.49 lbs (12,239 acres needed to meet phosphorus goal)	13.4 lbs (33,969 acres needed to meet nitrogen goal)	Critical Area 1
Reduced Tillage	5.16 tons (3,158 acres needed to meet sediment goal)	4.59 lbs (11,973 acres needed to meet phosphorus goal)	13.9 lbs (32,747 acres needed to meet nitrogen goal)	Critical Area 1
Fencing Cattle from Stream	5.16 tons (3,158 acres needed to meet sediment goal)	5.09 lbs (10,799 acres needed to meet phosphorus goal)	15 lbs (30,145 acres needed to meet nitrogen goal)	Critical Area 1
Animal Waste Management System	Not Applicable	127.4 lbs (432 acres needed to meet phosphorus goal)	566 lbs (803 acres needed to meet nitrogen goal)	Critical Area 1
Waste Storage Facility	Not Applicable	84.9 lbs (648 acres needed to meet phosphorus goal)	460 lbs (988 acres needed to meet nitrogen goal)	Critical Area 1
BMP	**Loading Information**			**Applicable Critical Area**
Tile Drain Management	Can't estimate precise load reductions, but the practice will reduce flow and nitrogen use.			Critical Area 1
Precision GPS Farming	Can't estimate precise load reductions, but the practice will reduce fertilizer use (both commercial and manure).			Critical Area 1
Manure Management Plans	Can't estimate precise load reductions, but the practice includes testing of field nutrient needs and plans for proper manure storage, staging, and application.			Critical Area 1
Manure Injection	Can't estimate precise load reductions, but the practice will reduce nutrient and E. coli runoff.			Critical Area 1
2-Stage Ditch and other natural channel restoration methods	Can't estimate precise load reductions, but the practice will reduce flow and sediment and increase denitrification.			Critical Areas 1 and 2

BMP	Loading Information	Applicable Critical Area
Restore wetlands	Can't estimate precise load reductions, but the practice will absorb storm water and reduce sediment and nutrients.	Critical Areas 1 and 2
Practices that reduce acid mine drainage (i.e. land reclamation and land reconstruction	Can't estimate precise load reductions. Practices 453, 455, and 543 from the USDA Field Office Technical Guide for Indiana will be used.	Critical Area 3
Plant Trees	Trees primarily will reduce storm water flow. A medium sized tree intercepts 2,380 gallons of rainfall a year. From: the Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002.	Critical Areas 1 and 2
Pervious pavers, concrete, etc	This practice will reduce storm water flow.	Critical Area 2
Rain garden, bioretention cell, vegetative swales or other infiltration device	Reduces sediment, phosphorus, and nitrogen, but couldn't be installed in the numbers needed to meet those reduction goals. These practices will also reduce storm water flow.	Critical Area 2
Rain Barrels, cisterns	Reduces storm water flow	Critical Area 2

8.1 Action Register and Schedule

The Action Register (Figure 20) is a figure displaying the goals' objectives. Objectives are specific strategies that the steering committee felt would help achieve its goals. Where objectives are shared by multiple goals, it is noted. The steering committee prioritized the objectives by voting. The prioritization was used to create the project schedule, with higher prioritized objectives being placed at the beginning of the project. The Action Register also includes milestones, estimated financial costs, and possible partners and needed technical assistance. Milestones are steps that show the objective is being implemented on a schedule. Keeping track of milestones will help us stay on schedule and demonstrate progress. The schedule includes three phases of implementation spread across 10 years. Progress on the source water plan should be evaluated and the plan revised as necessary after each implementation phase is completed.

Figure 21: Middle Patoka River Watershed Action Register

Priority 1: Each objective hopefully will begin and end during the first phase of implementation (years 1-3). Unforeseen realities may change that schedule.

Objective	Goals	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Provide cost-share for practices that reduce the impacts of row crop farming and manure from CFOs	2-5	Row crop producers and CFO owners	Get cost-share program approved by IDEM	< $1,000		Landowners can also apply for USDA Farm Bill incentives and in some cases combine Farm Bill with other cost-share programs
			Work with FSA to contact landowners	$2,500-$5,000	PP=FSA	
			Work with landowners to spend cost-share funds and implement BMPs	$139,000 (for all cost-share objectives)	PP=SWCDs TA=NRCS Tech Teams or Private Consultant	
Provide cost-share for practices that reduce the impacts of acid mine drainage	6	Private landowners	Get cost-share program approved by IDEM	< $1,000		Partners for Reclamation, a committee of Sycamore Trails RC&D has done similar work in and around Clay County
			Advertise the program and its benefits	$2,500-$5,000	PP=Steering Committee and DNR	
			Work with landowners to locate AMD sites and spend cost-share funds and implement BMPs	$139,000 (for all cost-share objectives)	TA=Someone to design the practices PP=DNR	
Provide cost-share for practices that reduce the impacts of urban storm water	2-5	Residential homeowners and municipalities	Get cost-share program approved by IDEM	< $1,000		Appendix C has possible projects
			Advertise the program and its benefits	$2,500-$5,000	PP=SWCDs, Utilities, and Municipalities	
			Work with landowners to spend cost-share funds and implement BMPs	$139,000 (for all cost-share objectives)	PP=SWCDs, Utilities, and Municipalities TA=Someone to design the practices	
Work with city and county leaders on adopting a conservation ethic into local plans and ordinances: examples include urban sustainability, smart growth, low impact	1-5	County commissioners, city councils and mayors, and the public	Survey the target audience on conservation topics they think are implementable and want information about	$2,500-$5,000		Save the Dunes and the Upper White River Watershed Alliance are two Indiana watershed groups that have put on these sorts of workshops. IDEM may know of other examples.
			Hire an expert to run a workshop on conservation topics	$5,000	TA=Workshop speaker	
			Follow up with attendees on what other resources they need	$2,500-$5,000		

development, and sensible limits on CFOs						
Objective	**Goals**	**Target Audience**	**Milestone**	**Cost**	**Possible Partner (PP) and needed Technical Assistance (TA)**	**Existing Resources**
Provide urban education about proper use of and alternatives to lawn chemicals	1-3	Residential homeowners	Hold two public events to educate on this topic	$2,500-$5,000	PP=SWCDs, Garden Clubs, Nurseries	
Provide watershed management education to children	1	Children and schools, clubs, and organizations that cater to children	Identify places that need a children's speaker	$1,000-$2,000	PP=Steering Committee	Project Wet
			Develop an appropriate message for each audience	$2,500-$5,000		
			Speak to at least six groups	<$1,000		
Hold tours at water treatment plants to teach the link between water quality and drinking water	1	The public	Advertise the tours through CCRs and other media	<$1,000	PP=Utilities	
			Hold four tours	<$1,000	PP=Utilities	
Educate public on septic maintenance	1-3, and 5	Septic owners	Work with Health Departments on appropriate message	$1,000	PP=Health Departments and Septic Installers	
			Hold one workshop	$2,500-$5,000		
Address illegal dumping	1	Adults	Schedule a cleanup day each year	$2,500-$5,000	PP=SWCD, utilities, trash haulers	
			Work with Steering Committee to develop other strategies to educate and promote less dumping	$2,500-$5,000		
			Work with IDEM and DNR to clarify how to deal with known dumpers	$2,500-$5,000	TA=IDEM and DNR	

