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Upper Salamonie River Watershed Plan

A project of the Jay County Commissioners in Cooperation with the Jay County Soil and Water Conservation District

By: Timothy S. Kroeker, Watershed Coordinator, Kroeker Consulting
November 18, 2015

Jay County Commissioners
Jay County Courthouse, Portland, IN 47371
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Special thanks to the Upper Salamonie River Watershed Steering Committee; Jay and Blackford County SWCDs; the Indiana Department of Environmental Management; the Indiana Department of Natural Resources; the US Army Corps of Engineers; the Indiana State Department of Agriculture; Taylor University; and the many other stakeholders involved in this planning effort. For your insight, technical skills and service we are grateful.

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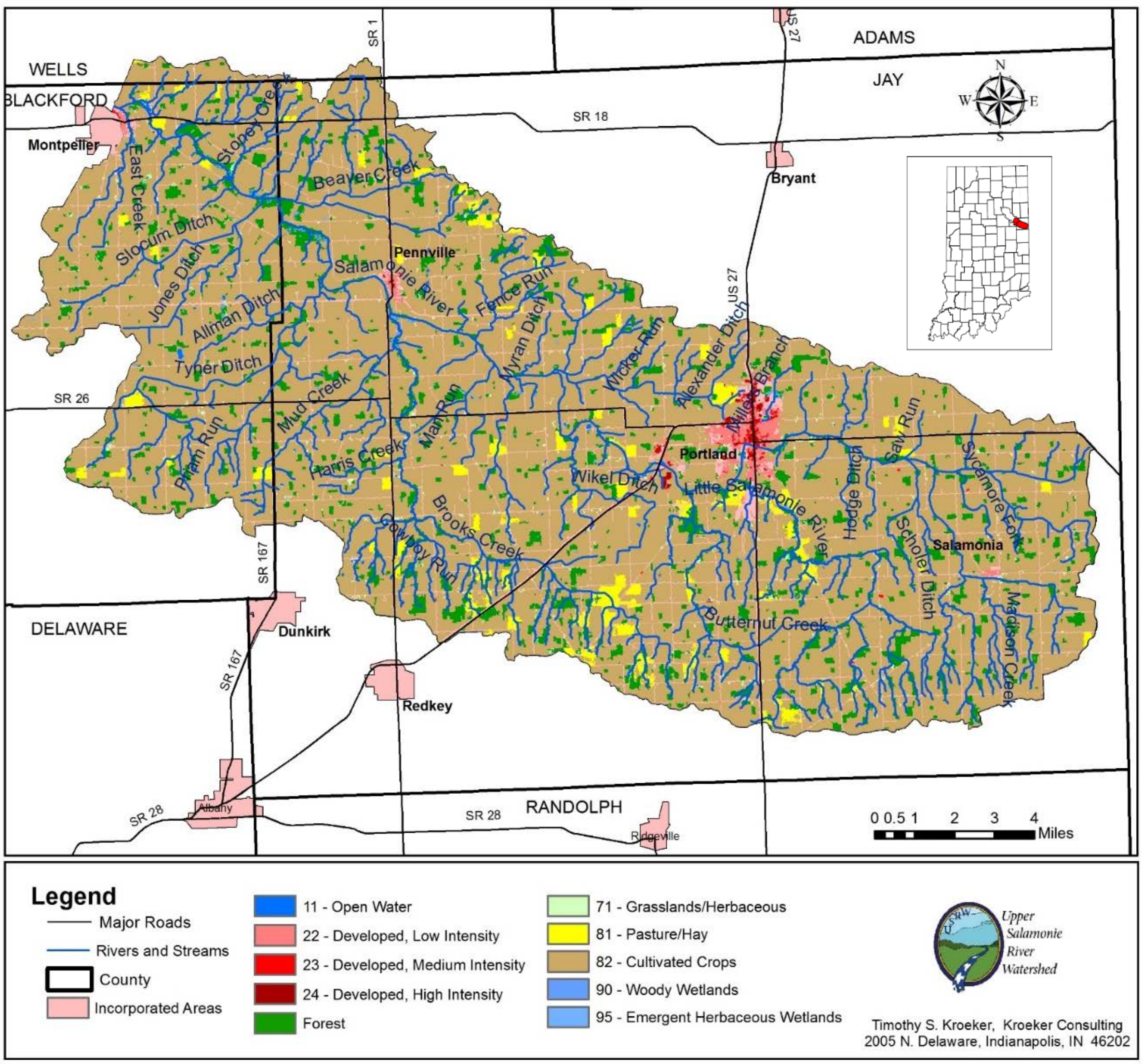
1.0 Community Watershed Initiative

In 2009 sampling in the Salamonie River Reservoir indicated the presence of toxic blue-green algae. This finding prompted the U.S. Army Corps of Engineers (USACE) to begin a two-year program of testing water throughout the watershed to determine the cause of these blue-green algae blooms. They sampled 23 sites including 12 sites in Jay County and 3 sites in Blackford County. It was determined that sites throughout the Upper Salamonie River Watershed were high for Nitrogen and Phosphorus, nutrients that could be driving the algae blooms in the reservoir. Results from the first round of testing in 2010 revealed Total Kjeldahl Nitrogen (TKN) above the U.S. Environmental Protection Agency (U.S. EPA) recommendation of 0.591 mg/l at all 15 sites in the Upper Salamonie, ammonia levels of 0.28 to 0.94mg/l at sites in Jay County, nitrate-nitrite levels at or above the maximum recommended 10mg/l, and total solid readings of 800, 1000, 1600, and 2000mg/l at various locations throughout the watershed. In addition Total Phosphorus levels were as high as 1.1mg/L in 2010. This is significant in that phosphorus is the limiting nutrient in most freshwater systems in Indiana. Testing throughout 2011 and additional testing in 2012 continued to indicate excessive nutrient loading in the watershed.

Figure 1 General Watershed Map of the Upper Salamonie River



Data collected by the Indiana Department of Environmental Management also showed impairments due to water-quality throughout the Upper Salamonie River watershed (USRW). According to the Indiana's 303d list of impaired waters, specific river reaches in the USRW are impaired for *E. coli* bacteria, Chlorides, and Impaired Biotic Communities.

These findings prompted the Jay County Commissioners in cooperation with the Jay County Soil and Water Conservation District to begin looking at the problems and searching for methods to address these issues. After discussions with IDEM, they applied for and received a grant to develop a Watershed Management Plan (WMP) for the Upper Salamonie River watershed (Figure 1). The WMP is a strategy for achieving water-quality goals by characterizing the watershed, setting goals and actions steps, and developing an implementation plan to address documented problems. The commissioners would use the county resources to administer the plan, and the SWCD would contribute its knowledge of the watershed and contacts with people in the field. The grant was approved in November of 2013, and a Watershed Coordinator was hired in January of 2014 to begin WMP development.

1.1 Community Leadership

A Steering Committee was assembled with representatives from local government, agricultural producers, environmental organizations, and concerned citizens (Table 1). Potential members of this committee were solicited via direct mailings, phone calls, and personal communications. Official requests were made to commissioners of both Jay and Blackford Counties to help develop local government support from counties with land in the watershed. Commitments were obtained at the first informational/steering committee meeting held on January 30, 2014. Additional members were recruited via a survey that was distributed at public meetings and other events.

Table 1 Steering Committee Members for the Upper Salamonie River Watershed

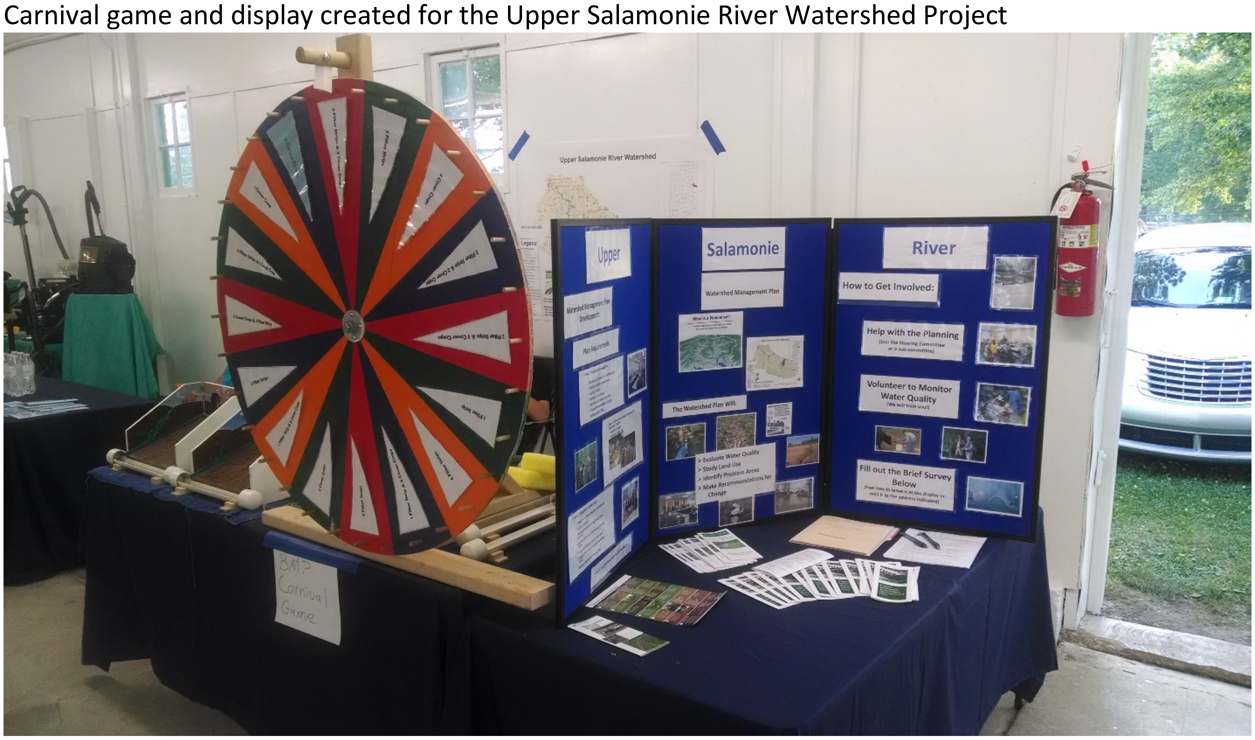
Name		Affiliation
Darrell	Brown	Citizen
Perry	Hanlin	Citizen
Steve	Holtzlieter	Blackford County SWCD
Bettie	Jacobs	Jay County SWCD
Karen	Kitterman	Blackford County SWCD
Ron	Krieg	Citizen
Tim	Kroeker	Upper Salamonie River Watershed Coordinator
Ted	McCammon	Indiana Department of Agriculture
Faron	Parr	Jay County Commissioner
Jim	Rhoton	Agricultural Producer
Connie	Ronald	Citizen
Dave	Smith	Agricultural Producer, Blackford County SWCD
Kevin	Stultz	Agricultural Producer
Larry	Temple	Purdue Extension
Kurt	Theurer	Agricultural Producer, Jay County SWCD Board
Carl	Walker	Jay County SWCD
Fred	Walker	Blackford County Commissioner

Stakeholder Involvement

To insure success of the planning process and future implementation, it was important to have the support and input of stakeholders throughout the watershed. It was also important to insure that major stakeholder groups were represented. Farmers, businesses, agencies, organizations, industries, and the general public could all be impacted by the plans and decisions made during the planning and implementation processes. Every attempt was made to identify and inform these stakeholders on the WMP process and how they could be involved.

Throughout the process the steering committee discussed who needed to be represented and how best to reach them. Personal communications and invitations were made to specific individuals, and other resources including radio, newspapers, public presentations, information booths at events, and the internet were used to inform and recruit volunteers and participants. A program was also developed within the local school system to get students involved in the process, and to educate and inform them concerning the issues and concerns within the watershed.

Carnival game and display created for the Upper Salamonie River Watershed Project



Youth enjoying the Agricultural BMP Carnival Game

Two public meetings were held at the beginning of the process. One was held in Portland in Jay County and the other in Montpelier in Blackford County. These meetings had three main objectives:

- Introduce the purpose and process of developing a watershed management plan
- Solicit input from the public on their concerns related to water, land use and other natural resources throughout the Upper Salamonie River Watershed
- Inform the public on how they can be involved and/or remain informed on project development and progress

These meetings were a success and resulted in additions to the Steering Committee, and a list of volunteers who were interested in giving of the time to help with the planning effort. In addition, attendees shared their concerns about the watershed, and these concerns will be addressed in the watershed plan.

First public meeting in Jay County

Discussions following public meeting in Montpelier

Stakeholder Concerns

Stakeholder concerns were gathered during the first public meetings and from the steering committee. During the public meeting three methods were used to collect this information. All attendees were encouraged to voice their concerns regarding the watershed, and input was recorded on flip charts by the meeting facilitator. Because some concerns might be controversial and people uncomfortable voicing them, participants were allowed to write these concerns on a survey that they were given. In addition, since the survey required their name, they were given the opportunity to write their concerns on the back of their meeting agenda and turn them in unsigned to the meeting facilitator. In this way it was hoped an accurate and comprehensive list would be developed. Table 2 includes the concerns that were recorded during these first meetings and from the steering committee and individual conversations with stakeholders.

The Upper Salamonie is fortunate in that there is another watershed management plan being developed for the Lower Salamonie River watershed. Because they are immediately downstream of our watershed, it is important that their concerns are considered as we develop our plan. Their concerns are listed in Table 3.

Table 2 Stakeholder Concerns Gathered During Initial Public Meetings

Drainage & Flooding	Flooding
	Drainage for Farmland
	Altered Hydrology
	Debris Clean-up in Streams
Pathogens & *E. coli*	CSO's (Combined Sewer Overflows)
	CFOs and CAFOs
	Impact of septic systems -Old, Malfunctioning, Straight Pipes, Poor Maintenance, Inadequate Soils or Leach fields
	E. coli Levels in Waterbodies
	Manure Application Timing, Amounts, on Frozen Ground, Other
Urban & Industrial	Yard Spray (Pesticides, Fertilizer)
	Run-off from Development
	Application of Inorganic Fertilizers - City
Water Quality	Nutrient Loads
	Nutrient Run-off from Golf Courses
	Drainage as it relates to Water Quality - Farm Tiles and Other
	Manure Application Timing, Amounts, on Frozen Ground, Other
	Nutrient Run-off from Farm Land
	Decreasing Adoption of Conservation Tillage
	Application of inorganic fertilizers - city and residential
	CFOs and CAFOs
	Out of State Manure
	Application of Inorganic Fertilizers - Golf Courses, Farmland
	Well Water Quality… are Aquifers at Risk in the Watershed
Wildlife	Wetland Conservation/Creation/Restoration
	Balance Need for Drainage with Natural Habitat for Wildlife
Other	Lack of Fish in the River (Fishable Size)
	Increase Recreational Use Capacity in the Watershed
	Quantify Blue-Green Algae in the Reservoir. What Data do we Have, How Bad is the Problem
	Quantify Best Management Practices Already in Place to Help Determine Next Steps

Table 3 Lower Salamonie River Watershed Concerns

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

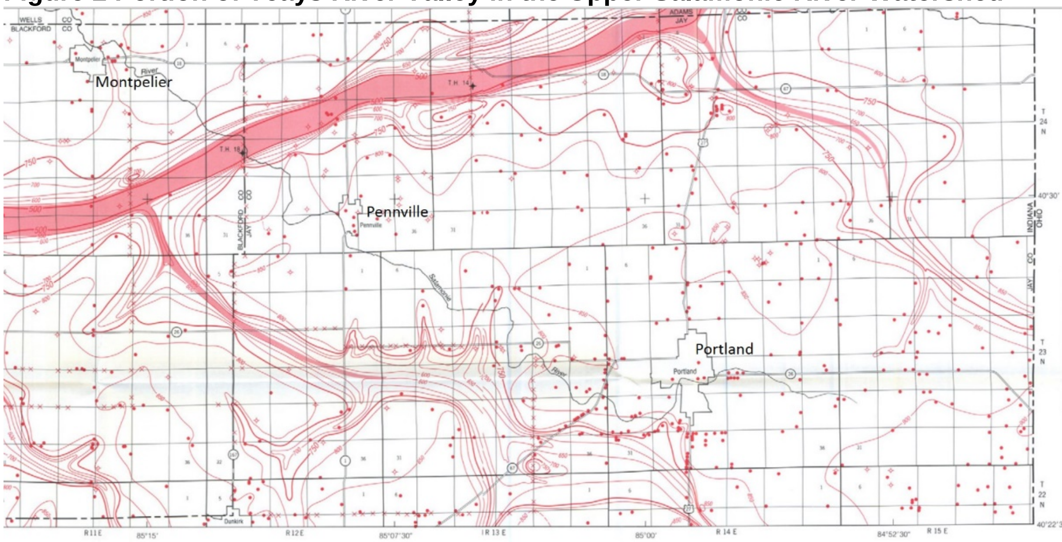
2.0 Description of the Upper Salamonie River Watershed

2.1 Geology and Topography

Located in East Central Indiana, the Upper Salamonie River watershed is a nearly level area between a series of three concentric moraines. There is very little relief, and breaks to drainage ways are not very long or steep.

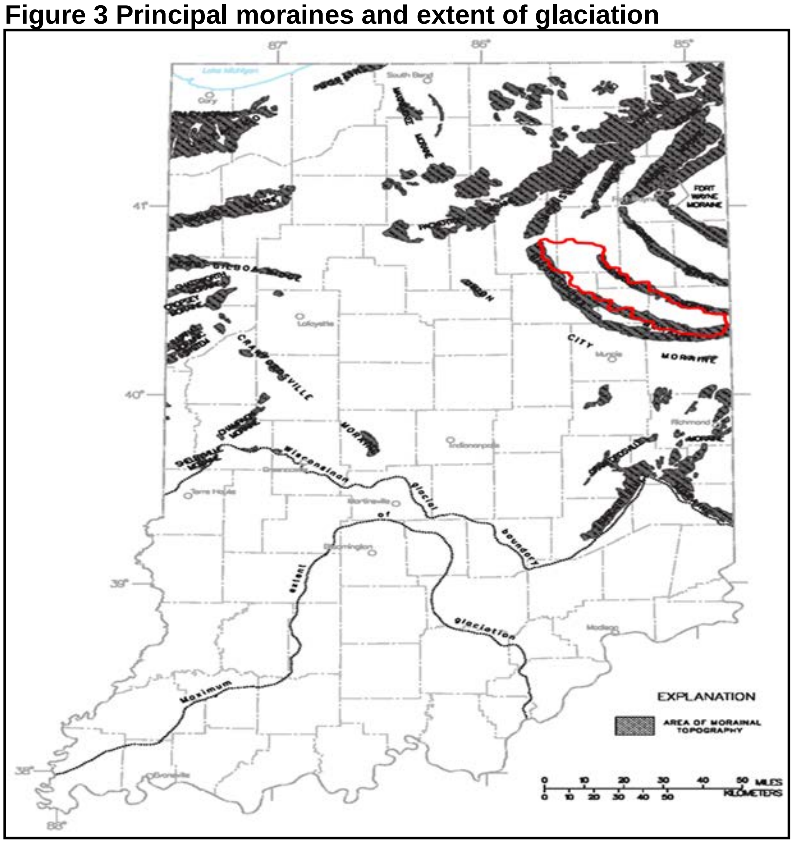
The bedrock in Indiana experienced erosion since the late Pennsylvanian time (300 million years ago), and has only been covered with unconsolidated materials for the last 2 million years due to advancing and retreating glaciers. Most of the bedrock surface in the Upper Salamonie is of Silurian age except in the Teays River Valley where the surface dips down into Ordovician age rock. The Teays River Valley is a striking bedrock feature that cuts through Adams, Jay, Blackford, Grant, Wabash, Miami, and Cass Counties (Figure 2 – Red lines are depth contours). Although buried during glaciation, a portion of the Wabash River still follows the Teays River Valley.

Figure 2 Portion of Teays River Valley in the Upper Salamonie River Watershed



North America experienced several periods of glaciation during the Pleistocene Era, and has resulted in a complex assortment of unconsolidated material. The last three major glacial events were the pre-Illinoian, Illinoian, and Wisconsin. Most of the unconsolidated material found on the land surface in the Upper Salamonie was deposited during the Wisconsin glaciation 21,000 to 13,600 years ago. The many moraines that help define this area of the state were formed by the different lobes of ice that were part of the Wisconsin glaciation (Figure 3).

Figure 3 Principal moraines and extent of glaciation



Salamonie River Watershed Outlined in Red

Aquifer Systems

Water use in the Upper Salamonie is mainly ground water although there is some supplemental surface water use, mainly related to agriculture. Glacial till yields very little water, whereas reliable supplies can be found in sand and gravel deposits and in some bedrock areas. Pollutants, such as nitrates found in surface water and soils can leach into these aquifer systems and contaminate drinking water sources. Because of this, many conservation practices that are commonly used to address particular pollutants in surface waters can help protect the aquifer systems as well.

Bedrock Aquifers consist of two major groups (Figure 4). The first is the Maquoketa Group which is mostly shale with inter-bedded limestone. Wells in this group tend to have a low yield of 1-10gpm, and many dry holes can be expected. The second consists of Silurian and Devonian Carbonates. These consist of predominately carbonate rock units (limestone and dolomite) and some imbedded shale. Yields of 10 – 25gpm can be expected decreasing southward. Some high capacity wells yield 70 gpm or more. Wells completed in bedrock have more reliable yields if drilled into cracks and voids in the rock.

Unconsolidated Aquifers vary in their ability to yield adequate water supplies. Glacial till yields very little water, whereas many sand and gravel deposits can have very reliable and high yields. Most of the wells in the Upper Salamonie are drilled below 150 feet which is deeper than the glacial till. Wells drilled in the Teays River Valley tend to average around 400 feet in depth, and the sand and gravel deposits in this area can be very high yield. Table 4 shows the different aquifer systems in the Upper Salamonie and what yields can be expected.

Figure 4 Aquifer Systems in the Upper Salamonie River Watershed

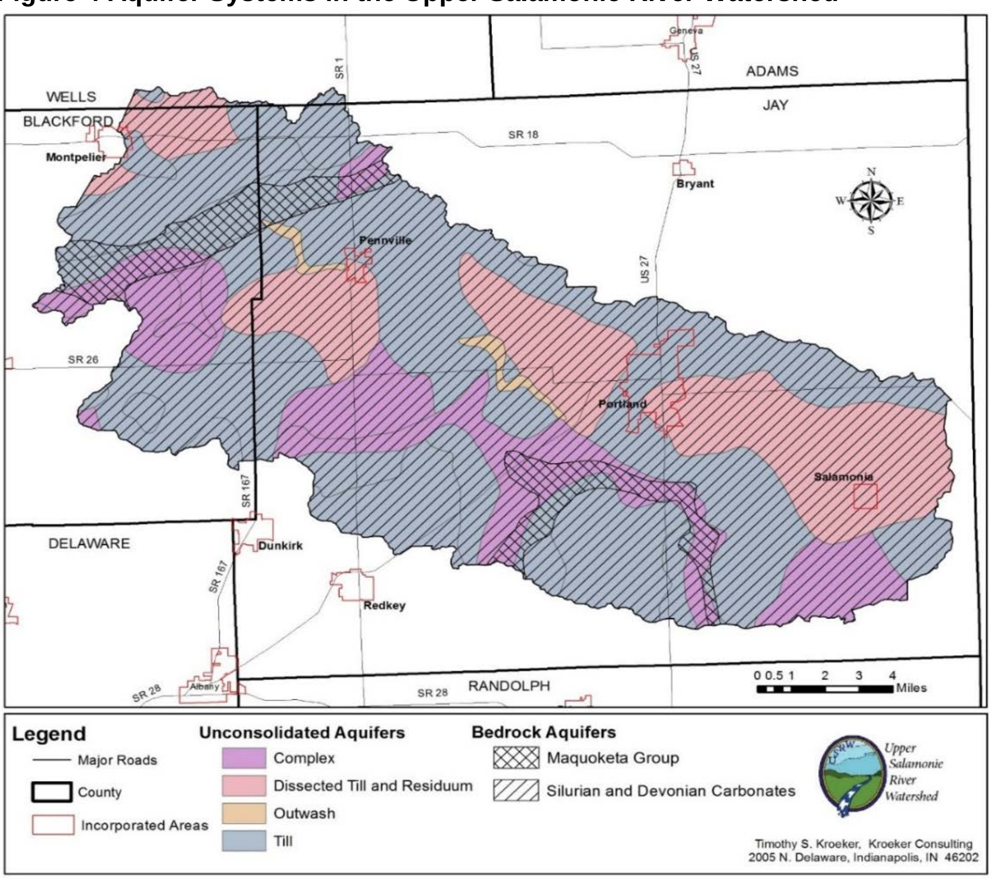


Table 4 Expected Yield for Unconsolidated and Bedrock Aquifer Systems

Unconsolidated Aquifer System	Type of System	Aquifer Thickness (In Feet)	Aquifer Yield in Gallons per Minute (gpm)
Complex	Multiple, intertill and basal sand and gravel or buried outwash sands and gravels overlying a known bedrock valley with some deep aquifer potential	Individual units utilized are generally 10 to 20 (however, about 10 percent of the wells started in this system are completed in bedrock)	Generally 10 to 50 domestic; typically 400 for large-diameter high-capacity wells
Dissected Till and Residuum	Residual, intertill, or basal fine-grained sand and gravel and/or weathered bedrock	Individual units, if present, are generally less than 3 (almost all of the wells started in these systems are completed in bedrock)	Generally less than 5; dry holes common
Outwash	Outwash sand and gravel or valley-train sand and gravel	Generally less than 20	Generally 20 domestic; commonly 300 to large-diameter high-capacity wells
Till	Regionally discontinuous intertill or basal sand and/or gravel	Individual units are commonly 5 to 15 but are absent in some areas (generally about 40% of the wells started in this system are completed in bedrock)	Generally 10 to 25 domestic; typically 200 for large-diameter high-capacity wells. Till subsytems often yield less than 10, domestic only; extremely limited high-capacity potential
Bedrock Aquifer System	**Type of System**	**Aquifer Thickness (In Feet)**	**Aquifer Yield in Gallons per Minute (gpm)**
Maquoketa Group	Mostly shale with some interbedded limestone.	200-1000	Generally 1-10; many dry holes reported
Silurian and Devonian Carbonates	Predominantly carbonate rock units (limestone and dolomite) with some interbedded shale units; not easily distinguished on water well records and so considered as a single water-bearing system.	0-1000	Typically 10-25 decreasing southward; about 650 high-capacity wells (70 gpm or more)

Climate

The climate in the Upper Salamonie Watershed is cold and snowy in the winter and hot in the summer. The frequent snow in the winter results in good spring soil moisture, and there is adequate annual precipitation for many crops adapted to the temperature and length of growing season. The area averages about 37 inches of precipitation per year with 60% of that falling from April through September, and there are an average 117 precipitation days. With sunshine occurring 70% of the time in summer and 40% in winter this area is well suited for its primary land use of agriculture.

Using climate data from Portland, Indiana, the average daily maximum temperature in July is 84.1ºF, and the average daily minimum in January is 15.2ºF. The mean temperature in winter ranged from 34.3ºF to 18.4ºF over the period of record of 1964 - 2001. The lowest temperature on record of -29 ºF occurred on January 20, 1985. In summer, the mean temperature extremes were from 73.9ºF to 67.4ºF. Winds are most often from the southwest and thunderstorms occur about 40 days out of the year.

Precipitation and temperature data can be found in Table 5. Rainfall is moderate and averages around 37.25 inches annually. Precipitation is generally well distributed throughout the year, but is slightly lower in late winter. The record rainfall based on data from 1948 – 2001 occurred on June 8, 1958 and totaled 4.19 inches. The heaviest snowfalls occurred on February 4, 1982 and March 15, 1975 and totaled 8.0 inches in one day. Average annual snowfall is 21.6 inches.

Growing Degree Days or GDD are also shown in Table 5. Growing Degree Days are equivalent to “heat units” and can be used to determine when to plant crops and what crops may be best grown in that area. During the month, GDD accumulate by the amount that the average temperature exceeds a base temperature, in this case, 40ºF. This value is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in the fall.

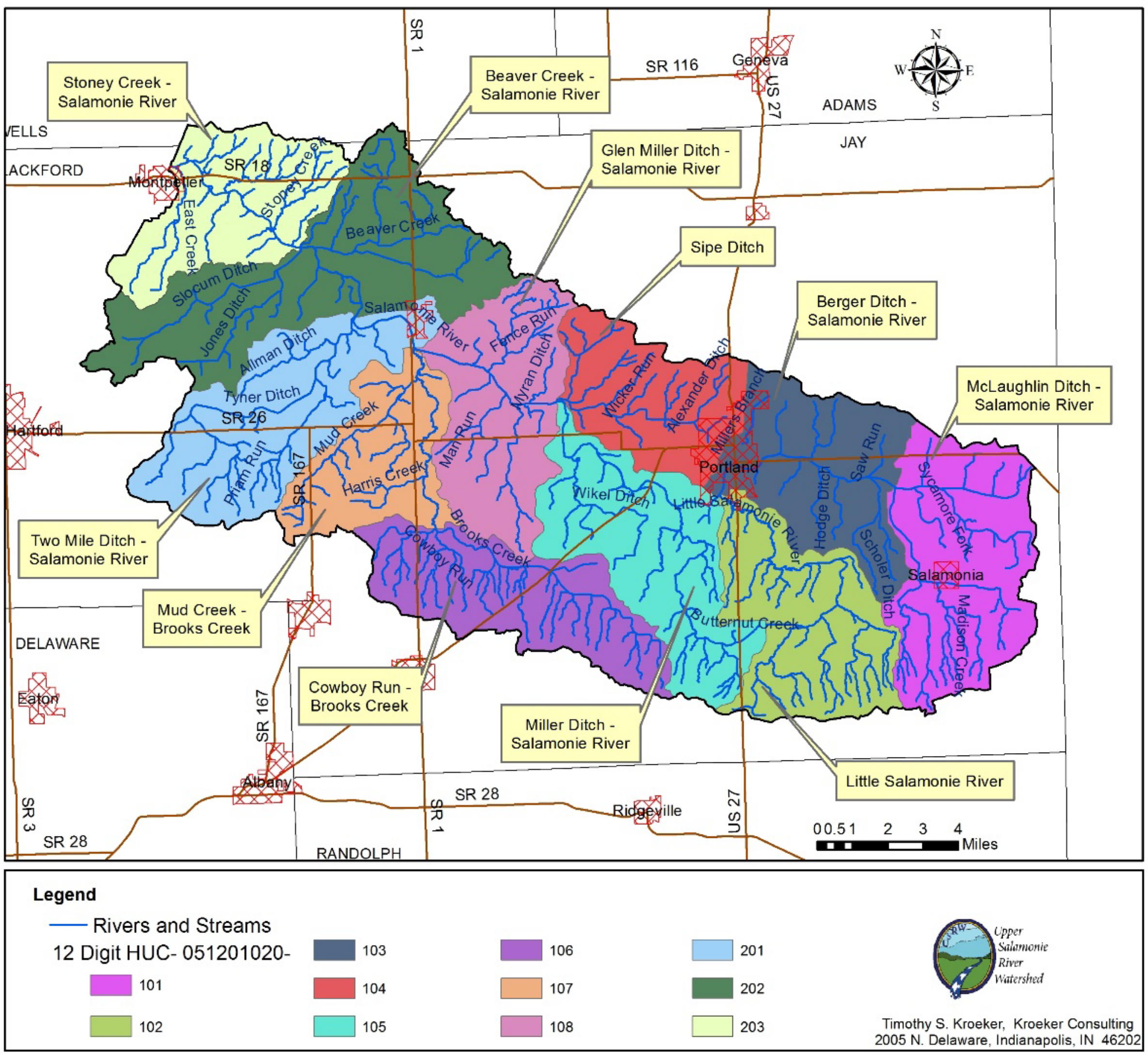
Table 5 Historical Climate Data, NCDC Normals, Station 127069, Portland, Indiana, 1971 – 2000
Source: Midwest Regional Climate Center

Month	Maximum Temperature (ºF)	Minimum Temperature (ºF)	Mean Temperature (ºF)	Mean Precipitation (in)	Mean Snowfall (in)	GDD Base 40
January	32.1	15.2	23.7	1.87	6.7	14
February	36.5	17.7	27.1	1.93	5.6	25
March	47.7	27.4	37.6	2.60	3.0	110
April	60.1	37.8	49.0	3.61	0.4	302
May	71.1	48.7	59.9	3.94	0.0	625
June	80.1	58.5	69.3	4.13	0.0	883
July	84.1	62.0	73.1	4.40	0.0	1038
August	81.7	59.5	70.6	3.96	0.0	955
September	75.8	51.7	63.8	2.71	0.0	719
October	63.7	40.2	52.0	2.58	0.2	384
November	49.8	31.9	40.9	3.04	0.7	136
December	37.3	21.0	29.2	2.48	5.0	31
Monthly Mean	60.0	39.3	49.7	na	na	na
Annual Total	na	na	na	37.25	21.6	5233.0

2.2 Hydrology

The Salamonie River has its origins near Salamonia, IN close to the Indiana-Ohio border and flows approximately 60 miles before discharging into the Wabash River near Lagro, IN. Of this 358,375 acre watershed, nearly half is considered the Upper Salamonie River watershed. In the Upper Salamonie, 456 miles of rivers, streams and ditches drain 161,949 acres of mixed landuse consisting mainly of row crop agriculture and pasture (Table 10). Major tributaries to the Salamonie River in this watershed include the Little Salamonie River and Brooks Creek. It is a fairly long and narrow watershed so many of the other tributaries drain a relatively small portion of the watershed. The watershed drains major sections of Jay and Blackford counties, and a small portion of Wells County. The Upper Salamonie River watershed includes two 10-digit Hydrologic Unit Codes or HUCs. They include HUC 0512010202 (East Creek-Salamonie River) and HUC 0512010201 (Brooks Creek-Salamonie River). These sub-watersheds are further divided into eleven 12-digit HUCs (Figure 5).

Figure 5 Upper Salamonie River Watershed divided into 12 Digit Hydrologic Unit Codes (HUCs)



Wetlands are also an important part of the hydrologic system in the Upper Salamonie, and generally occur where the groundwater table is at or near the surface of the land. Wetlands have been described by Cowardin and others as having one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes, 2) the substrate is predominantly undrained hydric soil, and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season.

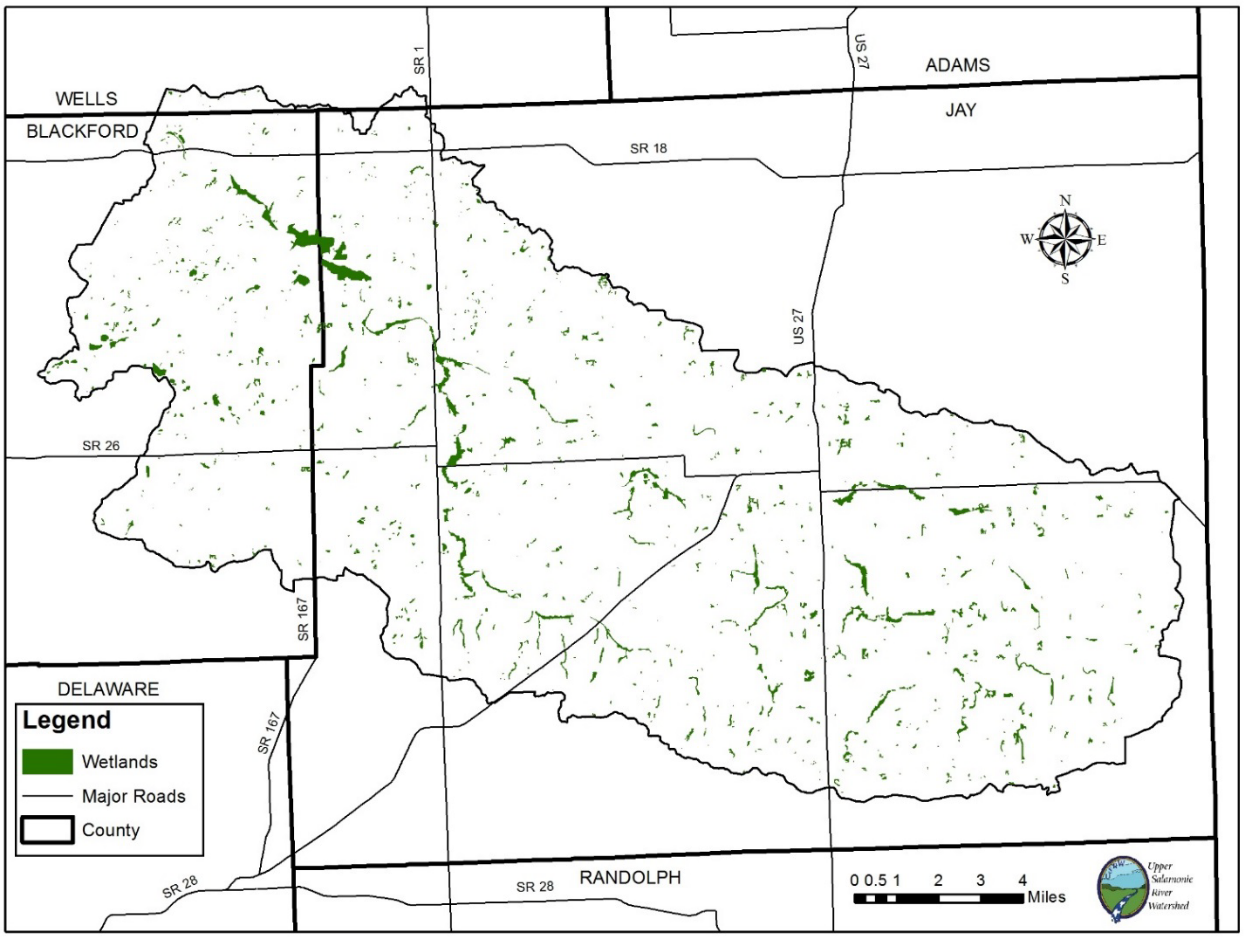
In addition, Cowardin and others (1979) have aggregated wetlands into five major classifications. Three of these are present in Indiana, lacustrine wetlands, riverine wetlands, and palustrine wetlands. Lacustrine wetlands are permanently flooded lakes and reservoirs of at least 20 acres, or smaller waterbodies with a depth that equals or exceeds 6.6 feet throughout the year. Riverine wetlands are contained within natural or artificial channels which often, or continuously have moving water, or connect bodies of water. Palustrine wetlands are what people usually envision when they think of a wetland. They are standing bodies of water or saturated soils that are dominated by wetland vegetation and are commonly called marshes, swamps or fens. In agricultural communities these palustrine wetlands are often found in the wetter areas of the farm. They may also include farmland that would support wetland vegetation if it were not planted to crops or drained. The National Wetlands Inventory indicates that palustrine and riverine wetlands both exist within the Upper Salamonie River watershed (Figure 6). The vast majority of these are palustrine wetlands covering approximately 4494 acres. Riverine wetlands total only 8.5 acres (Table 6). Included in the palustrine wetlands in the Upper Salamonie, are about 320 acres of ponds, borrow pits, and other small open water areas. There are no natural or manmade lakes in the watershed.

Table 6 Hydrologic Features in the Upper Salamonie River Watershed

Waterbody	Measurement
Rivers and Streams	360.9 Miles
Artificial Paths	42.3 Miles
Canal or Ditch	53.1 Miles
Palustrine Wetlands	4493.6 Acres
Riverine Wetlands	8.5 Acres
Small, Open Waterbodies (ponds, borrow pits, other)	319.3 Acres (Included in palustrine acreage)

Wetlands provide a variety of benefits to the watershed and should be preserved and restored when possible. Benefits include: **1) Water Storage** - wetlands temporarily retain water in upstream reaches and slow its release to downstream areas. This storage capacity helps to decrease downstream flooding. The city of Portland has been subject to many flood events. Conversely, during dry periods, stored water may discharge into the main river channel, thereby helping to maintain streamflow. **2) Ground-Water Recharge** - Under certain conditions, water from wetlands supplements ground-water recharge. Most of the drinking and irrigational water used in the USRW is obtained from ground water, so it is important to protect and maintain this valuable resource. **3) Water Quality** - Wetlands also play an important role in water-quality maintenance and improvement by functioning as natural filters to trap sediment, recycle nutrients, and remove or immobilize pollutants, including toxic substances that would otherwise enter adjoining rivers and streams, and would ultimately negatively affect the Salamonie Reservoir. **4) Erosion Control** – Wetlands along rivers and streams can help prevent erosion by stabilizing substrates, dissipating current energy, and trapping sediments. Sediments can smother aquatic habitats and transport important pollutants such as phosphorus to downstream lakes and reservoirs. Excess phosphorus has had a damaging effect on the Salamonie Reservoir. **5) Fish and Wildlife Habitat** - Many species of fish and shellfish, and virtually all important game fish rely on wetlands. Many spawn, feed, or use wetlands as nursery grounds. In addition, as other habitats become scarce, additional species have come to rely increasingly on these wetland resources.

Figure 6 Wetlands within the Upper Salamonie River Watershed



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In addition to the benefits listed above, most of the rivers streams and ditches in the watershed are heavily used for drainage. Much of the farmland is considered prime farmland if drained. There is also limited recreational use of this resource for boating and fishing. It is a desire of the steering committee to improve the quality of the resource and the recreational opportunities.

2.3 Soils

Soils are classified by looking at both their physical and chemical properties. Two classifications system databases have been used throughout Indiana. The first is the State Soil Geographic Database or STATSGO. This system classifies soils into general groups with similar characteristics. It is helpful for planning and understanding the best uses for lands on a county wide or watershed wide area. For example, for zoning it may help you to know the best location for urban areas vs agricultural production. The major soil groups found in the Upper Salamonie River watershed and their general descriptions are shown in Table 7 below.