Priority 2: Each objective hopefully will begin and end during the second phase of implementation (years 4-6). Unforeseen realities may change that schedule. Objectives from Phase I may have to carry over into Phase II.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Provide cost-share for more natural stream banks/buffer corridors	2-5	Landowners along streams	Get cost-share program approved by IDEM	< $1,000		
			Advertise the program and its benefits	$2,500-$5,000	PP=Steering Committee and DNR	
			Work with landowners to spend cost-share funds		TA=Someone to design the practices	
Reduce nutrient and other chemical use by promoting organic agriculture	2-3	Farmers and gardeners	Work with Steering Committee to develop strategies to promote organics	$2,500-$5,000		
			Hold one educational event a year	$5,000-$10,000	TA=Expert needed to speak at events	
Restore wetlands	2-4	Landowners parks cities	Use hydric soils map to ID potential restoration sites	$2,500-$5,000	PP=FSA, Auditor Offices	Wetland Reserve Program (WRP)
			Educate site owners about WRP	$2,500-$5,000	PP=NRCS, SWCD, Patoka Wildlife Refuge	
			Work with Steering Committee to determine if WRP is sufficient incentive or if additional cost-share is needed	< $1,000		
Work with DNR to become more of a partner in their AMD work	6	DNR	Create a presentation showing AMD problems the project has addressed	$1,000		
			Meet with DNR to discuss our successes and how we might partner	$1,000		
Provide watershed education to adults: topics include log jam prevention, reducing urban runoff, info on channelization, etc	1	Adults	Work with Steering Committee to decide on topics and venues	< $1,000		
			Hold two education events a year	$5,000-$10,000	SWCD	

Priority 3: Each objective hopefully will begin and end during the third phase of implementation (years 7-10). Unforeseen realities may change that schedule. Objectives from Phase I and II may have to carry over into Phase III.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Find alternative uses for animal manure/litter	1-3, and 5	CFOs	Work with Steering Committee to explore the ideas in Section 2.5.4	< $1,000		
			Work with potential markets for the manure/litter	$2,500-$5,000	PP=see Section 2.5.4	
Hold septic workshops for installers	1-3, and 5	Septic System contractors	Hold two workshops	$2,500-$5,000	PP/TA=County Health Departments	
Post watershed road signs to educate the public about the MPRW	1	The public	Meet with city and county road departments	$1,000-$2,000	PP=municipalities	
			Work with Steering Committee to discuss number and placement of signs	< $1,000		
			Install signs	$250 for sign, post, and installation	PP=municipalities	

Figure 22: Action Register for the Goals' Indicators

Indicator	Goal	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)
The number and type of public participation events and opportunities as well as progress towards achieving goals 2-6.	1	Those interested in evaluating this plan	During each implementation phase, keep track of events and participation	<$1,000	PP=Volunteers to track event participation
			At the end of each implementation phase, look for increases in public participation from year 1 and success reaching indicators 2-6	$1,000	
Modeling that factors nitrogen reductions from installed BMPs.	2	Those interested in evaluating this plan	During each implementation phase, model load reductions from all BMPs	$2,000-$3,000	TA=Someone to run STEPL or other model
			At the end of each implementation phase, compare modeled data with needed reductions	<$1,000	
Modeling that factors phosphorus reductions from installed BMPs.	3	Those interested in evaluating this plan	During each implementation phase, model load reductions from all BMPs	$2,000-$3,000	TA=Someone to run STEPL or other model
			At the end of each implementation phase, compare modeled data with needed reductions	<$1,000	
Modeling that factors sediment reductions from installed BMPs.	4	Those interested in evaluating this plan	During each implementation phase, model load reductions from all BMPs	$2,000-$3,000	TA=Someone to run STEPL or other model
			At the end of each implementation phase, compare modeled data with needed reductions	<$1,000	
Water quality sampling done by IDEM as part of their rotational basin sampling program.	5	Those interested in evaluating this plan	Once IDEM samples again, compare data with the bacteria water quality standard	$2,000-$3,000	
Geographic and water quality data on acid mine drainage and work done at already known sites.	6	Those interested in evaluating this plan	At the end of each implementation phase, tally the stream miles impacted by remediation work and the number of known sites still needing work	$1,000-$2,000	

9.1: Future Activity

Our short term goal is to find funding in order to start implementing the plan. Though the Alliance of Indiana Rural Water completed this source water plan, our hope is that we are not the only organization to put it to use. Even before the plan was finalized, Winslow and Ferdinand were working with the Alliance on urban storm water projects. We hope other organizations and municipalities follow that lead. Whoever uses this plan is responsible for ensuring that the information within is still accurate. The features of a watershed continually change, as should a source water plan. Updating the MPRW Plan after every phase of implementation is the responsibility of those using the plan and the community as a whole.

Appendix A: 2008 IDEM 303(d) Impairments

Stream Name	County	Impairment	Assessment Unit
Sugar Creek	Pike	DO, Sulfates, TDS	INP0968_00
Patoka River	Pike	Hg and PCB	INP0968_T1014
	Pike	Hg and PCB	INP0965_T1013
	Pike	Hg and PCB	INP0964_T1012
	Pike	Hg and PCB	INP0962_T1011
	Pike and Dubois	Hg and PCB	INP0961_T1010
	Pike and Dubois	Hg and PCB	INP0948_T1009
	Pike and Dubois	Hg and PCB	INP0946_T1008
	Pike and Dubois	Hg and PCB	INP0946_T1006
Patoka River	Dubois	Hg, PCB, Pb, and E. coli	INP0947_T1007
Hall Creek Headwaters	Dubois	E. coli	INP0931_00
Ell Creek and Tributaries	Dubois	Nutrients	INP0947_00
Outlet of Huntingburg City Lake	Dubois	IBC	INP0947_T1025
Hunley Creek Headwaters	Spencer and Dubois	Nutrients and Siltation	INP0941_00
Unnamed Tributary	Dubois	E. coli and Nutrients	INP0953_T1066
Flat Creek	Dubois	E. coli	INP0953_00
Little Flat Creek	Dubois	Siltation, TDS, and E. coli	INP0953_T1065
Flat Creek Headwaters	Pike	E. coli, IBC, Sulfates, and TDS	INP0951_00
Flat Creek/Buck Creek	Pike and Dubois	E. coli, IBC, Sulfates, and TDS	INP0952_00
Patoka River/Lick Mill Creeks	Pike	IBC, Sulfates, TDS	INP0965_00

Indiana County Endangered, Threatened and Rare Species List

County: Dubois

Species Name	Common Name	FED	STATE	GRANK	SRANK
Crustacean: Malacostraca					
Orconectes indianensis	Indiana Crayfish		SR	G3	S2
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Fusconaia subrotunda	Longsolid		SE	G3	SX
Pleurobema clava	Clubshell	LE	SE	G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema rubrum	Pyramid Pigtoe		SE	G2G3	SX
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Insect: Odonata (Dragonflies & Damselflies)					
Gomphus hybridus	Cocoa Clubtail		SE	G4	S1
Fish					
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Etheostoma maculatum	Spotted Darter		SSC	G2	S2S3
Etheostoma tippecanoe	Tippecanoe Darter		SSC	G3G4	S3
Amphibian					
Acris crepitans blanchardi	Northern Cricket Frog		SSC	G5	S4
Reptile					
Agkistrodon piscivorus leucostoma	Western Cottonmouth		SE	G5T5	S1
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Bird					
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Buteo platypterus	Broad-winged Hawk	No Status	SSC	G5	S3B
Cistothorus platensis	Sedge Wren		SE	G5	S3B
Dendroica cerulea	Cerulean Warbler		SE	G4	S3B
Haliaeetus leucocephalus	Bald Eagle	LT,PDL	SE	G5	S2
Helmitheros vermivorus	Worm-eating Warbler		SSC	G5	S3B
Ixobrychus exilis	Least Bittern		SE	G5	S3B
Lanius ludovicianus	Loggerhead Shrike	No Status	SE	G4	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Pandion haliaetus	Osprey		SE	G5	S1B
Rallus elegans	King Rail		SE	G4	S1B
Tyto alba	Barn Owl		SE	G5	S2
Wilsonia citrina	Hooded Warbler		SSC	G5	S3B
Mammal					
Lutra canadensis	Northern River Otter		SSC	G5	S2

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Indiana County Endangered, Threatened and Rare Species List

County: Dubois

Species Name	Common Name	FED	STATE	GRANK	SRANK
Lynx rufus	Bobcat	No Status	SSC	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Asplenium bradleyi	Bradley's Spleenwort		SE	G4	S1
Carex atlantica ssp. capillacea	Howe Sedge		SE	G5T5?	S1
Crataegus viridis	Green Hawthorn		ST	G5	S2
Hottonia inflata	Featherfoil		ST	G4	S2
Hymenocallis occidentalis	Carolina Spider-lily		WL	G4?	S3
Itea virginica	Virginia Willow		SE	G4	S1
Limnobium spongia	American Frog's-bit		SE	G4	S1
Linum striatum	Ridged Yellow Flax		WL	G5	S3
Passiflora incarnata	Purple Passion-flower		SR	G5	S2
Poa paludigena	Bog Bluegrass		WL	G3	S3
Ranunculus laxicaulis	Mississippi Buttercup		SE	G5?	S1
Rudbeckia fulgida var. fulgida	Orange Coneflower		WL	G5T4?	S2
Scutellaria parvula var. australis	Southern Skullcap		WL	G4T4?	S2
Spiranthes vernalis	Grassleaf Ladies'-tresses		WL	G5	S2
Strophostyles leiosperma	Slick-seed Wild-bean		ST	G5	S2
Styrax americanus	American Snowbell		WL	G5	S3
Trachelospermum difforme	Climbing Dogbane		SR	G4G5	S2
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3
Wetland - seep acid	Acid Seep		SG	GU	S1
Wetland - swamp forest	Forested Swamp		SG	G2?	S2

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Indiana County Endangered, Threatened and Rare Species List

County: Gibson

Species Name	Common Name	FED	STATE	GRANK	SRANK
Crustacean: Malacostraca					
Orconectes indianensis	Indiana Crayfish		SR	G3	S2
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma torulosa torulosa	Tubercled Blossom	LE	SE	G2TX	SX
Epioblasma triquetra	Snuffbox		SE	G3	S1
Fusconaia subrotunda	Longsolid		SE	G3	SX
Lampsilis abrupta	Pink Mucket	LE	SE	G2	SX
Obovaria subrotunda	Round Hickorynut		SSC	G4	S1
Plethobasus cicatricosus	White Wartyback	LE	SE	G1	SX
Plethobasus cooperianus	Orangefoot Pimpleback	LE	SE	G1	SX
Plethobasus cyphyus	Sheepnose	C	SE	G3	S1
Pleurobema clava	Clubshell	LE	SE	G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema plenum	Rough Pigtoe	LE	SE	G1	S1
Pleurobema rubrum	Pyramid Pigtoe		SE	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G1G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Quadrula cylindrica cylindrica	Rabbitsfoot	C	SE	G3G4T3	S1
Insect: Ephemeroptera (Mayflies)					
Homoeoneuria ammophila	A Sand-filtering Mayfly		SE	G4	S1
Pseudiron centralis	A Mayfly		SE	G5	S1
Insect: Lepidoptera (Butterflies & Moths)					
Euphyes dukesi	Scarce Swamp Skipper		ST	G3	S1S2
Amphibian					
Scaphiopus holbrookii	Eastern Spadefoot		SSC	G5	S2
Reptile					
Kinosternon subrubrum subrubrum	Eastern Mud Turtle		SE	G5T5	S2
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Pseudemys concinna concinna	Eastern River Cooter		SE	G5T5	S1
Terrapene carolina carolina	Eastern Box Turtle		SSC	G5T5	S3
Bird					
Accipiter striatus	Sharp-shinned Hawk	No Status	SSC	G5	S2B
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Botaurus lentiginosus	American Bittern		SE	G4	S2B
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Circus cyaneus	Northern Harrier		SE	G5	S2
Cistothorus platensis	Sedge Wren		SE	G5	S3B