Table 7 STATSGO Soil Associations in the Upper Salamonie River Watershed

Major Association	Basic Characteristics
Blount-Glynwood-Morley	Gently sloping and moderately sloping, moderately well drained, loamy soils formed in glacial till on till plains and moraines
Blount-Pewamo -Glynwood	Nearly level and gently sloping, poorly drained to moderately well drained, silty, clayey, and loamy soils formed in glacial till on till plains and moraines.
Hoytville-Nappanee-Blount	Deep somewhat poorly drained, loamy, clayey, soils formed on till plains and moraines
Eldean-Ockley-Sleeth	Nearly level to moderately sloping, well drained, loamy and silty soils formed in outwash material on outwash plains and terraces

The second soil classification database is the Soil Survey Geographic Database or SSURGO. This database is far more detailed and can be used to evaluate soils at the field level. This database was used to evaluate soils throughout the watershed to determine septic suitability, and because of the importance of agriculture in the watershed, location and extent of highly erodible lands, hydric soils, drainage class, cropland capability, and farmland classification.

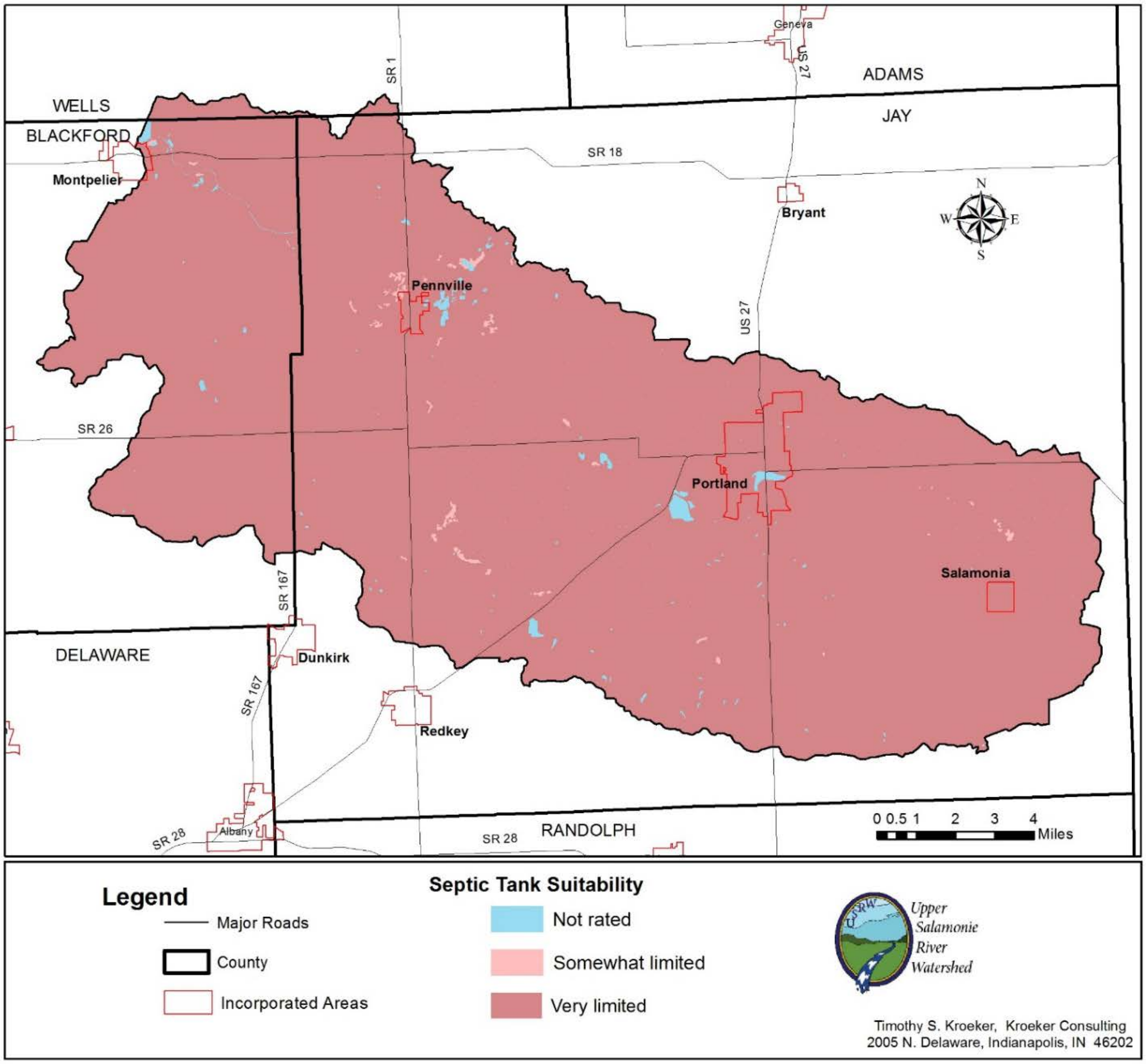
Septic Suitability

Like many areas of the State, pathogens and bacterial contamination of surface waters is an issue in the USRW. These concerns were raised by stakeholders in the Upper Salamonie, and failing septic systems were thought to be a contributor to the problem. It is estimated that nearly 25% of septic systems in Indiana have failed and up to 70% to 80% are functioning below anticipated efficiencies. This can be due to a lack of maintenance or the limitations of area soils. Soil properties that limit the effectiveness of septic systems include: high water tables, poorly permeable soil horizons or rapidly permeable horizons. Many health departments will attempt to mitigate these deficiencies by requiring large absorptions fields and perimeter drains. Others may require that suitable soil be trucked in to form a mounded system.

Soils in the SSURGO database were ranked as somewhat limited, very limited, or were unrated in terms of septic system suitability. In the Upper Salamonie River watershed, 99% of the soil is considered very limited, 0.4% were considered somewhat limited, and 0.6% were unrated (Figure 7). Because of such severe limitations throughout the watershed, it is important for residents to ensure that their septic systems are properly maintained, and that new systems meet or exceed State and County requirements for such systems.

Concerns were also expressed in regards to waste treatment in more populated areas in the watershed. Fortunately there are no large un-sewered communities in the Upper Salamonie. Portland and Montpelier have wastewater treatment plants, Pennville has a package plant, and Salamonia utilizes treatment lagoons. Portland still struggles with combined sewer overflow issues, but has been and is presently pursuing options to correct these problems including sewer separation and the possibility of storing storm-water during rain events for later treatment.

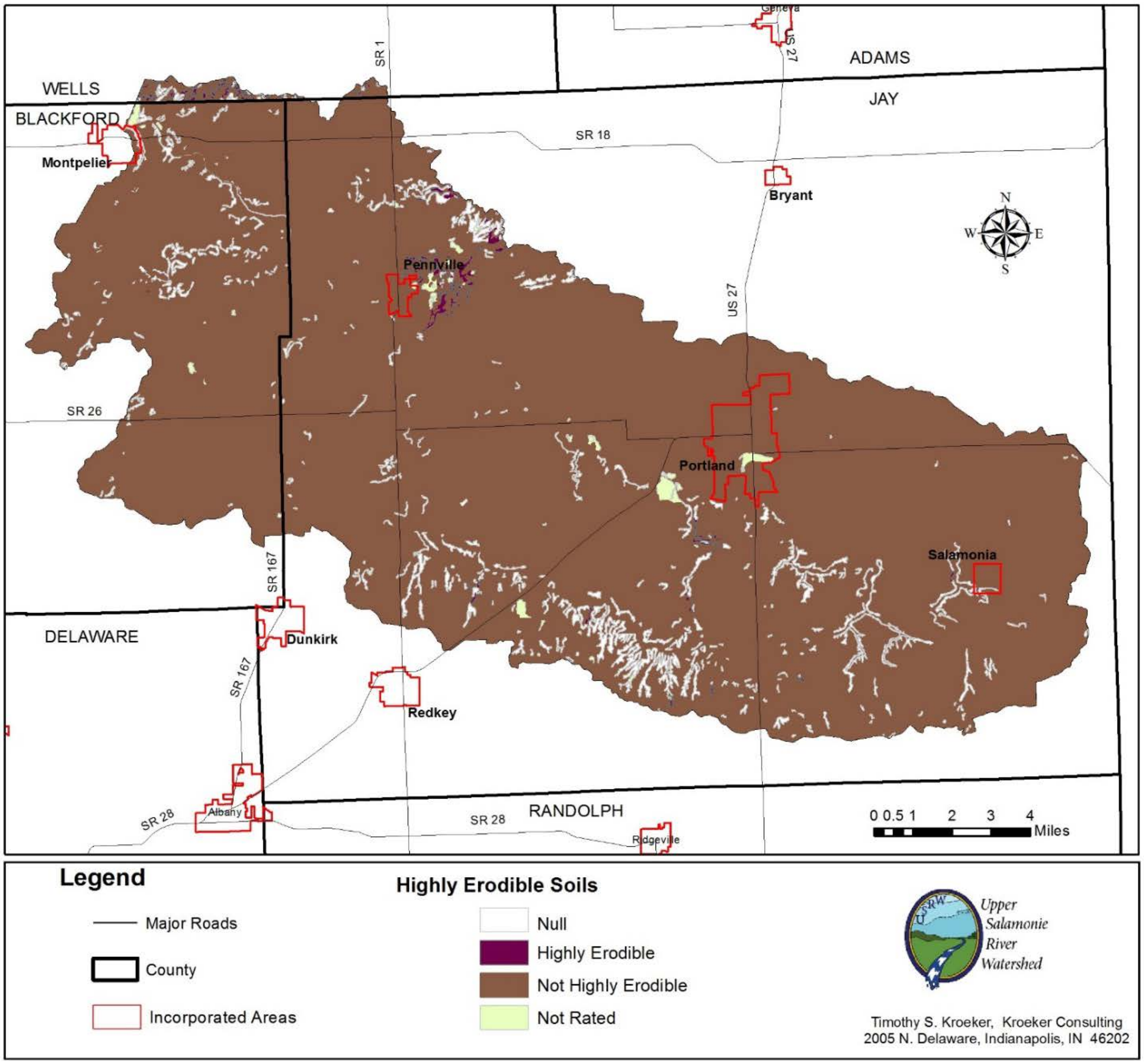
Figure 7 Soil Suitability for Septic Systems in the Upper Salamonie River Watershed



Highly Erodible Lands

Nutrient loading is a major concern in the watershed. Because phosphorus which is often the limiting nutrient in fresh water aquatic systems is often bound to sediment particles, it is important to control erosion. Identifying where soils are highly erodible and applying best management practices to these areas is important. Some soils types are inherently very susceptible to erosion and if combined with factors such as wind and rain intensity, sloping topography (length and gradient) and soil loss tolerance, are considered highly erodible and are of special concern. These factors are considered together and a soil erodibility index (EI) is calculated. Any soils with an EI of eight or greater is considered highly erodible. In the Upper Salamonie only 0.54 percent of the soils are considered highly erodible (Figure 8). These lands can contribute a large amount of sediment to area streams if they are not properly managed.

Figure 8 Highly Erodible Lands in the Upper Salamonie River Watershed

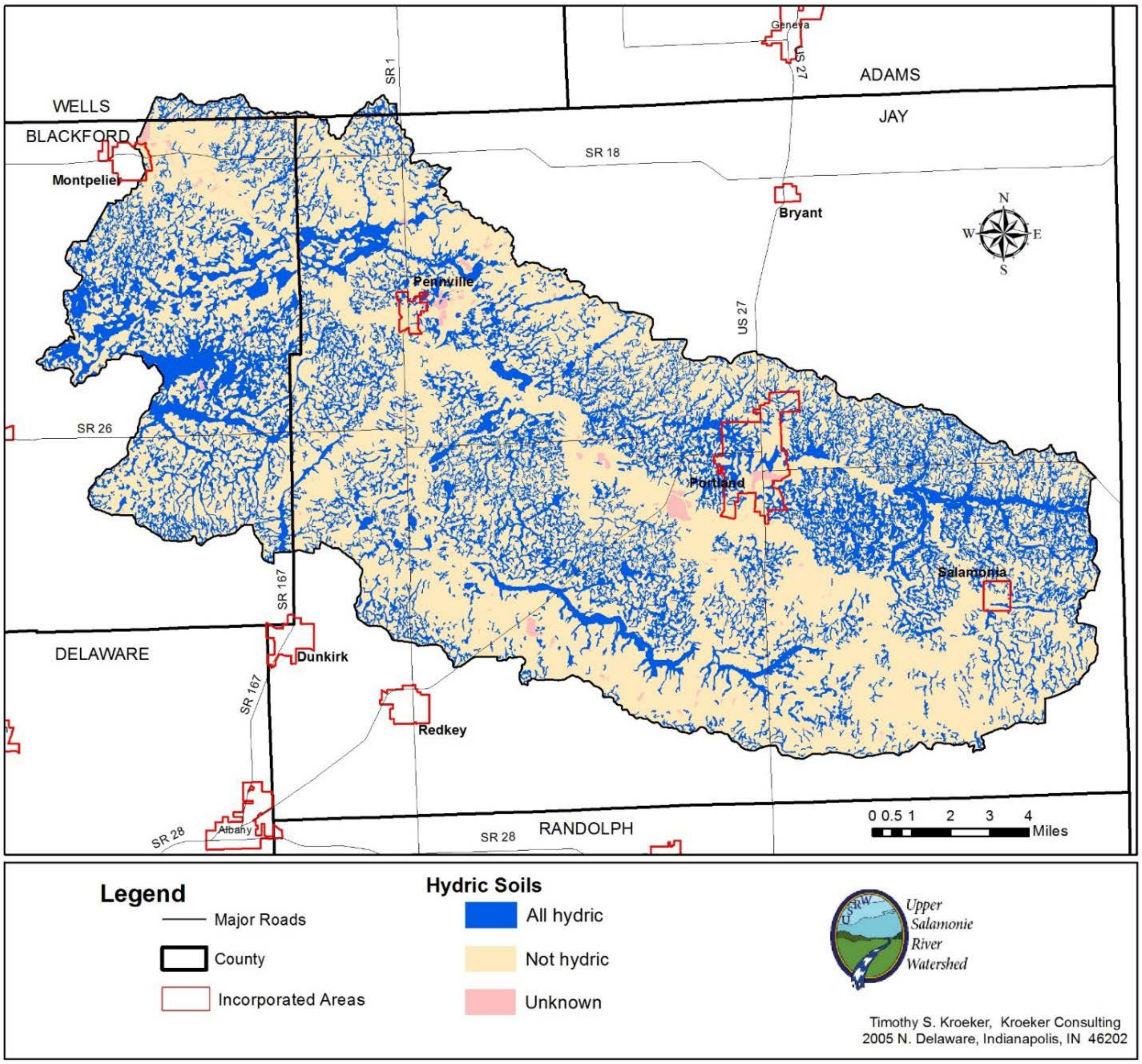


Hydric Soils

Hydric soils are described as those soils that are formed under saturated conditions. Under these conditions, soils become anaerobic (low or depleted oxygen content). Hydric soils indicate the presence of wetland systems either past or present. Wetland systems can have a positive effect on water quality by filtering pollutants and utilizing nutrients in the water column. In addition, they provide habitat for a great number of species, and are one of the most bio-diverse habitats on earth.

Approximately 29% of the soils are considered hydric in the Upper Salamonie (Figure 9). There are a number of stakeholders in the watershed who would like to see wetland systems restored. This plethora of hydric soils provides a number of locations where wetland restoration could be successful. In addition, wetland restoration could be used to specifically address areas that are contributing to water quality issues in the watershed.

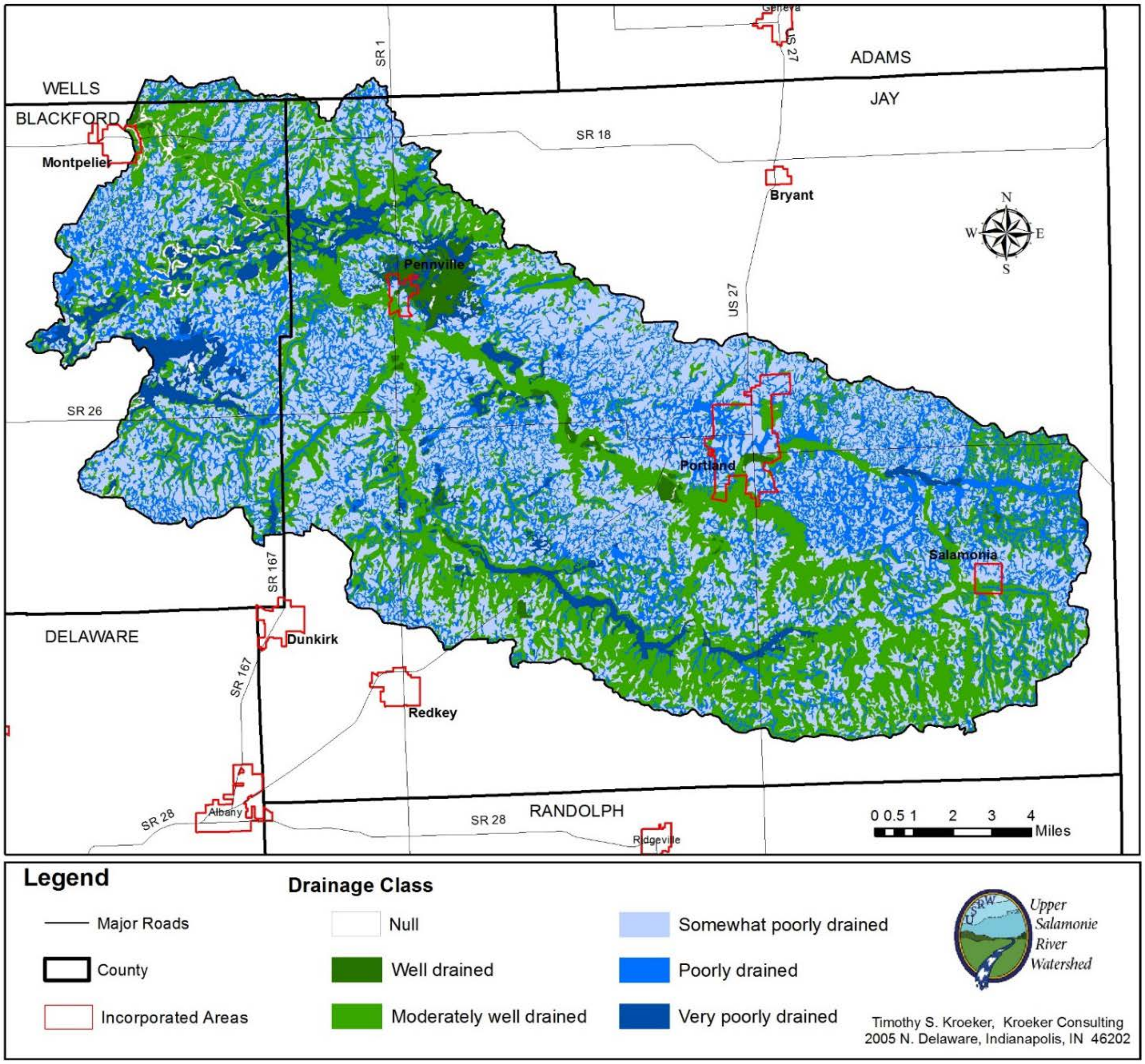
Figure 9 Hydric Soils in the Upper Salamonie River Watershed



Drainage Class and Farmland Classification

Soils types can be classified by their hydrologic properties. Drainage Class is one such classification that looks at the frequency and duration of wet periods under which the soils were formed. There are seven classes of natural soil drainage ranging from excessively drained to very poorly drained. Five of these classes exist in the Upper Salamonie from well drained to very poorly drained (Figure 10).

Figure 10 Soil Drainage Classes in the Upper Salamonie River Watershed



Sixty-six percent of the land area of the Upper Salamonie ranges from Somewhat Poorly Drained to Very Poorly Drained. Saturated soils are often not suitable for agricultural purposes. However, if Farmland Classification (Figure 11) is evaluated in the Upper Salamonie river it is apparent that the majority of the land is considered prime farmland if it is adequately drained. Because of this fact, the Upper Salamonie has been heavily tiled and ditched to maximize drainage for agricultural production (Table 8). This has resulted in a highly modified hydrology which in turn results in reduced water-quality and destruction of habitat for many species, especially aquatic organisms. It will be important to balance these two conflicting needs if the water-quality issues in the Upper Salamonie are to be effectively addressed.

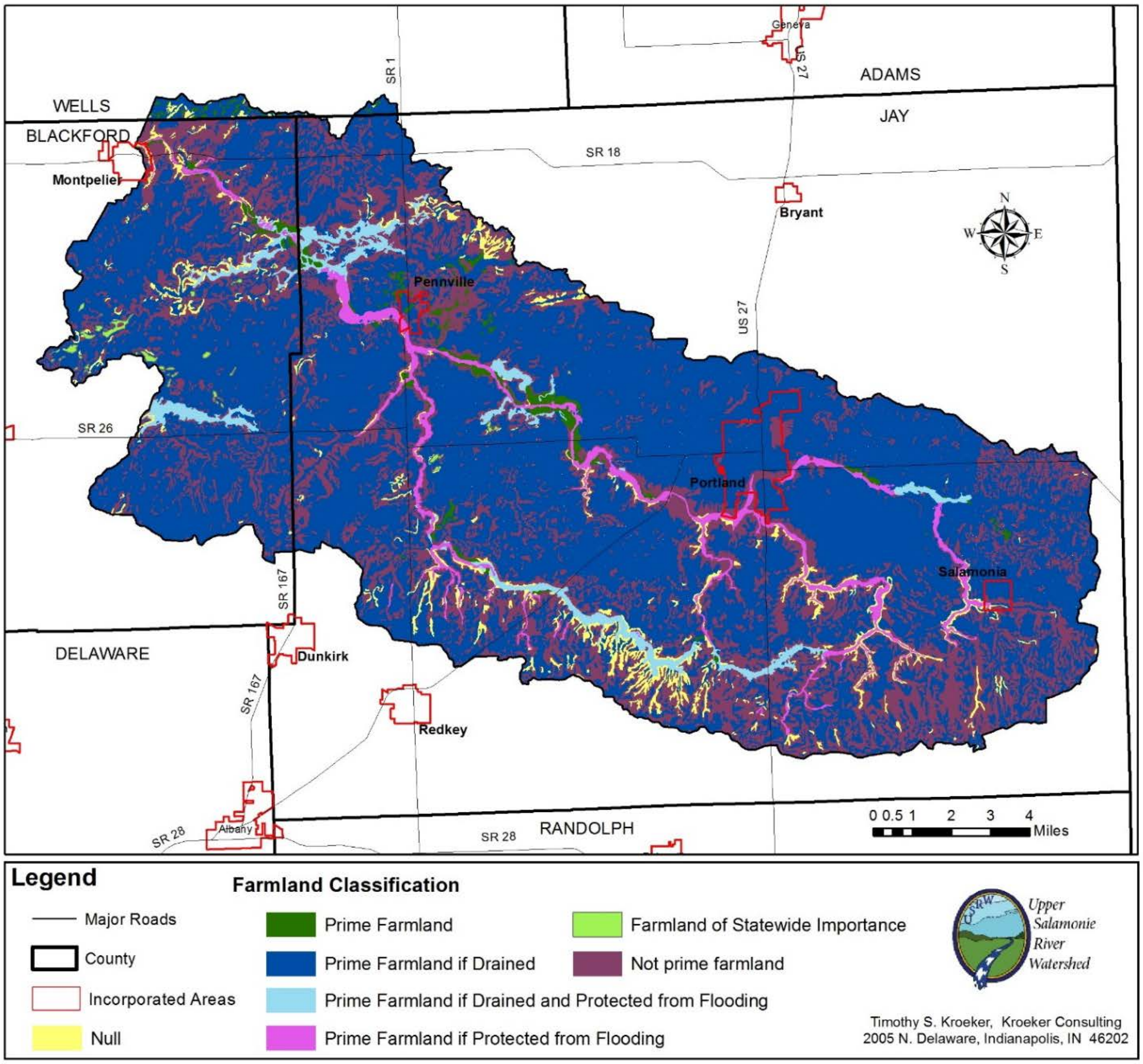
Table 8 Legal Drains in the Upper Salamonie River Watershed

County	Jay			Blackford			USRW Reported Totals		
Drain Type	Tile	Open	Total	Tile	Open	Total	Tile	Open	Total
Linear Miles	65.2	83.8	**149**	*	101	**101**	**65.2**	**184.8**	**250**

*Data Unavailable

Note: Blackford Data includes a portion of the Lower Salamonie River Watershed.

Figure 11 Farmland Classification in the Upper Salamonie River Watershed



2.4 Tillage Transect Data

Agriculture is the dominant land use in the watershed, and has the potential to have the greatest impact on water quality in the Upper Salamonie. It is important to understand what types of crops are being grown, and what best management practices (BMPs), such as conservation tillage, are being practiced.

Tillage transects are windshield surveys that collect this important information. The importance of these conservation tillage practices is evident to many stakeholders, and the lack of acceptance and use of these practices is of concern in the watershed. It is important that farmers in the watershed increasingly adopt conservation tillage and other BMPs in order to improve water quality. Data shows fluctuations in the use of conservation tillage and other BMPs, but what is needed is increased adoption of these practices.

Conservation tillage practices include: no-till (any direct seeding system, including site preparation, with minimal soil disturbance which includes strip and ridge till), mulch-till (30%-75% residue cover after planting, excluding no-till), and reduced-till (16%-30% residue cover after planting). Conventional tillage systems leave less than 15% residue cover after planting leaving the soil more susceptible to sheet or rill erosion. Conservation tillage data was collected for Jay and Blackford counties for 2011 and 2013. From 2011 to 2013, conventional tillage increased. In Jay County, however, this was not due to a lack of dedication to conservation tillage in the county. During planting in 2013 the ground was too hard from the drought for many no-till drills to be used. In order to get the seed at proper depth, many farmers had to move from no-till to a reduced-tillage system. This change was not reflected in the 2013 data in Jay County, where it was recorded that there was no reduced till in the county. Because of local knowledge, it was determined that this data was not accurate and should be considered an estimate of the true condition on the ground.

In Blackford County the same was true to some extent. However, reduced-till acreage was accounted for in the survey. It is also believed that because of the soil conditions many farmers did switch to conventional tillage to get proper seed depth, while some used reduced-till. Conservation tillage acreages for 2011 and 2013 are shown in Table 9.

Many farmers in both counties are dedicated to some form of conservation tillage. However, much more work needs to be done to continue to move more acreage from conventional tillage to conservation tillage. Because the vast majority of the land use in the Upper Salamonie River is row crop agriculture, water-quality improvements depend largely on farmers adopting practices that keep more soil and nutrients in place and out of local streams and rivers. Work must continue to be done to make these changes both practical and economically beneficial.

Table 9 Tillage System Percentage for Each Crop Present in Blackford and Jay Counties

	Blackford County - 2011						Jay County - 2011					
Present Crop	**No Till %**	**Strip Till %**	**Ridge Till %**	**Mulch Till %**	**Reduced Till %**	**Conventional Tillage %**	**No Till %**	**Strip Till %**	**Ridge Till %**	**Mulch Till %**	**Reduced Till %**	**Conventional Tillage %**
Corn	28	0	0	13	16	43	22	0	0	12	19	47
Soybeans	62	0	0	13	9	15	64	0	0	10	13	13
Small grains	8	0	0	0	0	0	55	0	0	30	15	0
Hay/Pasture	0	0	0	0	0	0	100	0	0	0	0	0
Fallow	0	0	0	0	0	0	58	0	0	0	0	42
Specialty Crops	0	0	0	0	0	0	0	0	0	0	0	0
CRP and similar	0	0	0	0	0	0	88	0	0	0	0	13

Table 10 (Cont.) Tillage System Percentage for Each Crop Present in Blackford and Jay Counties

	Blackford County - 2013						Jay County - 2013					
Present Crop	No Till %	Strip Till %	Ridge Till %	Mulch Till %	Reduced Till %	Conventional Tillage %	No Till %	Strip Till %	Ridge Till %	Mulch Till %	Reduced Till %	Conventional Tillage %
Corn	6	0	0	16	19	59	17	0	0	24	0	59
Soybeans	55	0	0	14	11	21	49	0	0	34	0	17
Small grains	33	0	0	0	0	0	69	0	0	13	0	19
Hay/Pasture	0	0	0	0	0	8	0	0	0	0	0	9
Fallow	0	0	0	0	0	0	0	0	0	0	0	0
Specialty Crops	0	0	0	0	0	0	0	0	0	0	0	0
CRP and similar	0	0	0	0	0	0	0	0	0	0	0	0

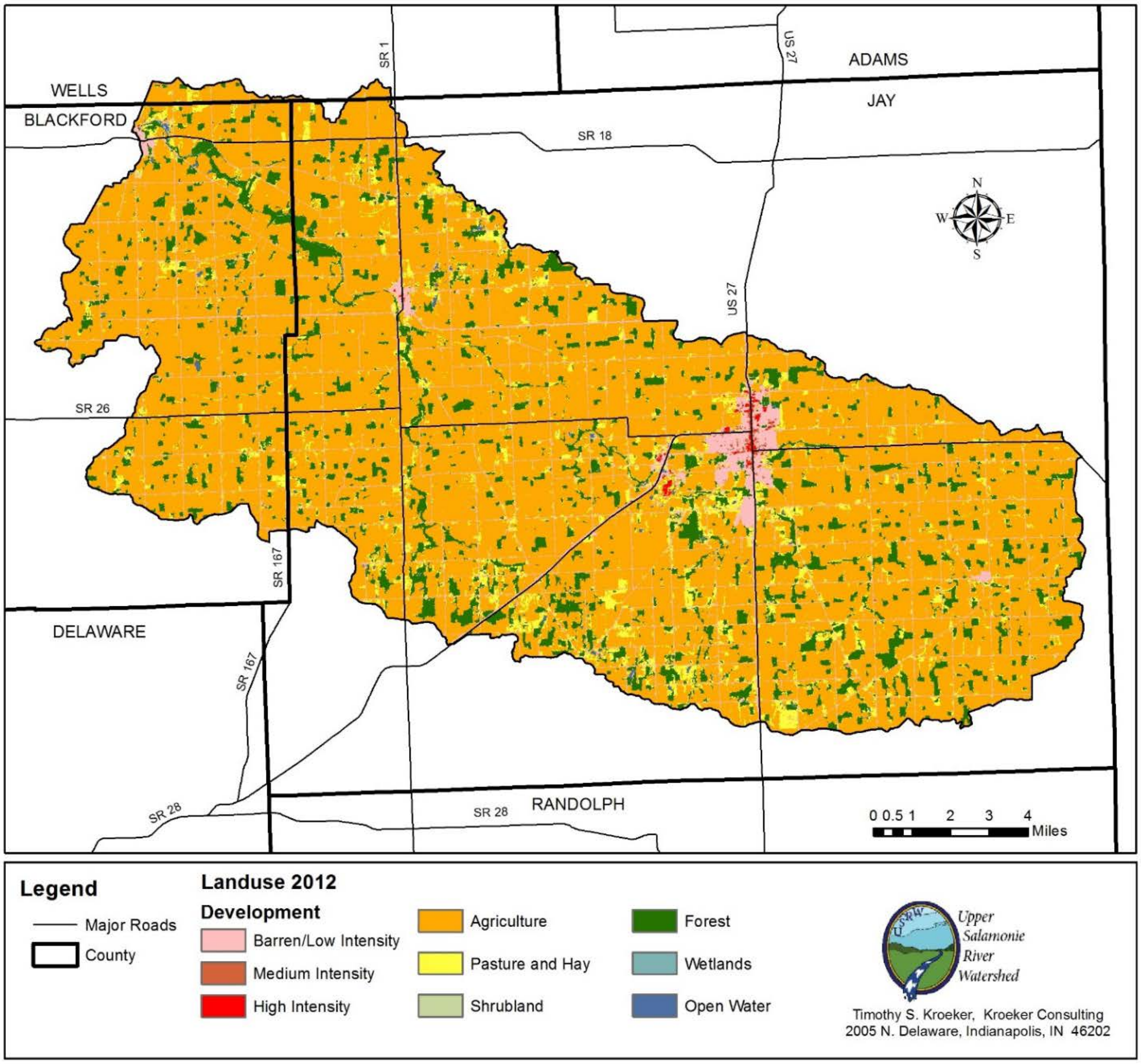
2.5 Land Use

The predominant land use in the watershed is agriculture with 73% dedicated to row crops and another 7% indicated as pasture and hay (Figure 12 and Table 10). Most of the agricultural production consists of corn and soy beans, however wheat, oats and other small grains and specialty crops such as tomatoes and pumpkins are grown as well. The remaining land use is divided among the other major categories: Forested Land (10%), Developed Land (7%), Shrubland (2%) and Open Water and Wetlands (0.4%). Low intensity development includes single family residence and large lot residential and sprawling developments in rural areas. For this study, open space is also wrapped into the definition of the Low Intensity/Barren category and includes undeveloped lots, parks, and golf courses.

Table 11 Landuse in the Upper Salamonie River Watershed

Landuse	Total Acres	Percent of Watershed
Row Crop Agriculture	118529	73.18
Pasture and Hay	11571	7.14
Developed/High Intensity	193	0.12
Developed/Med Intensity	351	0.22
Developed/Low Intensity	10465	6.46
Forest	16660	10.29
Shrubland	3521	2.17
Wetlands	201	0.12
Open Water	482	0.30
Totals	161972	100

Figure 12 Landuse in the Upper Salamonie River Watershed



As is evident, agriculture is a vital component of the economy in the Upper Salamonie. In addition, the impact of agricultural practices on water quality is well known and is a concern to stakeholders in the Upper Salamonie. Many forms of nonpoint source pollution are related to agricultural practices. Eroding soil transports particle bound nutrients and other pollutants into local waterbodies through surface runoff, and other nutrients and chemicals are carried to the river via tile drains. Of increased concern in the watershed is also the application of manure on farmland, both from local feed lots and out of state sources. Often the timing and location of the manure application can be detrimental such as putting the material on frozen ground, next to open streams and ditches, applying immediately before a rain event, and other environmentally unwise practices. This in combination with the proliferation of feedlots themselves in the watershed has raised concern about ever increasing nutrient loads in the steam and the possibility of biological contamination associated with animal waste.

Livestock production in the watershed has continued to rise for several years, and more facilities are presently going through the approval process (Table 11). It is important that the growth in confined feeding operations be accompanied by proper practices to reduce any negative environmental impacts while maintaining a viable business. A summary of the livestock statistics for 2012 is shown below. The data was provided by the U.S. Department of Agriculture, and are the latest statistics to be released. Data is on a county basis so numbers don't correspond exactly with what we expect in the Upper Salamonie.

Table 12 2012 Livestock Statistics for Jay and Blackford County

	Layers	Pullets for layer flock replacement	Turkeys	Hogs and Pigs	Ducks	Cattle	Goats
Blackford County	296	Data Withheld	Data not available	32,452	Data not available	1,557	261
Jay County	2,751,524	2,462,090	294,704	166,217	83,021	Data not available	Data not available

Urban areas in the watershed include Portland, Pennville, Montpelier, and Salamonia. Urban landuse can have a number of negative effects on water quality. Increased runoff form impervious surfaces such as parking lots, roads, and rooftops drains quickly into area streams causing streambank erosion and washing out vital aquatic habitat. These increased flows also carry a host of pollutants such as sediment; oil, grease and toxic chemicals from motor vehicles; pesticides and nutrients from lawns and gardens, road salts and viruses, bacteria and nutrients from pet waste and combined sewer overflows. So although the majority of the landuse in the Upper Salamonie is agricultural, possible urban sources of pollution must also be addressed.

2.6 Other Planning Efforts in the Watershed

Plans that only cover a portion of the Upper Salamonie River (USR) watershed are shown in Figure 13. Other plans are more regional in nature and include the entire USR watershed.

Federal Clean Water Act – Section 303(d)

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify waters, based on assessment that do not or are not expected to meet applicable water-quality standards. States must then rank these waters based on severity, and develop a Total Maximum Daily Load or TMDL for each waterbody listed. A TMDL is the total amount of a pollutant that can be assimilated by a body of water and still meet applicable water-quality standards. Although there are several streams listed in the Upper Salamonie River watershed (Figure 14), there are presently no TMDLs developed for the Upper Salamonie.

County Comprehensive Plans

County Comprehensive Plans are designed to encourage the most appropriate use of resources within the county consistent with the interests of the citizens. These plans set forth goals, objectives, policies, and implementation techniques that will guide development activity within the area and promote, preserve, and protect the health, safety, and general welfare of its citizens. From a watershed planning perspective, the plans provide a common language and vision, as well as a basic framework for future decision making. The following is a summary of known plans and their relevance to this watershed planning effort.

Blackford County - 2011

Among the goals and strategies discussed in the Blackford County Comprehensive Plan are the topics of land use and natural resources. Agricultural land and CAFOs are discussed. In the plan it is recognized that CAFOs result in a positive economic impact for many rural communities. However, exactly how to deal with setbacks, neighboring property values, and potential increased pollution from animal wastes makes this issue a difficult one. The plan suggests creating a separate land use category for “Rural Residential” and to provide appropriate set-backs to help avoid problems with CAFOs.

Quality of life is important to the residents of Blackford County, and one of the overarching goals of the comprehensive plan is to “Protect things that make Blackford County such a nice place to live”. One way to make this possible is to protect the county’s recreational lands and facilities. Six priority actions were set forth by the plan regarding parks and recreation:

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

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

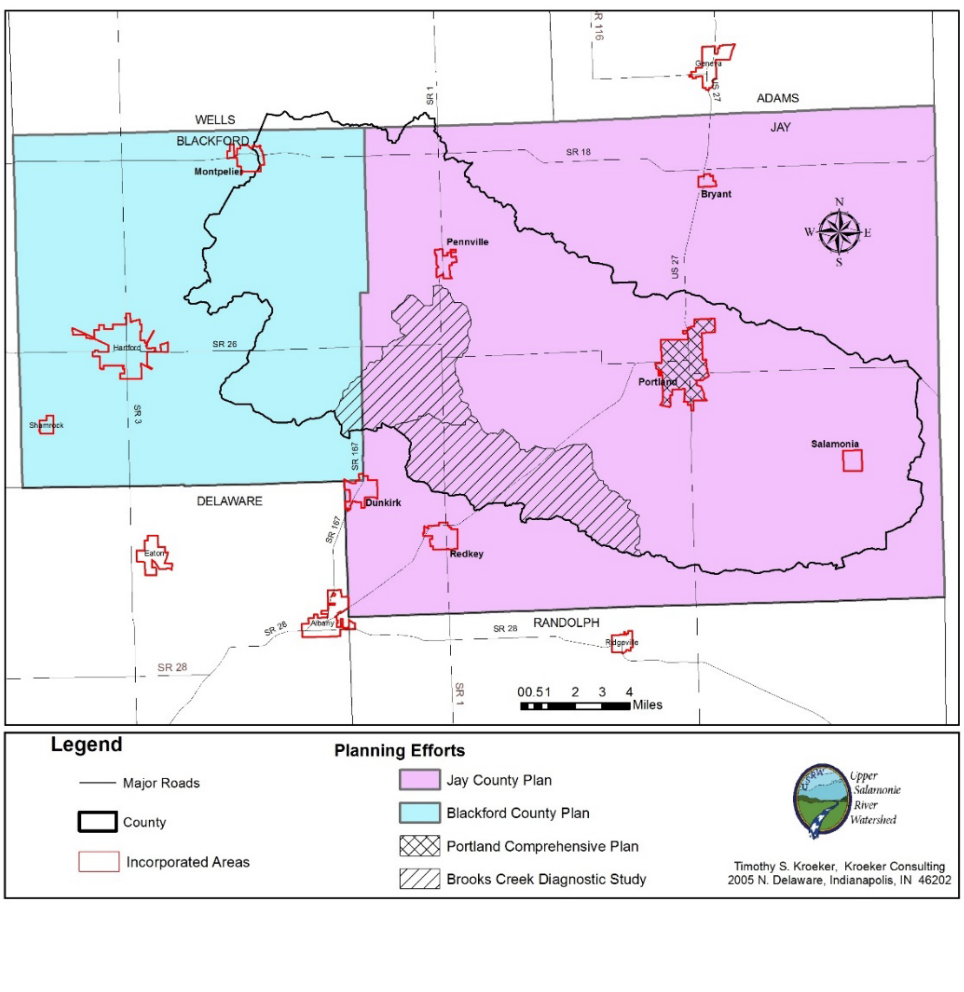
The county also has numerous floodplains associated with the Salamonie River and other area streams. To protect these areas and to maintain eligibility for federal flood insurance, the community has adopted the federal guidelines for building and other activities in the floodplain. The plan recommends that the community continue to monitor and update their standards to mirror any changes to federal requirements.

Jay County - 1990

The Jay County Comprehensive Plan was developed in 1990. It has a few general recommendations that deal with the environment including: 1) General guidelines for development discouraging construction that would harm any environmentally sensitive areas such as wetlands, flood plains, aquifers etc. 2) A general acknowledgement of NEPA environmental policies in the planning process. 3) Encourages farmland preservation. It also states that if any zoning takes place relating to agriculture, it should be minimal, but enforcement of state laws for CAFOs should be pursued. 4) General statements regarding recreational facilities including parks, and that the county should look at purchasing quality land for these parks. 5) Supports the proper utilization of natural resources including mineral extraction and timber harvesting and encourage the availability of these resources for future generations.