Indiana County Endangered, Threatened and Rare Species List

County: Gibson

Species Name	Common Name	FED	STATE	GRANK	SRANK
Dendroica cerulea	Cerulean Warbler		SE	G4	S3B
Falco peregrinus	Peregrine Falcon	No Status	SE	G4	S2B
Haliaeetus leucocephalus	Bald Eagle	LT,PDL	SE	G5	S2
Ixobrychus exilis	Least Bittern		SE	G5	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Phalaropus tricolor	Wilson's Phalarope		SSC	G5	SHB
Rallus elegans	King Rail		SE	G4	S1B
Sternula antillarum athalassos	Interior Least Tern	LE	SE	G4T2Q	S1B
Tyto alba	Barn Owl		SE	G5	S2
Vermivora chrysoptera	Golden-winged Warbler		SE	G4	S1B
Mammal					
Lasiurus borealis	Eastern Red Bat		SSC	G5	S4
Lutra canadensis	Northern River Otter		SSC	G5	S2
Mustela nivalis	Least Weasel		SSC	G5	S2?
Myotis lucifugus	Little Brown Bat		SSC	G5	S4
Myotis septentrionalis	Northern Myotis		SSC	G4	S3
Myotis sodalis	Indiana Bat or Social Myotis	LE	SE	G2	S1
Nycticeius humeralis	Evening Bat		SE	G5	S1
Pipistrellus subflavus	Eastern Pipistrelle		SSC	G5	S4
Sylvilagus aquaticus	Swamp Rabbit		SE	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Acalypha deamii	Mercury		SR	G4?	S2
Armoracia aquatica	Lake Cress		SE	G4?	S1
Azolla caroliniana	Carolina Mosquito-fern		ST	G5	S2
Calycocarpum lyonii	Cup-seed		ST	G5	S2
Carex socialis	Social Sedge		SR	G4	S2
Carex straminea	Straw Sedge		ST	G5	S2
Catalpa speciosa	Northern Catalpa		SR	G4?	S2
Chelone obliqua var. speciosa	Rose Turtlehead		WL	G4T3	S3
Clematis pitcheri	Pitcher Leather-flower		SR	G4G5	S2
Crataegus grandis	Grand Hawthorn		SE	G3G5Q	S1
Crataegus viridis	Green Hawthorn		ST	G5	S2
Cyperus pseudovegetus	Green Flatsedge		SR	G5	S2
Didiplis diandra	Water-purslane		SE	G5	S2
Diodia virginiana	Buttonweed		WL	G5	S2
Gleditsia aquatica	Water-locust		SE	G5	S1
Hibiscus moscheutos ssp. lasiocarpos	Hairy-fruited Hibiscus		SE	G5T4	S1
Iresine rhizomatosa	Eastern Bloodleaf		SR	G5	S2

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Indiana County Endangered, Threatened and Rare Species List

County: Gibson

Species Name	Common Name	FED	STATE	GRANK	SRANK
Juglans cinerea	Butternut		WL	G4	S3
Linum striatum	Ridged Yellow Flax		WL	G5	S3
Ludwigia decurrens	Primrose Willow		WL	G5	S2
Orobanche riparia	Bottomland Broomrape		SE	G5	S2
Platanthera flava var. flava	Southern Rein Orchid		SE	G4?T4?Q	S1
Potamogeton pusillus	Slender Pondweed		WL	G5	S2
Sparganium androcladum	Branching Bur-reed		ST	G4G5	S2
Strophostyles leiosperma	Slick-seed Wild-bean		ST	G5	S2
Styrax americanus	American Snowbell		WL	G5	S3
Taxodium distichum	Bald Cypress		ST	G5	S2
Trachelospermum difforme	Climbing Dogbane		SR	G4G5	S2
Vitis palmata	Catbird Grape		SR	G4	S2
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3
Wetland - swamp shrub	Shrub Swamp		SG	GU	S2
Other					
Geomorphic - Nonglacial Erosional Feature - Water Fall and Cascade	Water Fall and Cascade			GNR	SNR

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Indiana County Endangered, Threatened and Rare Species List

County: Pike

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mollusk: Bivalvia (Mussels)					
Cyprogenia stegaria	Eastern Fanshell Pearlymussel	LE	SE	G1Q	S1
Epioblasma torulosa torulosa	Tubercled Blossom	LE	SE	G2TX	SX
Fusconaia subrotunda	Longsolid		SE	G3	SX
Obovaria subrotunda	Round Hickorynut		SSC	G4	S1
Pleurobema clava	Clubshell	LE	SE	G2	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Pleurobema plenum	Rough Pigtoe	LE	SE	G1	S1
Pleurobema rubrum	Pyramid Pigtoe		SE	G2G3	SX
Potamilus capax	Fat Pocketbook	LE	SE	G1G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Quadrula cylindrica cylindrica	Rabbitsfoot	C	SE	G3G4T3	S1
Simpsonaias ambigua	Salamander Mussel		SSC	G3	S2
Insect: Ephemeroptera (Mayflies)					
Pseudiron centralis	A Mayfly		SE	G5	S1
Fish					
Ammocrypta clara	Western Sand Darter		SSC	G3	S2
Etheostoma tippecanoe	Tippecanoe Darter		SSC	G3G4	S3
Amphibian					
Rana areolata circulosa	Northern Crawfish Frog		SE	G4T4	S2
Scaphiopus holbrookii	Eastern Spadefoot		SSC	G5	S2
Reptile					
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Terrapene carolina carolina	Eastern Box Turtle		SSC	G5T5	S3
Bird					
Accipiter striatus	Sharp-shinned Hawk	No Status	SSC	G5	S2B
Asio flammeus	Short-eared Owl		SE	G5	S2
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Buteo platypterus	Broad-winged Hawk	No Status	SSC	G5	S3B
Circus cyaneus	Northern Harrier		SE	G5	S2
Dendroica cerulea	Cerulean Warbler		SE	G4	S3B
Ictinia mississippiensis	Mississippi Kite		SSC	G5	S1B
Lanius ludovicianus	Loggerhead Shrike	No Status	SE	G4	S3B
Mniotilta varia	Black-and-white Warbler		SSC	G5	S1S2B
Nyctanassa violacea	Yellow-crowned Night-heron		SE	G5	S2B
Nycticorax nycticorax	Black-crowned Night-heron		SE	G5	S1B
Rallus elegans	King Rail		SE	G4	S1B
Tyto alba	Barn Owl		SE	G5	S2
Vermivora chrysoptera	Golden-winged Warbler		SE	G4	S1B

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Indiana County Endangered, Threatened and Rare Species List