One of the more specific recommendations deals with waste reduction in landfills. The plan calls for waste reduction to landfills by 35% by 1996 and 50% by 2001. It encourages source reduction, recycling, composting and other solid waste management alternatives over landfill disposal and incineration.
In regards to open waterways including legal ditches, rivers, streams, and creeks, the plan indicates that these waterbodies should be maintained properly to reduce property damage and health threats. The focus is on flooding and drainage, and not on the health of the aquatic systems or recreational uses of the waterbodies themselves. It is hoped that the Upper Salamonie River watershed planning effort will encourage the county to update their comprehensive plan, and that goals identified in the watershed plan might be incorporated into a new strategic plan for Jay County.

Figure 13 Additional Planning Efforts in the Upper Salamonie Rive Watershed



IDEM Watershed Restoration Action Strategy for the Salamonie River Watershed

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

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

Rapid Watershed Assessment for the Salamonie River Watershed

Rapid watershed assessments (RWA) developed by USDA_NRCS provide general recommendations as to where conservation investments would best address the concerns of landowners, conservation districts, and other community organizations and stakeholders. The Salamonie River Watershed RWA, 2008, consists of geographically displayed data layers as a pdf map, along with a text and tabular report summarizing data and source information. RWAs pertain to 8 digit HUCs, in order to provide a watershed view of resource concerns that can be compared on a statewide scope. As such, information pertains to the entire Salamonie River Watershed and is general in nature, with the goal of assisting watershed planners and local stakeholders in the development of a more detailed watershed management plan. Resource concerns identified by the RWA as being top priority include: 1) impaired surface water quality due to excessive nutrients, sediments, and bacteria; 2) poor fish populations; 3) contaminated ground water quality due to soils with a high leaching index; 4) threatened and endangered species; and 5) soil quality affected by soil and wind erosion (U.S. Department of Agriculture, Natural Resources Conservation Service, 2008).

Brooks Creek Diagnostic Study - 2002

A Lake and River Enhancement Grant was obtained from the Indiana Department of Natural Resources Division of Soil Conservation by the Jay County Soil and Water Conservation District. The diagnostic study was a comprehensive plan very similar to the Upper Salamonie River Watershed Management Plan. It looked at both causes and sources of water-quality impairments in Brooks Creek and made recommendations on work that can be done to address these issues.

In general it was found that the chemical and physical characteristics of the watershed indicate a high degree of degradation. Nutrient concentrations were higher than expected for the Eastern Corn Belt region, and several water-quality violations were noted. Nitrate values ranged from 0.02 – 18.70mg/L with most values over 7mg/L. Total phosphorus values ranged from 0.087 – 0.4mg/L. In addition, E. coli values at all sites exceeded the state standard during a storm event with values ranging from 1000 – 6600cfu/100ml. The biological data also indicated a degree of impairment, and since the habitat quality and biological quality didn't correlate, some other factor then habitat must be playing a role in the degradation of the biological community.

The conclusion of the study was that Brooks Creek would benefit from land treatment and best management practices to help address sediment and nutrient issues. Finding ways to restore a more natural hydrology may also be key to addressing the issues in Brooks Creek. Because Brooks Creek is a major sub-watershed of the Upper Salamonie River, this data will be of value both historically and as a guide for implementation in this area.

US Army Corps of Engineers Water Quality Assessment of the Salamonie River Watershed

An assessment of the Salamonie Watershed was made by Jade L. Young of the US Army Corps of Engineers. The impetus for the study was to discover the causal factors of harmful algal blooms in the Salamonie Reservoir in 2009. In 2012 toxic algal blooms attracted media attention when two dogs were reported to have died after swimming in the reservoir. A 2009 reservoir study attributed toxic algal blooms to increased nutrients from land-use activities around the reservoir and from the Salamonie River watershed. Since 2010, twelve different chemical parameters have been sampled at 20 sites on the Salamonie River. This data provides a solid background to the existing water quality of the Salamonie River and its impact on the Salamonie Reservoir.

City of Portland Comprehensive Plan – 2007

The purpose of the City of Portland Comprehensive Plan was to guide local officials when making future zoning and land development decisions. The bulk of the plan was developed in 2003, however increased development around the city of Portland necessitated the updating of the Future Land Use section of the plan. Although the plan is for the city itself, it does speak of preserving native areas and vegetation and improving water quality.

Rule 5

Rule 5 is a regulation designed to reduced pollutants that are associated with construction or other land disturbing activities. These activities include such things as clearing, grading, excavation and other land disturbing activities that will result in the disturbance of one acre or more. Or if the area is less than an acre but is part of larger development where in total the land area disturbed will be over an acre, then Rule 5 still applies.
Jay County has developed a procedure and a fee schedule to deal with Rule 5 requests in the county. It consists of the following:

Fee Schedule:
Residential - $100.00
Livestock Facilities – Under 10 acres - $200.00; 10+ acres - $400.00
Commercial Builds - $500.00
Wind Turbines – Multiple Turbines/Multiple Landowners in one plan - $5,000.00

Individual Landowners - $200.00/Turbine

Plans are received in the Jay SWCD and dated with date of receipt. At this point a 30 day review period begins. The SWCD Coordinator/Educator conducts initial review of plan, and then the SWCD Associate Supervisor and Soil Scientist conducts final review. If the plan meets all the minimum requirements the engineering firm is advised of this fact. Should the plan not meet minimum requirements, the SWCD Coordinator/Educator advises the client and solicits required information in an effort to complete the review of the plan within the 30 day review period. Should the client indicate their inability to provide the requested information, the plan is documented as “Not Complete” and returned to the client. To insure that development does not move forward without properly completing the process, the Jay County SWCD has a working agreement in place with the Jay County Building & Planning Department that no local permits are granted until the Rule 5 is reviewed and approved. These issues, as they arise, may provide insight into the type and number of BMPs that may be necessary to affectively address problems that arise.

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

Blackford County also reviews Rule 5 applications and has a similar procedure. The applicant submits their construction plan to the Blackford County Soil and Water Conservation District (BCSWCD). The office administrator reviews the plan and determines if the plan is adequate or deficient. The form is than returned to the submitter, and they send this on to IDEM along with a (NOI) Notice Of Intent form. The BCSWCD office charges the applicant a flat rate of $100 which must be paid to the district before the NOI form is released to them. This review process for both counties help insure that non-point source pollution from construction activities is adequately controlled in the Upper Salamonie River watershed.

Stream Classification Study – Taylor University

As part of the development of the USRW Management Plan, a preliminary study was conducted by environmental science students from Taylor University on stream classification in the Upper Salamonie River Watershed. The purpose was to take an initial look at several locations throughout the watershed and classify these stream segments using applied river morphology methods developed by Dave L. Rosgen. Preliminary data indicates that these segments are classified as E4 and E5 stream types. Both these stream types tend to be located in broad riverine or lacustrine valleys and river deltas and have gentle slopes. Channel materials tend to be dominated by gravel in E4 streams and sand in E5 streams. Both these stream types are considered very stable unless the stream banks are disturbed, and significant changes in sediment supply and/or stream flow occurs. Observations and data in the watershed indicate that the hydrology has been significantly altered, and farming practices have led to a large increase in sediment load to the streams. This has led to a system of unstable streams resulting in poor water quality, reduced biological integrity, and negative impacts locally and downstream. It is hoped that implementation of the Upper Salamonie River WMP will lead to adoption of conservation practices which will improve both stream stability and water quality, and improve soil health and profitability of farmland within the watershed.

Social Indicator Study – Taylor University

In the spring of 2015, the Taylor University Environmental Science Department was awarded a grant to conduct a Social Indicator Study in the Salamonie River Watershed. Data was collected and analyzed throughout the summer and a report is under development and will be released the fall of 2015. It is hoped that this data will help improve the effectiveness and efficiency of the implementation of conservation practices in the watershed.

2.7 NATURAL AREAS AND ENDANGERED SPECIES

Stakeholders in the watershed were concerned with wildlife and wanted to ensure that wildlife habitat was protected. It was suggested that wetland conservation, creation, and restoration also be considered in the USRW to provide needed habitat for many species (Table 2). The Indiana Department of Natural Resources Natural Heritage Database indicates that there are several threatened, endangered or rare species, high quality natural communities and natural areas documented within the Salamonie River watershed. These are discussed below.

Mammals

Least Weasel (Mustela nivalis) *State Species of Special Concern*

The least weasel is one of the smallest mammalian carnivores. Males are only 10 inches in length, and females at most are 9 inches. They weigh only 1.2 to 3.2 ounces. Populations of least weasels tend to be scattered occurring in areas that have good habitat and high numbers of rodents for prey. Least weasels tend to be found in meadows, grasslands, and river bottoms.

Least Weasels can benefit from soil, water, and wildlife conservation practices. Installing grass buffer strips along streams and rivers provide increased habitat for weasels, as well as reducing soil erosion and protecting waterbodies from other non-point source pollution.

Indiana Bat (Myotis sodalis) *State Endangered Species and Federally Endangered Species*

The Indiana Bat is a small grayish colored bat weighing about ¼ ounce and having a body length ranging from 1.5 to 2 inches. The Indiana Bat only resides in caves in the winter during hibernation. Cave environments must be very specific. Temperatures must be low to keep their metabolic rates down, and they will hibernate in dense clusters which can contain thousands of individuals. During the summer, they disperse into the countryside so it is difficult to study them and learn of their habits. Females may form maternity colonies of up to 100 individuals during the summer, but few of these colonies have ever been found.

Indiana Bats feed exclusively on night flying insects, consuming upwards of 3000 insects per night. This allows them to store fat to sustain themselves through the winter months. There decline can be effected by natural causes such as cave flooding, but humans are the major cause of their decline. Indiana Bats are highly susceptible to disturbance and cave vandalism, and may also be effected by pesticides. Habitat is also an important consideration with forestland being important for summer foraging. With the economy struggling in many parts of Indiana, farmers in the USRW are clearing more land for row crops. Loss of this forested acreage could have a negative impact on the Indiana Bat population.

Birds

Black-crowned Night-heron (Nycticorax nycticorax) *State Endangered Bird*

Black-crowned Night-herons are stocky birds, and as their name implies are most active at night when they forage in water, on mudflats, and on land. In the day they tend to conceal themselves among the foliage and branches. Although they tend to forage alone, they are social birds and prefer to roost and nest in groups. They breed in colonies of stick nests often built over water. They can live in fresh, salt, or brackish wetlands. Their coloring is light gray with a distinctive black back and black crown

Amphibians

Northern Leopard Frog (Rana pipiens) *State Species of Special Concern*

Once the most widespread frog species in North America, the Northern Leopard frog has declined in numbers due to habitat loss, disease, and competition from non-native species. It is an attractive green or brown frog with spots on its back and legs. It is typically 2 to 3.5 inches in length. Its' call is distinctive consisting of a long, deep snore followed by a chuckling (chuck-chuck-chuck).

Leopard Frogs will not breed until they are two to three years of age. Mating in late April, females can lay up 6000 eggs in submerged masses. The eggs are generally attached to aquatic vegetation. Leopard frogs require a wide range of habitats to survive. Their breeding habitat consists of marshes, wetlands, and small fishless ponds. In summer they move into grasslands, wet meadows and forest edges, and may travel up to 2 miles from water. In the fall they move to the bottom of lakes and ponds where they will overwinter.

Reptiles

Western Ribbon Snake (Thamnophis proximus proximus) *State Species of Special Concern*

The Western Ribbon Snake is a medium sized non-venomous snake ranging from 20 to 30 inches in length. It is black in color with white or mint green between the scales and has three longitudinal stripes. The dorsal stripe is usually orange in color and the lateral stripes range from cream to yellow. The head is brown or black with two small yellow parietal scales.

Being the most aquatic of garter snakes it is usually associated with ponds, marshes, sloughs, rivers, and lakes. This snake is a diurnal active snake and an active thermoregulator. It will alternately hunt and bask throughout the day. They are good

climbers and may be found in bushes or shrubs near water. They often hide beneath logs and rocks and in the burrows of other animals. Western Ribbon Snakes breed in the spring and their young are born alive in late summer or autumn. They have strong jaws and feed on frogs, toads, salamanders, fish and earthworms.

Mollusks

Kidneyshell (Ptychobranchus fasciolaris) *State Species of Special Concern*

Freshwater mollusks are invertebrates (lacking a skeleton) that live on the bottom of streams, rivers, lakes and ponds. Like most freshwater mussels, the Kidneyshell larva are parasitic and require a host fish to complete the beginning of their life cycle. The female releases larvae in a mucous substance disguised as food. Once ingested by a fish host the larva are released from the mucous substance and attach to the fish's gills. Here they remain until they reach their juvenile stage where they drop off and burrow into the substrate.

They prefer the riffle areas of small to medium sized rivers and streams where clear water flows over coarse firmly packed sand and gravel. They will spend most of their lives burrowed in the sediments and live up to 10 years or more. Because of this interaction with the sediment, they are susceptible to heavy loadings of silt which is often characteristic of agricultural lands. The agricultural nature of the Upper Salamonie River watershed puts these organisms at risk, and it is important to control stream sediment loading if this species is to survive in this area. They are also susceptible to heavy nutrient loads and other pollutants and habitat loss.

Insects (Odonata)

Wabash River Cruiser (Macromia wabashensis) *State Endangered Species*

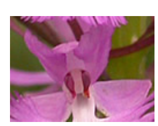
There are very few confirmed sightings of the Wabash River Cruiser in the United States, and the Upper Salamonie River Watershed is privileged to have hosted this rare species. Dragonflies are of the order Odonata, and are characterized by large multifaceted eyes and two pairs of strong wings that can propel them at 22 – 34mph. Their larval stages are aquatic and can last up to 5 years before becoming adults. Because of this lengthy larval stage, dragonflies are susceptible to poor water quality.

In their larval stage they feed on other invertebrates such as mosquito larva and even tadpoles and fish. In their adult phase they prey on mosquitoes and other small insects such as flies, bees, wasps, and rarely butterflies.

Vascular Plants and High Quality Natural Communities

The Indiana Department of Natural Resources also strives to protect rare plant species and high quality natural communities throughout the state to preserve biodiversity. Rare and threatened plants in the Upper Salamonie River Watershed include the following:

Small Purple-fringe Orchis (Platanthera psycodes) *State Rare Species*



Long-bract Green Orchis (Coeloglossum viride var. virescens) *State Threatened Species*

The high quality natural communities located in the Upper Salamonie include Marshes, Central Till Plain Flatwoods, and Mesic Floodplain Forests. These unique communities provide a variety of habitats for different species of animals and plants to live. It is important that these communities be protected.

3.0 Watershed Summary

Landuse is predominantly agriculture in the Upper Salamonie River watershed. The relatively flat topography and soils, especially if properly drained are considered prime farmland. Row crops dominate, and because of the need for drainage, the hydrology throughout the basin has been extensively modified. This has altered the natural systems ability to provide benefits such as water quality improvement, protection from flooding, stream stability, and wildlife habitat. There are also many confined feeding operations active within the watershed and more are coming on line. These operations create specific challenges which need to be addressed especially in the area of manure management. Manure from these operations are spread throughout the watershed to supplement fertilizer use, and manure is also being applied from sources out of state. It is important to insure that this process is being completed in the most environmentally sensitive way. Because of these issues, the farming community has the potential to have a great positive effect on the health of the Upper Salamonie River watershed through the adoption of conservation practices.

The agricultural nature of the watershed also lends itself to rural development, as opposed to concentrated urban settings. This results in wide spread housing that relies on septic systems to treat waste from homes. Almost all the soils within the watershed are considered very limiting for septic system use, so many systems throughout the watershed are failing or have failed. Proper installation and maintenance of these systems is important for the health of the watershed.

There are also a number of communities that have developed within the watershed. Two small cities, Portland and Montpelier are located in the watershed, as are the towns of Pennville and Salamonia. Each has a centralized sewage treatment system, but each has issues that need to be addressed. Water quality can be greatly affected by the runoff from residential, commercial, and industrial landuses. It will be important to develop urban best management practices to address the unique issues these landuses produce. Portland is presently working with IDEM to solve issues with combined sewer overflows which when fully implemented will help improve downstream water quality.

3.1 Environmental and Water Quality Data

Water Quality Targets

Water-quality targets for each parameter have been selected based on applicable Indiana Administrative Code and other targets accepted by the Indiana Department of Environmental Management. Table 12 shows selected targets for each parameter which will apply to the Upper Salamonie River watershed. Some of the parameters include multiple targets to provide information on target levels that have been used by different groups and organizations, and/or to show interim goals. For parameters with no interim goal, the target selected for the USRW will be highlighted. Data sets for biological data are very limited, and volunteer data is not as precise as the professional data available. Therefore it was difficult to set a true baseline of current conditions. The goals for biological and habitat data collected by volunteers will be to see a gradual improvement in the quality of both. Table 12 shows the scoring ranges and associated quality rankings. For professional data, the 303(d) listing bench marks will be the target levels, and these are listed below.

Table 13 Water Quality Parameters and Suggested Target Levels for the Upper Salamonie River Watershed

Parameter	Target Level	Source
pH	> 6 or <9	Indiana Administrative Code Article 2 327-IAC
Temperature	Monthly Standard	Indiana Administrative Code Article 2 327-IAC
Dissolved Oxygen	> 4 mg/L and <100%	Indiana Administrative Code Article 2 327-IAC
E.coli	<235 cfu per 100ml sample	Indiana Administrative Code Article 2 327-IAC
Total Phosphorus	0.08mg/L (30 year goal)	Ohio EPA recommended criteria for Warm Water Habitat
	0.3mg/L (5 year goal)	IDEM target used in the development of TMDLs for Indiana Streams
Ortho-phosphate	0.02mg/L (30 year goal)	Median concentration found in Indiana Lakes (Indiana Clean Lakes Program 2010-2011)
	Max: 0.005 mg/L (Ultimate goal)	Wawasee Area Conservancy Foundation recommendation for lake systems, NESWP344
Nitrate-nitrogen (NO3-N)	Max: 1.0 mg/L (30 year goal)	Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams in Ohio EPA Technical Bulletin MAS//1999-1-1 [PDF]
	1.5 mg/L (10 year goal)	Dividing line between mesotrophic and eutrophic streams (Dodds, W.K. et al., 1998, Table 1, pg. 1459, and in EPA-822-B-00-002 [PDF], p 27.)
	10.0 mg/L (5 year goal)	IDEM target used in the development of TMDLs for Indiana Streams
Turbidity	Max: 25.0 NTU	Minnesota TMDL for protection of fish/macroinvertebrate health
	Max: 10.4 NTU	U.S. EPA recommendation

Table 14 (Cont.) Water Quality Parameters and Suggested Target Levels for the Upper Salamonie River Watershed

Parameter	Target Level	Source
Total Suspended Solids (TSS)	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, T.F.,, 1995). Sediment in streams: sources, biological effects and control. American Fisheries Society, Bethesda, MD. 251 p.
	Max: 40.0 mg/L (30 year goal)	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of - fish/macroinvertebrate health
Citizen Habitat Evaluation Index CQHEI	> 100 High quality Stream	Hoosier River Watch
	> 60 Generally Healthy	Hoosier River Watch
Pollution Tolerance Index (PTI)	> 23 Excellent	Hoosier River Watch
	17-22 Good	Hoosier River Watch
	11-16 Fair	Hoosier River Watch
	<10 Poor	Hoosier River Watch
Qualitative Habitat Evaluation Index (QHEI)	>50	IDEM 303(d) List Criteria for Aquatic Life Use Support
Macroinvertebrate Index of Biotic Integrity (mIBI)	>35	IDEM

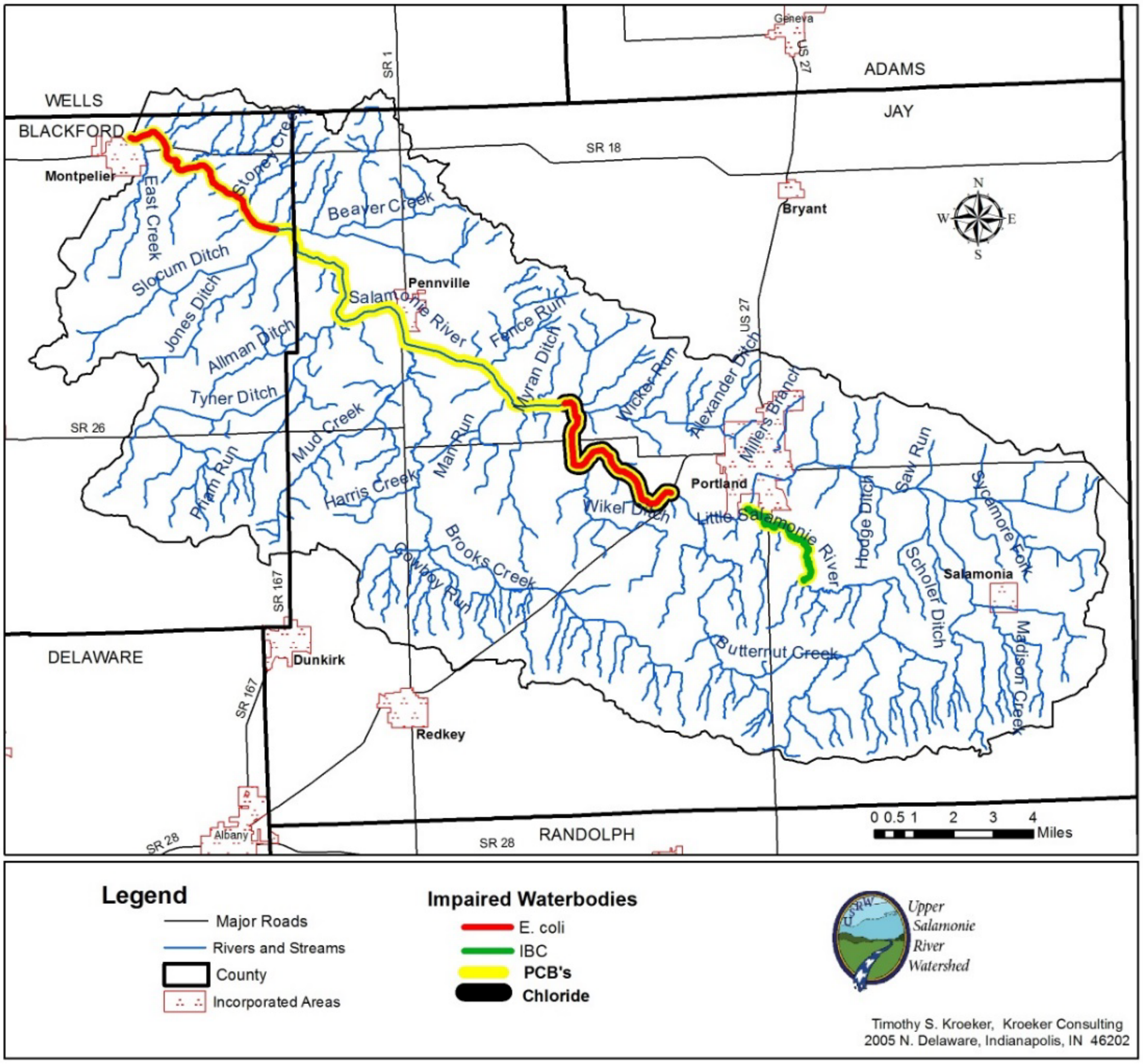
Historical Water Quality Data

Several sources of applicable water-quality data (ranging from 1991 to present) were available and were reviewed to determine trends in water quality throughout the Upper Salamonie River watershed. A brief review of these data sources are discussed below. Data will be further analyzed in their respective sub-watershed discussions.

IDEM Water-Quality Data for 305(b) and 303(d)

The Indiana Department of Environmental Management routinely collects water-quality data throughout the state under a variety of programs. This data, if determined of sufficient quality, is entered into the Assessment Information Management System (AIMS) database. Data collected from other sources is also added to the database if it meets the strict quality assurance-quality control standards set by IDEM. This data is then evaluated and used to determine if streams and other waterbodies in Indiana meet water-quality standards, or if they are impaired. There are several streams in the Upper Salamonie that have been listed as impaired on the 2012 and draft 2014 303(d) list by IDEM (Figure 14). If a stream is not indicated as impaired it may be because it meets standards, has not been evaluated, or does not have enough data to make a determination. The IDEM data used in this report were collected from 1991 to 2014. Locations for historic IDEM sampling sites in the Upper Salamonie River watershed are shown in Figure 15.

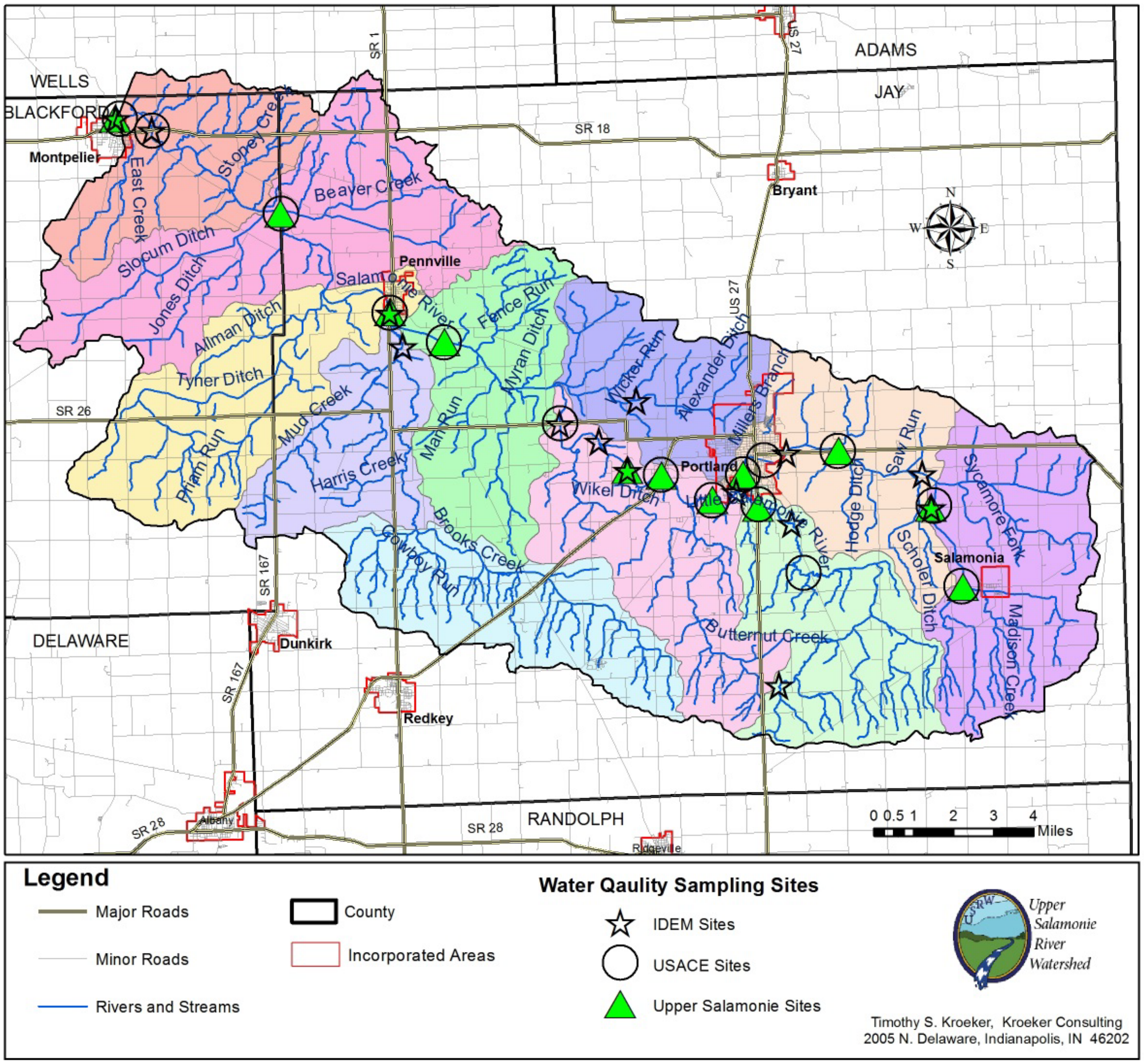
Figure 14 Impaired Waterbodies in the Upper Salamonie River Watershed



US Army Corps of Engineers Water Quality Assessment of the Salamonie River Watershed

A water-quality assessment was completed by the USACE to determine the water quality of the Salamonie River and its impact on the Salamonie Reservoir. The Salamonie Reservoir has been experiencing problems with toxic blue-green algae blooms which prompted the study. Sample data from 2010 to 2012 for 15 sites (Figure 15) within the Upper Salamonie have been provided. The samples were analyzed for total alkalinity, chloride, ammonia, TKN, nitrate-nitrite nitrogen, total phosphorus, sulfate, total organic carbon, total solids, total dissolved solids, total suspended solids, and E.coli. Sites were sampled eight times during the project. Results will be discussed in the sub-watershed section.

Figure 15 IDEM, USACE, and Upper Salamonie River Watershed Project Sample Sites (Background shows 12-Digit Hydrologic Unit Codes for the Upper Salamonie River Watershed)



Fish Consumption Advisories

The Indiana State Department of Health (ISDH), IDEM, and the Indiana Department of Natural Resources, with support from Purdue University collect and analyze available fish tissue data to produce an annual Indiana Fish Consumption Advisory for Indiana waters. Advisories are based on long-lasting contaminants such as polychlorinated biphenyls (PCBs), pesticides, and heavy metals such as mercury. Samples are taken from fish at all water depths. Table 13 defines the different amounts of fish that may be eaten from local waters, and Table 14 highlights the specific fish that have been tested in the Upper Salamonie River watershed (ISDH Website-2014).

Table 15 Safe Eating Guidelines for Recreationally Caught Fish from Indiana Inland Waters

GROUPS	Women of childbearing years, Nursing mothers and children under 15. Limit consumption to:	Other Adults limit consumption to:
Group 1	**1 meal per week:** Any fish species listed as Group 1	**Unlimited Consumption**
Group 2	**1 meal per month:** All black bass (smallmouth) largemouth and spotted), channel catfish, flathead catfish shorter than 38 inches, walleye or sauger shorter than 24 inches, northern pike white bass, striped bass shorter than 28 inches, rock bass, other species	**1 meal per week:** All black bass (smallmouth) largemouth and spotted), channel catfish, flathead catfish shorter than 38 inches, walleye or sauger shorter than 24 inches, northern pike white bass, striped bass shorter than 28 inches, rock bass, other species
Group 3	**Do Not Eat:** Walleye and sauger longer than 24 inches, flathead catfish longer than 38 inches, and striped bass longer than 28 inches.	**One meal per month:** Walleye and sauger longer than 24 inches, flathead catfish longer than 38 inches, and striped bass longer than 28 inches.
Group 4	**Do Not Eat,** same as Group 3	**One meal every 2 months**
Group 5	**Do Not Eat**, same as Group 3	**Do Not Eat**

Table 16 Specific Restrictions by Species

Location	Species	Fish Size	Contaminant	Group
Salamonie River	Common Carp	ALL	Hg, PCB	Group 2
	Freshwater Drum	up to 11"		unrestricted
	Golden Redhorse	up to 11"		unrestricted
	Rock Bass	up to 6 '		unrestricted
	Spotted Sucker	up to 10"		unrestricted
	White Crappie	up to 8"		unrestricted
	White Sucker	up to 7"		unrestricted

Hoosier Riverwatch

The Hoosier Riverwatch program trains volunteers throughout the state on how to conduct monitoring on Indiana's rivers and streams. They have developed a methodology and equipment package so that results are comparable from one area of the state to another. Physical data are collected using a simplified version of the QHEI known as the citizens QHEI or CQHEI. The CQHEI provides a measure of both riparian and in-stream habitat. Volunteers are also encouraged to document any man made alterations to the system.

Biological data is also collected using kick-nets and dip nets to collect macroinvertebrates. Macroinvertebrates are sorted by taxa to the family level and given a score based on pollution tolerance. Looking at the tolerance levels of the macroinvertebrate community provides a picture of the general water quality of the stream over the past year or so.

Chemical data is also collected for a variety of parameters including temperature, dissolved oxygen, nutrients, pH, turbidity, biological oxygen demand, and bacteria. Volunteers use a variety of methods to obtain this data using equipment recommended by the Hoosier Riverwatch program. Flow measurements are also collected so actual pollutant loads may be calculated.

The Upper Salamonie River Watershed Project has, and continues to solicit volunteers, and has begun sampling in the watershed. The goal is for volunteers to sample six sites four times a year; once for macroinvertebrates and using the CQHEI, and three times for chemistry and flow. Volunteer findings will be discussed later in the report.

Brooks Creek Diagnostic Study

As part of the Brooks Creek Diagnostic Study developed in 2002, 10 sites were sampled in various sub-watersheds of Brooks Creek. Sites were chosen based on accessibility and the relative amount of information that could be obtained from each watershed. A reference site on Eightmile Creek was also chosen. Both the Jay and Wells County SWCD personnel felt that this reference site would be a good "measuring stick" by which to compare the sub-watersheds of Brooks Creek. Samples were collected once during base flow and once during a storm flow event. Parameters evaluated include: temperature, dissolved oxygen, alkalinity, pH, turbidity, total Kjeldahl nitrogen (TKN), ammonia, nitrate-nitrite, total phosphorus, orthophosphate, and total suspended solids. As mentioned earlier, nutrient and E. coli data was over target values and mirrored problems throughout the watershed. This data will be useful for guiding implementation in this sub-watershed.

Watershed Inventories

In addition to historical water quality data, landuse and other inventories on potential sources were analyzed. These are briefly discussed below.

Indiana Department of Environmental Management, Office of Land Quality

IDEM works with the US EPA on compliance issues and tracks such land uses as confined feeding operations (CAFO/CFO), hazardous waste, industrial waste, landfills, and underground storage tanks (UST). (They also track underground storage tanks that have developed leaks (LUST), and pursue remediation of these sites.) These facilities are expected to meet certain permitting requirements that have been put in place to protect the environment and human health. Each of these sites have the potential to impact environmental quality and should be considered possible pollution sources when evaluating the Upper Salamonie. These sites are shown in figures 16 and 17 (Site data obtained from Indiana Maps).

Figure 16 Potential Sources of Pollutants in the Upper Salamonie River Watershed

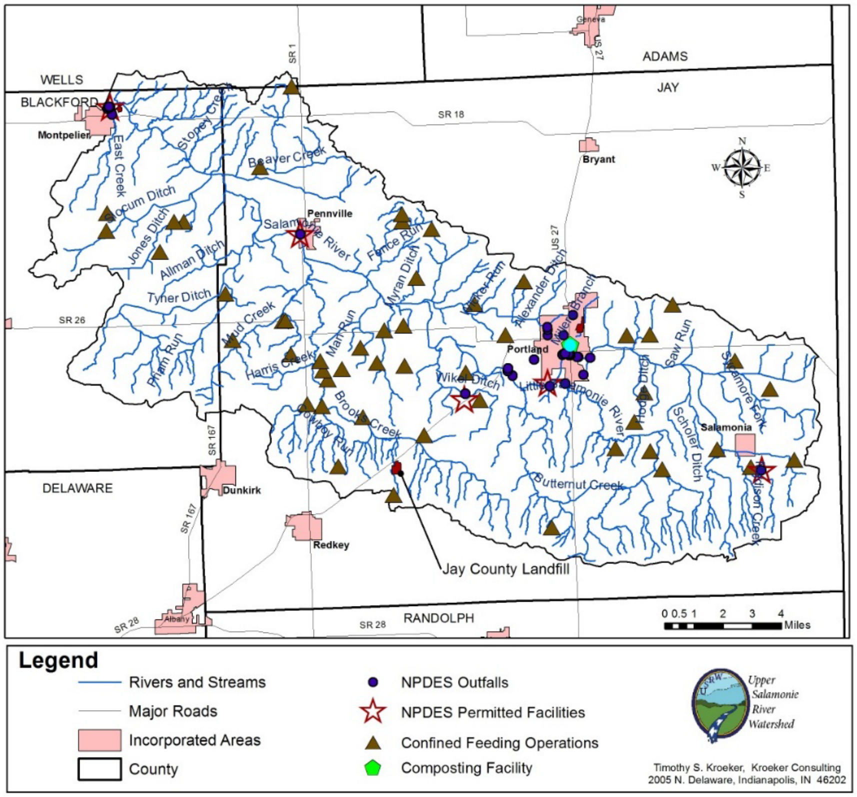
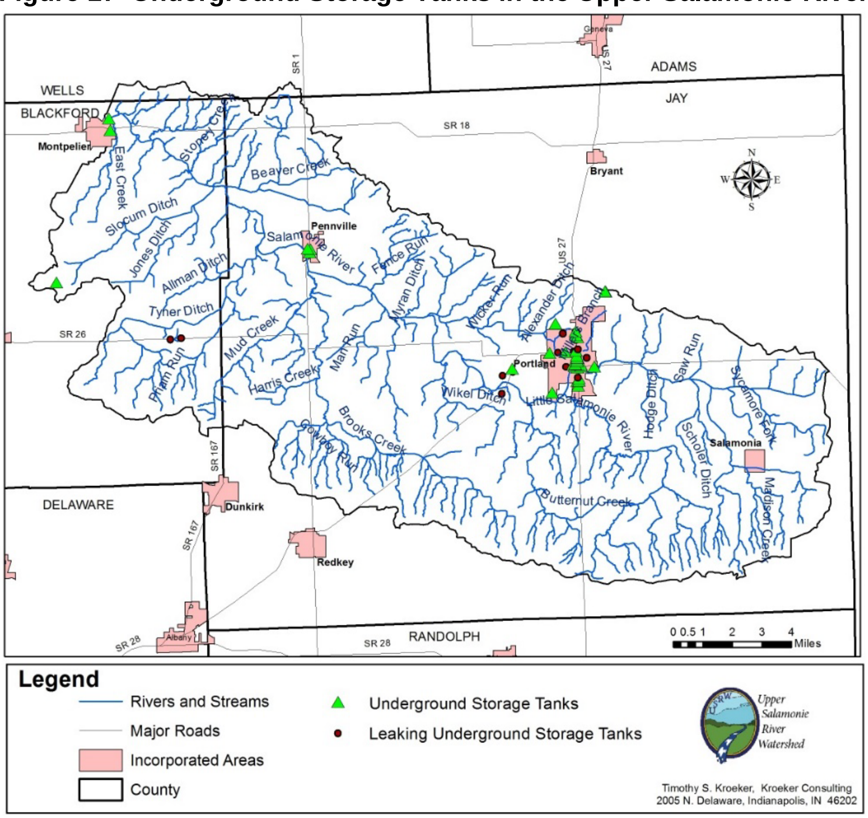


Figure 17 Underground Storage Tanks in the Upper Salamonie River Watershed



NPDES

Several facilities and discharges are regulated by the National Pollutant Discharge Elimination System. Permits are issued for each facility and limits established for the amount of each pollutant that the facility is allowed to discharge into waters of the state. There are several different types of permits including: Municipal, Industrial, and Wet Weather (which covers storm water discharges and combined sewer overflows). There are five NPDES sites in the Upper Salamonie River watershed (Figure 16, Table 15). They include the Salamonia Wastewater Treatment Plant, Portland Wastewater Treatment Plant, Pennville Wastewater Treatment Plant, Premier Ethanol, and the IMI/Erie Stone Company. The Montpelier Wastewater Treatment Plant is located outside the watershed in the Lower Salamonie River watershed. All five facilities have had some violations in the past. These violations will be further evaluated in the sub-watershed discussions.

Table 17 NPDES Permitted Facilities in the Upper Salamonie River Watershed

Facility	NPDES - ID	Address	City	County
SALAMONIA WWTP	IN0060437	4742 S 650 E	SALAMONIA	Jay
PREMIER ETHANOL, LLC	IN0062618	SR 67 CR 300 W AND CR 200 W	PORTLAND	Jay
PORTLAND WWTP	IN0020095	1315 SHADELAND DR	PORTLAND	Jay
PENNVILLE WWTP	IN0040495	330 W RIVER RD	PENNVILLE	Jay
IMI/Erie Stone Company	IN0002551	5067 E CUMMINGS RD	MONTPELIER	Blackford

Windshield Survey

In the Upper Salamonie River watershed, 445 sites were visually surveyed as part of the development of the USR watershed management plan. The purpose of the survey was threefold:

1) Gain an understanding of the overall condition of the watershed
2) Document where there are problems to determine which areas of the watershed should be considered Critical Areas
3) Document what types of Best Management Practices are required, and where these practices are most needed

Sites were located at every location where a road crossed a stream unless it was determined to be unsafe due to traffic problems. In addition, because of the number of streets in urban areas, not all crossings in the city were monitored. Other than general observations about the present weather conditions, location information, and stream width and depth, the information gathered includes data concerning: channel modification, stream bank erosion, type and width of stream buffers, adjacent land use, type of tillage, livestock access to streams, combined feeding operations, hobby farms, drain tiles, trash, construction and other land perturbations, and other conservation practices noted. Upstream and downstream pictures were also taken at each site, and georeferenced, so that changes over time can be noted.

Each site was evaluated for 8 of the above listed parameters. They include, degree of stream bank erosion (slight, moderate, severe), buffer width (none, 0-30 feet, 30-100 feet, >100 feet), type of tillage (conventional vs conservation) and presence of cover crops, stream access for livestock, presence of confined feeding operations, presence of hobby farms, presence of drain tiles, and presence of trash. This data was assigned values where good conservation practices or environmentally healthy situations were given a low score and the opposite was true for degraded sites. Scores for all sites within a sub-watershed were summed and divided by the number of sites visited in that sub-watershed. These individual scores are shown in Table 16.

Scores for windshield survey sites were scored as follows:

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

Since all the sub-watersheds in the USR watershed were degraded and in need of improvement, it was decided to divide the sub-watersheds into three tiers. Watersheds were then ranked as either Good, Fair, or Poor (Table 16). Scoring ranges for ratings are listed in Table 17. The data is somewhat normally distributed, but is skewed to the degraded side. It is important to note that from the observations made, all sub-watersheds are in need of improvement if water-quality goals are to be met. The ranking enables the steering committee to better prioritize where and how funds will be spent in the future to improve water quality in the Salamonie River and Salamonie Reservoir. The windshield survey will be discussed further in the report section dealing with critical areas.

Table 18 Windshield Survey Degradation Rating

Sub-Watershed Name	Windshield Survey Score	Windshield Survey Rating
McLaughlin Ditch	3.954545455	Tier 1
Berger Ditch	3.767857143	Tier 2
Little Salamonie River	2.692307692	Tier 3
Sipe Ditch	3.326923077	Tier 2
Miller Ditch	3.075471698	Tier 3
Cowboy Run	2.932692308	Tier 3
Glen Miller Ditch	4.661290323	Tier 1
Mud Creek	4.708333333	Tier 1
Two-mile Ditch	4.346153846	Tier 1
Beaver Creek	3.641304348	Tier 2
Stoney Creek	2.128205128	Tier 3

Table 19 Windshield Rating Table

Score	Level	Rating
3.9 – 4.7	Tier 1	Poor
3.6 – 3.8	Tier 2	Fair
2.1 – 3.5	Tier 3	Good

In general, the watershed is highly agricultural in nature and the hydrology has been heavily modified through dredging, straightening of streams, and extensive tiling and other drainage for agricultural purposes. Two stage ditches, retention areas, and other BMPs that would help restore some of the original hydrologic functions would be helpful to solve some of the water-quality issues. Streambank erosion and a lack of buffers along the stream was wide-spread, and can best be addressed while addressing these hydrologic modifications. It is also important that acceptance and application of conservation practices be increased in all areas of the USRW to help reach water-quality goals. Critical areas, and a discussion of the effectiveness and type of BMPs to be promoted will be discussed later on in Sections 7 and 8.

4.0 Sub-watershed Analysis of the Upper Salamonie River Watershed

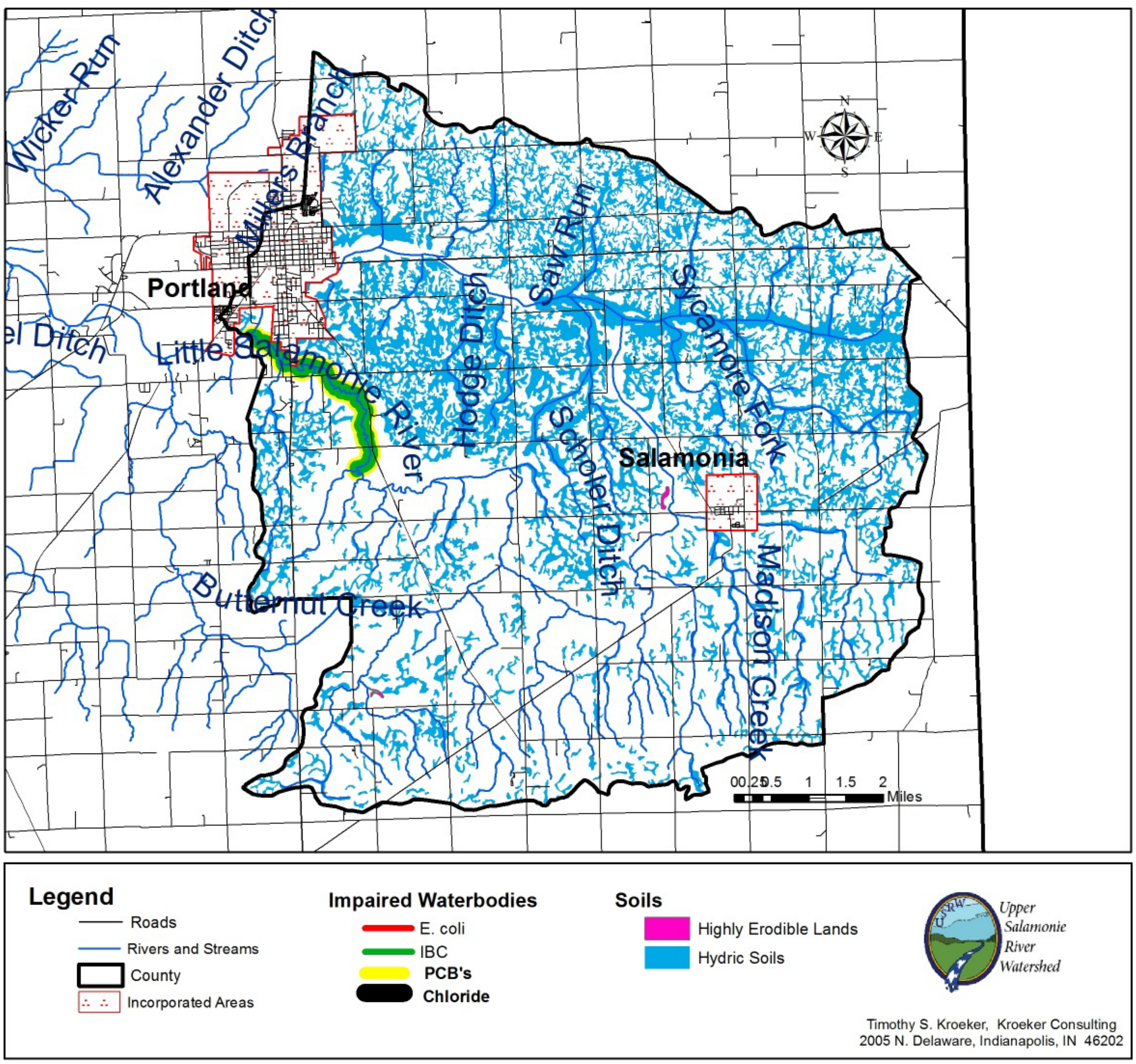
The Upper Salamonie River watershed consists of two 10-digit HUCs that are further subdivided into eleven 12-digit HUCs. To begin teasing out possible differences in this highly agricultural landscape, sample data was analyzed and desktop and windshield survey data was evaluated. This data and information was examined on a close to 10-digit HUC level. The watershed was divided into three parts, the Salamonie River headwaters, the watershed from Portland to Pennville, and the area from Pennville to Montpelier; differences in the 12-digit HUCs were discussed as they became evident. Discussions of these three areas are presented below beginning with the Upper Salamonie River headwaters (Figure 18).

4.1 Salamonie Headwaters from Salamonia to Portland (HUC 051201020103, HUC 051201020102, HUC 051201020101)

303(d) Listing

The headwaters of the Upper Salamonie from Salamonia to Portland drain approximately 45,108 acres. One hundred thirty-two miles of waterways are located in this sub-watershed including the Little Salamonie River, Buckeye Creek, Madison Creek, Walnut Creek, Burkey Ditch, Berger Ditch, Scholer Ditch and several other open drains and ditches. Only one segment is listed as impaired on IDEMs 303(d) list. That segment is on the Little Salamonie River (HUC 051201020102) and is on Category 5A for Impaired Biotic Communities (IBC). Although the QHEI or habitat score indicated a physical environment suitable for aquatic life, the IBI or fish community score was 30. Any number under 36 is considered impaired. This segment is also listed for PCBs. However, since this is a legacy pollutant, it will not be addressed in this plan.

Figure 18 Hydric Soils, Highly Erodible Soils and Water Quality Impairments



Hydric Soils and Highly Erodible Lands

In this sub-watershed most of the hydric soils are located to the north. Most soils in the southern portion are at least moderately well drained. Hydric soils to the north indicate locations where wetland restoration may be successful. However, the majority of the land is in agriculture, so to farm these areas successfully, much of this land needs to be drained. The windshield survey indicated that many of these areas have fields that have been tile drained, and the streams themselves have been highly modified to facilitate drainage. This has improved crop production, but has led to increased stream bank erosion, destruction of habitat, downstream flooding, and high nutrient and sediment loading to the Salamonie Reservoir. Adoption of conservation Best Management Practices (BMPs) my help balance the economic needs of farmers with the sustainability of the area's natural resources.

Flooding

Flooding has historically been a problem in the city of Portland. Because of the increase in drainage and stream modifications, water is quickly drained from the landscape resulting in higher flow peaks during rainstorms. Flooding was so bad in July of 2014 that Governor Mike Pence and Indiana State Police Superintendent Doug Carter visited the community to survey the flood damage and witnessing first-hand volunteer efforts to fight back against the worst of the several flooding episodes during the spring and summer. In addition, to help quantify the flow regime of the Salamonie River in this sub-watershed, the USGS installed a stream gauging station just west of Portland on the Salamonie River

Landuse

Landuse in the Salamonie Headwaters is shown in Figure 19. This sub-watershed reflects the watershed as a whole with the majority of landuse being devoted to agriculture. However, Portland is the largest city in the USR watershed and a majority of the high intensity development is in this sub-watershed. Urban run-off is a concern in this area not only due the variety of pollutants that may be contained in urban runoff, but also the fact that drainage from the urban landscape is tied into combined sewers which can lead to flows higher than the waste water treatment plant can handle. When this happens, stormwater combined with wastewater flow directly into area streams through this antiquated system. Solutions to these issues are discussed in section 4.

Landuse types and acreages in this sub-watershed are shown in Table 18. Urban open space and land possibly available for development is included in the category Developed/Low Intensity. The industrial park for Portland is also located in this sub-watershed on the northwest side of the city.

Figure 19 Landuse, Salamonie Headwaters from Salamonia to Portland

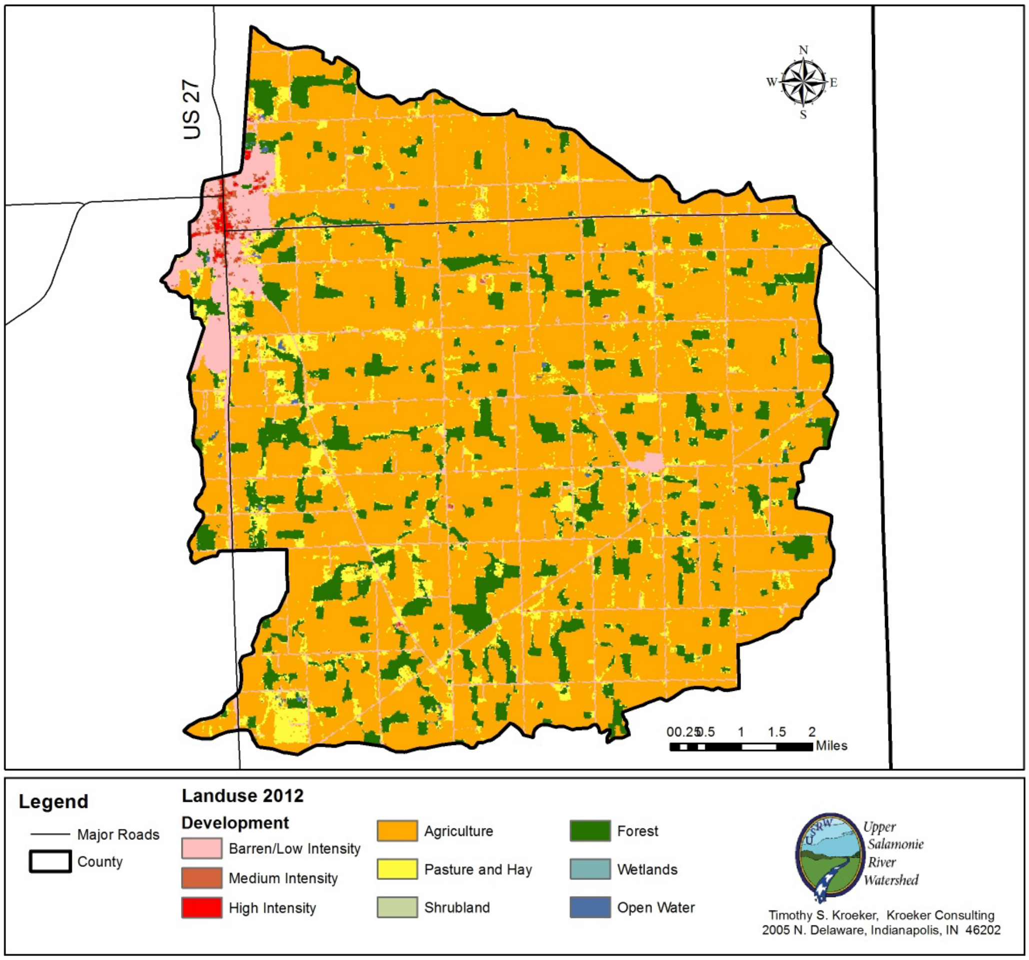


Table 20 Landuse in the Salamonie River Headwaters Sub-watershed

Landuse	Total Acres	Percent of Watershed
Agriculture	32821	72.75
Pasture and Hay	3071	6.81
Developed/High Intensity	81	0.18
Developed/Med Intensity	175	0.39
Developed/Low Intensity	3260	7.23
Forest	4923	10.91
Shrub/Scrub	678	1.50
Wetlands	104	0.23
Open Water	79	0.18
Totals	45115	100

Potential Sources

Figures 20 and 21 show some of the potential sources of pollution in the Salamonie Headwaters, many related to urban development. One such source is the Salamonia WWTP. This is a small plant, and usually functions well with little impact to the environment. However, there have been some violations, mostly related to E. coli (Table 19). In Figure 20, all eleven *NPDES Outfalls* clustered around Portland in this sub-watershed are CSO outfalls and associated lift stations. These CSO discharges will more heavily impact the sub-watersheds downstream, as CSOs are located near the border of this sub-watershed. Combined sewers can be a large contributor of pollutants to the environment. Portland has been in the process of separating sewers and making sewage treatment plant improvements over the past few years. More work remains to be done, and the city is working with IDEM to determine the most effective and economically advantageous way to address the remaining issues. This type of work can be very expensive and a hardship on the community, so it is important that the best solution be found.

Figure 21 show underground storage tanks, and those that have been found to be leaking. At present these sources have not had a large impact on the environment as a whole and the problems are being addressed through specific State programs to deal with these issues. Potential sources that are more widespread include the combined feeding operations (CFOs) shown in Figure 20. Thirteen sites are shown in this figure, but only those operations that are large enough to meet specific requirements of IDEM are listed. There are an increasing number of CFOs (often referred to as Animal Feeding Operations or AFOs) that don't meet these requirements and are thus not tracked by IDEM. Many of these were documented during the windshield survey. These CFOs are an important part of the economy in the USR Watershed and are not a large issue provided they are properly run and waste products are properly addressed. However, in September of 2015, two spills from confined feeding operations were documented by IDEM in the Upper Salamonie Headwaters. One impacted the Salamonie River, and the other effected McLaughlin Ditch. Both these spills are presently under investigation. These problems highlight the need to insure that as CFOs continue to expand in the watershed, that proper maintenance and environmental controls be practiced at these operations.

Table 21 NPDES Violations in the Salamonie River Headwaters

Facility	NPDES - ID	Violation Type	Parameter	Value	Limit	Date
SALAMONIA WWTP	IN0060437	Numeric Violation	BOD-5	**35.**	**25.**	4/29/2010
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**320.5**	125 Geomean	11/23/2010
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**480.**	235 Daily	11/23/2010
SALAMONIA WWTP	IN0060437	Numeric Violation	pH	**9.1**	**9.0**	8/1/2011
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**341.**	125 Geomean	8/1/2011
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**424.**	235 Daily	8/1/2011
SALAMONIA WWTP	IN0060437	Numeric Violation	BOD-5	**30.**	**25.**	2/22/2013
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**1326.**	125 Geomean	7/27/2013
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**2419.**	235 Daily	7/27/2013
SALAMONIA WWTP	IN0060437	Numeric Violation	Dilution factor	**0.8**	0.1	1/28/2014
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**2420.**	125 Geomean	5/28/2014
SALAMONIA WWTP	IN0060437	Numeric Violation	E. coli (CFU/100ml)	**2420.**	235 Daily	5/28/2014

Figure 20 Potential Sources in the Salamonie Headwaters

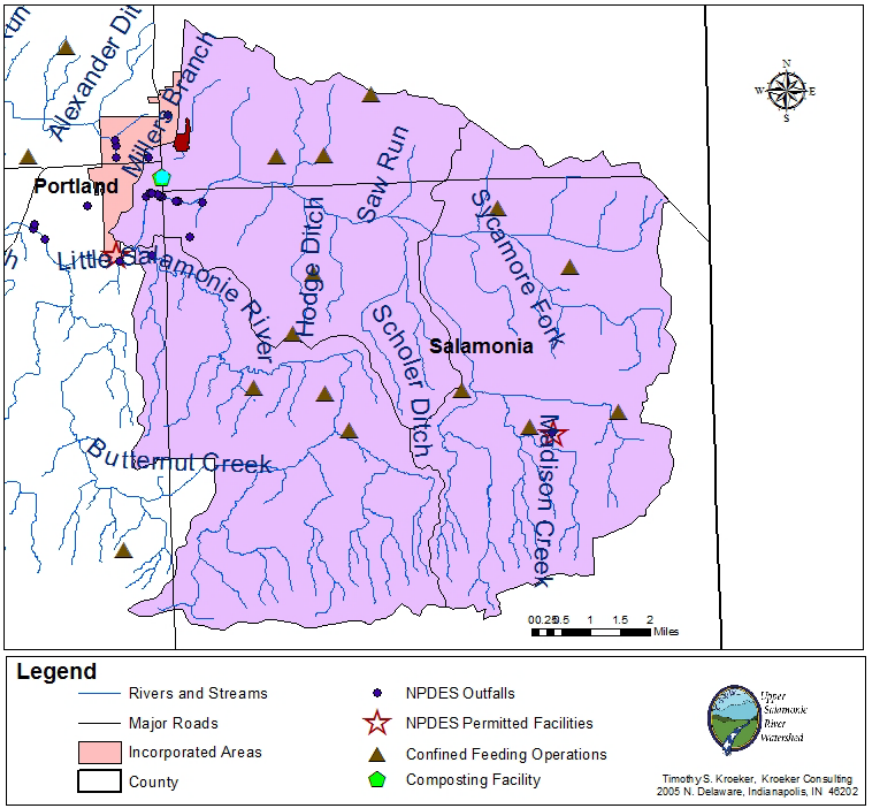
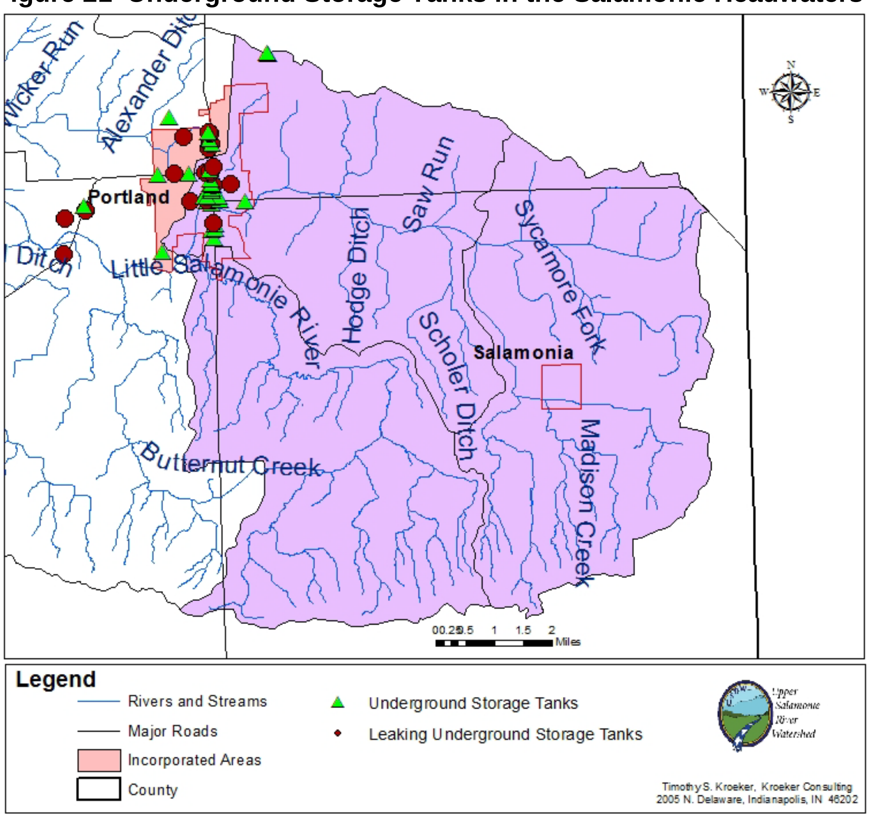


Figure 21 Underground Storage Tanks in the Salamonie Headwaters



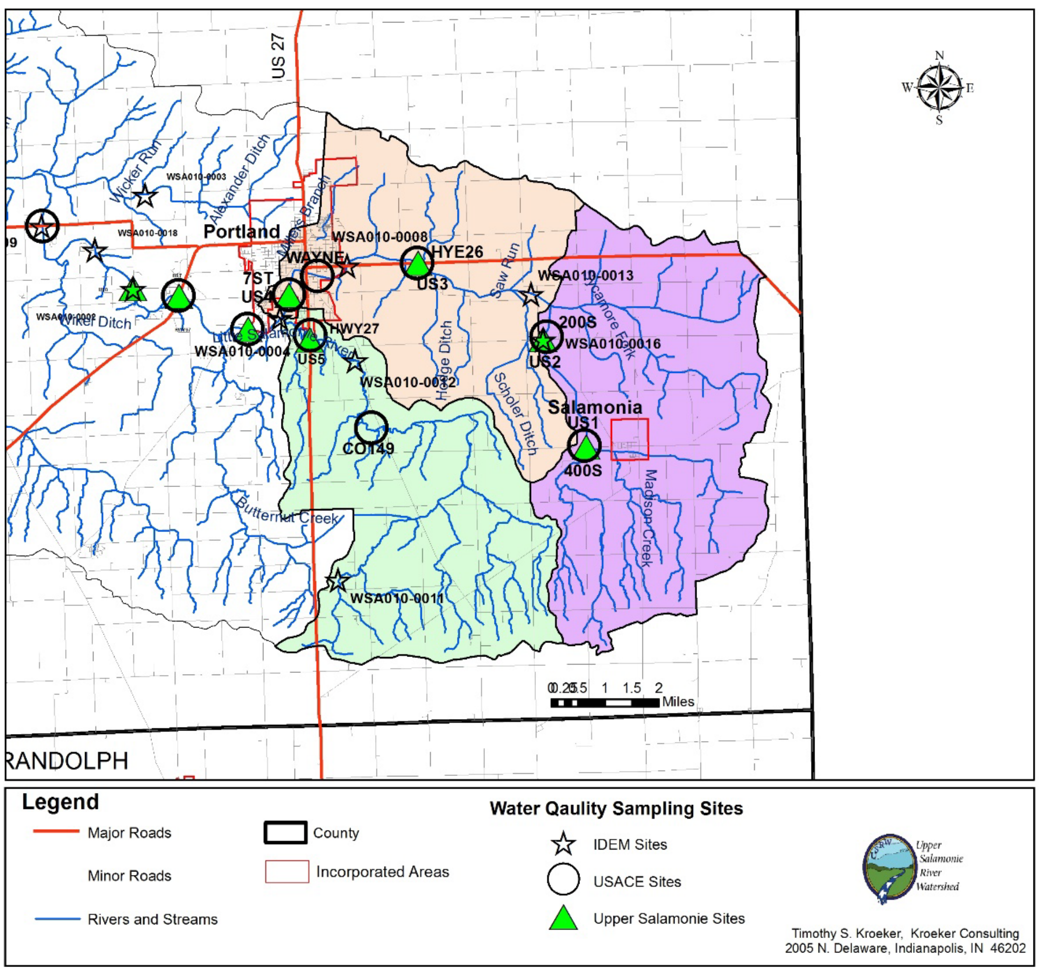
Windshield Survey – Potential Sources

The windshield survey also pointed out a number of potential sources. Out of the 135 sites visited in this sub-watershed, 76% had land under conventional tillage. This combined with the general lack of filter strips throughout the basin can lead to erosion of cropland and sedimentation of rivers and streams. Increased drainage for agriculture can also destabilize stream banks leading to stream bank erosion. Forty-four percent of sites surveyed showed active drain tiles, and 46% of the sites had stream bank erosion. Five sites were also noted where cattle had access to streams. Because of their size, cattle can have damaging effects on stream bank vegetation leading to severe erosion. In addition, 19 sites had CFO operations. Land application of waste material, or poor methods of operation can potentially lead to high nutrient and E. coli values in adjacent waterbodies.

Upper Salamonie River Watershed Sampling Data

Sampling in the Salamonie Headwaters sub-watershed has been completed by the USRW, USACE, and IDEM. Specific locations of sample sites are shown in Figure 22. Sampling included physical parameters, chemical data, biological data, and habitat evaluations. Findings are outlined below.

Figure 22 Sampling Station Location in the Salamonie Headwaters



Biological and Habitat Data – Riverwatch Methods

As part of the requirements for the development of the Upper Salamonie River Watershed Management Plan, a sampling protocol was developed. Part of this protocol was to sample macro-invertebrates once a year at six volunteer sampling sites to investigate water quality. Volunteer sites include US1, US2, US8, US9, US10 and US12. Because macro-invertebrates spend a year or more of their time in the aquatic environment, the number, diversity, and type of organisms found in the river or stream can provide a good understanding of the overall quality of the resource. However, macro-invertebrates also require specific substrates or habitats in order to survive, therefore it is important that these habitats are present. A poor macro-invertebrate community does not necessarily mean that the water quality is poor unless the proper habitat is available. A lack of habitat can be due to stream alterations, modified hydrology, and other man-made causes. Trying to preserve the natural system is also important in the improvement of overall stream health.

Macro-invertebrate sampling was completed in 2014 and 2015, and the results are shown below (Table 20). In addition, Table 21 provides a range of values that define the habitat and biological rating for each particular sample site. Habitat values for the watershed ranged from Fair to Poor during the 2014 and 2015 sampling season, which isn't surprising given the widespread erosion and stream modification noted during the windshield survey. Macro-invertebrate values ranked as Poor in 2014 and Good in 2015. This data is based on Indiana's Riverwatch sampling methods which identifies species to the family level. Although this data is not specific enough to provide a specific determination of stream quality it affords an idea of the general quality of the stream and potential changes from year to year. Citizens Qualitative Habitat Evaluation Index (CQHEI) ratings from year to year were similar, but the Pollution Tolerance Index (PTI), which determines whether the species found reflect a quality habitat or a degraded one, went from Poor in 2014 to Good in 2015. It is doubtful that the stream improved in quality to this degree, and differences may be related to volunteer effort, abilities, and identification skills, as well as the timing of sampling. However, the data is still valuable as the species found can be tracked and changes over time observed.

Table 22 Salamonie Headwaters Sub-watershed Macroinvertebrate & Habitat Assessment Ratings

Sample Site	12 Digit HUC	2014 CQHEI Score	2014 CQHEI Rating	2014 PTI Score	2014 PTI Rating	2015 CQHEI Score	2015 CQHEI Rating	2015 PTI Score	201 PTI Rating
US1	051201020101	59	Fair	8	Poor	46	Poor	20	Good
US2	051201020101	55	Fair	8	Poor	44	Poor	19	Good

Table 23 CQHEI and PTI Scores and Ratings

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

IDEM Biological and Habitat Data

IDEM sampled fish at two locations in the Salamonie River Headwaters sub-watershed (Table 22). Because fish live for several years, looking at the health of the present population and the community structure can speak to the overall health of the aquatic system. Along with the fish sampling effort, an examination of the habitat was made to help determine if any negative impact on the fish population was due to lack of habitat or another stressor such as pollutants or turbidity in the water. Fish communities in both the Little Salamonie River and Buckeye Creek were rated as Poor. In Buckeye Creek the Qualitative Habitat Evaluation Index (QHEI) ranged from Poor to Fair, so habitat may be the driver in this situation. Further study would be necessary to determine the exact cause of the impairment. The Little Salamonie River, however, boasted a QHEI with a Good rating, but the Index of Biotic Integrity (IBI) indicated that the fish community was in poor health. This points toward the possibility that pollutants in the aquatic environment are causing the impairment. In the USRW, many of the water-quality parameters studied are above recommended limits and may be causing damage to the aquatic community.

Table 24 IDEM Fish Community Data for the Salamonie Headwaters

Station Name	Date	12-Diget Huc	Waterbody Name	IBI Score	IBI Rating	QHEI Score	QHEI Rating
WSA010-0012	01-Jul-03	051201020102	Little Salamonie River	30	Poor	63	Good
WSA010-0011	20-Jul-98	051201020102	Buckeye Creek	34	Poor	41	Poor
WSA010-0011	29-Sep-98	051201020102	Buckeye Creek	34	Poor	45	Fair

IDEM also evaluated macroinvertebrates at two sites on the Salamonie River in this sub-watershed (Table 23). The Macroinvertebrate Index of Biotic Integrity (mIBI) tended to trend slightly higher than habitat values would indicate. Although there is much room for improvement, the aquatic invertebrates at least faired a bit better than the fish community. (Narrative ratings for QHEI, mIBI, and IBI are found in Tables 24 - 26).

Table 25 IDEM Macroinvertebrate Data and QHEI for Salamonie Headwaters

Station Name	Date	12-Diget Huc	Waterbody Name	mIBI Score	mIBI Rating	QHEI Score	QHEI Rating
WSA010-0008	16-Jul-91	051201020103	Salamonie River	3.8	Fair	36	Poor
WSA020-0003	17-Jul-91	051201020201	Salamonie River	4.6	Good	52	Fair

Table 26 IDEM Macroinvertebrate Index of Biotic Integrity Scores and Ranking

Total mIBI Score	Integrity Class
6.0 - 8.0	Excellent
4.0 - 5.9	Good
2.2 - 3.9	Fair
1.0 - 2.1	Poor
0 - 0.9	Very Poor

Table 27 Index of Biotic Integrity Scores, Ratings and Attributes

Total IBI Score	Integrity Class	Attributes
53 - 60	Excellent	Comparable to "least impacted" conditions, exceptional assemblage of species.
45 - 52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
35 - 44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23 - 34	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12 - 22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
<12	No Fish	No fish captured during sampling.

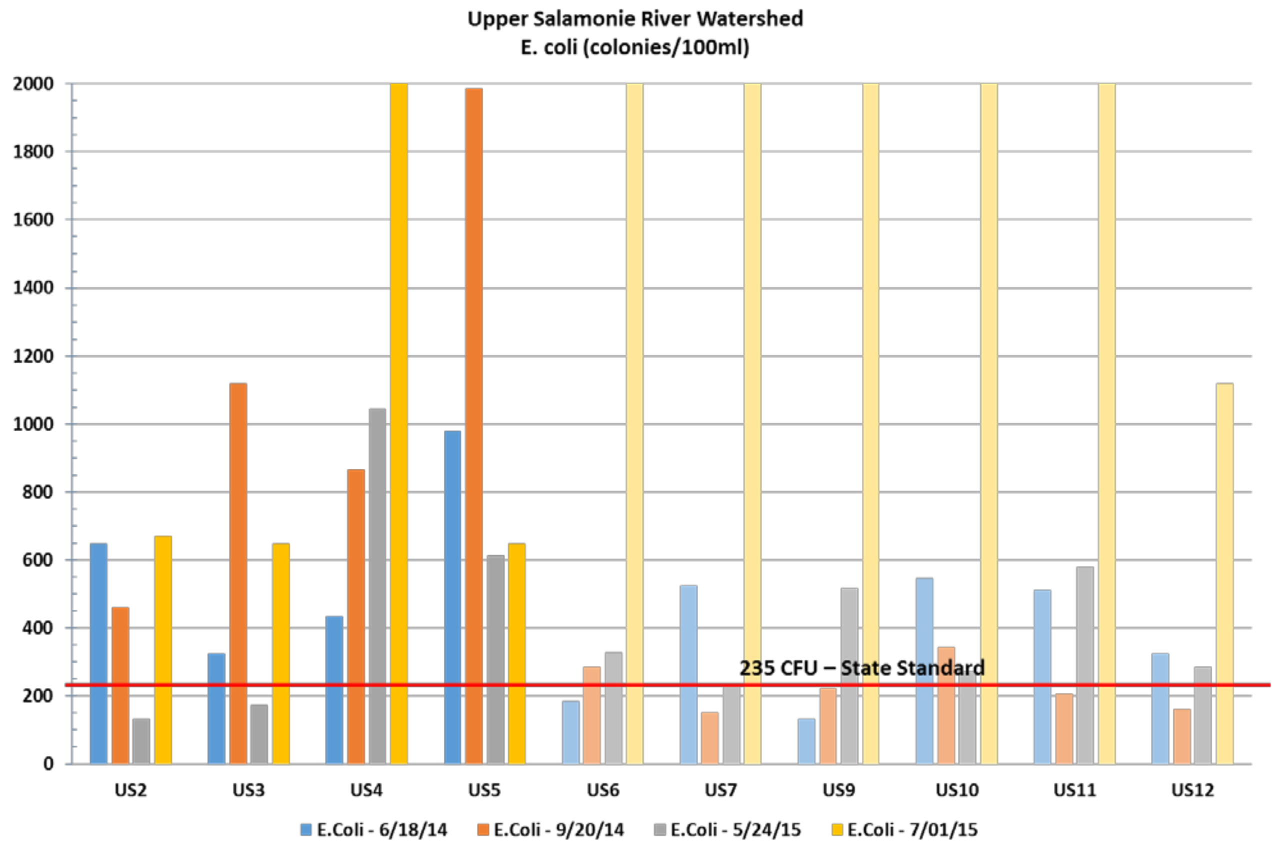
Table 28 General narrative ranges assigned to Ohio EPA QHEI

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

Upper Salamonie River Bacteriological Data

Figure 23 shows *E. coli* data for the Upper Salamonie River watershed. The State standard for *E. coli* is a one-time sample of 235 CFU (Colony Forming Units)/100ml, or a geometric mean of five equally spaced samples over a 30 day period, of less than 125 CFU/100ml. The data below consists of grab samples from June and September 2014 and May and July 2015. The headwaters of the Upper Salamonie River include sample sites US2 – US5. Sites US6 through US12 are shown with faded bars so that values for this sub-watershed can easily be compared to the rest of the sample sites. Except for two samples, all samples from all sites in the Salamonie Headwaters exceeded the state standard of 235 CFU/100ml. High *E. coli* values indicate fecal contamination and thus the potential that other pathogens could be present in the water and could cause human illness. This fecal material could be from human and/or animal sources. Human sources are typically from failing septic systems, combined sewer overflows and poorly functioning wastewater treatment plants. Animal sources include wildlife, waterfowl, pets, and livestock. Manure applied to agricultural fields for fertilizer is also a common source of *E. coli*. Further investigation will be required to determine specific sources of *E. coli* contamination. However, windshield surveys and other observations identified some possible sources as being improperly applied manure and septic system failures.

Figure 23 *E. coli* Values for the Upper Salamonie River Watershed

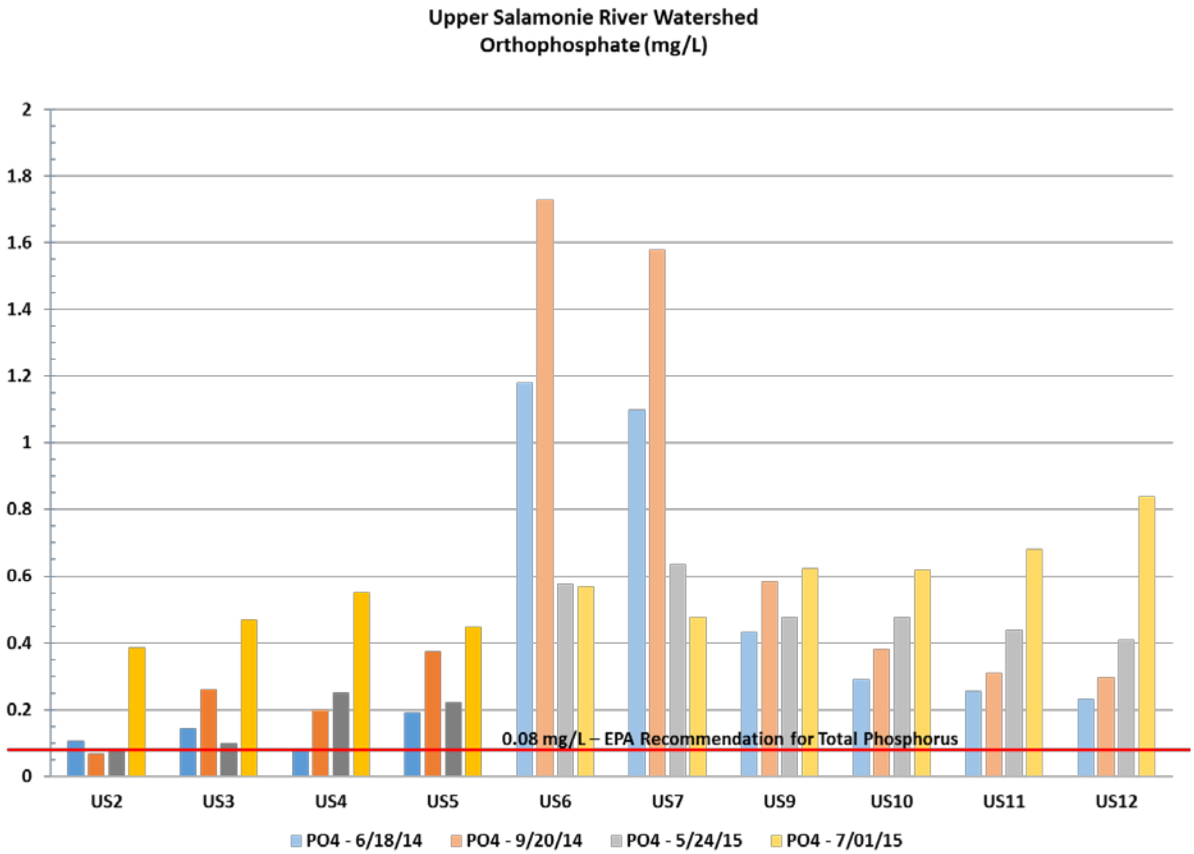


Upper Salamonie River Watershed and USACE Chemical Data

Excess nutrients in the water column are the driving factor for the toxic blue-green algae blooms in the Salamonie Reservoir. These algal blooms were the impetus for the creation of a watershed management plan for the Upper Salamonie River watershed. To control these pollutants, the nutrient content of upstream rivers and streams must be reduced. The limiting nutrient for growth in most aquatic systems in Indiana is phosphorus. Therefore, the main priority is to address this particular pollutant. Figure 24 shows ortho-phosphorus data collected from June and September 2014 and May and July 2015. There are several different target values for phosphorus that are used in Indiana. IDEMs Total Maximum Daily Load (TMDL) program has set a target of 0.3mg/L total phosphorus for Indiana streams. However, the Ohio EPA has found that total phosphorus levels above 0.08 mg/L have a negative effect on river and stream biological systems. In addition, for streams and rivers that flow into lakes or reservoirs, the recommended target level for total phosphorus is 0.03mg/L, the level that can cause nuisance algae blooms in lakes and reservoirs. The current recommendation of the US EPA for this area of Indiana is 0.05mg/L total phosphorus. The USRW has chosen to adopt Ohio EPA's recommendation of 0.08mg/L total phosphorus.

Figure 24 displays orthophosphate data in mg/L for the Upper Salamonie River Watershed. Orthophosphate is the inorganic form of phosphorus and is readily available to algae. It is often referred to as Soluble Reactive Phosphorus (SRP) and is only a fraction of the total phosphorus found in the aquatic system. SRP values as low as 0.005mg/L cause eutrophic or highly productive conditions in lakes systems. As is evident by the data in figure 24, even though the measurements are for orthophosphate (a fraction of total phosphorus), almost all the samples for the Upper Salamonie River headwaters (US2 – US5) exceed the Ohio's total phosphorus standard of 0.08mg/L.