County: Pike

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mammal					
Lasiurus borealis	Eastern Red Bat		SSC	G5	S4
Lutra canadensis	Northern River Otter		SSC	G5	S2
Lynx rufus	Bobcat	No Status	SSC	G5	S1
Myotis septentrionalis	Northern Myotis		SSC	G4	S3
Myotis sodalis	Indiana Bat or Social Myotis	LE	SE	G2	S1
Nycticeius humeralis	Evening Bat		SE	G5	S1
Pipistrellus subflavus	Eastern Pipistrelle		SSC	G5	S4
Sylvilagus aquaticus	Swamp Rabbit		SE	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Catalpa speciosa	Northern Catalpa		SR	G4?	S2
Chelone obliqua var. speciosa	Rose Turtlehead		WL	G4T3	S3
Cyperus pseudovegetus	Green Flatsedge		SR	G5	S2
Didiplis diandra	Water-purslane		SE	G5	S2
Diodia virginiana	Buttonweed		WL	G5	S2
Hottonia inflata	Featherfoil		ST	G4	S2
Itea virginica	Virginia Willow		SE	G4	S1
Ludwigia decurrens	Primrose Willow		WL	G5	S2
Mikania scandens	Climbing Hempweed		SE	G5	S1
Phacelia covillei	Buttercup scorpionweed		SE	G3	S1
Phacelia ranunculacea	Blue Scorpion-weed		SE	G4	S1
Potamogeton pusillus	Slender Pondweed		WL	G5	S2
Rhexia mariana var. mariana	Maryland Meadow Beauty		ST	G5T5	S1
Sagittaria australis	Longbeak Arrowhead		SR	G5	S2
Selaginella apoda	Meadow Spike-moss		WL	G5	S1
Senna obtusifolia	Blunt-leaf Senna		SR	G5	S2
Styrax americanus	American Snowbell		WL	G5	S3
Trachelospermum difforme	Climbing Dogbane		SR	G4G5	S2
Vitis palmata	Catbird Grape		SR	G4	S2
Wisteria macrostachya	Kentucky Wisteria		SR	G5	S2
High Quality Natural Community					
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Forest - upland mesic	Mesic Upland Forest		SG	G3?	S3

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

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Indiana County Endangered, Threatened and Rare Species List

County: Spencer

Species Name	Common Name	FED	STATE	GRANK	SRANK
Mollusk: Bivalvia (Mussels)					
Plethobasus cyphyus	Sheepnose	C	SE	G3	S1
Pleurobema cordatum	Ohio Pigtoe		SSC	G4	S2
Quadrula cylindrica cylindrica	Rabbitsfoot	C	SE	G3G4T3	S1
Fish					
Acipenser fulvescens	Lake Sturgeon		SE	G3G4	S1
Amphibian					
Acris crepitans blanchardi	Northern Cricket Frog		SSC	G5	S4
Scaphiopus holbrookii	Eastern Spadefoot		SSC	G5	S2
Reptile					
Nerodia erythrogaster neglecta	Copperbelly Water Snake	PS:LT	SE	G5T3	S2
Opheodrys aestivus	Rough Green Snake		SSC	G5	S3
Bird					
Ammodramus henslowii	Henslow's Sparrow		SE	G4	S3B
Buteo lineatus	Red-shouldered Hawk		SSC	G5	S3
Helmitheros vermivorus	Worm-eating Warbler		SSC	G5	S3B
Ictinia mississippiensis	Mississippi Kite		SSC	G5	S1B
Lanius ludovicianus	Loggerhead Shrike	No Status	SE	G4	S3B
Sternula antillarum athalassos	Interior Least Tern	LE	SE	G4T2Q	S1B
Tyto alba	Barn Owl		SE	G5	S2
Mammal					
Lynx rufus	Bobcat	No Status	SSC	G5	S1
Myotis grisescens	Gray Bat	LE	SE	G3	S1
Sylvilagus aquaticus	Swamp Rabbit		SE	G5	S1
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Acalypha deamii	Mercury		SR	G4?	S2
Armoracia aquatica	Lake Cress		SE	G4?	S1
Calycocarpum lyonii	Cup-seed		ST	G5	S2
Carex bushii	Bush's Sedge		ST	G4	S1
Carex socialis	Social Sedge		SR	G4	S2
Catalpa speciosa	Northern Catalpa		SR	G4?	S2
Chelone obliqua var. speciosa	Rose Turtlehead		WL	G4T3	S3
Crataegus viridis	Green Hawthorn		ST	G5	S2
Crotonopsis elliptica	Elliptical Rushfoil		SE	G5	S1
Cyperus acuminatus	Short-point Flatsedge		WL	G5	S3
Cyperus pseudovegetus	Green Flatsedge		SR	G5	S2
Didiplis diandra	Water-purslane		SE	G5	S2
Eleocharis wolfii	Wolf Spikerush		SR	G3G4	S2

Indiana County Endangered, Threatened and Rare Species List

County: Spencer

Species Name	Common Name	FED	STATE	GRANK	SRANK
Fimbristylis annua	Annual Fimbry		SE	G5	S1
Hypericum denticulatum	Coppery St. John's-wort		ST	G5	S2
Iresine rhizomatosa	Eastern Bloodleaf		SR	G5	S2
Isoetes melanopoda	Blackfoot Quillwort		ST	G5	S1
Ludwigia decurrens	Primrose Willow		WL	G5	S2
Passiflora incarnata	Purple Passion-flower		SR	G5	S2
Perideridia americana	Eastern Eulophus		SE	G4	S1
Phlox pilosa ssp. deamii			SE	G5T3T4	S1
Platanthera peramoena	Purple Fringeless Orchis		WL	G5	S3
Poa wolfii	Wolf Bluegrass		SR	G4	S2
Prenanthes aspera	Rough Rattlesnake-root		SR	G4?	S2
Ranunculus pusillus	Pursh Buttercup		SE	G5	S1
Rhexia mariana var. mariana	Maryland Meadow Beauty		ST	G5T5	S1
Rhynchospora corniculata var. interior	Short-bristle Horned-rush		ST	G5TNR	S2
Saxifraga virginiensis	Virginia Saxifrage		WL	G5	S3
Selaginella apoda	Meadow Spike-moss		WL	G5	S1
Stenanthium gramineum	Eastern Featherbells		ST	G4G5	S1
Strophostyles leiosperma	Slick-seed Wild-bean		ST	G5	S2
Thalictrum pubescens	Tall Meadowrue		ST	G5	S2
Trifolium reflexum var. glabrum	Buffalo Clover		SE	G5T2T4Q	S1
High Quality Natural Community					
Barrens - clay	Clay Barrens		SG	GNR	S1
Forest - flatwoods dry	Dry Flatwoods		SG	G2?	S2
Forest - floodplain mesic	Mesic Floodplain Forest		SG	G3?	S1
Forest - floodplain wet	Wet Floodplain Forest		SG	G3?	S3
Forest - floodplain wet-mesic	Wet-mesic Floodplain Forest		SG	G3?	S3
Forest - upland dry	Dry Upland Forest		SG	G4	S4
Forest - upland dry-mesic	Dry-mesic Upland Forest		SG	G4	S4
Other					
Freshwater Mussel Concentration Area	Mussel Bed		SG	G3	SNR

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Ferdinand Project Ideas

<u>Library drainage ditch</u>

The west side of the new library's parking lot drains to a small ditch that ends at a grated drain. Replanting the ditch with native species will filter the parking lot runoff, infiltrate some of the water, and reduce the amount going into the drain. The drain will remain as an overflow precaution. Ferdinand in/kind could come from any earth moving that's necessary and planting. Cost would be a few hundred to $2000 depending on if underdrains were needed and if the work had to be contracted out. Cost may increase if the ditch has to be regraded, but I don't think it will be.