Figure 24 Orthophosphate Values in the Salamonie Headwaters



Because of the variable nature of the chemistries of river and stream systems, a helpful way to view greater amounts of data is using box and whisker plots. This enables the viewing of all the data at a glance, and median values, data variability, and outliers are immediately evident. Figure 25 shows a basic box and whisker plot. The box contains half the data points. The color change indicates the median value, and the extent of the box ranges from the 1st quartile of the data to the 3rd quartile. The whiskers show the data range of the two quartiles furthest from the median, minus any outliers. Outliers are values that statistically don't make immediate sense. They are data extremes that may not truly reflect the reality of the system. These value should be investigated to determine if they are sampling, analysis, or data entry errors or are true events. In rivers and streams, chemistry data that are often shown as outliers may be due to extreme events such as flooding. For example, turbidity in a particular stream may range from 10 to 20 NTU, but may jump to 120 NTU when a storm event causes the stream to flood its banks and soil and other particles from streets and farmland wash into the stream

Figure 25 Box and Whisker Plot Diagram

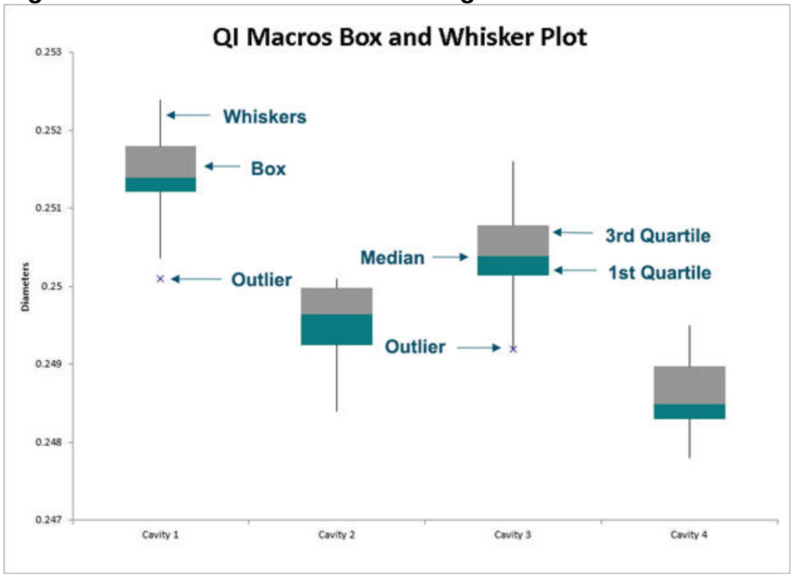
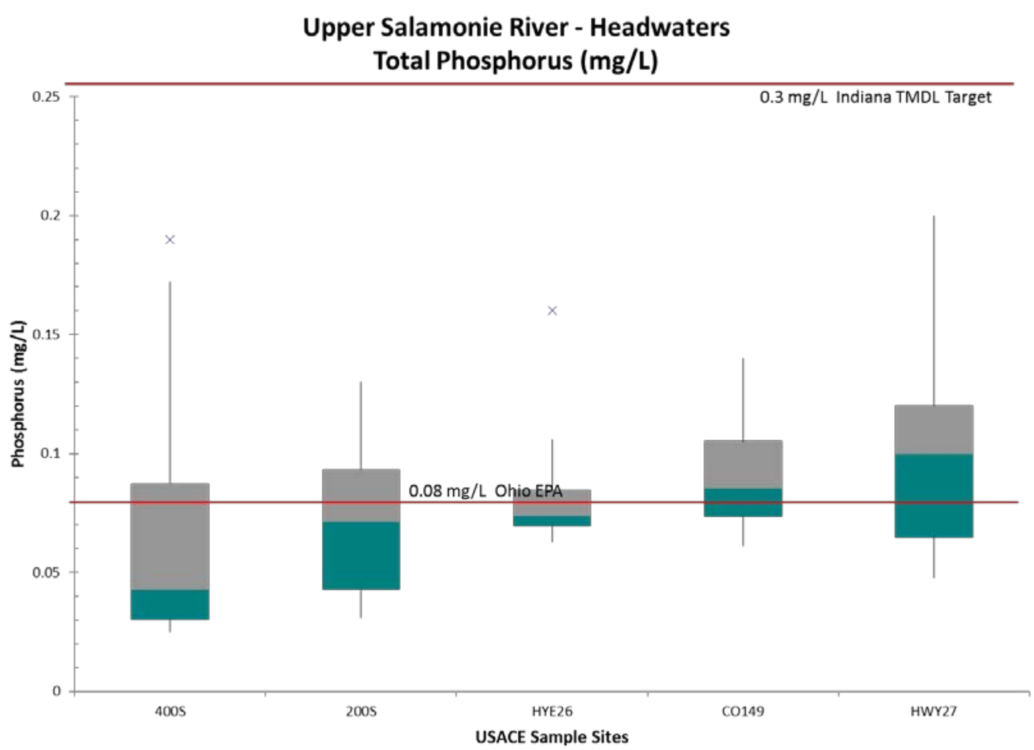


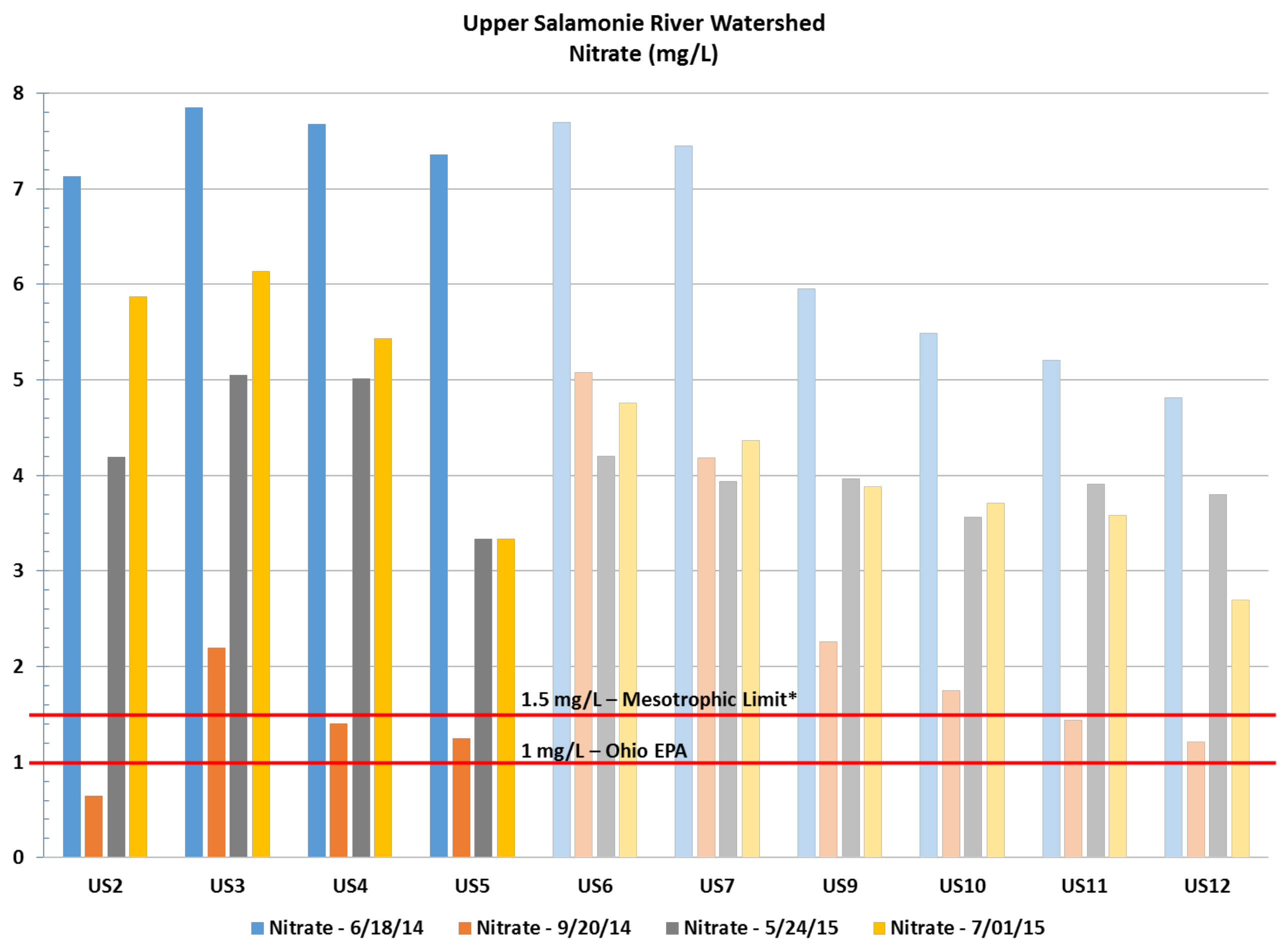
Figure 26 shows total phosphorus data collected by the US Army Corps of Engineers from 2010 to 2012. All sites had values over the 0.08mg/L target, however, median concentrations were within the target for three of the 5 sites tested. It is hoped that as more landowners install BMPs in the watershed, values will continue to decline.

Figure 26 Total Phosphorus Values in the Salamonie Headwaters Sub-watershed



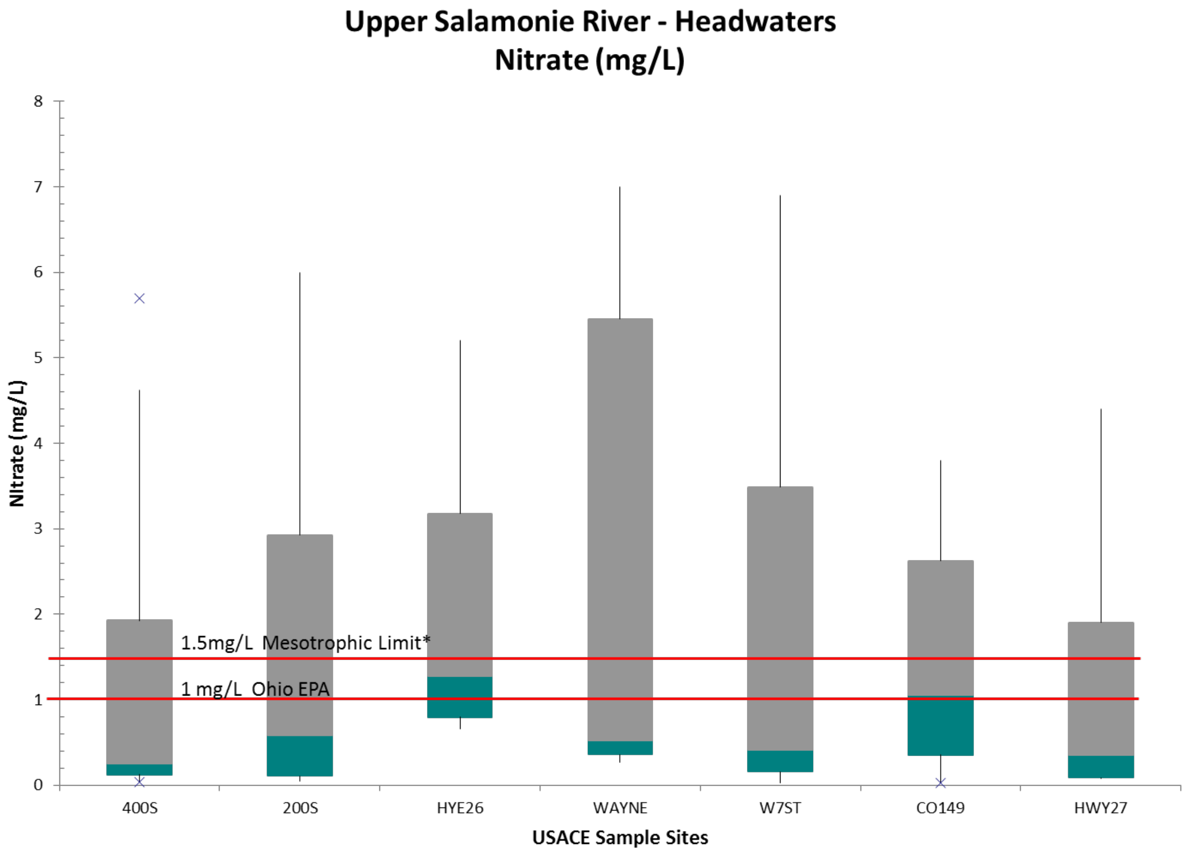
Nitrate values for the USR headwaters are shown in figure 27 (sites US2 – US5). Although not as important as phosphorus in relation to the problems in the Salamonie Reservoir, nitrogen, the limiting nutrient for marine systems has been found to be the main driver for the dead zone in the Gulf of Mexico. Water from the Salamonie River eventually flows into the Gulf of Mexico, so it is important to address this nutrient due to downstream impacts. In addition, nitrate levels in the USRW headwaters are often above recommended levels for the local aquatic systems and the highest concentrations appear to be tied mostly to spring application of nitrogen as fertilizer (blue bars). Samples taken on July 1, 2015 (yellow bars) were collected soon after a rain event and illustrate the large increase in nitrogen levels associated with storm events. Although not intuitive in this graph which reflects nutrient concentrations, the flow was much higher during the storm event, so overall loading of Nitrogen was higher. Nitrogen also has been found to be leaching from the soil through the increasing number of drainage tiles used throughout the watershed. During storm events, pollutants that have accumulated on the land surface are washed away. The result is high nutrient loads from both the land surface and from drain tile flows. Conservation practices tend to favor either the reduction of phosphorus, or the reduction of nitrogen. To control both these nutrients to acceptable levels will require a suite of conservation practices.

Figure 27 Nitrate Values in the Salamonie Headwaters



Nitrate levels were measured by the USACE from 2010 to 2012 and are shown in Figure 28. Median values tend to be below target levels, but data is heavily skewed toward the higher end. This is most likely due to application of inorganic and organic nitrogen sources for row crop agriculture. Conservation practices that focus on precision application and proper timing of fertilizer application may help alleviate these problems. Cover crops that can tie up nitrogen in vegetation may also help solve this problem.

Figure 28 Nitrate Values in the Salamonie Headwaters - USACE

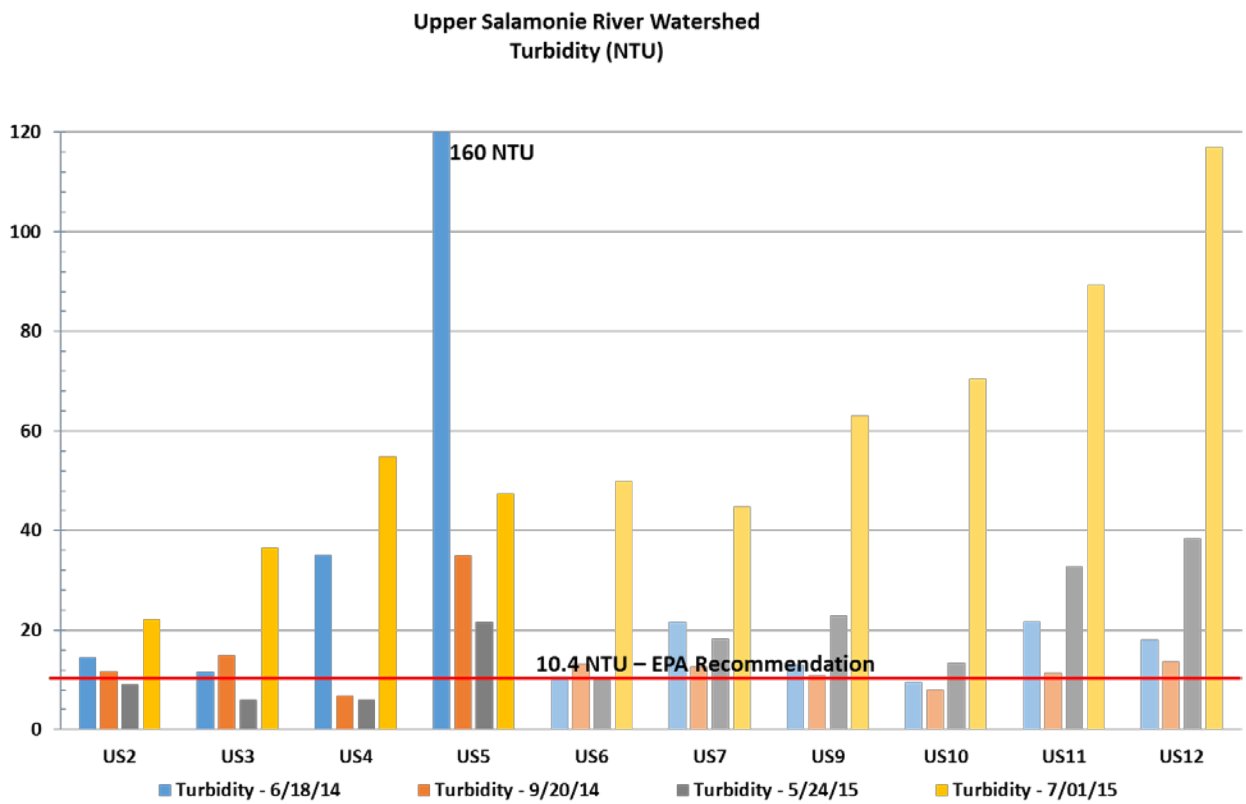


Upper Salamonie River Watershed and USACE Data Related to Sediment

Turbidity values exceeded US EPA recommendations for 12 of 16 samples in the USR headwaters (sites US2 – US5)(Figure 29). The U.S. Environmental Protection Agency recommends a turbidity value of 10.4 NTU (Nephelometric Turbidity Unit) for the Eastern Corn Belt Plains of which the Upper Salamonie River watershed is a part. Turbidity values are expected to rise during high flows when water washes sediment and other particles into the stream from adjacent land and stream banks are eroded. This is evident from the July 2015 data below (yellow bars). Values continue to increase downstream as sediment loading from an increasing number of tributaries enter the Salamonie River. Much of the sediment is coming from the stream banks themselves, although the amount from this source has not been quantified. However, most of these samples were taken during normal or low flow conditions, and turbidity values remained high. Only four of 16 sample were below the recommended level. The June 2014 sample taken at site US5 appears to be an anomaly, although there could have been an unseen cause upstream, or the material may consist of smaller particles that tend to stay suspended in the water column. It could also be a data recording error, since TSS values for the same site don't show this excessive a jump in sediment levels, although they are still higher than other sampling events. Values further downstream are more indicative of the flow regime noted during this sampling event.

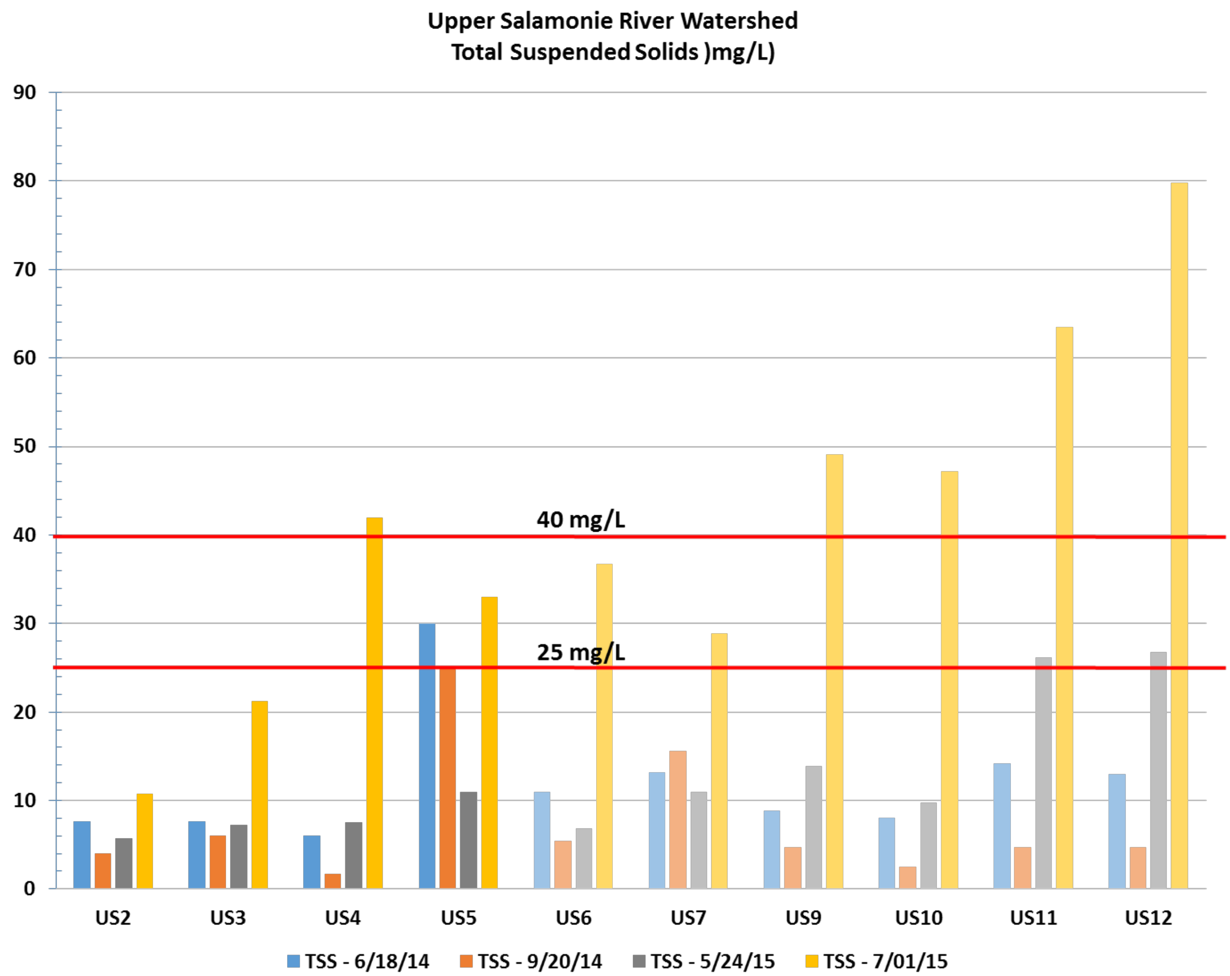
It will be important to strive for proper conservation practices to keep soil and other pollutants from washing into area streams. It will also be important to find ways to restore a more natural hydrology so that stream banks are stabilized and extreme flows don't cause serious in-stream and bank erosion. As mentioned in Section 2, preliminary studies completed by Taylor University students suggests that more of the sediment being transported downstream may be due to in stream erosion than previously believed. Therefore conservation practices will need to focus on both stabilizing steam bands and preventing soil from being washed from the land surface. This knowledge will help direct which Best Management Practices (BMPs) will be most effective in the Upper Salamonie River watershed.

Figure 29 Turbidity in the Salamonie Headwaters



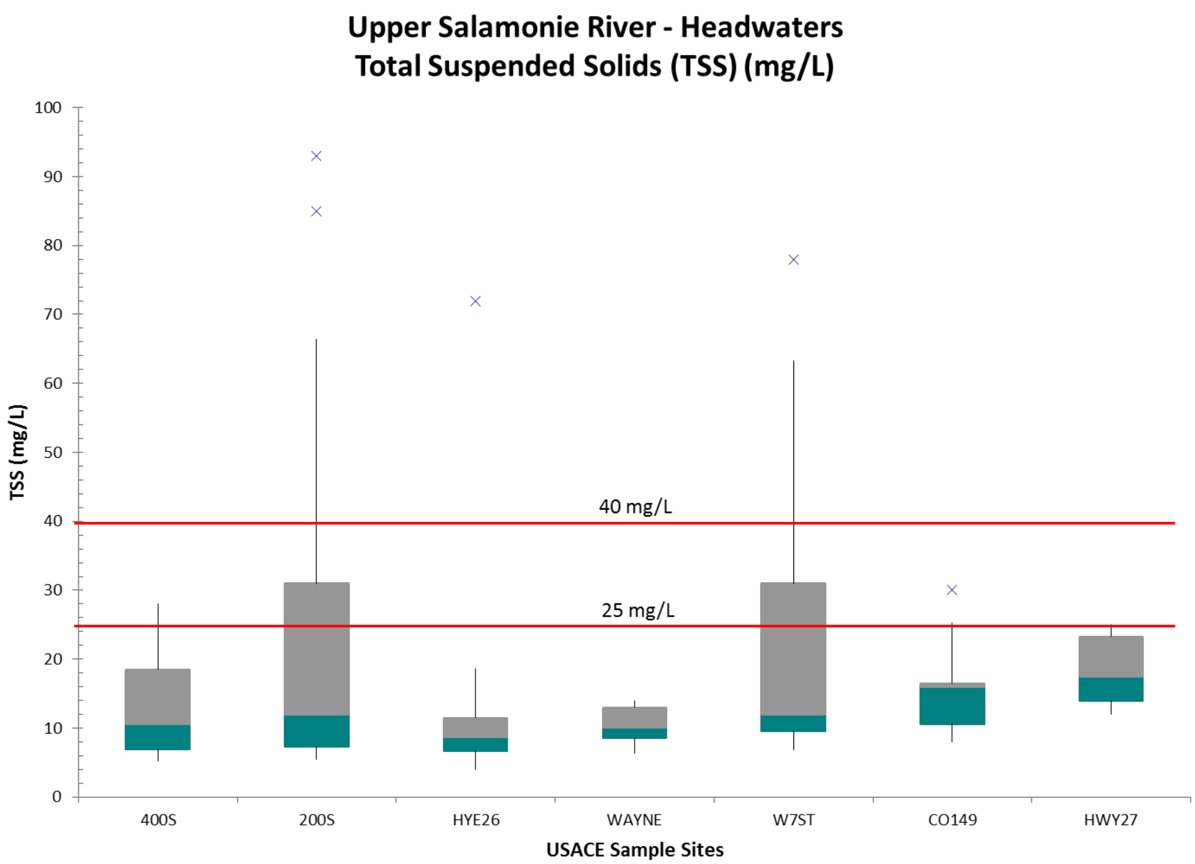
Turbidity is one measurement for the amount of material suspended in the water column. Another measurement that is analyzed in the laboratory is Total Suspended Solids (TSS). TSS values for the USR watershed are displayed in figure 30. The median value for the Eastern Corn Belt Region is 19mg/L. Values above 25 mg/L have been found to negatively affect aquatic life. Values in the USR headwaters (sites US2 – US5) range from 1.7 – 42mg/L. Three values surpassed the recommended 25mg/L, with two of the exceedances occurring during moderate to high flows. The USRW has set a goal of a maximum of 40mg/L over the next 30 years. When this goal is achieved, the USRW may set a more aggressive goal of 25mg/L.

Figure 30 Total Suspended Solids in the Salamonie Headwaters



TSS data collected by USACE also shows sites with values above the recommended 25mg/L (Figure 31). Values range from 4 to 93mg/L. This indicates that the problem with sediment is mostly due to non-point sources of pollution as soil is washed from the land surface and eroded from stream banks during rain events.

Figure 31 Total Suspended Solids in the Salamonie Headwaters – USACE Data



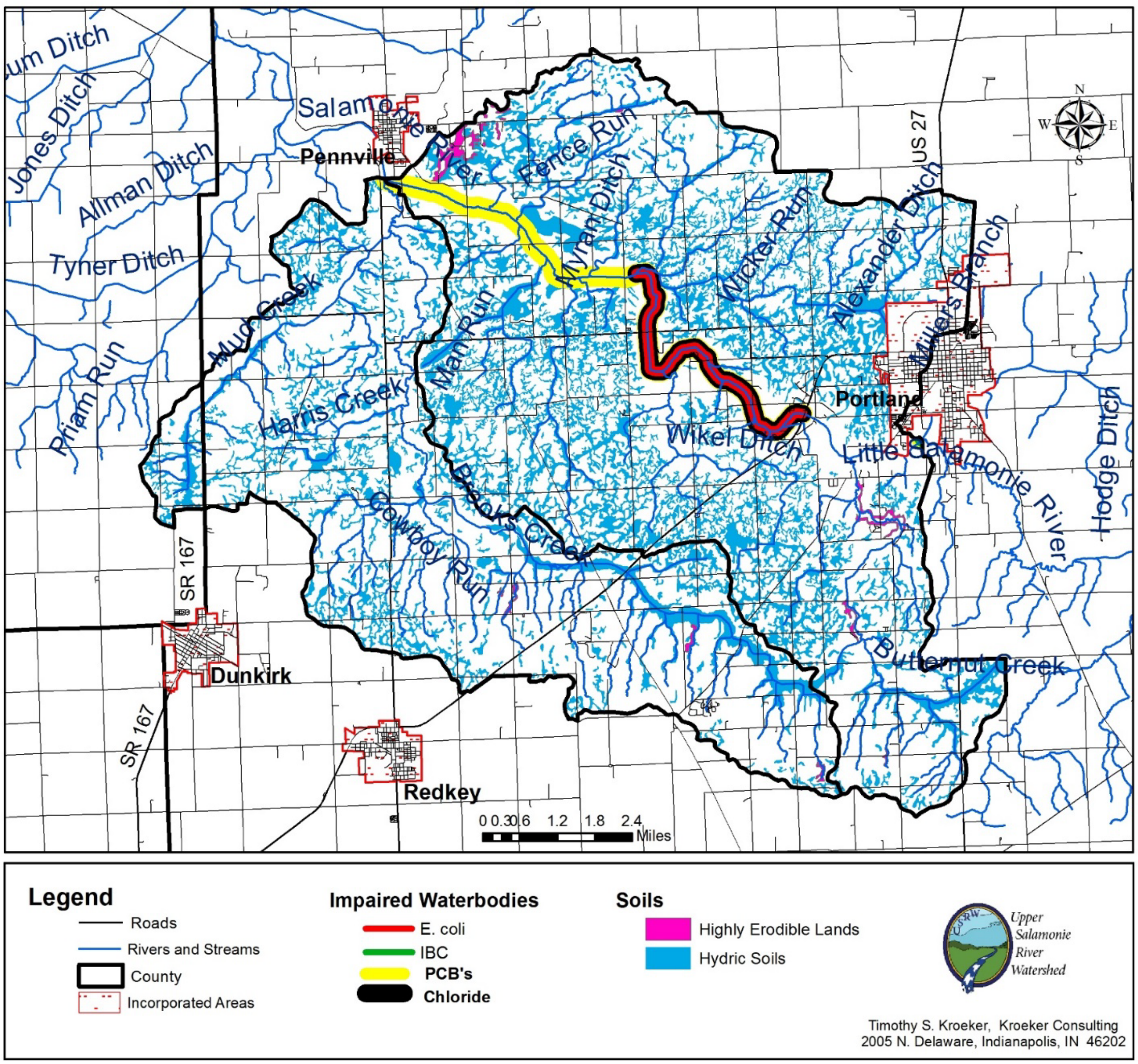
4.2 Brooks Creek (HUC 051201020107, HUC 051201020106) and Salamonie River (HUC 051201020108, HUC 051201020104, HUC 051201020105) from Portland to Pennville

303(d) Listing

This sub-watershed contains the largest tributary to the Upper Salamonie River, Brooks Creek which drains approximately 24,288 acres of land. The streams and ditches which drain this area include Brooks Creek, Mud Creek, Crooked Creek, Harris Creek, Cowboy Run, Stevens Run, McKinley Ditch and several other open drains and ditches. There are no streams listed on IDEMs 303(d) list for this section of the sub-watershed, however the Brooks Creek Diagnostic Study completed in 2002 suggests problems with nutrients, sediment, bacteria, and impaired biotic communities.

The other section of this sub-watershed includes the Salamonie River and smaller tributaries between Portland and Pennville. This portion drains approximately 41,632 acres. Waterways within this area include Walling Ditch, Glenn Miller Ditch, Sipe Ditch, Miller Ditch, Myron Ditch, Wikel Ditch, Butternut Creek and several other smaller open drains and ditches. The Salamonie River is listed as impaired on 303(d) list Category 5B for PCBs in HUC 051201020108, and for PCBs (Category 5B), and Chloride and *E. coli* (Category 5A) in HUC 051201020104. PCBs are legacy pollutants, and will not be addressed in this WMP. It is believed that Chloride is tied a point source, and will be addressed with a different program. If funds are available, a chloride water-quality probe may be purchased so that the USRW can test for this parameter and better verify the source of this impairment. These two regions which make up the second sub-watershed area contain 196 miles of streams and ditches.

Figure 32 Hydric Soils, Highly Erodible Soils and Water Quality Impairments Portland to Pennville



Hydric Soils and Highly Erodible Lands

As in the previous sub-watershed, most of the hydric soils are located in the northern part of the region (Figure 32). However there are many large areas along Brooks Creek which are hydric and if farmed would be good candidates for wetland restoration. These are most likely traditional floodplain areas which if functioning properly help protect downstream areas from flooding. The limited areas that are considered highly erodible tend to be concentrated along streams where land slopes more steeply. There is also an area just east of Pennville where there is a concentration of highly erodible lands. This is one of the few areas of the watershed with rolling topography and steeper slopes. Most areas in the sub-watershed are flat and are excellent areas for row-crop agriculture if properly drained.

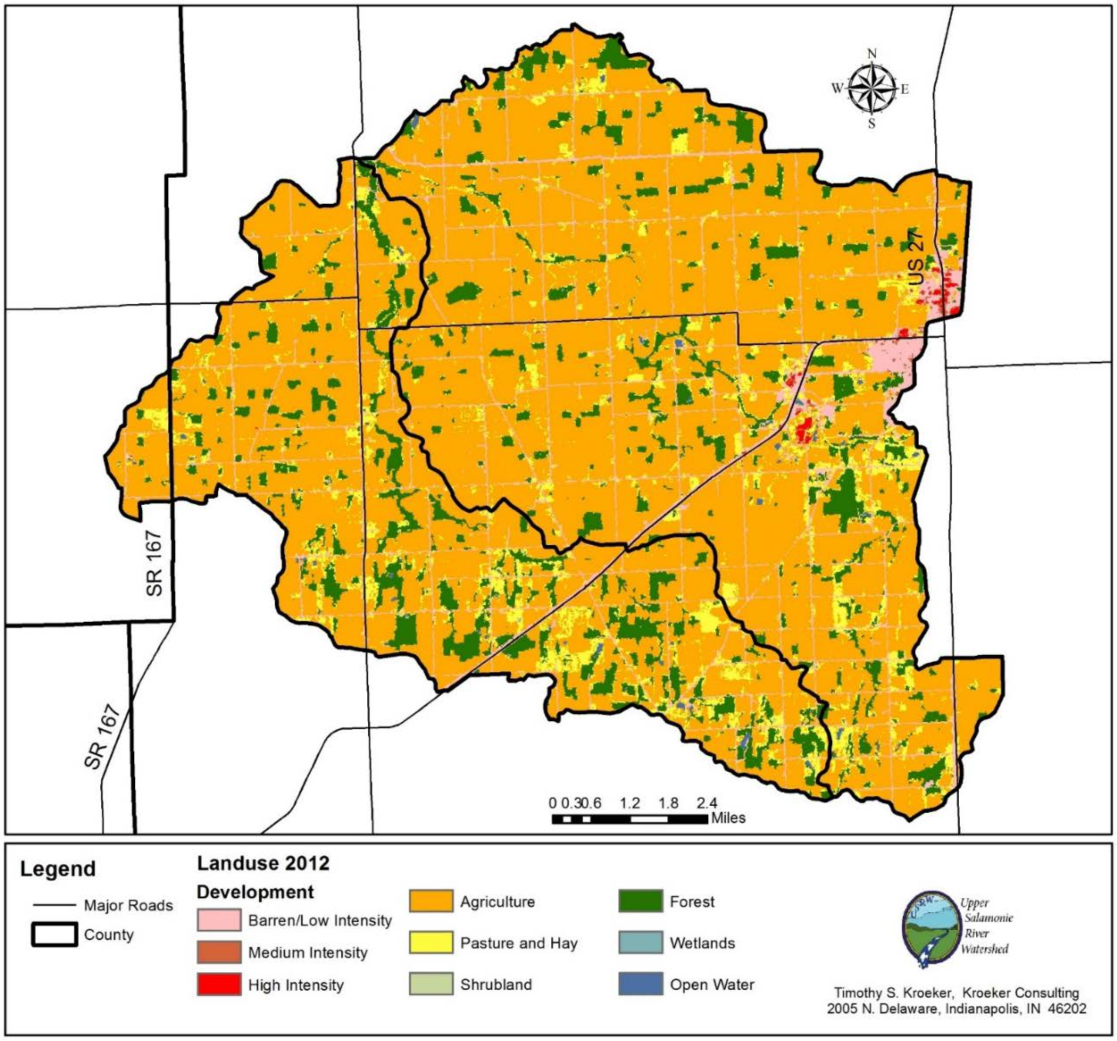
Landuse

Landuse from Portland to Pennville is shown in Figure 33. This sub-watershed is also similar to the watershed as a whole with the majority of acreage under agricultural production. However, the Brooks Creek area tends to have a higher percentage of natural areas and may have sections that are good candidates for preservation. Most of this report focuses on improving areas that have been extensively modified, but it is also important to insure that those areas that are more natural be preserved if possible. Table 27 breaks down the distribution of land uses in this region. The main urban areas in this sub-watershed include the west side of Portland, and other development along State Road 67 near the Portland High School.

Table 29 Landuse in the Portland to Pennville Sub-watershed

Landuse	Total Acres	Percent of Watershed
Agriculture	47121	71.47
Pasture and Hay	5484	8.32
Developed/High Intensity	103	0.16
Developed/Med Intensity	144	0.22
Developed/Low Intensity	4353	6.60
Forest	6851	10.39
Shrub/Scrub	1594	2.42
Wetlands	278	0.42
Open Water	213	0.32
Totals	65928	100

Figure 33 Landuse Portland to Pennville



Potential Sources

Figures 34 and 35 show some of the potential sources of pollution in the Salamonie Headwaters, some related to urban development. One such source is the Portland WWTP and its main outfall to the Salamonie River. This plant serves the greatest population center in the USRW. As mentioned earlier, Portland has been in the process of separating sewers and making sewage treatment plant improvements over the past few years, and will continue to do so in cooperation with IDEM. A few CSO structures in Portland are also in this sub-watershed, but most of the CSO activity is upstream in the Salamonie Headwaters sub-watershed. Despite the continued efforts to improve waste treatment in Portland, violations do happen and are shown in Table 28 for the years 2010 – 2014. Most of the violations are for Ammonia, Chlorine, and E. coli. Other violations include pH, Dissolved Oxygen, and Total Suspended Solids. Ammonia (NH_3) is a toxic form of nitrogen formed when organic matter breaks down in water. It is important to control discharges of ammonia to prevent negative impacts to downstream aquatic fish and macroinvertebrates. Chlorine can also have a negative effect on macroinvertebrate populations and other aquatic organisms. Because the Portland WWTP discharges to this watershed, and most of the CSO discharges are immediately upstream, this sub-watershed will benefit most from improvements to Portland's waste water treatment system. Premier Ethanol, LLC also had two violations for chlorine in 2010, and on 8/28/2012, their discharge had some issues with toxicity. The problem was corrected and there were no further violations through 2014.

Figure 35 show underground storage tanks, and those that have been found to be leaking. Most of these are clustered around Portland with a few noted in the urban development along SR 67 near Portland High School. No significant environmental impacts are tied to these at present, and as mentioned earlier, these issues are being addressed through one of IDEMs programs. Confined feeding operations are shown in Figure 34. Twenty eight sites are shown, 19 of which were documented in the windshield survey. Also documented were 29 hobby farms which can be a source of animal waste to aquatic systems. Education may be needed to help these smaller sources properly dispose of animal waste. Eight of these hobby farms allowed their animals access to area streams which can lead to direct input of waste materials into the aquatic environment as well as erosion and damage to stream banks and aquatic habitat. The Jay County Landfill is also located in this sub-watershed but is carefully regulated under one of IDEMs programs.

Figure 34 Potential Sources Portland to Pennville

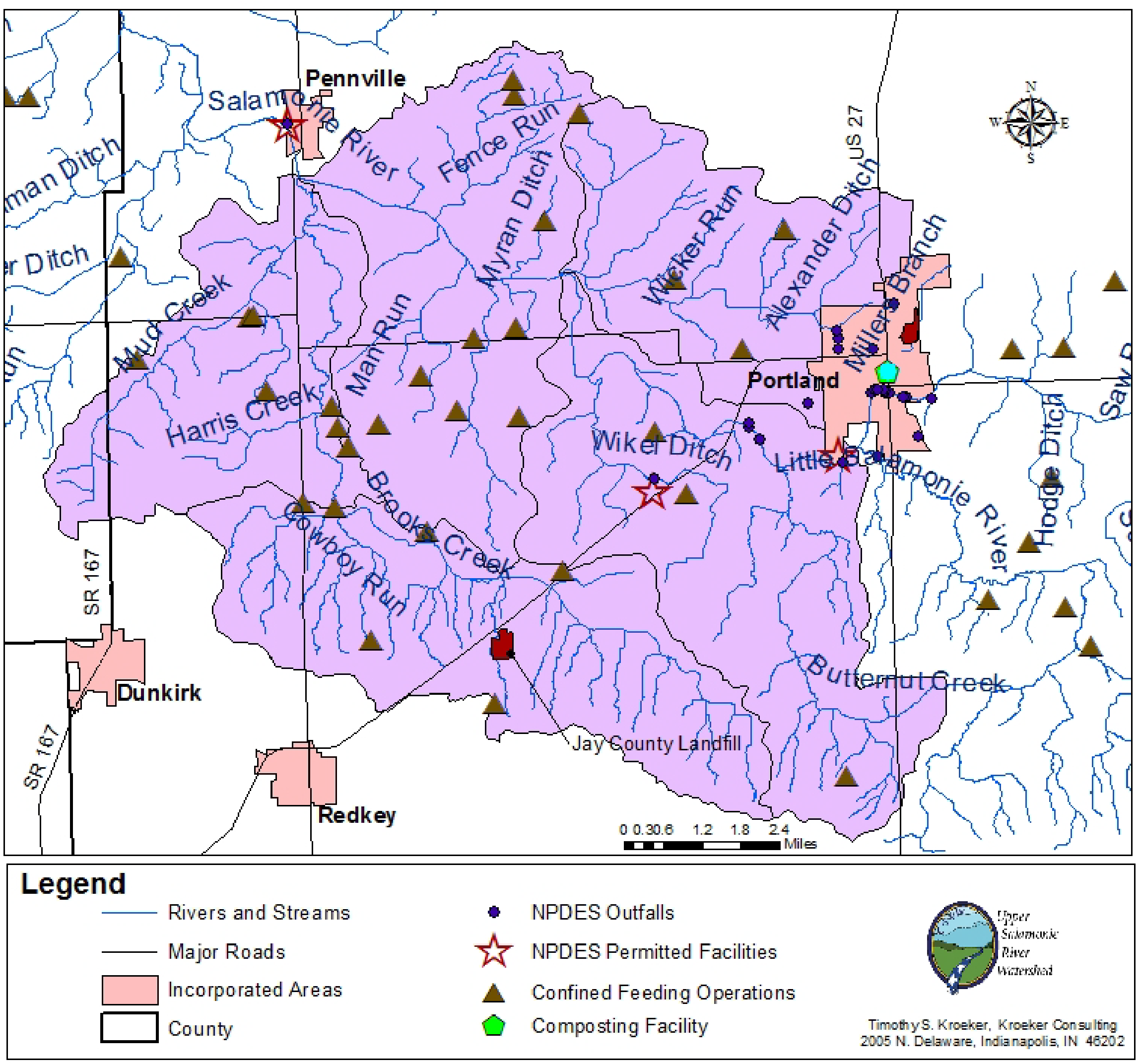


Figure 35 Underground Storage Tanks Portland to Pennville

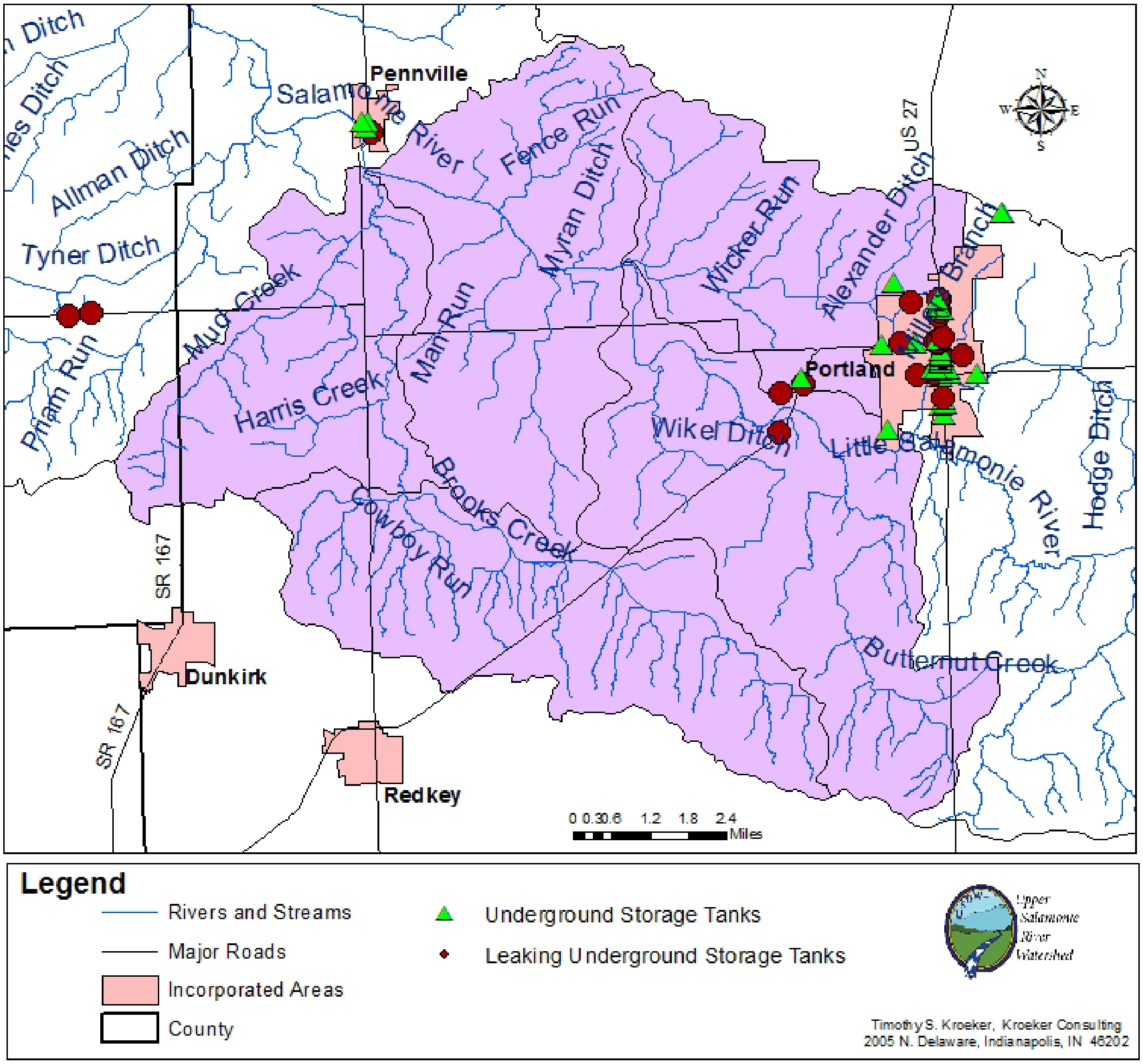


Table 30 NPDES Violations in the Salamonie River Portland to Pennville

Facility	NPDES - ID	Violation Type	Parameter	Value	Limit	Date
PREMIER ETHANOL, LLC	IN0062618	Numeric Violation	Chlorine (mg/L)	**0.09**	0.06	4/29/2010
PREMIER ETHANOL, LLC	IN0062618	Numeric Violation	Chlorine (mg/L)	**0.2**	0.06	4/29/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.1**	0.9	05/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.5**	1.4	05/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.08**	0.06	05/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Dissolved Oxygen (mg/L)	**4.9**	6.	06/30/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.5**	1.4	06/30/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.1**	0.06	06/30/2010

Table 31 (Cont.) NPDES Violations in the Salamonie River Portland to Pennville

Facility	NPDES - ID	Violation Type	Parameter	Value	Limit	Date
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**500.**	235.	06/30/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Dissolved Oxygen (mg/L)	**5.**	6.	07/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.1**	0.06	07/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Dissolved Oxygen (mg/L)	**5.1**	6.	08/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.08**	0.06	09/30/2010
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**260.**	235.	09/30/2010
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**3000.**	235.	10/31/2010
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**2.5**	2.4	03/31/2011
PORTLAND WWTP	IN0020095	Numeric Violation	pH	**9.1**	9.	04/30/2011
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**19863.**	235.	04/30/2011
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**2420.**	235.	07/31/2011
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**1414.**	235.	08/31/2011
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**756.**	235.	09/30/2011
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**2420.**	235.	10/31/2011
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**3.3904**	2.4	03/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.5635**	0.06	05/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**770.**	235.	05/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Dissolved Oxygen (mg/L)	**5.6**	6.	06/30/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.609**	0.9	07/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**6.6242**	1.4	07/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	18.767	17.6	07/31/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	77.756	27.5	07/31/2012
PREMIER ETHANOL, LLC	IN0062618	Numeric Violation	Chronic Pimephales (%)	**55.6**	100	8/28/2012
PREMIER ETHANOL, LLC	IN0062618	Numeric Violation	Toxicity [chronic], Ceriodaphnia dubia	**16.**	1.8	8/28/2012
PREMIER ETHANOL, LLC	IN0062618	Numeric Violation	Chronic Ceriodaphnia (%)	**6.25**	100	8/28/2012
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**3.2826**	2.4	03/31/2013
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.08**	0.06	09/30/2013
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**3.4565**	1.6	01/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**6.606**	2.4	01/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	35.977	31.4	01/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	96.301	47.1	01/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.9255**	1.6	02/28/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**3.248**	2.4	02/28/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.686**	1.6	03/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**3.6533**	2.4	03/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**2419.6**	235.	04/30/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**1.6431**	0.9	05/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (mg/L)	**2.422**	1.4	05/31/2014

Table 32 (Cont.) NPDES Violations in the Salamonie River Portland to Pennville

Facility	NPDES - ID	Violation Type	Parameter	Value	Limit	Date
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	19.57	17.6	05/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Ammonia (lbs/day)	27.848	27.5	05/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.065**	0.06	05/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**235.2**	235.	05/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Total Suspended Solids (mg/L)	**32.08**	27.	6/30/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**272.3**	235.	06/30/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**2419.6**	235.	07/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.06**	0.06	08/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**1011.**	235.	08/31/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**0.0927**	0.06	09/30/2014
PORTLAND WWTP	IN0020095	Numeric Violation	Chlorine (mg/L)	**2.44**	0.06	09/30/2014
PORTLAND WWTP	IN0020095	Numeric Violation	E. coli (CFU/100ml)	**2419.6**	235.	10/31/2014

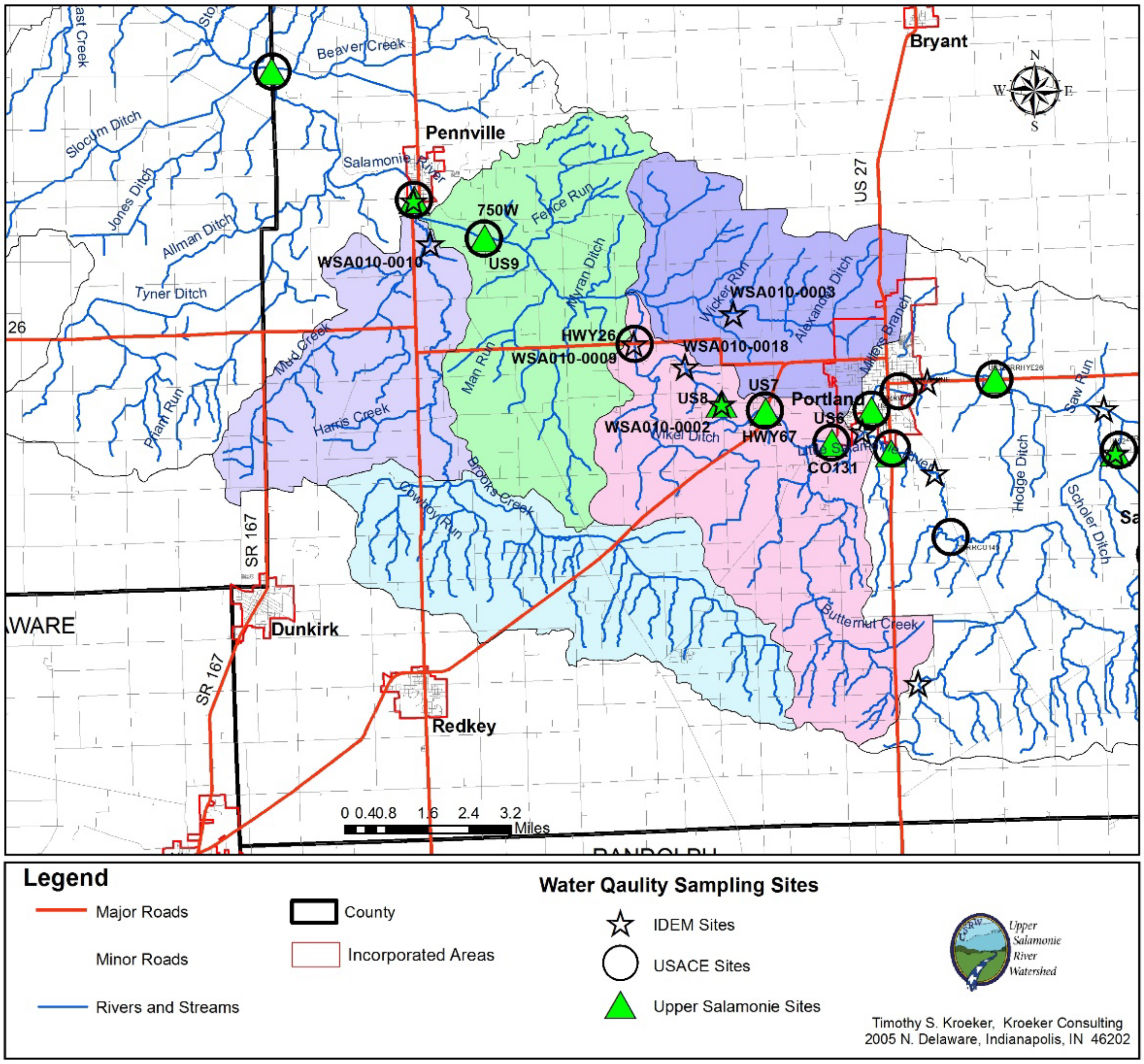
Windshield Survey – Potential Sources

The windshield survey also pointed out a number of potential sources. Of the 186 sites visited in this sub-watershed, 71% had land under conventional tillage. Fifty-five percent of sites surveyed showed active drain tiles, and 61% of the sites exhibited problems with stream bank erosion. Six sites were also noted where cattle had access to streams. Nineteen CFOs were also noted at these sites. It is important to note that there are far more CFOs in the watershed then those listed in this survey. Only CFOs that were in the near vicinity of the survey site and were believed to contribute to the waterbody being surveyed were listed.

Upper Salamonie River Watershed Sampling Data

Sampling from Portland to Pennville has been completed by the USRW, USACE, and IDEM. Specific locations of sample sites are shown in Figure 36. Sampling included physical parameters, chemical data, biological data, and habitat evaluations. Findings are outlined below. In addition, the Brooks Creek Lake and River Enhancement Project completed in 2002 found similar values for these parameters.

Figure 36 Sampling Station Locations Portland to Pennville



Biological and Habitat Data

Macro-invertebrate sampling was completed at two sites in Portland to Pennville sub-watershed in 2014 and 2015 as part of the development of the USR WMP. These results are shown below (Table 29). Habitat values for the watershed ranged from Poor to Good during the 2014 and 2015 sampling season. Macro-invertebrate values ranked as Poor in 2014 and Excellent in 2015. This data, based on Indiana's Riverwatch sampling methods, is variable and may reflect the abilities and knowledge of the volunteers, as well as the quality of the data. However, the two seasons were very different and may be reflected in the health of the biological community. More data over a longer time period would help the analysis of this metric.

Table 33 Salamonie Macroinvertebrate & Habitat Assessment Ratings, Portland to Pennville

Sample Site	12 Digit HUC	2014 CQHEI Score	2014 CQHEI Rating	2014 PTI Score	2014 PTI Rating	2015 CQHEI Score	2015 CQHEI Rating	2015 PTI Score	2015 PTI Rating
US8	051201020105	54	Fair	8	Poor	65	Good	23	Excellent
US9	051201020108	45	Fair	19	Good	38	Poor	18	Good

IDEM also evaluated macroinvertebrates at three sites in this sub-watershed, two on the Salamonie River, and one on Brooks Creek (Table 30). Habitat values were consistent across the watershed with all sites receiving a Fair rating. The Macroinvertebrate Index of Biotic Integrity (mIBI) received a Fair rating for two of the sites, while one site on the Salamonie River received a Good rating. Although there is much room for improvement, the aquatic invertebrates at least faired a bit better than the fish community in Sipe Ditch (Table 31). For this site both the Habitat and Fish Community received a Poor rating.

Table 34 IDEM Macroinvertebrate Data and QHEI, Portland to Pennville

Station Name	Date	12-Diget Huc	Waterbody Name	mIBI Score	mIBI Rating	QHEI Score	QHEI Rating
WSA010-0002	18-Aug-03	051201020105	Salamonie River	2.6	Fair	46	Fair
WSA010-0009	16-Jul-91	051201020105	Salamonie River	4.2	Good	48	Fair
WSA010-0010	17-Jul-91	051201020107	Brooks Creek	2.4	Fair	45	Fair
WSA010-0002	29-Oct-91	051201020105	Salamonie River	3.4	Fair	55	Fair

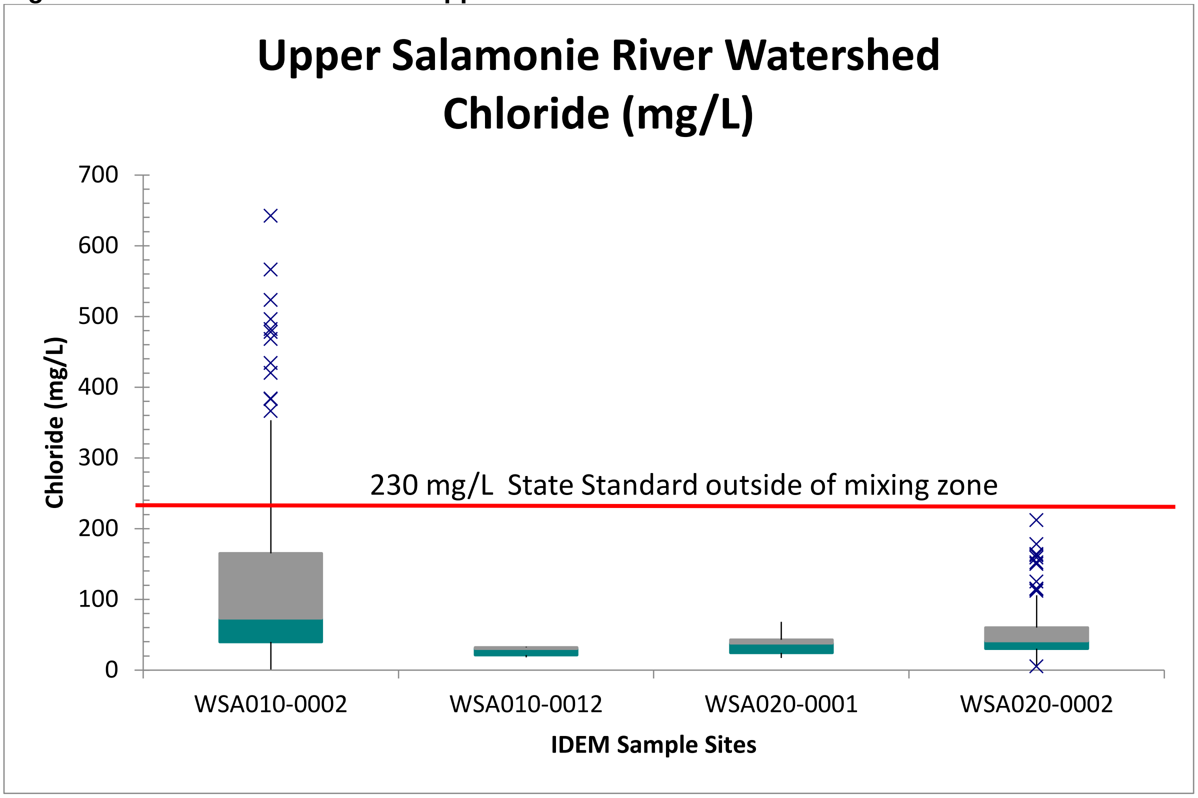
Table 35 IDEM Fish Community Data, Portland to Pennville

Station Name	Date	12-Diget Huc	Waterbody Name	IBI Score	IBI Rating	QHEI Score	QHEI Rating
WSA010-0003	17-Aug-98	051201020104	Sipe Ditch	34	Poor	37	Poor

Chloride Data

Although it is difficult to link the Macroinvertebrate Index of Biotic Integrity to one pollutant source, in the care of site WSA010-0002, chlorine violations associated with the Portland WWTP may be partially to blame for the compromised biologic community. Figure 37 shows chloride values in the USRW, and values at this site often exceed the water-quality standards outside mixing zones for chloride. These values, along with documented violations (Table 28), lead to the conclusion that this is one of the possible causes of a compromised biological community.

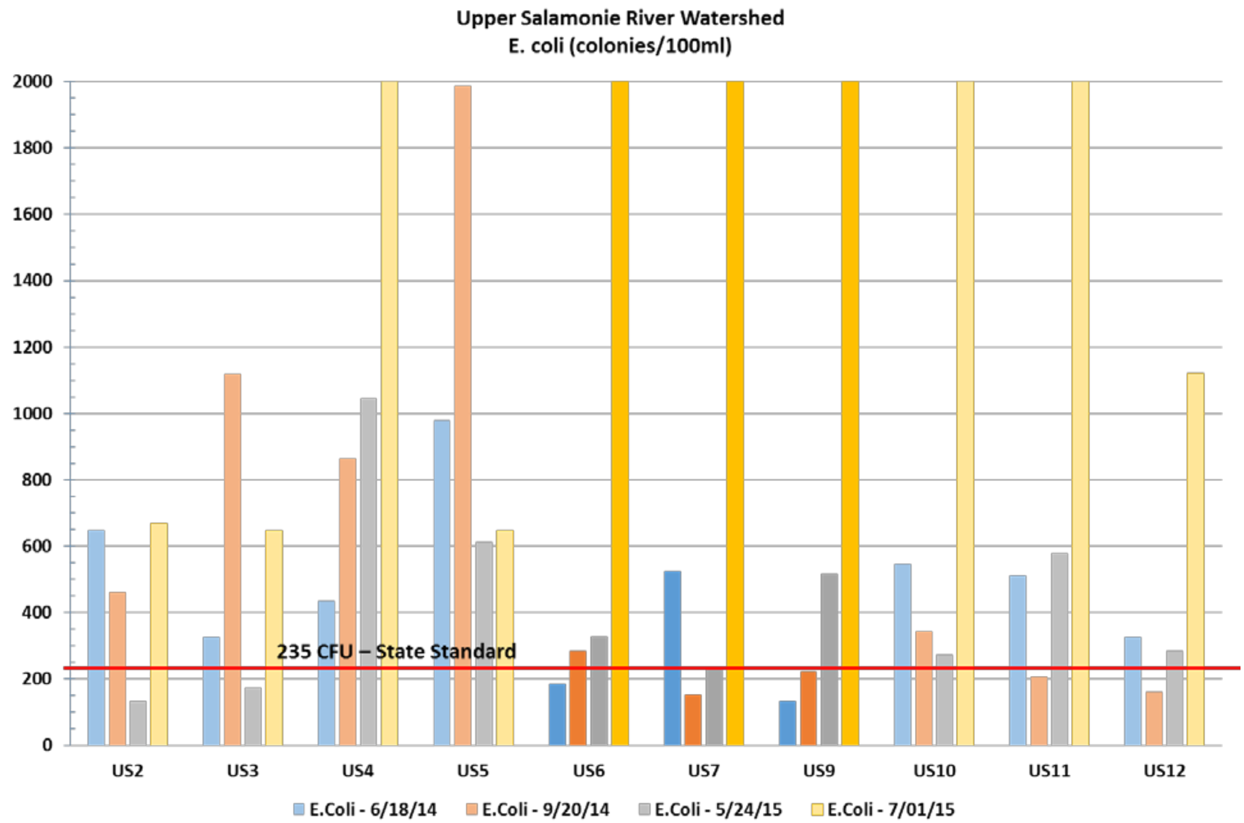
Figure 37 Chloride Values in the Upper Salamonie River Watershed



Upper Salamonie River Bacteriological Data

Figure 38 shows *E. coli* data for the Upper Salamonie River watershed. The Salamonie River from Portland to Pennville include sample sites US6 – US9. Only two of six sampled exceeded the state standard of 235 CFU/100ml. The reason for the sudden decrease in *E. coli* values (other than for 7/01/2015 – yellow bars) is the Portland Wastewater Treatment Plant. The plant is required to treat for *E. coli*, and because of the volume of water they discharge in comparison to stream-flow during normal summer conditions, the treated water serves to dilute the *E. coli* pollution in the stream. From that point on, *E. coli* values remain somewhat stable and lower than what is observed in the headwaters. This highlights the importance of the Portland Wastewater Treatment Plant for water quality during low flow conditions.

Figure *38* *E. coli* Values for the Upper Salamonie River Watershed



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Samples taken on 7/01/2015 were soon after a storm. Headwater streams were starting to return to normal and had moderate flow, whereas the Salamonie River from US4 to US12 still had high flow. It is during these high flows, that the bulk of the pollutant loading to the Salamonie River, and thus downstream Salamonie Reservoir is realized. Rain events wash pollutants from the land surface and often cause combined sewers to flow, both of which lead to high E. coli values. In this sub-watershed, CSO flows are due to the Portland sewage treatment system, and the bulk of the loading appears to come from the land surface and may be related to manure and fertilizer applications to farm ground and phosphorus attached to sediment. It is important that conservation be practiced on area farms and that manure be applied properly to help keep this product from entering area streams.

Figure 39 Orthophosphate in the Upper Salamonie River Watershed

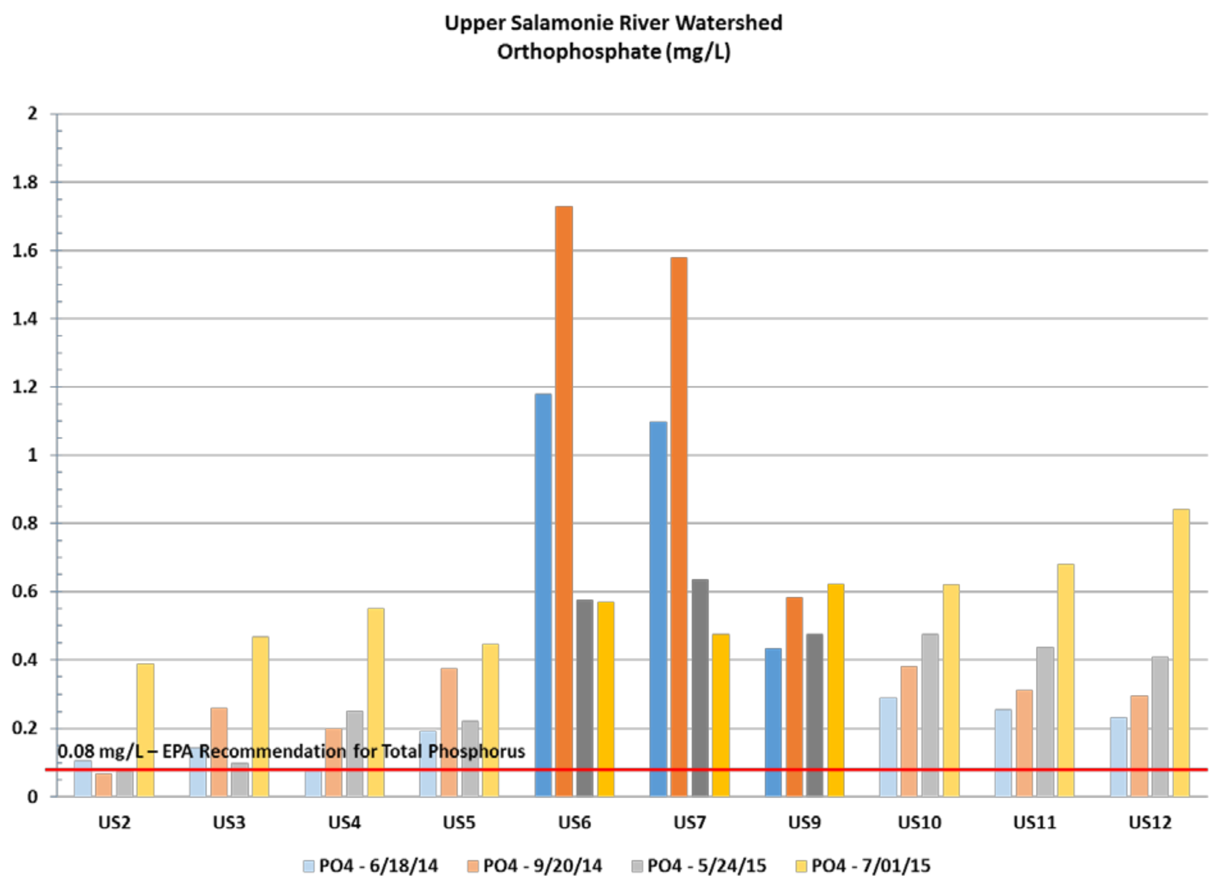
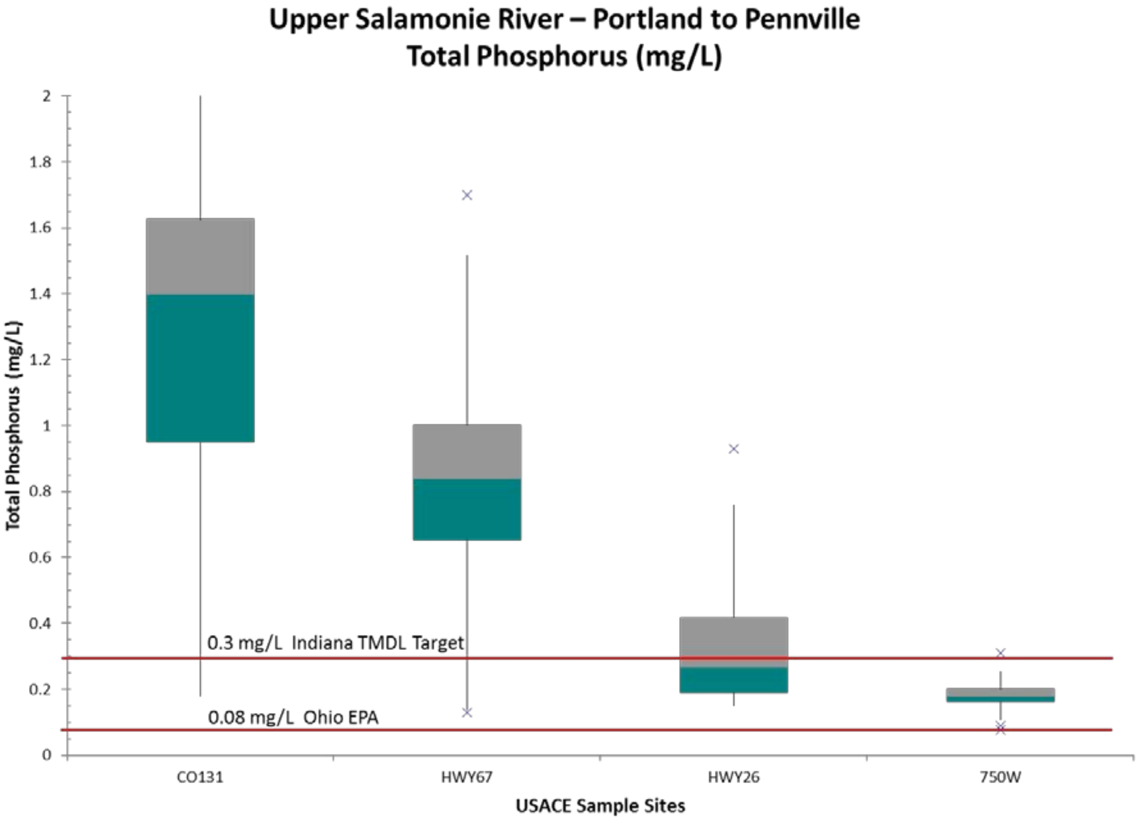


Figure 39 displays orthophosphate data in mg/L for the Upper Salamonie River Watershed. Values for the Salamonie River from Portland to Pennville exceed Ohio EPA's recommendation for Total Phosphorus. As is evident, there is a large spike in orthophosphate levels downstream of Portland (except for 7/01/0215 – yellow bars). It is believed that this is due to the Portland Wastewater Treatment Plant. At present the plant is not required to treat or test for phosphorus. It may be a recommendation of the USR watershed plan that this be changed and the plant be updated to treat for phosphorus. The effect of the plant is somewhat mitigated further downstream as tributaries lower in orthophosphate combine with the Salamonie River. This trend is also noted in data collected by USACE (Figure 40). However, the bulk of the loading is from non-point sources of pollution. Although the concentrations of phosphorus on 7/01/2015 may not be as high as on other occasions, the flow was exponentially higher so overall phosphorus loading was higher on 7/01/2015. During low flows, phosphorus levels appear to be lower upstream and further downstream from the WWTP. During high flows, values tend to continue to increase as you move downstream.

Figure 40 Total Phosphorus Portland to Pennville - USACE



Nitrate values for the Salamonie River from Portland to Pennville are shown in figure 41 (sites US6 – US9). Nitrate levels tend to be well above acceptable limits, especially in the spring. This is most likely due to application of nitrogen to row crops during the spring. It is important that every effort be made to insure that applied nitrogen stays on the field, and that it not be applied in access. Values also tend to decrease from upstream to downstream. This is also reflected in data collected by USACE (Figure 42). However, in the USRW data values seem to spike after the WWTP. This may be due to conversion of toxic ammonia to nitrate at the plant before discharge into the Salamonie River.

Figure 41 Nitrate Values in the Upper Salamonie River Watershed

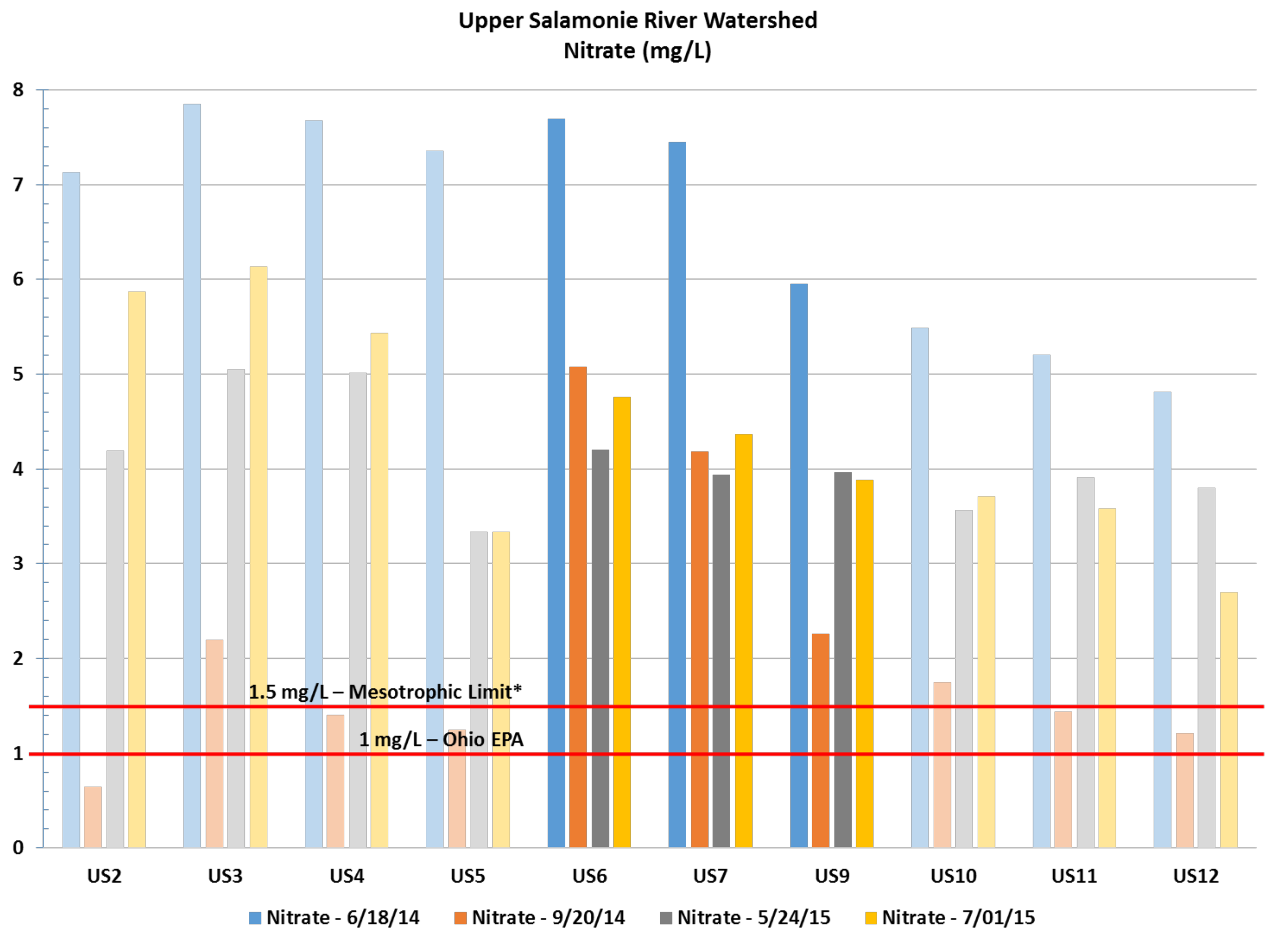
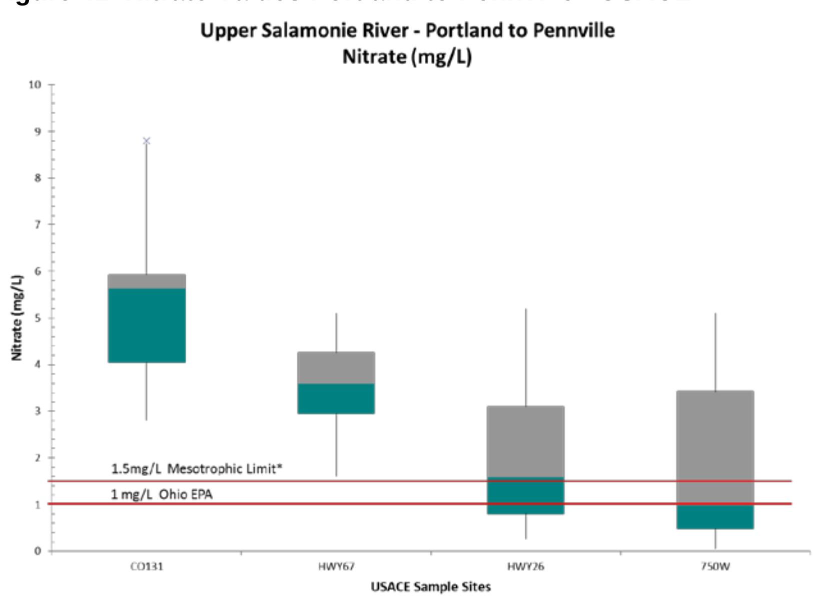


Figure 42 Nitrate Values Portland to Pennville - USACE



Turbidity values exceeded US EPA recommendations for all samples in the Salamonie River from Portland to Pennville (sites US6 – US9, Figure 43). Values are especially high for 7/01/2015 which was soon after a storm event. These high values are due to sediment being washed from the land surface and from instream and bank erosion processes. Total Suspended Solids (TSS) measurements are another way to look at sedimentation to streams and these values show similar trends (Figure 44). USACE TSS values are shown in figure 45, and show similar findings to the data collected by the USRW, once again indicating that values tend to be higher during storm events, indicating the non-point source nature of the problem.