<u>Parking Lot Enhancement</u>

Building north of library has a parking lot that slopes to the north and is sectioned into 5 areas by curbed parking lot islands. Near the east end of each island is a drain. The drain passes under the lot, the green space immediately north of the parking lot and from there turns east. By cutting the island's curb away in places so runoff can flow into them, and regrading the islands so they are concave and not convex, the islands can be turned into storm water infiltration islands.

Example of an infiltration island

The existing drains at the end of each island can be used as an outlet/overflow. An engineer would have to design the new islands; taking into account infiltration rates, what soil amendments are needed, and whether an underdrain would be necessary. If all of the islands are enhanced (probably not necessary) cost would probably range from $12-15,000.

In addition or separate from this idea is the grassy space north of the lots. This area could serve as a large rain garden/storm water infiltration cell. The parking lot drain would have to be moved so it empties its water across this grassy surface instead of piping it underneath it.

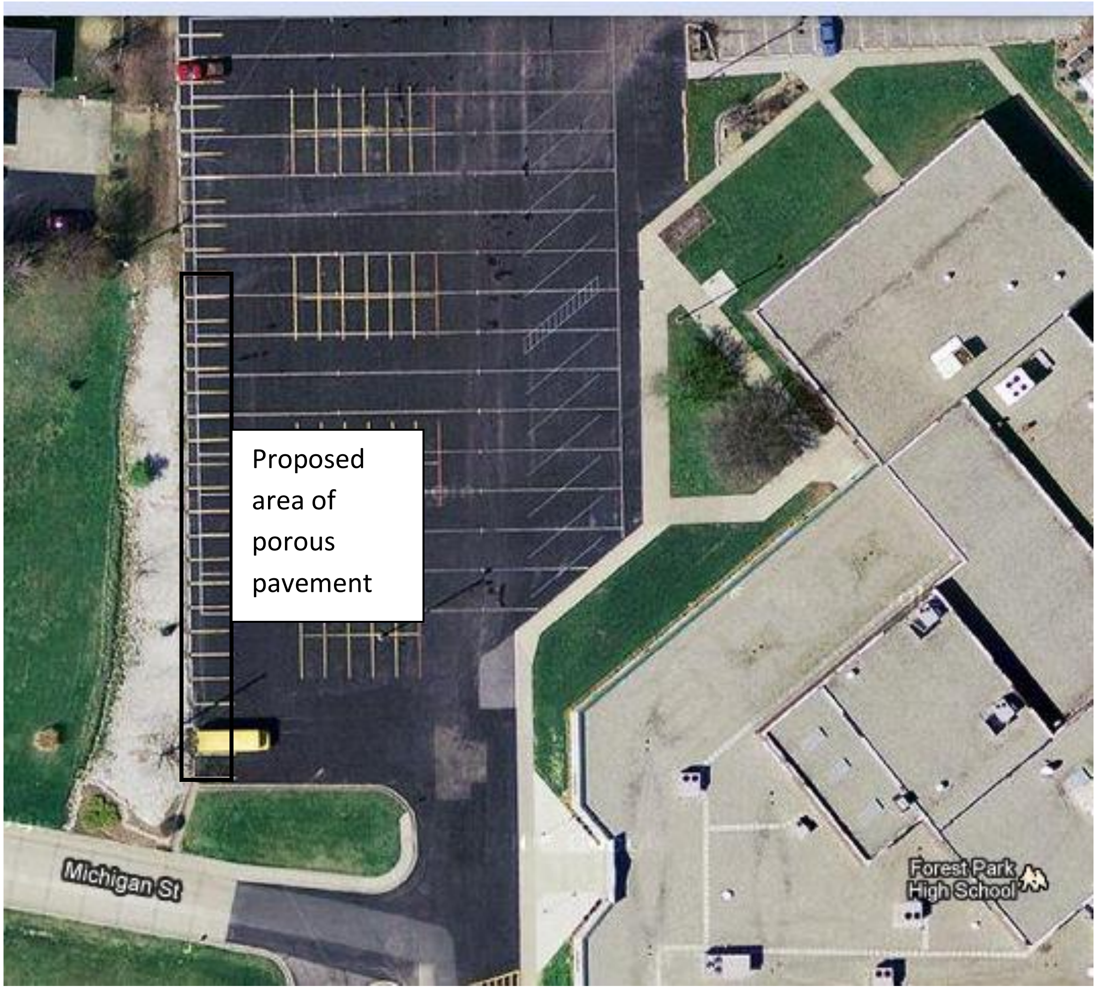
Example of infiltration cell

Total cost of the cell is hard because I'm not sure how much work would be involved in modifying the existing pipe. Ferdinand in/kind could come from earth moving, planting the cell, and perhaps contribution of some soil amendments.

School Parking Lot

Precipitation from Forest Park High School parking lot flows down a steep rip rapped slope and into a small ditch that moves towards Michigan St. Flow off the parking lot is obviously an erosion concern (hence the rip rap) and is contributing polluted runoff to local streams. Adding a strip of porous pavement along the edge of the lot (perhaps as deep as a parking space) will allow runoff to infiltrate. Ferdinand in/kind could come from tearing up part of the existing lot. Costs depend on the type of porous pavement used. Assume project area is 2400 square feet.

Porous Asphalt	$1200-2400
Porous Concrete	$4800-15600
Porous Pavers (grass/gravel)	$3600-13800
Interlocking concrete pavers	$12000-24000



<u>5th Street Park</u>

Runoff comes off the rolling farm fields to the west of the park and enters a small settling basin. From there it either flows on the surface across a small swale or enters a pipe exiting the settling basin and moves underneath the swale. The swale has a four check dams, and at each one is a drain where more water can enter the underground pipe. The pipe eventually outlets in a nearby stream carrying sediment, chemicals, and nutrients from the farm fields.

Settling Basin

The whole thing looks fairly new, so you may not want to do anything if you've just invested in it. However, the basin and swale could be redone so they have native plants that will filter the water and help infiltrate it. The existing pipes could continue to act as an overflow precaution. The riser on the basin would likely need to be modified so more water is held back in that area. The basin likely would have to increase in size too. Likewise, the drains by each of the swale's check dams may have to be raised so water has more of a chance to infiltrate. An engineer would definitely have to be involved. Total cost likely around $10,000. Ferdinand in/kind could come from earth work, grading, and planting.