Figure 43 Turbidity Values in the Upper Salamonie River Watershed

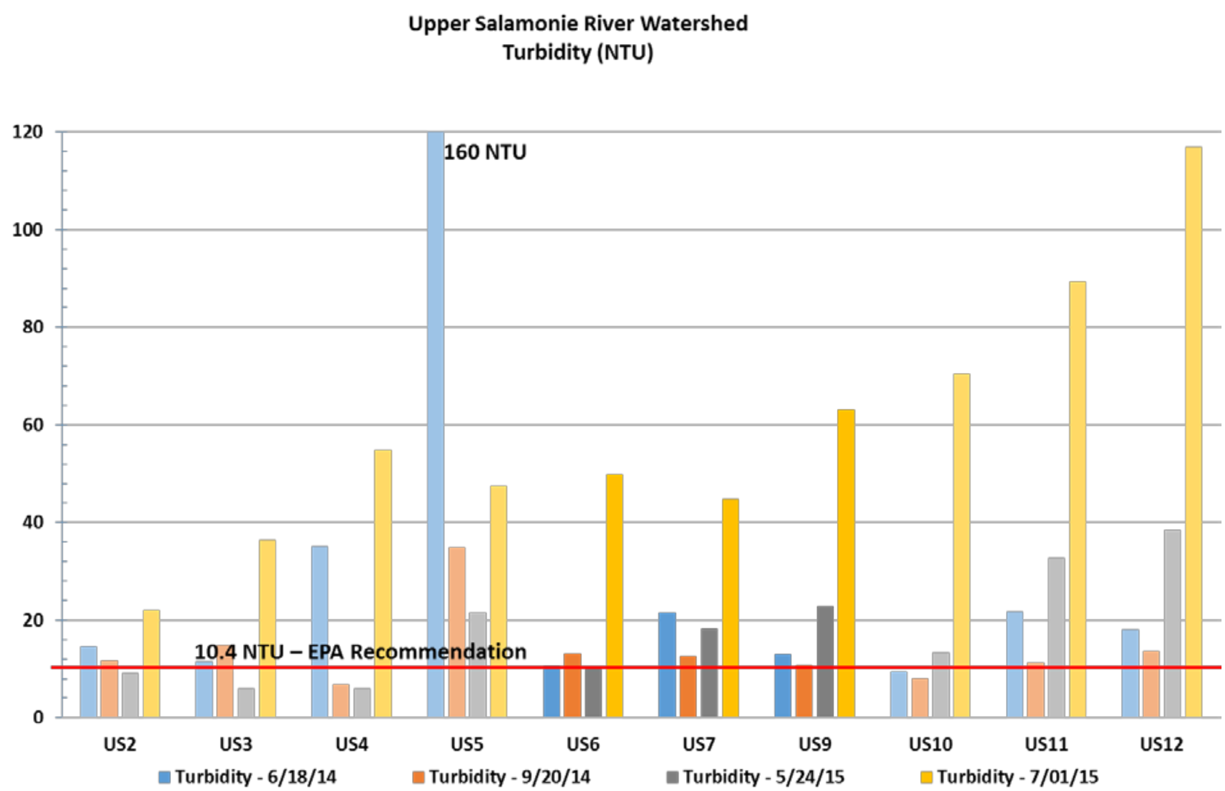


Figure 44 Total Suspended Solids in the Upper Salamonie River Watershed

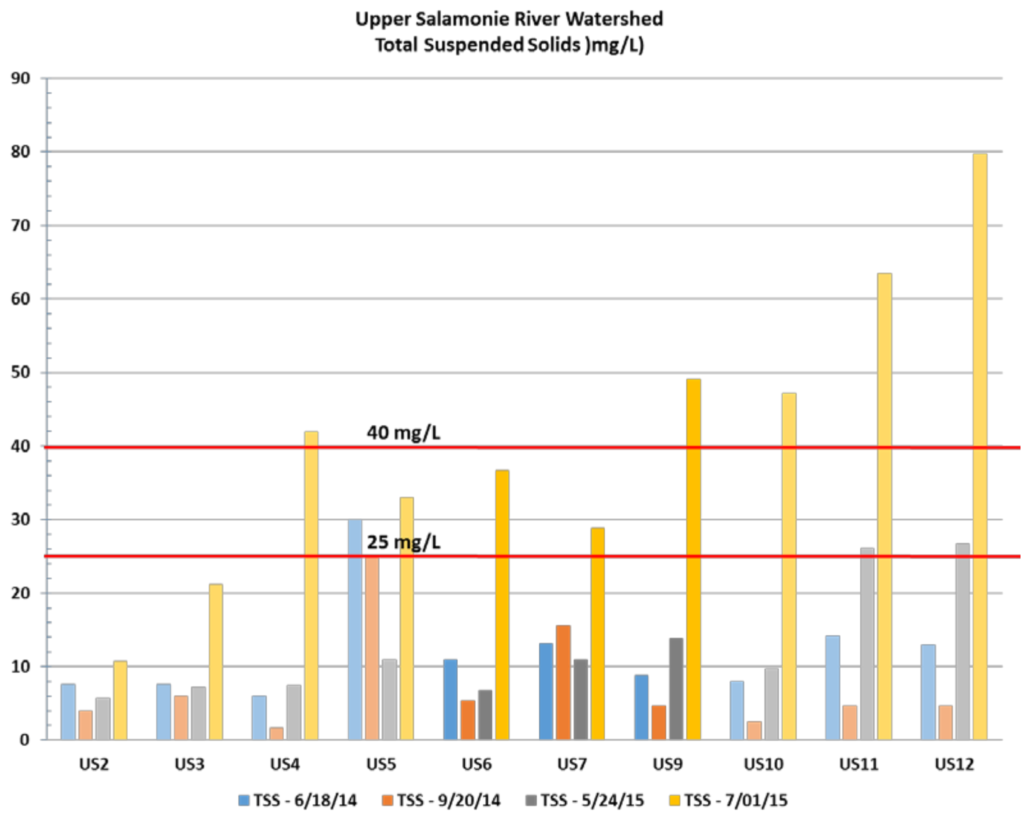
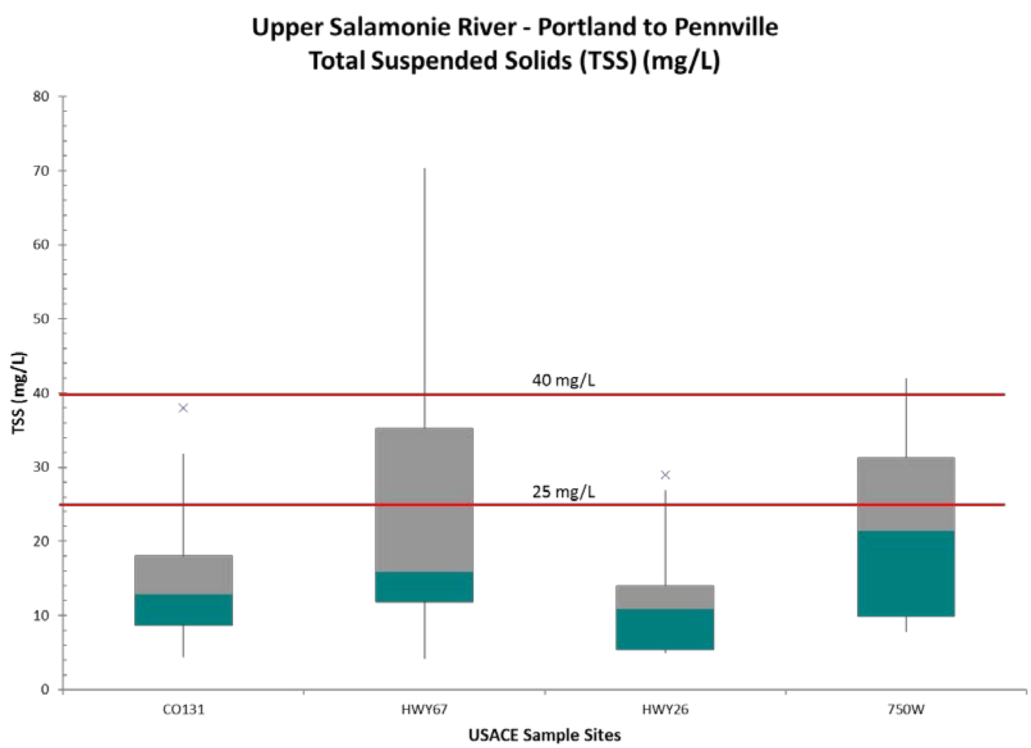


Figure 45 Total Suspended Solids Portland to Pennville - USACE

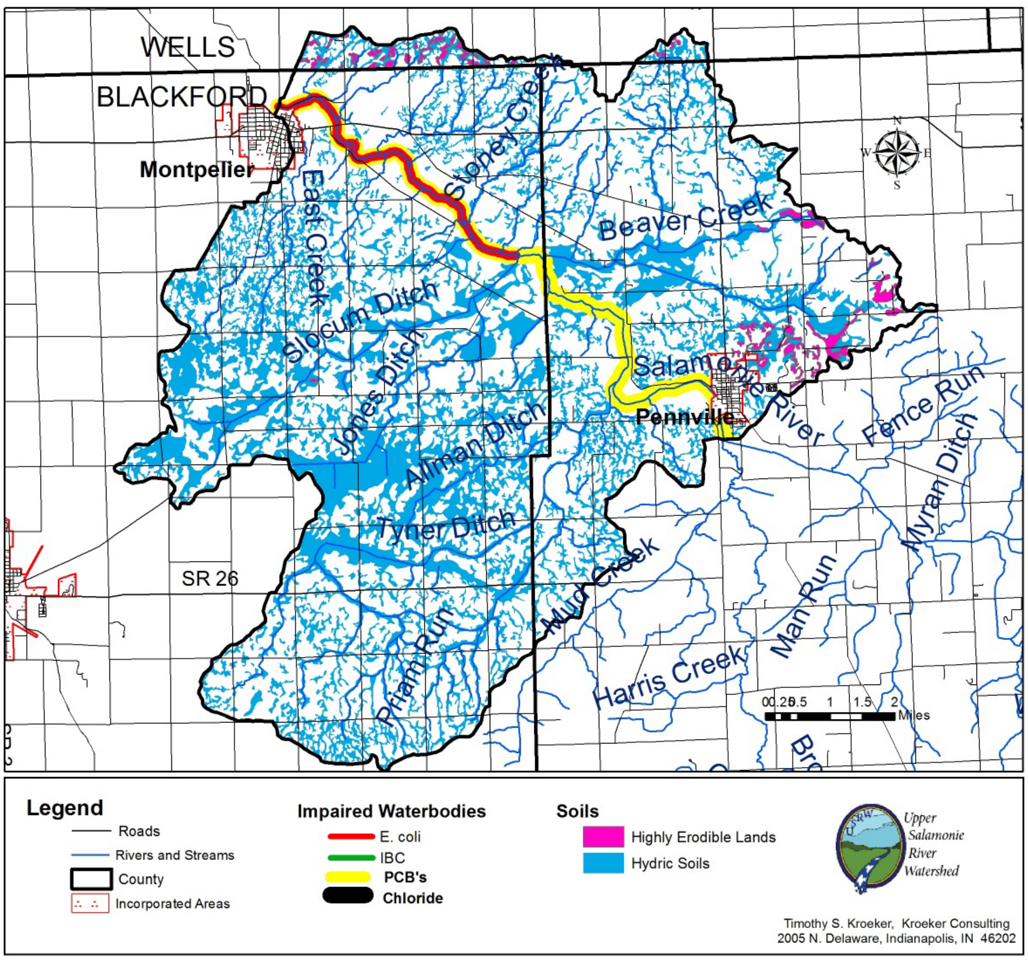


4.3 Salamonie River from Pennville to Montpelier (HUC 051201020203, HUC 051201020202, HUC 051201020201

303(d) listing

The Salamonie River from Pennville to Montpelier drains approximately 50,942 acres in Jay County, Blackford County, and a very small portion of Wells County. There are 131 miles of streams in the sub-watershed which includes East Creek, Stoney Creek, Beaver Creek, Slocum Ditch, Tyner Ditch, Shook Ditch, Hickman Ditch, Allman Ditch, and Daily Ditch. The Salamonie River in this sub-watershed is listed on IDEMs 303(d)list Category 5B as impaired for PCBs, and the portion that flows through HUC051201020203 is listed in Category 5A for *E. coli*.

Figure 46 Hydric Soils, Highly Erodible Soils and Water Quality Impairments Pennville to Montpelier



Hydric Soils and Highly Erodible Lands

Much of the sub-watershed from Pennville to Montpelier contains hydric soils. However, unlike the rest of the basin, these soils tend to be more hydric to the south than the north (Figure 46). Most of the highly erodible land appears once again to be located around Pennville where the landscape is more rolling and steeper slopes exist. Another area of the map which shows highly erodible lands is the small portion in Wells County. Since these erodible lands appear to stop at the county line, it is suspected that this is more of a soil classification difference between counties than an actual indication of a difference in soil types. Topography also doesn't appear to change near the county line.

Landuse

Landuse from Pennville to Montpelier is mostly agricultural as expected (Figure 47). Urban areas consist mainly of the town of Pennville and the extreme eastern boarder of Montpelier. Landuse values are found in Table 32.

Figure 47 Landuse, Salamonie River from Pennville to Montpelier

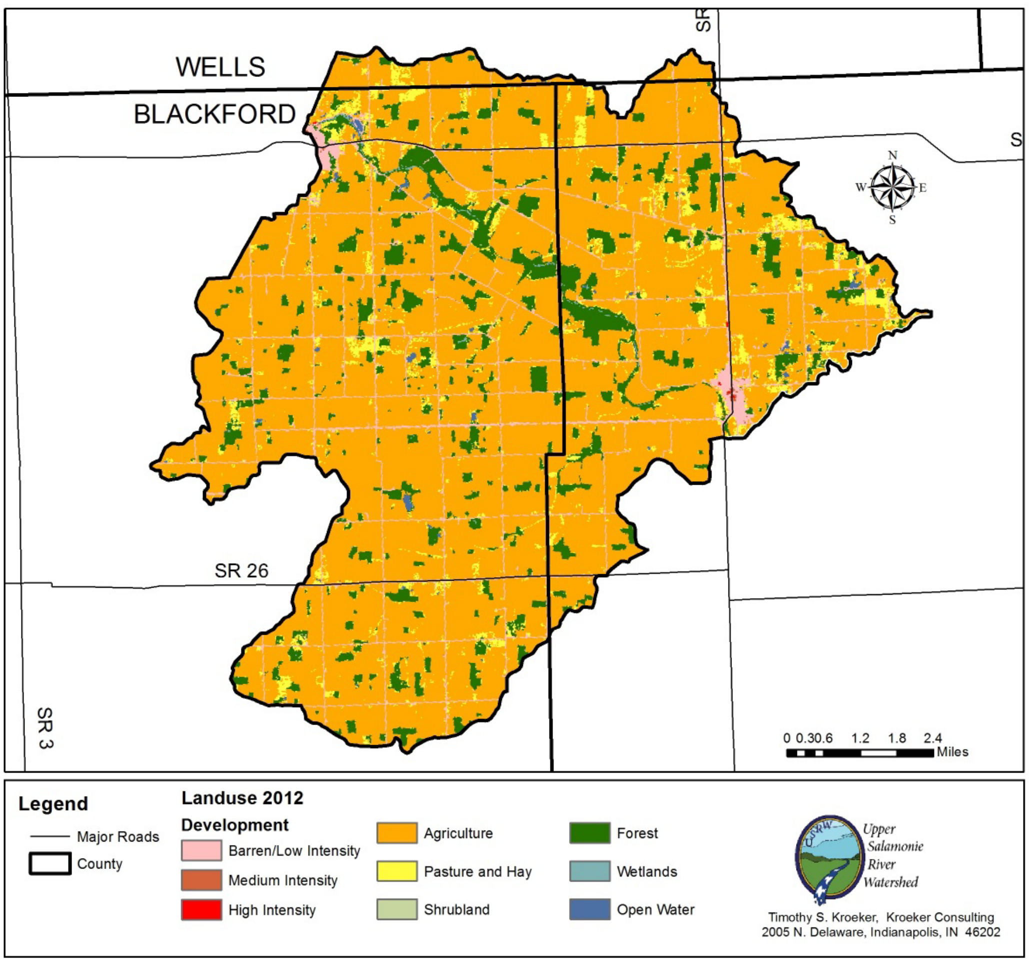


Table 36 Landuse in the Pennville to Montpelier Sub-watershed

Landuse	Total Acres	Percent of Watershed
Agriculture	38621	75.80
Pasture and Hay	3011	5.91
Developed/High Intensity	9	0.02
Developed/Med Intensity	30	0.06
Developed/Low Intensity	2832	5.56
Forest	4894	9.61
Shrub/Scrub	1250	2.45
Wetlands	303	0.59
Open Water	191	0.37
Totals	50950	100

Potential Sources

The main NPDES permitted facility impacting this sub-watershed is the Pennville WWTP (Figure 48). Although it generally runs smoothly there have been some violations. Table 33 shows the violations noted from 2011 – 2014. Most violations have been for ammonia, although there was one violation for TSS, and one for chlorine during this period. The only other permitted facilities and outfalls in the sub-watershed are the Montpellier Municipal STP and the IMI/Erie Stone Company. Both these facilities are on the extreme downstream edge of the USRW and have little effect on this sub-watershed as a whole. Any problems will be realized by downstream areas.

Eight confined feeding operations are shown in figure 48. Five of these were noted during the windshield survey along with 19 hobby farms. Of these 19 hobby farms only two had stream access for their animals. Confined feeding operations seem to be sparse in this portion of the USRW. There are also fewer underground storage tanks (Figure 49). The few that are noted are associated with Pennville and Montpelier. Two are located elsewhere in the watershed along SR 26.

Figure 48 Potential Sources Pennville to Montpelier

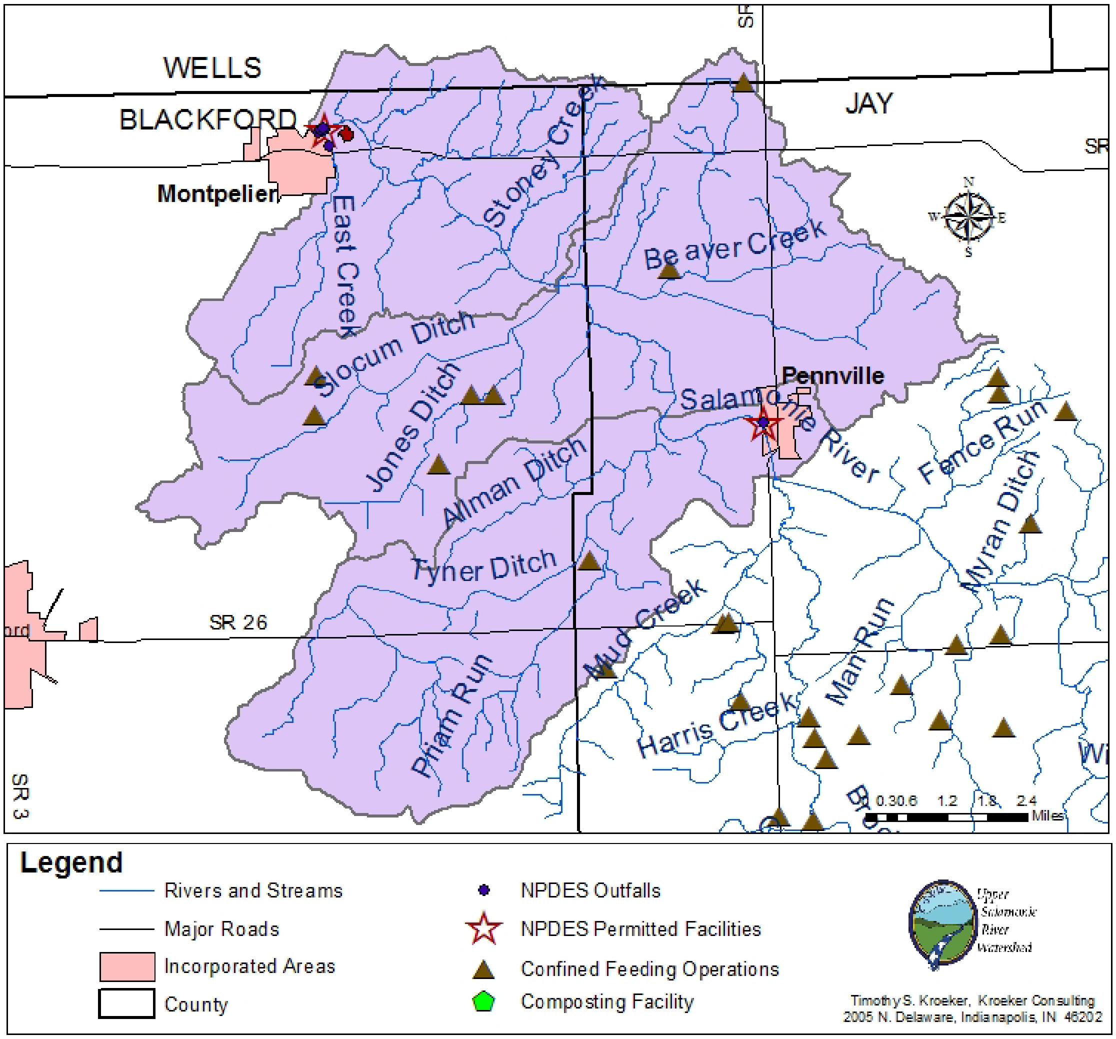
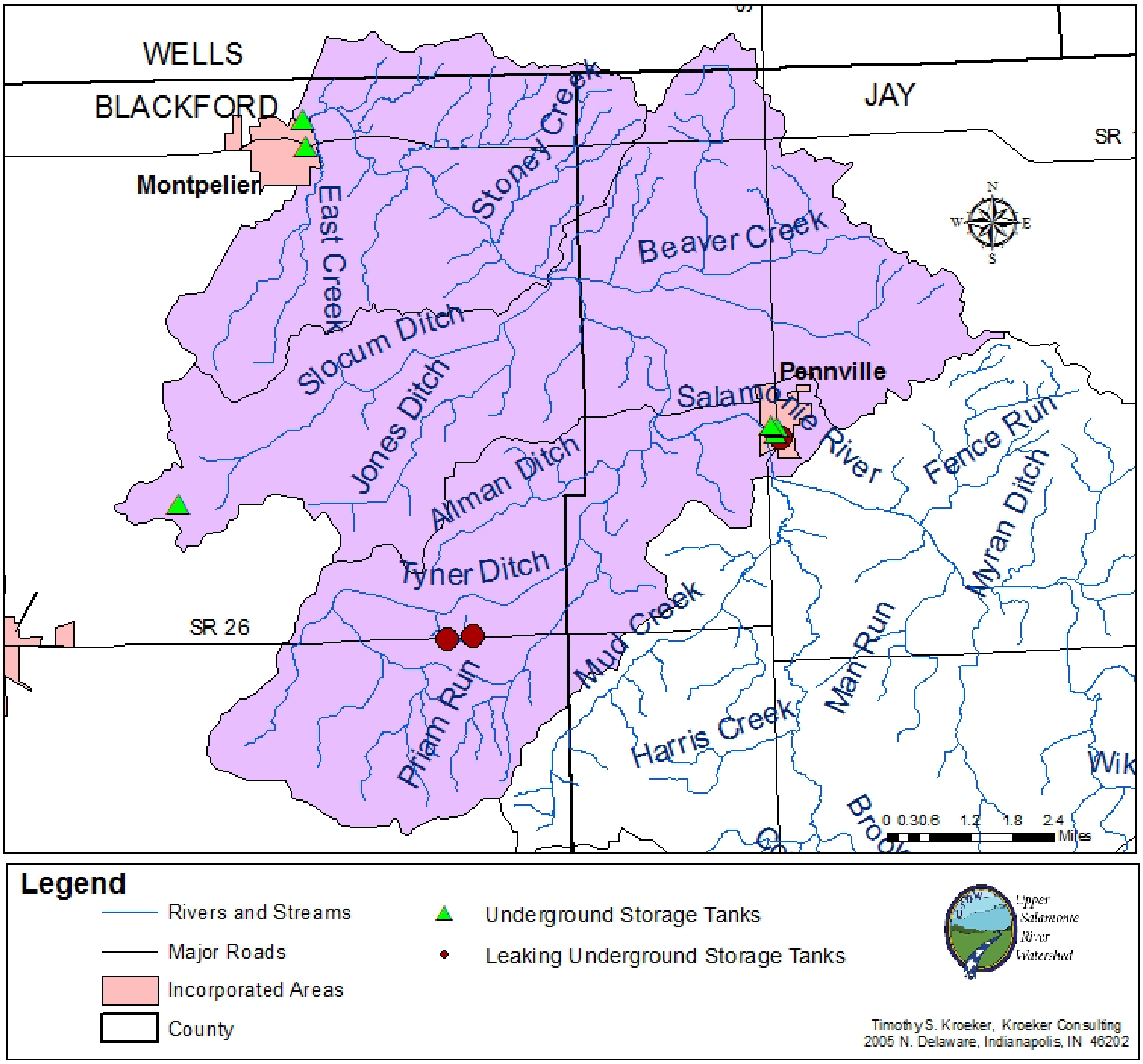


Table 37 NPDES Violations in the Salamonie River Pennville to Montpelier

Facility	NPDES - ID	Violation Type	Parameter	Value	Limit	Date
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (mg/L)	**4.2**	4.	06/30/2010
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (mg/L)	**6.5**	6.	06/30/2010
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (lbs/day)	16.	13.8	04/30/2013
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (mg/L)	**8.65**	6.	06/30/2013
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (lbs/day)	8.7597	8.	06/30/2013
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (mg/L)	**8.05**	6.	09/30/2013
PENNVILLE WWTP	IN0040495	Numeric Violation	Ammonia (lbs/day)	8.8	8.	05/31/2014
IMI/Erie Stone Company	IN0002551	Numeric Violation	Total Suspended Solids (mg/L)	**280.**	30	09/30/2014
PENNVILLE WWTP	IN0040495	Numeric Violation	Chlorine (mg/L)	**0.06**	0.06	10/31/2014

Figure 49 Underground Storage Tanks Pennville to Montpelier



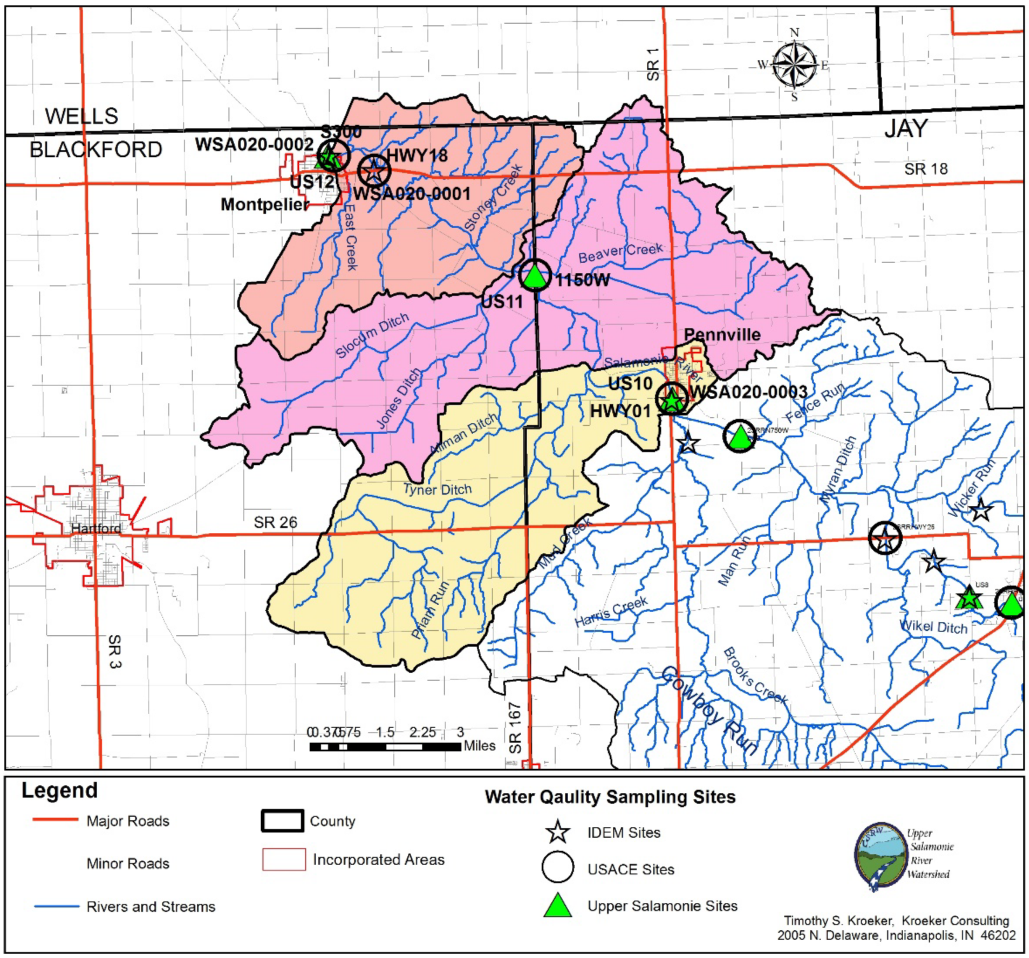
Windshield Survey – Potential Sources

Once again the windshield survey pointed out a number of potential sources. Of the 124 sites visited in this sub-watershed, 55% had land under conventional tillage. Fifty percent of sites surveyed showed active drain tiles, and 60% of the sites exhibited problems with stream bank erosion. In this sub-watershed however, only two sites indicated cattle had access to streams, and only five CFOs were noted.

Upper Salamonie River Watershed Sampling Data

Sampling in the Pennville to Montpelier sub-watershed has been completed by the USRW, USACE, and IDEM. Specific locations of sample sites are shown in Figure 50. Sampling included physical parameters, chemical data, biological data, and habitat evaluations. Findings are outlined below.

Figure 50 Sampling Station Locations Pennville to Montpelier



Biological and Habitat Data – Riverwatch Methods

Table 38 Salamonie Macroinvertebrate & Habitat Assessment Ratings, Pennville to Montpelier

Sample Site	12 Digit HUC	2014 CQHEI Score	2014 CQHEI Rating	2014 PTI Score	2014 PTI Rating	2015 CQHEI Score	2015 CQHEI Rating	2015 PTI Score	2015 PTI Rating
US10	051201020201	77	Good	18	Good	62	Good	16	Fair
US12	051201020203	70	Good	15	Fair	67	Good	28	Excellent

Macro-invertebrate sampling was completed in 2014 and 2015, and the results are shown above (Table 34). Habitat values for the two sites in this watershed were consistent from year to year and both received a rating of Good. Macroinvertebrate ratings were consistent year to year for site number US10, but changed from Fair to Excellent for site number US12.

Upper Salamonie River Bacteriological Data

Figure 51 *E. coli* Values for the Upper Salamonie River Watershed

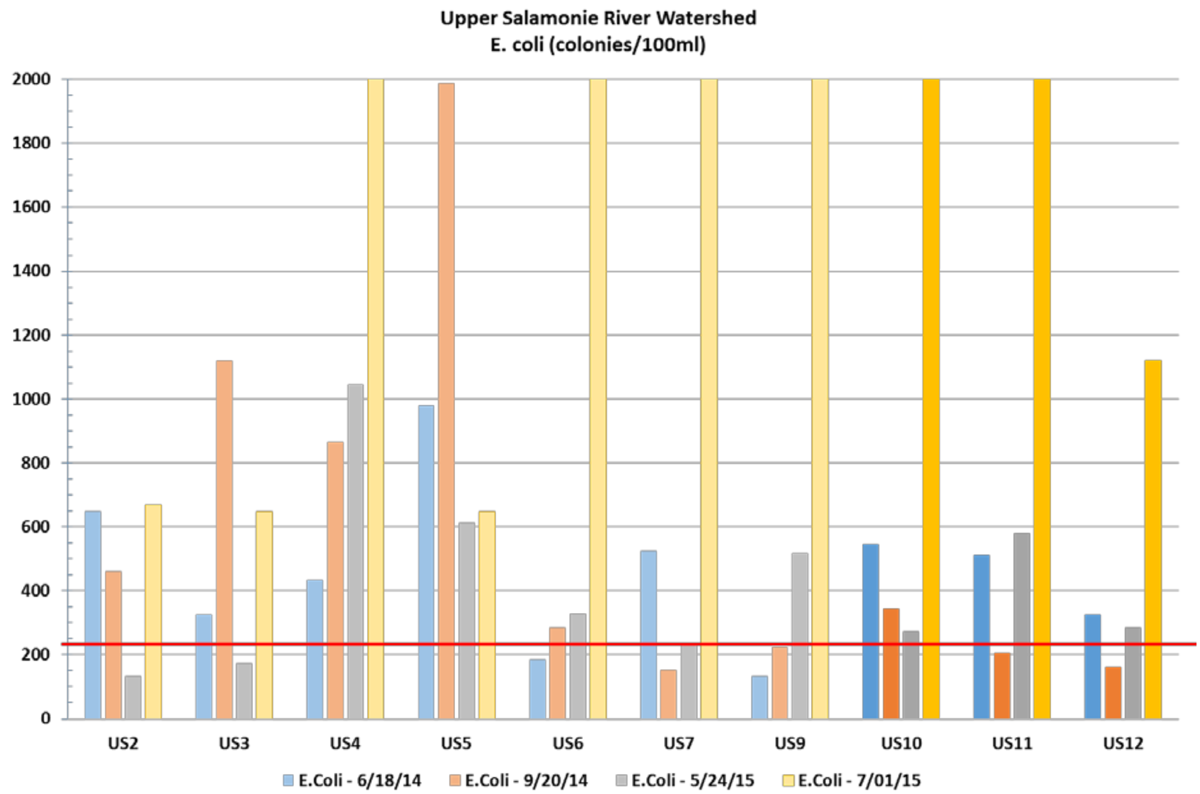


Figure 51 shows *E. coli* data for the Upper Salamonie River watershed. The Salamonie River from Pennville to Montpelier include sample sites US10 – US12. Ten of twelve samples exceeded the state standard of 235 CFU/100ml. Values tended to be higher during the spring for this portion of the watershed, probably due to more rainfall. Values for 7/01/2015 following a rainstorm were very high. Flows for most of the sampling were at low levels, whereas flows for 7/01/2015 were high in this portion of the USRW.

Figure 52 displays orthophosphate data in mg/L for the Upper Salamonie River Watershed. Orthophosphate values for the Salamonie River from Pennville to Montpelier were well above US EPA recommendations for Total Phosphorus. Values continue to trend downward from values immediately after the Portland WWTP except during high flows as evident by values from 7/01/2015. Samples collected by USACE (Figure 53) also indicate a problem with high phosphorus values.

Figure 52 Orthophosphate in the Upper Salamonie River Watershed

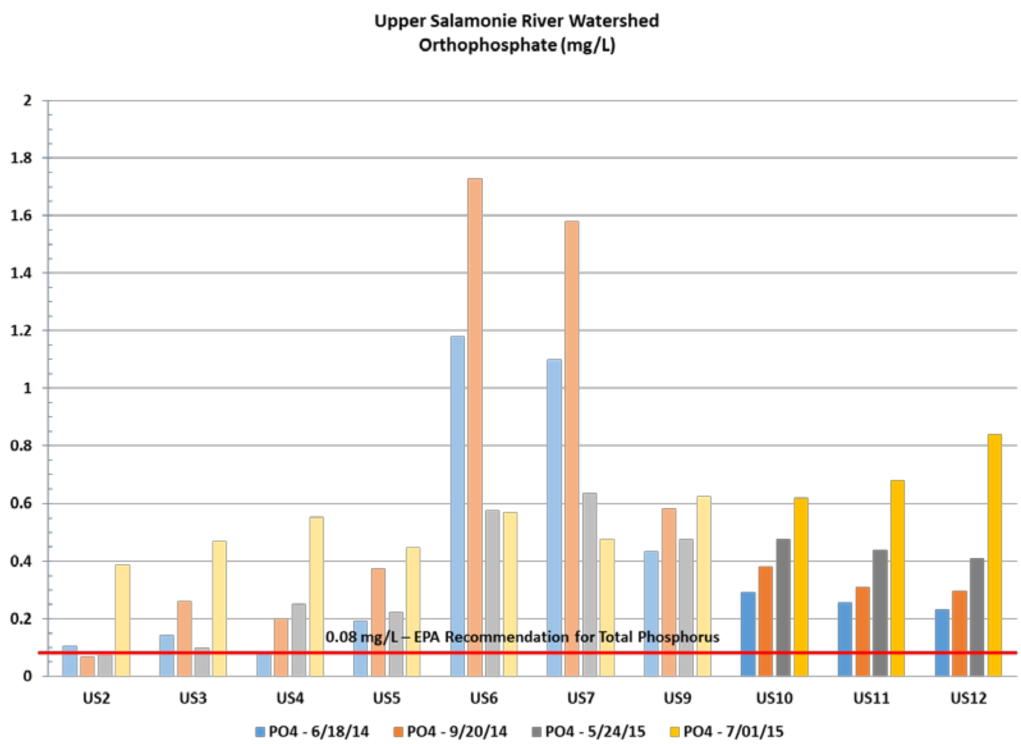
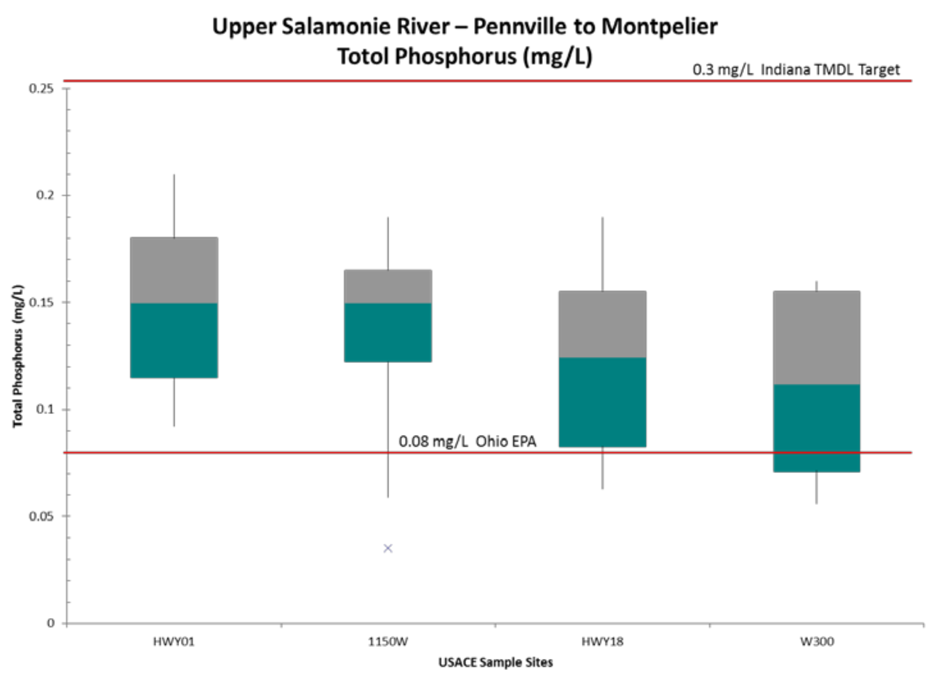


Figure 53 Total Phosphorus Pennville to Montpelier - USACE



Nitrate values for the Salamonie River from Pennville to Montpelier are shown in figure 54 (sites US10 – US12). Values in September are approaching acceptable limits at site US12. This is not surprising since nitrogen is applied early on in the season to increase the growth and development of row crops, and by fall, most of the soil nitrogen has been depleted. Precision application of nitrogen and adoption of BMPs may help meet these water-quality goals. Nitrate samples collected by USACE also indicate that most samples exceed desired benchmarks for this parameter (Figure 55).

Figure 54 Nitrate in the Upper Salamonie River Watershed

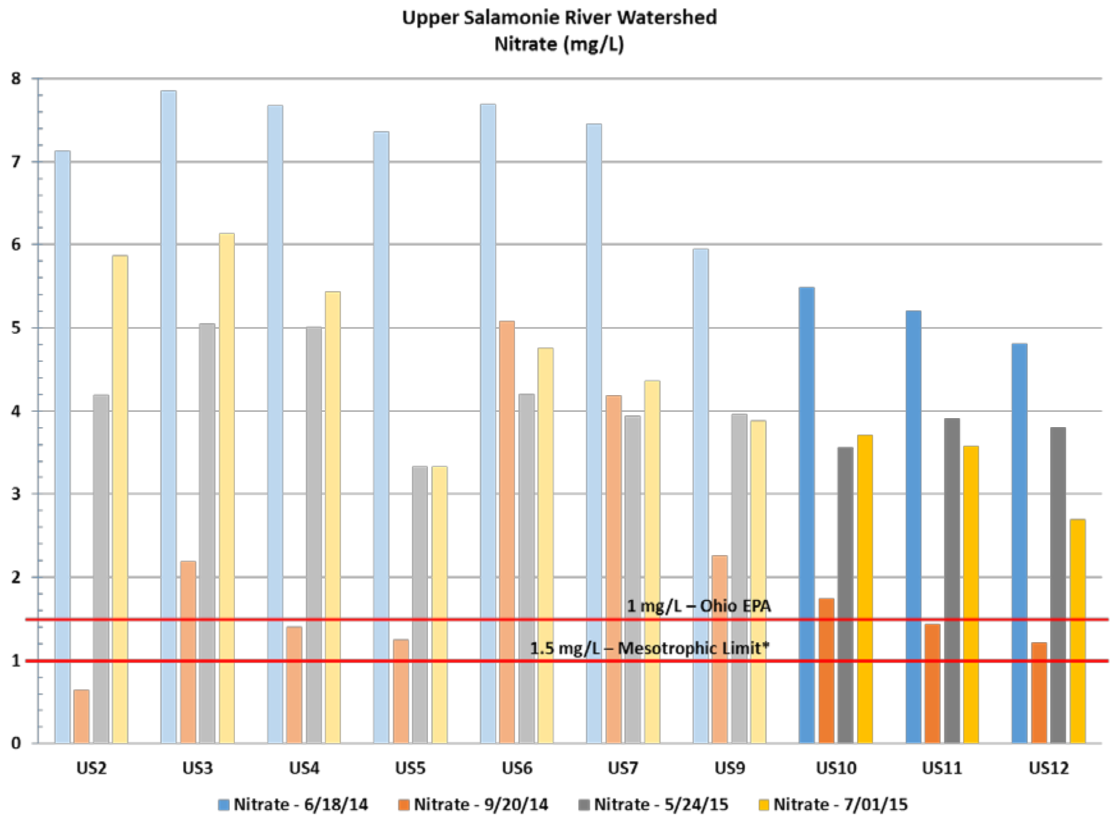
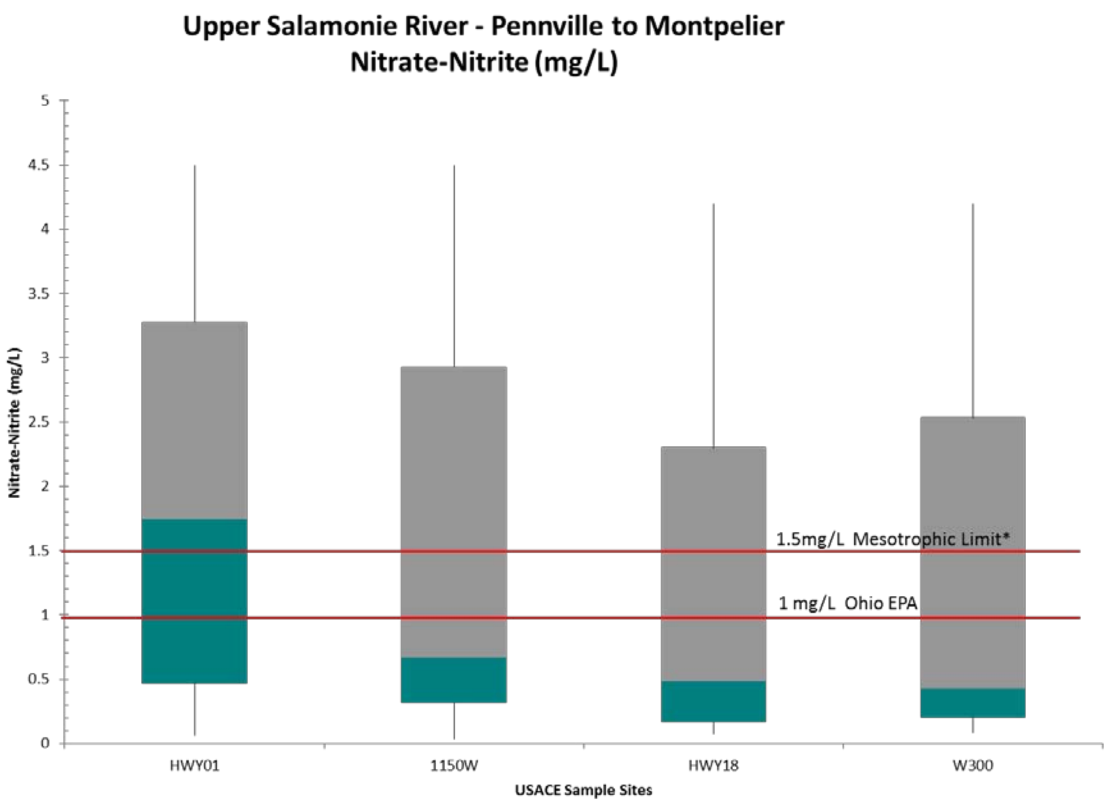


Figure 55 Nitrate-Nitrite Pennville to Montpelier - USACE



Upper Salamonie River Watershed and USACE Data Related to Sediment

Turbidity values exceeded US EPA recommendations for 10 of 12 samples (sites US10 – US12, Figure 56). Most of the sampling took place during low or normal flows. In these situations turbidity tended to be higher in the spring when much of the agricultural land had little or no vegetation to hold the soil. However, samples from 7/01/2015 illustrate what can happen when you have a major rain event and flows are high. Total Suspended Solids (Figure 57), a measure related to turbidity, reveals the same trend. Results from USACE sampling runs are shown in Figure 58.