Fenced Storm water Basin North of High School

We spent a lot of time looking at this with Tom, but when I went back to it, I felt less confident that it would make a good project. Water enters the basin from a pipe that collects runoff from uphill (Vienna Dr) and from a small ditch that runs along a stand of trees between the basin and high school. The ditch shows no signs of erosion and is highly vegetated, so I think you're already getting as much benefit from it as you can. The slope from Vienna down to the basin is so great that it's probably best to keep it in place and not try to infiltrate storm water on the surface of that hill. My only suggestion would be to modify the outlet of the basin so water is held in it longer and possibly vegetate the basin so you're filtering the water and helping to infiltrate it before it leaves. Let me know if you want to talk further about this site.

Rain Garden

Part of the Vienna Rd. hill drains to a small depression along the park's walking trail. A culvert takes the collected water under the trail and into the streambed that follows the trail. This area might make a nice rain garden. A rain garden is a planted depression that filters and infiltrates stormwater. It's location on the trail would make it a good educational project. The culvert would need to remain as an overflow option. The depression would have to be excavated a little deeper to increase capacity and then planted. Depending on existing soil, some amendments might be needed. With the city's help, volunteers could do most of the work; I don't think any engineering is needed. Total cost around $3000. City in/kind would be from excavating and planting and maybe putting up an educational sign.

Project Ideas

1. Curb cuts and rain garden in island
2. Pervious concrete near back of parking lot
3. Regrading/replanting of slope to promote storm water cleansing
4. Water cleansing plants around perimeter
5. Trees

1. Cut openings into the curb around the existing island to allow storm water to flow into it. Dig out the landscaping to build a rain garden. The garden will be graded so overflow water spills out through the curb cuts on the south side and flows back across the parking lot. Opportunities for Ferdinand in-kind are:

- Making the curb cuts (if town owns a concrete saw)
- Excavating the island (backhoe or other large equipment needed)
- Layering the island with new soils and regarding the soil (backhoe and workers with shovels needed)
- Putting new plants into the island (man-hours)

Example of a curb cut and adjoining rain garden

2. You can clearly see where water is flowing off the southwest corner of the parking lot and eroding the slope as it moves towards the ditch. The velocity and volume of water can be diminished by installing pervious pavement in this area. There are several types of pervious pavements.

Pervious asphalt $0.50--$1.00 per square foot

Pervious concrete $2.00--$6.50 per square foot

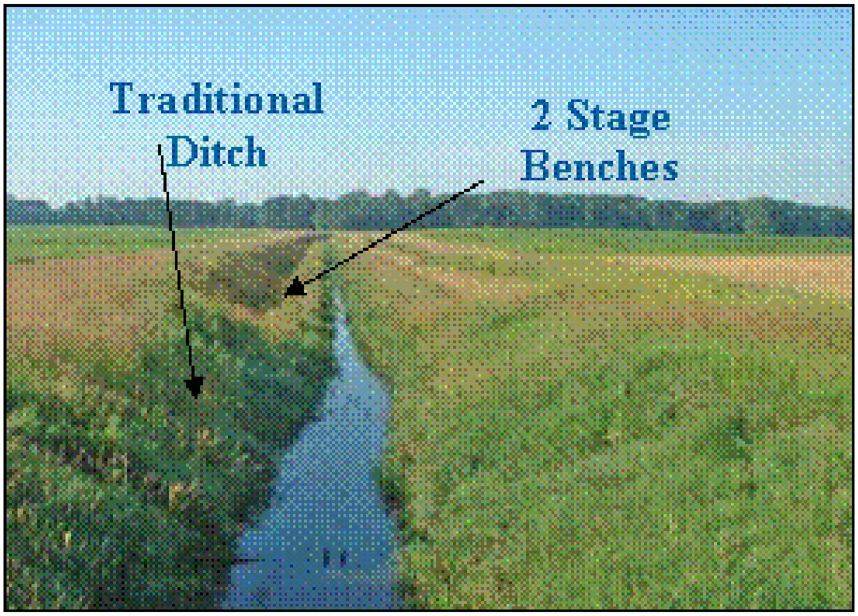
Grass/gravel pavers $1.50--$5.75 per square foot

Most pervious pavements have to be professionally installed, so beyond removing the existing pavement (heavy equipment needed) there is little opportunity for in-kind. A cash match would likely be needed.

Example of grass parking lot (used for low-use areas)

3. The stream on the west side of the property has a deep channel and no floodplain to filter water. Grading the slope and creating benches for high water to sit on would help water quality. Benches will help slow down the water that's coming off the west side of the parking lot. Cost is hard to estimate, but if you have equipment and staff that could regrade it according to an engineer's specs, you could use that as in-kind. Additional in-kind could come from replanting the area.

Example of benches: AKA 2-stage ditch



4. Since there is no curb around the lot, storm water flows off it and into the surrounding grass. Grass does a poor job filtering and slowing down moving water. In areas where lots of water is moving off the lot, we could put plants that would do a better job of cleansing the water. Depending on the area, minimal regrading may be necessary. Ferdinand in-kind could come from use of equipment, shovels, man-hours, and volunteers to do the planting. Besides water quality benefits, this project would improve aestics and reduce the amount of mowing.

Example of water cleansing plants at the side of a parking lot

5. We'd like to plant trees as part of the project. With few exceptions, we could put trees on any Ferdinand property you'd like. In-kind could come from equipment and man hours need to plant the trees and keeping them watered.

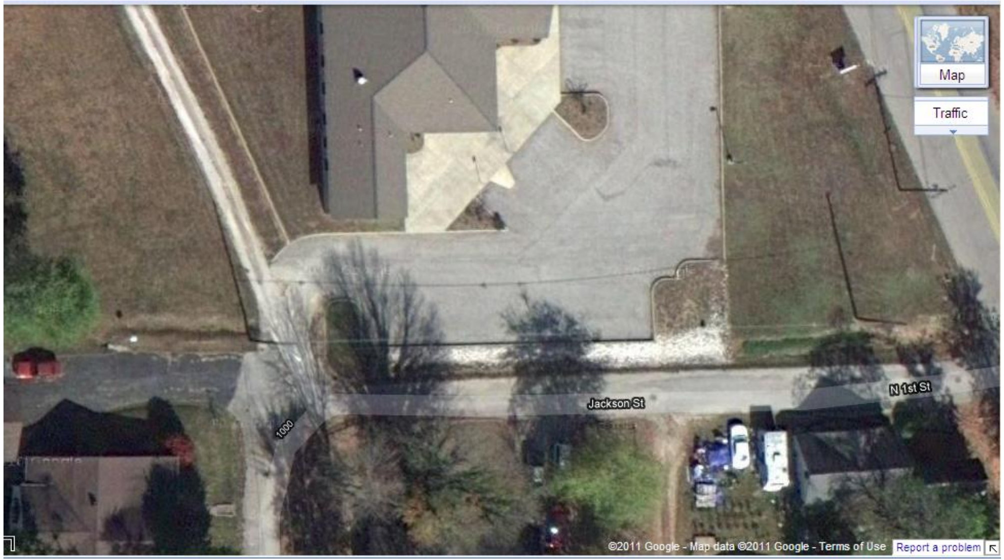
Town of Winslow Project Ideas

Rain Gardens/Rain Barrels in neighborhood south of E. Porter St.

This area drains to a swale that empties into the ditch running through the park and under 61. Rain gardens and rain barrels on residential property would reduce stormwater and pollution runoff from entering that swale and the ditch. The swale could also be planted with native plants to increase stormwater infiltration. Winslow in/kind could be help building rain gardens, advertising the project through utility mailings, and plant the swale. Cost of this project would likely be $1-5,000 depending on how many people wanted to participate.

Improve drainage ditch along Jackson St.

A rip rapped ditch accepts stormwater from an adjacent parking lot and uphill residential area. Remove the rip rap and turn the ditch into a planted swale that will filter the runoff and infiltrate it into the ground. An engineer would be needed to design the swale. Winslow contribution could be removal of existing rip rap, earth moving, and planting once the swale is done. Cost may be $10-15,000.



<u>Small ditch plantings in residential area</u>

There are a series of intermittent roadside drainage ditches running along 2nd St from its beginning to its end at W. Factory St. Some of these ditches could be planted with native plants to increase runoff filtering and infiltration. The whole neighborhood between 61 and 3rd Street would be a good place to promote rain gardens, rain barrels, and ditch plantings. Winslow in/kind could be help building rain gardens, advertising the project through utility mailings, and planting the ditches. Cost of this project would likely be $1-5,000 depending on how many people wanted to participate.

<u>West/North Side of Community Center</u>

Rain from the Community Center's roof goes to underground pipes and outlets to a nearby ditch. There are some grassy areas near the Center that possibly could be turned into large stormwater retention cells. Engineering may be needed to complete this project. The retention capacity of the grassy areas would needs to be known, as well as how much of the roof runoff can be diverted. Diverting the runoff will involve creating an inlet and outlet structure to the grassy area. The inlet likely would have to be placed underneath the gravel road. The outlet would have to tie into the existing storm drain system. Winslow support could be earth moving, connecting inlets and outlets, and planting the grassy area. Estimating the cost is hard. Likely tens of thousands.

Ditch Plantings in neighborhood bounded by Oak, Porter, Bryant, and Lafyette

This area is the headwaters of one of the 4 main drainage areas in town, so is a good place to try to slow down some water and infiltrate it into the ground. Promoting rain gardens and rain barrels would be a good idea, as would doing some plantings to the intermittent drainage ditches running through the area. Winslow in/kind could be help building rain gardens, advertising the project through utility mailings, and planting the ditches. Cost of this project would likely be $1-5,000 depending on how many people wanted to participate and how complicated some of the ditch work may be.


Map
Traffic
E Porter St
E Porter St
E Porter St
E Porter St
E Porter St
E North St
E North St
E North St
E North St
E North St
E Lafayette St
E Lafayette St
E Lafayette St
E Lafayette St
E Lafayette St
E Lafayette St
Bluff St
N Oak St
N Hickory St
N Public St
N Pearl St
Whitman St
N Collins St
N Bryant St
400
500
600
700
1000
638

Appendix C

Town of Winslow Project Ideas

Rain Gardens/Rain Barrels in neighborhood south of E. Porter St.

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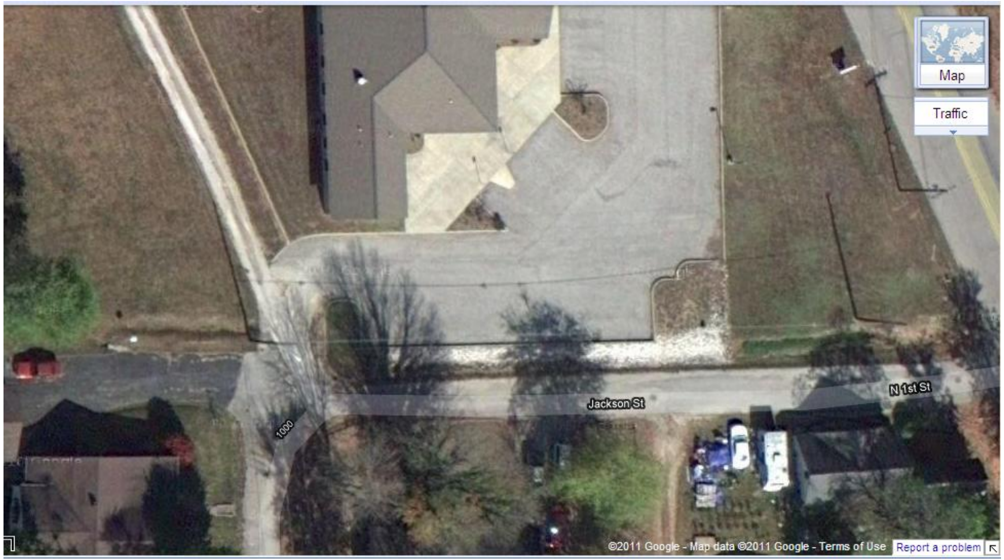
Appendix C



Small ditch plantings in residential area

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West/North Side of Community Center

Appendix C

Rain from the Community Center's roof goes to underground pipes and outlets to a nearby ditch. There are some grassy areas near the Center that possibly could be turned into large storm water retention cells. Engineering may be needed to complete this project. The retention capacity of the grassy areas would needs to be known, as well as how much of the roof runoff can be diverted. Diverting the runoff will involve creating an inlet and outlet structure to the grassy area. The inlet likely would have to be placed underneath the gravel road. The outlet would have to tie into the existing storm drain system. Winslow support could be earth moving, connecting inlets and outlets, and planting the grassy area.

<u>Ditch Plantings in neighborhood bounded by Oak, Porter, Bryant, and Lafyette</u>

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Appendix C

E Porter St
E North St
E Lafayette St
Bluff St
N Oak St
N Hickory St
N Public St
N Pearl St
Whitman St
N Collins St
N Bryant St
500
600
700
1000
400
Map
Traffic

Appendix C