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Figure 56 Turbidity in the Upper Salamonie River Watershed

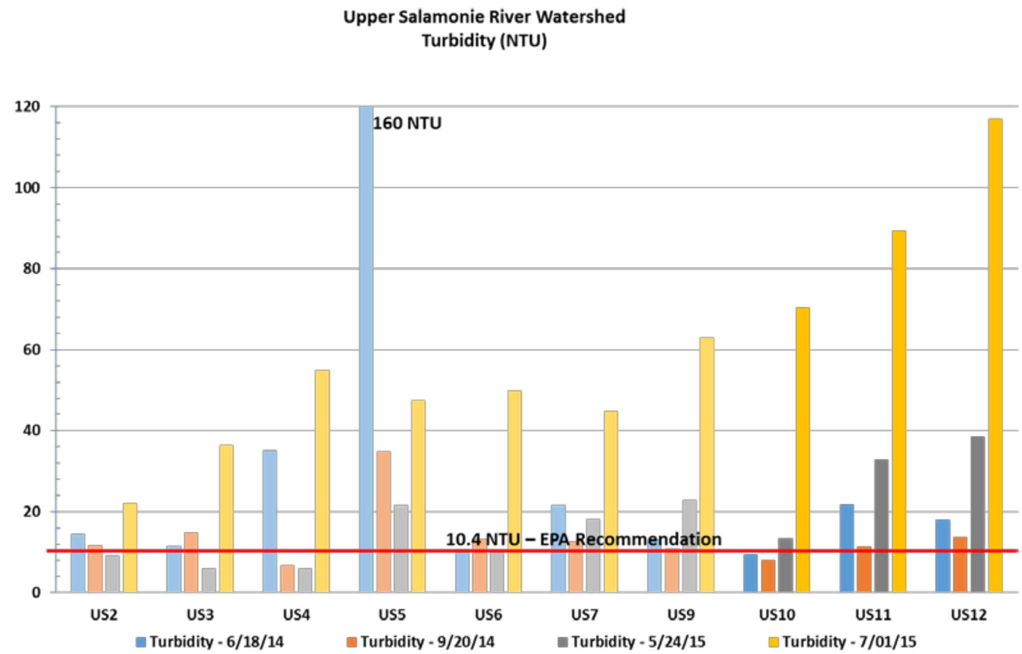


Figure 57 Total Suspended Solids in the Upper Salamonie River Watershed

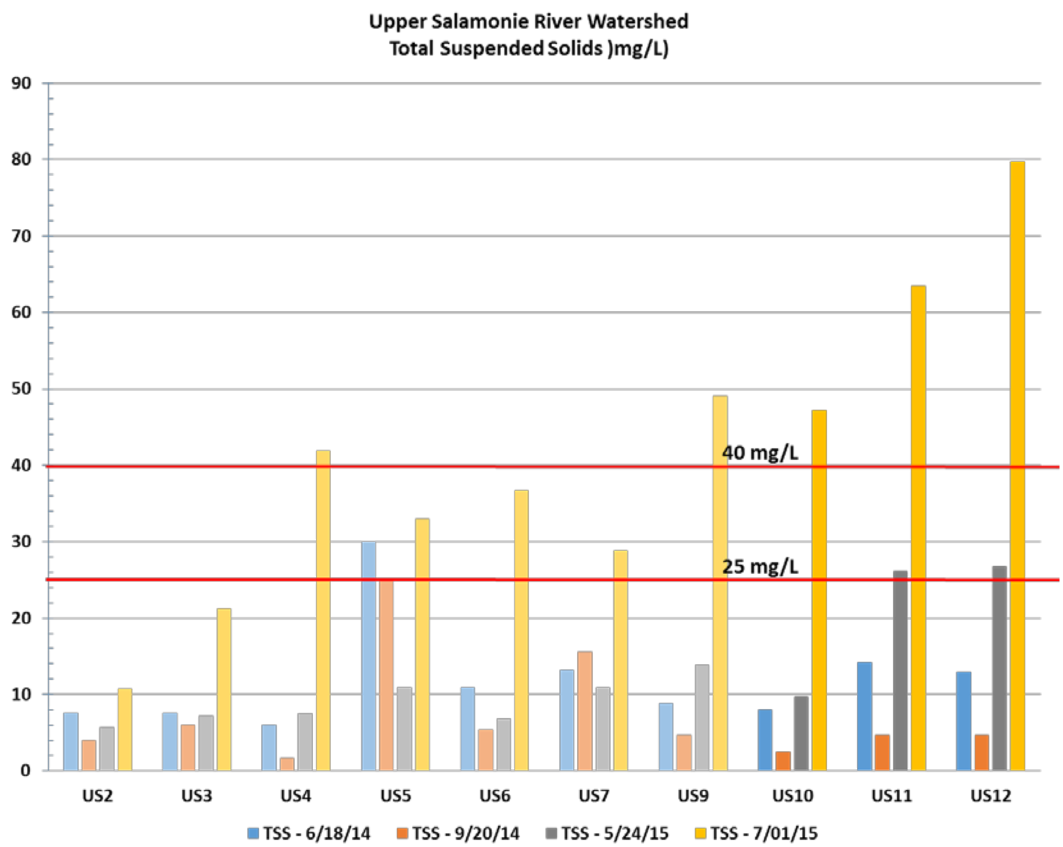
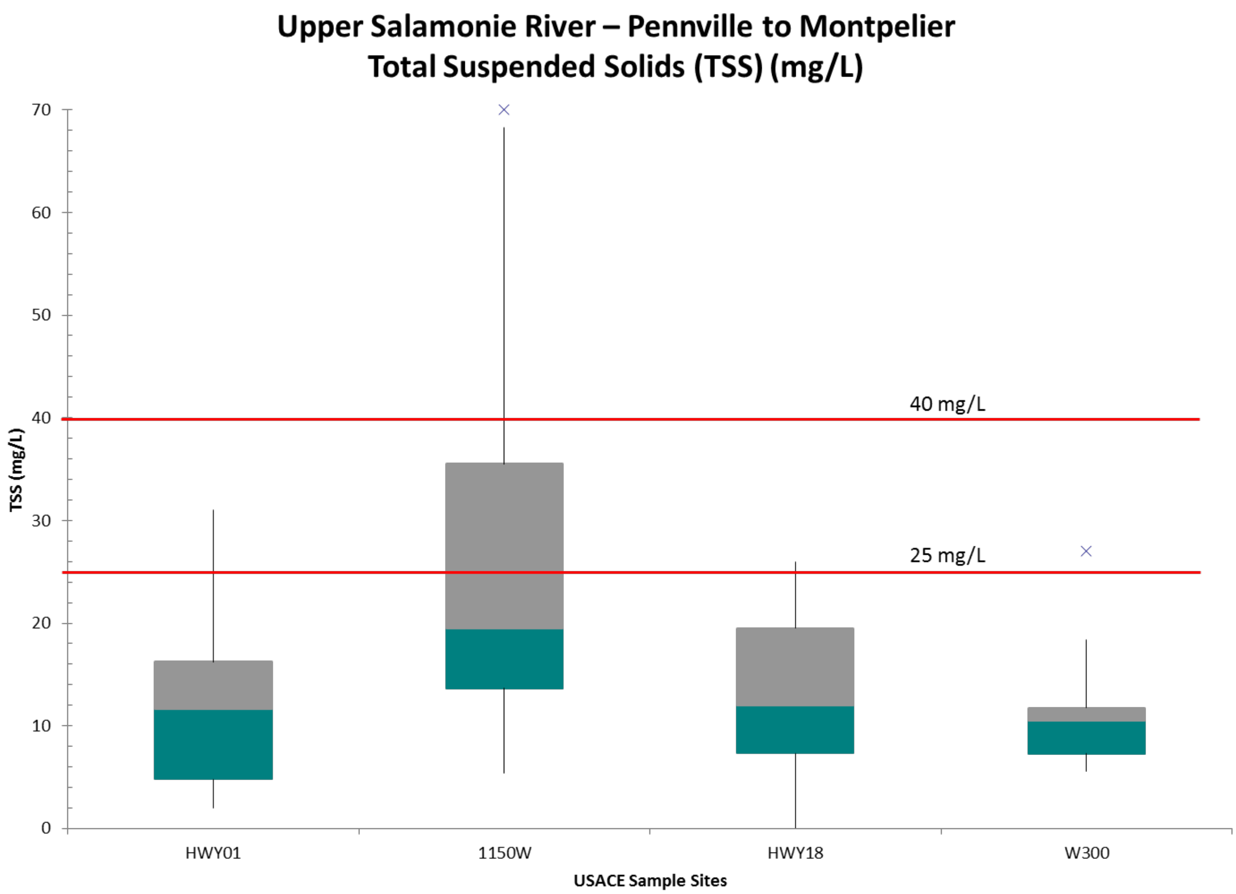


Figure 58 Total Suspended Solids Pennville to Montpelier - USACE



5.0 Watershed Summary and Identifying Problems and Causes

5.1 Watershed Summary

E.coli

E.coli is another important water-quality parameter in the USR watershed. High levels of E.coli are included on the stakeholders list of concerns. The 2012 303(d) list identifies E.coli impairments in two sub-watersheds: the Salamonie River in the Stoney Creek sub-watershed and the Little Salamonie River in the Miller Ditch sub-watershed. Water-quality monitoring indicates that E.coli is often above state standards for safe full contact recreation. Although the problem is wide spread, it appears to be more of an issue in the sub-watersheds upstream of the Portland WWTP. However, depending on the time of year, the discharge can be a large portion of the flow in the Salamonie River downstream of the plant. This water which is treated for *E. coli* serves to dilute the river and is the main reason for the sudden drop in *E. coli* levels. During high flows, E. coli values are extremely high throughout the watershed. Likely sources include CSOs, land application of manure, and failing septic systems.

Nutrients

Excess nutrients are a major problems in the USR watershed and is a stakeholder concern. Water quality monitoring shows consistently high values of total phosphorous that exceed the target level of 0.08mg/L. They also exceed the 0.3mg/L that IDEM uses to determine the necessity of a TMDL. Values indicate that all areas of the watershed are in need of measures to reduce phosphorus loading to rivers and streams. However, stream phosphorus levels rise substantially after the Portland WWTP during low flow periods. It is recommended that the plant begin both treatment and testing for phosphorus levels. Although concentrations of orthophosphate is highest below the Portland WWTP during low flow periods, the highest loading of phosphorus to area streams occurs during high flows when soils and nutrients from the landscape are swept into area streams and stream beds and banks are eroded. Best Management Practices that help keep soil in place, stabilize stream banks, and reduce in-stream erosion will help reduce phosphorus levels in area streams.

Nitrate levels are not as critical as phosphorus in the USR watershed, but still often exceeded recommended values. However, whereas phosphorus is the limiting nutrient in the USRW, nitrogen is the main issue causing hypoxia in the Gulf of Mexico. It is important to control this nutrient to help alleviate this problem. In the USRW, values change radically from spring to summer, which may be due to run-off events in association with nitrogen fertilizer application, and increased tile drainage which has been found to be high in nitrogen because of the ability of nitrogen to leach from soils. Better farm practices and the use of drainage management may help solve this issue.

Turbidity

Turbidity measurements are often used as a surrogate for total suspended solids measurements. Turbidity values exceed recommendations for the majority of samples taken in the USR watershed. This problem is widespread even though most of the sampling shown took place during normal to low flows. In higher flow situations, turbidity tends to be substantially higher due to run-off and erosion. Maintaining a low turbidity is important for the health of the aquatic ecosystem. In addition, soil particles can transport phosphorus downstream resulting in toxic algae blooms when this nutrient becomes bio-available. It will be important to reduce loading of suspended solids in all areas of the watershed.

5.1 Analysis of Stakeholder Concerns

Following the characterization and inventory of the Upper Salamonie River Watershed, stakeholder concerns were analyzed. Each concern was evaluated to determine if supporting data existed and if so, if the concern was within the scope of this project, could the data help quantify that concern (Table 35). This analysis helped the steering committee decide which concerns to focus on and how to prioritize those concerns. All concerns are supported by data and inside the scope of the project, but not all may be focused on by the USRW Steering Committee. Fish Consumption Advisories are due to legacy pollutants and awareness of the problem will be addressed through educational efforts only.

Table 39 Analysis of Stakeholder Concerns

Concern		Supported by Data	Evidence	Quantifiable	Outside Scope	Group Focus
Drainage & Flooding	Flooding	Yes	Documented Events, Observed Events, USGS Stream Flow Gauge	Yes	No	Yes
	Drainage for Farmland	Yes	Estimated >50% Tiled from Windshield Survey	Estimates	No	Yes
	Altered Hydrology	Yes	Windshield Survey, Stream Classification Study, USGS Stream Flow Gauge	Yes	No	Yes
	Debris Clean-up in Streams	Yes	County Surveyor Records	Yes	No	Yes*
Pathogens & *E. coli*	CSO's (Combined Sewer Overflows)	Yes	Documented CSOs in the Watershed	Yes	No	Is being addressed by local municipalities
	CFOs and CaFOs	Yes	Windshield Surveys, IDEM Data, Observations, Rule 5 Permits	Yes	No	Yes
	Impact of septic systems -Old, Malfunctioning, Straight Pipes, Poor Maintenance, Inadequate Soils or Leach fields	Yes	Health Department Data, Soil Suitability Data, Windshield Survey	Estimates	No	Yes
	E. coli Levels in Waterbodies	Yes	Water Quality Data	Yes	No	Yes
	Manure Application Timing, Amounts, on Frozen Ground, Other	Yes	Observations, Complaints	Estimates	No	Yes*
Urban & Industrial	Yard Spray (Pesticides, Fertilizer)	Yes	Observations, General Knowledge from the Literature	Estimates	No	No**
	Run-off from Development	Yes	Observations, General Knowledge from the Literature	Estimates	No	Is being addressed by local municipalities
	Application of Inorganic Fertilizers - City	Yes	Observations, General Knowledge from the Literature	Estimates	No	No**

*Will be addressed through education and outreach by local SWCDs.
**May be addressed through education and outreach by local SWCDs as time allows. Because this impact is considered small in the watershed, this concern will not be a focus of the project.

Table 40 (Cont.) Analysis of Stakeholder Concerns

Concern		Supported by Data	Evidence	Quantifiable	Outside Scope	Group Focus
Water Quality	Nutrient Loads	Yes	WQ Data, Modeling Estimates, General Knowledge from the Literature	Estimates	No	Yes
	Nutrient Run-off from Golf Courses (only one noted in the watershed)	Yes	General Knowledge from the Literature	Estimates	No	No**
	Manure Application (from local and out of state sources) Timing, Amounts, on Frozen Ground, Other	Yes	Observations, Complaints	Estimates	No	Yes
	Drainage as it Relates to Water Quality - Farm Tiles and Other	Yes	General Knowledge from the Literature Regulated Drains in the Watershed (miles)	Estimates	No	Yes
	Decreasing Adoption of Conservation Tillage	No	Tillage Transects, Observations	Yes	No	Yes
	Nutrient Run-off from Farm Land	Yes	WQ Data, Modeling Estimates and General Knowledge from the Literature	Estimates	No	Yes
	Application of inorganic fertilizers - city and residential	Yes	Observations, General Knowledge from the Literature	Estimates	No	No**
	CFOs and CaFOs	Yes	Observations, Windshield Surveys, Recent Documented Spills, General Knowledge from the Literature	Estimates based on animal type, number and characteristics of the operation	No	Yes
	Application of Inorganic Fertilizers - Golf Courses, Farmland	Yes	General Knowledge from the Literature	Estimates	No	No**
	Well Water Quality… are Aquifers at Risk in the Watershed	No	General Knowledge from the Literature	Risk Factors	No	No**
Wildlife	Wetland Conservation/Creation/Restoration	Yes	Windshield Survey, Observations, Hydric Soils, NWI Data	Estimates	No	Yes
	Balance Need for Drainage with Natural Habitat for Wildlife	Yes	Windshield Survey, Observations	Estimates	No	Yes

*Will be addressed through education and outreach by local SWCDs.
**May be addressed through education and outreach by local SWCDs as time allows. Because this impact is considered small in the watershed, this concern will not be a focus of the project.

Table 41 (Cont.) Analysis of Stakeholder Concerns

Concern		Supported by Data	Evidence	Quantifiable	Outside Scope	Group Focus
Other	Increase Recreational Use Capacity in the Watershed	Yes	Observations, Limited Access Sites to River (None in Blackford County)	Estimates	No	Yes*
	Lack of Fish in the River	Yes	Fish and Habitat Surveys, Fishermen Observations	Yes	No	Yes
	Quantify Blue-Green Algae in the Reservoir. What Data do we Have, How Bad is the Problem	Yes	On-going Investigation and Water Quality Sampling by IDEM and USACE	Yes	Will be Completed by Outside Party	Will be Completed by Outside Party
	Quantify Best Management Practices Already in Place to Help Determine Next Steps	No	Windshield Survey (Limited), NRCS Data (Unavailable)	Yes	Yes	No

*Will be addressed through education and outreach by local SWCDs.
**May be addressed through education and outreach by local SWCDs as time allows. Because this impact is considered small in the watershed, this concern will not be a focus of the project.

5.2 Potential Sources of Water-Quality Impairments

Concerns identified by the steering committee and raised by the public during open meetings were used to identify specific problems or conditions in the watershed that relate to these concerns. Multiple concerns can relate to a specific problem as seen in Table 36. To address these concerns, problems were further divided into potential causes and sources. Historic and recent data, windshield data, observations, as well as information found in the literature were used to try and pinpoint specific parameters which were causing the problems. Many of these sources will be investigated in the development of Critical Areas.

Table 42 Identification of Potential Sources

Stakeholder Concern	Problem	Potential Causes	Potential Sources
Flooding Drainage for Farmland Altered Hydrology Debris Clean-up in Streams	There is a need to balance drainage necessary for farming with flooding and water-quality impacts. Current management degrades the natural function of the floodplain (riparian) areas.	Excessive Drainage, Stream modification, Destruction of natural habitat	-250 Miles of Regulated Drains in the USRW -223 (50%) windshield survey (WSS) sites had fields with tile drainage -Floodplains and riparian areas are farmed or grazed (problem was widespread with 290 WSS sites [65%] needing buffers). -Lack of conservation tillage - 229 WSS (50.3%) had fields with conventional tillage. -234 WSS (53%) had stream bank erosion. -These problems were widespread and affected all eleven sub-watersheds.

Table 43 (Cont.) Identification of Potential Sources

Stakeholder Concern	Problem	Potential Causes	Potential Sources
CSO's (Combined Sewer Overflows)	Many Surface Waters in the Watershed do not meet Recreational Use Standards	*E. coli* Levels Exceed State Water Quality Standards	-Failing septic systems and straight pipes (Indiana Department of Health estimates that 25% of septic systems are failing, and soil data indicates that 99% of soils in the USRW are not suitable for septic systems.)
CFOs and CaFOs			-Combined Sewer Overflows (In both Portland and Montpelier)
Impact of septic systems -Old, Malfunctioning, Straight Pipes, Poor Maintenance, Inadequate Soils or Leach fields			-Livestock access to streams (13 confirmed sites from WSS. Watersheds affected include McLaughlin Ditch, Little Salamonie River, Cowboy Run, Glenn Miller Ditch, Mud Creek, and Stoney Creek)
Increase Recreational Use Capacity in the Watershed			-Lack of buffers along surface waters - (problem was widespread with 290 WSS [65%] needing buffers)
E. coli Levels in Waterbodies			-Improper manure application, poorly managed CFOs (43 CFOs identified in the windshield survey - 33% were located in McLaughlin Ditch, 14% in Mud Creek, 12% om Cowboy Run, and 12% in Glenn Miller
Manure Application Timing, amounts, on Frozen Ground, Other			
Nutrient Loads	Surface Waters Throughout the Watershed Contain High Levels of Nutrients	Nitrogen and Phosphorus Exceed Acceptable Target Levels	-Lack of buffer strips between farmland and surface waters - (problem was widespread with 290 WSS [65%] needing buffers)
Nutrient Run-off from Golf Courses			-Cattle access to streams (13 confirmed sites. Watersheds affected include McLaughlin Ditch, Little Salamonie River, Cowboy Run, Glenn Miller Ditch, Mud Creek, and Stoney Creek)
Drainage as it Relates to Water Quality - Farm Tiles and Other Drainage Ways			-Improper Manure Application, Poorly Managed CFOs (43 CFOs identified in the windshield survey - 33% were located in McLaughlin Ditch, 14% in Mud Creek, 12% om Cowboy Run, and 12% in Glenn Miller Ditch)
Decreasing Adoption of Conservation Tillage			-Lack of Conservation Tillage and Cover Crops (229 WSS sites [50.3%] had land under conventional tillage, only 48 WSS sites [11%] had any land in cover crops)
Nutrient Run-off from Farm Land			-CSOs - Combined Sewer outlets from Portland and Montpelier are located in the USR Watershed
Application of inorganic fertilizers - city and residential			-Failing Septic Systems (Indiana Department of Health estimates that 25% of septic systems are failing, and soil data indicates that 99% of soils in the USRW are not suitable for septic systems.)
CFOs and CaFOs			-Run-off from impervious surfaces (7% of the watershed is urban, with the greatest portion in the Berger Ditch sub-watershed)

Table 44 (Cont.) Identification of Potential Sources

Stakeholder Concern	Problem	Potential Causes	Potential Sources
Application of Inorganic Fertilizers and Manure - Golf Courses, Farmland	Surface Waters Throughout the Watershed Contain High Levels of Nutrients	Nitrogen and Phosphorus Exceed Acceptable Target Levels	-Fertilizer applied to farmland and city properties
Well Water Quality… are Aquifers at Risk in the Watershed			-Lack of Phosphorus requirements for wastewater treatment facilities
Run-off from Development			-Drain tiles help leach nitrogen from the soils (223 [50%] WSS sites had fields with tile drainage)
Wetland Conservation/Creation/ Restoration	Fish and Wildlife numbers are low due to negative environmental impacts	Lack of Habitat and Low Water Quality Turbidity and TSS Values above acceptable target levels, Nutrient Values above acceptable Target Levels,	-Stream Channel Alterations (problem widespread)
			-Altered Hydrology (250 Miles of Regulated Drains in the USRW), 223 WSS sites (50%) had fields with tile drainage
Yard Spray (Pesticides, Fertilizer)			-Cattle Access (13 confirmed sites. Watersheds affected include McLaughlin Ditch, Little Salamonie River, Cowboy Run, Glenn Miller Ditch, Mud Creek, and Stoney Creek)
Lack of Fish in the River			-Lack of Suitable Riparian Buffers (problem was widespread with 290 WSS sites [65%] needing buffers)
Balance Need for Drainage with Natural Habitat for Wildlife			-Toxic Chemicals and Legacy Pollutants

6.0 Load Calculations and Designation of Critical Areas

The Upper Salamonie was subdivided into eleven 12-digit Hydrologic Unit Code areas to facilitate the identification of priority or critical areas. These are areas that have been classified as top priority areas for the limited funds available to address the concerns raised in this report. For this task, generalized modeling was performed using the web-based Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL) developed by Purdue University and Kangwon National University. Because there was limited water-quality data available, it was felt that modeling would provide a more accurate picture of what was occurring in the watershed.

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

General inputs required for the program include individual land uses for each sub-watershed, soil types and characteristics, climate data (specifically precipitation data) from the closest weather station available and flow data. Flow data from USGS gage 03324300 on the Salamonie River near Warren, IN was used to estimate flows for each of the eleven sub-watersheds in the USRW, and were input into the model. There are also some optional data types that may be entered to improve the models accuracy. For the Lower Salamonie we looked at two of these alternative inputs. The first was number of septic systems and estimated failure rates, and the second was livestock located in the watershed.

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

Livestock numbers were also input into the model. To get a general estimate of livestock numbers, data from the 2012 Census of Agriculture developed by the Unites States Department of Agriculture were used to determine numbers of livestock, by species, at the county level. These numbers were considered to be evenly distributed throughout the county containing the sub-watersheds, and the percentage of the county in the sub-watershed was used to determine number of animals within the watershed. Once these total numbers were calculated they were distributed to the different sub-watersheds depending on the overall percentage of confined feeding operations identified in the windshield survey. Although the windshield survey doesn’t provide a complete list of the confined feeding operations in each sub-watershed, it gives a more accurate estimate than just assuming that the animals are distributed evenly across all sub-watersheds, and thus improves the accuracy of the model. In the event a sub-watershed was located in more than one county, final numbers were determined looking at the percent of the watershed in each county and that county's overall livestock numbers. Once these numbers were input, the model was run with the following results (Tables 37 - 39).

Table 45 Total Loading Calculations for Sub-watersheds by STEPL

Watershed Name	12-Digit HUC Code	N Load (lbs/year)	P Load (lbs/year)	BOD Load (lbs/year	Sediment Load (tons/year)
McLaughlin Ditch	051201020101	81073	18373	183585	7060
Little Salamonie River	051201020102	66644	14687	157547	5566
Berger Ditch	051201020103	66696	14792	160796	5597
Miller Ditch	051201020105	77927	16944	185757	6320
Sipe Ditch	051201020104	54961	12121	134230	4665
Cowboy Run	051201020106	63280	13735	150762	5183
Glen Miller Ditch	051201020108	70796	15953	161346	6246
Mud Creek	051201020107	51154	11742	116385	4776
Two-mile Ditch	051201020201	79560	17885	182153	6857
Beaver Creek	051201020202	102345	22793	233334	8412
Stoney Creek	051201020203	59705	13504	138086	5301
Upper Salamonie Watershed		774141	172530	1803979	65982

Table 46 Total Loading Calculation from STEPL by Landuse

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	66444	10256	257727	1526
Cropland	651609	149317	1350288	63890
Pastureland	30953	2790	98710	472
Forest	3303	1617	8108	94
Septic	21832	8551	89146	0

Table 47 Loading Percentage Calculation from STEPL by Landuse

Sources	N Load (lb/yr)	N Loading Percentage	P Load (lb/yr)	P Loading Percentage	BOD Load (lb/yr)	BOD Loading Percentage	Sediment Load (t/yr)	Sediment Loading Percentage
Urban	66444	8.58	10256	5.94	257727	14.29	1525.88	2.31
Cropland	651609	84.17	149317	86.55	1350288	74.85	63890.35	96.83
Pastureland	30953	4.00	2790	1.62	98710	5.47	472.06	0.72
Forest	3303	0.43	1617	0.94	8108	0.45	93.93	0.14
Septic	21832	2.82	8551	4.96	89146	4.94	0.00	0.00
Total	774141	100	172530	100	1803979	100	65982.22	100

E. coli Loading

E. coli values will be addressed as percentage of samples over target levels as opposed to loading numbers. Percentages addressed in the goals include 1) 5 year goal: Less than 40% of samples exceed state standards (235 colony forming units (cfu)), 2) 10 year goal: Less than 25% of samples exceed the state standard, 3) 30 year goal: only statistical outliers and high flows exceed state standard. At present only 30% of samples meet the state standard, and nine of 10 sites were over the 235cfu. Only US9 met the state standard during both sampling events.

Nitrogen Loading

The STEPL model for watershed loading yielded anticipated yearly loads for nitrogen. Although nitrogen is of concern, the limiting nutrient in the aquatic systems of the Upper Salamonie is phosphorus. Phosphorus will be the most important nutrient for load reductions in the watershed. The STEPL model calculates the total load of nitrogen from the watershed. It does not give the specific speciation, or what percentage of nitrogen is in each form. Thus it is not possible to compare the STEPL loads to the forms of nitrogen being sampled by the Upper Salamonie group. Therefore it was decided that load reduction targets for nitrogen would consist of standard percentages based on the 5 year, 10 year, and 30 year targets. The percentages chosen were 10%, 15% and 20% for the respective target dates. Actual reductions in pounds per year of nitrogen are shown in Table 40. For nitrate sampling, the ultimate goal for the Upper Salamonie would be to meet the 1mg/L set by Ohio EPA for warm water aquatic systems.

Table 48 Load Reductions for Nitrogen

Watershed Name	N Load (lbs/year)	N Load 10% reduction	N Load 15% reduction	N Load 20% reduction
McLaughlin Ditch	81073	72965	68912	64858
Little Salamonie River	66644	59980	56647	53315
Berger Ditch	66696	60027	56692	53357
Miller Ditch	77927	70134	66238	62341
Sipe Ditch	54961	49465	46717	43969
Cowboy Run	63280	56952	53788	50624
Glen Miller Ditch	70796	63716	60176	56637
Mud Creek	51154	46038	43481	40923
Two-mile Ditch	79560	71604	67626	63648
Beaver Creek	102345	92111	86994	81876
Stoney Creek	59705	53735	50749	47764
Upper Salamonie Watershed	**774141**	**696727**	**658020**	**619313**

Phosphorus Loading

STEPL was also used to calculate anticipated phosphorus loads for the 11 sub-watersheds. These values are shown below (Table 41), along with the target values for phosphorus. The ultimate target value is based on Ohio EPA's warm water recommendations for phosphorus. This value is 0.08mg/L. To obtain loading values, the annual flow from each sub-watershed was calculated and multiplied by this standard of 0.08mg/L. The result is shown below in pounds per year. The reduction required is high, ranging from a 76% to 78% reduction. This will be the target for the 30 year goal. It is understood that this target is very aggressive, and will need to be re-evaluated as implementation of the plan proceeds. The five and ten year goals are 10% and 20% respectively.

Table 49 Load Reductions for Phosphorus

Watershed Name	P Load (lbs/year)	Phosphorus 10% reductionn lbs/year	Phosphorus 20% reduction lbs/year	Phosphorus lbs/year @0.08mg/L Target Value	Target Value % Reduction
McLaughlin Ditch	18373	16536	14699	4154	77.4
Little Salamonie River	14687	13218	11749	3494	76.2
Berger Ditch	14792	13313	11834	3318	77.6
Miller Ditch	16944	15250	13556	3951	76.7
Sipe Ditch	12121	10909	9697	2656	78.1
Cowboy Run	13735	12361	10988	3382	75.4
Glen Miller Ditch	15953	14358	12762	3513	78.0
Mud Creek	11742	10568	9394	2523	78.5
Two-mile Ditch	17885	16097	14308	4000	77.6
Beaver Creek	22793	20514	18235	5372	76.4
Stoney Creek	13504	12154	10803	3012	77.7
Upper Salamonie Watershed	172530	155277	138024	39376	77.2

Sediment Loading

Anticipated loading for sediment for each sub-watershed was calculated using STEPL. The result for sediment load in tons per year is shown in Table 42). Sediment is a key factor affecting biological communities, and also transports phosphorus, which can be bound to sediment particles. For these reasons, sediment needs to be reduced. TSS (Total Suspended Solids) is one method by which suspended sediment is measured. However, TSS can also contain algae and other organic material, so it is often an over estimate of the sediment in the water column. However, for this study we will use it as a surrogate for sediment concentrations.

It has been found that a TSS concentration between 25 and 80mg/L can reduce fish populations. Higher concentrations have an even greater negative effect on aquatic organisms. A target of 40mg/L was chosen based on New Jerseys warm water recommendations for aquatic life. This target is also aggressive requiring load reductions from 83 to 87%. Therefore, this goal will be set at 30 years and will need to be re-evaluated as implementation proceeds. The five and ten year goals are 10% and 20% respectively.

Table 50 Load Reductions for Sediment

Watershed Name	Sediment Load (tons/year)	TSS at 10% reduction	TSS at 20% reduction	TSS at 40mg/L in Tons per year Target Level	Target Value % Reduction
McLaughlin Ditch	7059.61	6353.65	5647.69	1038.49	85.3
Little Salamonie River	5566.19	5009.57	4452.95	873.42	84.3
Berger Ditch	5596.72	5037.05	4477.38	829.60	85.2
Miller Ditch	6319.89	5687.90	5055.91	987.80	84.4
Sipe Ditch	4664.55	4198.10	3731.64	664.11	85.8
Cowboy Run	5182.55	4664.30	4146.04	845.40	83.7
Glen Miller Ditch	6246.45	5621.80	4997.16	878.34	85.9
Mud Creek	4776.17	4298.55	3820.94	630.74	86.8
Two-mile Ditch	6857.44	6171.69	5485.95	1000.08	85.4
Beaver Creek	8412.11	7570.90	6729.69	1342.92	84.0
Stoney Creek	5300.54	4770.49	4240.43	753.08	85.8
Upper Salamonie Watershed	65982.22	59384.00	52785.78	9844.00	85.1

6.1 Water Quality Goals and Indicators

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

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

Bacteria and Pathogens

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

1) 5 year goal: less than 40% of all samples exceed target (presently only 30% of samples meet the standard)
2) 10 year goal: less than 25% of all samples exceed target
3) 30 year goal: only statistical outliers or high flows exceed target

Indicators of Progress:

Sampling will show a continuing decline in *E. coli* counts
Calculated load reductions for Best Management Practices installed
Number of livestock restricted from stream access
Improvement of agricultural waste management practices: number of practices implemented
Improvements in septic system maintenance and care as a result of disseminated information and attendance at workshops
CSO separation by communities in the Salamonie River watershed, or other urban waste management strategies such as WWTP improvements, and temporary storage and then treatment of CSO discharges (Portland is already working to solve these issues.)

Nutrients (Phosphorus and Nitrogen)

High nutrient concentrations have been documented in the Upper Salamonie. The steering committee would like to reduce phosphorus loading up to 78% and nitrogen loading up to 20%. Current loading for nitrogen and phosphorus are 774,141lbs/yr and 172,530lbs/yr respectively.

5 Year Goal: 10% reduction in Nitrogen (77,414lbs/yr), 10% reduction in Phosphorus (17,253 lbs/yr)
10 Year Goal: 15% reduction in Nitrogen (116,121 lbs/yr), 20% reduction in Phosphorus (34,506 lbs/yr)
30 Year Goal: 20% reduction in Nitrogen (154,828 lbs/yr), 77% reduction in Phosphorus (133,154 lbs/yr)

Indicators of Progress:

Number of BMPs implemented, and calculated load reductions for each
Number of farmers implementing conservation tillage and acreage involved
Number of Farmers using cover crops and acreage involved
Number of nutrient management plans completed
Linear feet of 2-stage ditches installed
Number of livestock stream access sites eliminated
Decrease in nitrate concentrations over time. 30 year goal would be a maximum concentration of 1mg/L

Number of attendees to workshops and other educational events
(Any BMPs installed will be modeled to determine their overall load reduction.)

Sediment (Total Suspended Solids)

Total Suspended Solids (TSS) such as sediment, organic matter, and other floating debris have been shown to be problematic throughout the watershed. Sediment smothers habitat, transports excess nutrients, and makes the stream aesthetically unappealing. The steering committee would like to see average sediment reduced by up to 85% in the next 30 years. Current loading for sediment is 65,982 tons/yr. An 85% reduction would be equivalent to 56,138 tons/yr.

5 Year Goal: Reduce sediment by 10% (6,598 Tons/yr)
10 Year Goal: Reduce sediment by 20% (13,196 Tons/yr)
30 Year Goal: Reduce sediment up to 85% (56,138 Tons/yr)

Indicators of Progress:

Steady or downward trend in documented TSS values meeting the 5, 10, and 30 year goals listed above
Number of BMPs implemented, and calculated load reductions for each.
Number of farmers implementing conservation tillage and acreage involved
Number of Farmers using cover crops and acreage involved
Linear feet of 2-stage ditches installed
Improvement in stream PTI scores
Number of attendees to workshops and other educational event
(Any BMPs installed will be modeled to determine their overall load reduction.)

Impaired Biotic Communities

Portions of the Upper Salamonie have Impaired Biotic Communities. The steering committee would like to improve habitat and educate stakeholders on the importance of protecting natural areas and restoring habitat in rivers and riparian areas. It is also desired that all rivers and streams meet aquatic life designations. After 5 to 10 years the Steering Committee would like to see PTI scores in line with CQHEI scores.

5 Year Goal: 20% of sampled sites show an increase in rating for either CQHEI or PTI. (ie. PTI rating increase from Poor to Fair.)

10 Year Goal: PTI scores will rate equal to, or better than CQHEI scores. (ie. If the CQHEI rating is Good, then the PTI rating will be Good or Excellent)

30 Year Goal: All sampled locations will have a CQHEI and PTI rating of Fair or Better.

Indicators of Progress

Improved ratings for both CQHEI and PTI.
Improved fish survey scores in future IDEM samplings
Restored wetland systems (One site during the first 5-year period. Three sites within the first 30 years, or an increase in acreage for existing sites from 15-30 acres.)
Reduced nutrient and sediment concentrations meeting the goals set forth above

Increase in linear feet of stream buffer
Linear feet of installed 2-stage ditches

Recreational Use

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

5 Year Goal:	Educate stakeholders on the value of the Salamonie River at workshops and field days. Hold at least one event per year Organize a river clean-up on the Salamonie River in Jay and Blackford Counties
10 Year Goal:	Improve riparian areas, aquatic habitats, and the fishery
30 Year Goal:	There are no public access points to the Salamonie River in Blackford County. The USRW will seek to create one Increase trails that intersect with the river

Indicators of Progress

Creation of Blackford County access site to Salamonie River
Stakeholder participation in workshops, field days, and river clean-ups
Implementation of recommendations from Taylor Universities' Social Indicator Study
Decrease in number of *E. coli* violations, measured by water-quality testing
Improved clarity of the water, reduction in turbidity readings
Stakeholder interest in improving the river, measured by number of landowners installing BMPs
Decrease in number of harmful blue-green algal blooms in downstream Salamonie Reservoir

7.0 Critical and Priority Area Selection

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

7.1 Windshield Survey Critical Area Evaluation

As previously mentioned, an extensive windshield survey resulting in 445 evaluated sites was completed in the Upper Salamonie. Several categories of data collected where used to determine the overall quality of the site, and the areas potential contribution to water-quality problems (Table 43). For each of the categories evaluated a scoring system was devised to compare information from site to site. Site scores for each sub-watershed where summed and then divided by the number of sites in the watershed. This resulted in a unique number for each sub-watershed. The higher the number, the more degraded the sub-watershed was according to the parameters studied. From these scores, the sub-watersheds were divided into three categories: Tier 1, Tier 2, and Tier 3. Tier 1 are the sub-watersheds of greatest concern, and Tier 3 are sub-watersheds of least concern. The score ranges for each Tier are shown in Table 17. Although all sub-watersheds are in need of improvement, this ranking system helps guide the prioritization of limited funds and technical assistance. Implementation funds will be restricted to Tier 1 and Tier 2 watersheds until all opportunities in those watersheds are exhausted.

Table 51 Windshield Survey Category Scores and Ratings

Stream Name	Steam Bank Erosion	Buffer Width	Conserva-tion Tillage	Livestock Access	CFO	Hobby Farms	Drain Tiles	Trash	Total Score	Score per site	Rating
McLaughlin Ditch	28.5	47	82	9	14	4	26	7	217.5	3.954545	Tier 1
Berger Ditch	12	34.5	36	0	4	0	16	3	105.5	3.767857	Tier 2
Little Salamonie River	30	17	66	6	1	3	17	1	140	2.692308	Tier 3
Sipe Ditch	18	32	14	0	1	2	17	3	86.5	3.326923	Tier 2
Miller Ditch	65	29	30	0	2	7	28	3	163	3.075472	Tier 3
Cowboy Run	40	31	26	9	5	10	16	16	152.5	2.932692	Tier 3
Glen Miller Ditch	39	41	18	6	5	7	24	5	144.5	4.66129	Tier 1
Mud Creek	47	24	8	3	6	3	17	6	113	4.708333	Tier 1
Two-mile Ditch	59	47	27	0	2	7	23	5	169.5	4.346154	Tier 1
Beaver Creek	48	57.5	29	0	2	5	23	3	167.5	3.641304	Tier 2
Stoney Creek	22	20	11.5	6	1	7	16	0	83	2.128205	Tier 3

7.2 STEPL Critical Area Evaluation

STEPL watershed modeling was performed on each of the 11 sub-watersheds to determine the loading of three parameters of concern (phosphorus, nitrogen, and sediments) to area streams. The total loads were calculated for each sub-watershed, and then divided by the number of acres in the watershed to determine relative contribution per acre of each of the parameters of concern. The intent was to use these values to help determine critical areas along with understanding the magnitude of the loads. However, values for each sub-watershed were very similar for each of the three parameters; nitrogen, phosphorus, and sediment (Table 44). Although the model gives some understanding of the magnitude of loads impacting area streams, it was not helpful in finding differences between sub-watersheds that would aid in critical area determination. In addition, it is believed the loading from sub-watersheds may be significantly higher than the model predicted. The model did not take into account stream-bank erosion, which could be contributing a significant amount of the pollutant load. From the windshield survey, stream-bank erosion appears to be a major problem throughout the Upper Salamonie.

Table 52 Pollutant Loads per Acre by Sub-watershed

Watershed Name	Acres	Nitrogen Load in Lbs/acre	Phosphorus Load in Lbs/acre	Sediment Load in Tons/acre
McLaughlin Ditch	17087	4.74	1.08	0.41
Little Salamonie River	14371	4.64	1.02	0.39
Berger Ditch	13650	4.89	1.08	0.41
Miller Ditch	16253	4.79	1.04	0.39
Sipe Ditch	10927	5.03	1.11	0.43
Cowboy Run	13910	4.55	0.99	0.37
Glen Miller Ditch	14452	4.90	1.10	0.43
Mud Creek	10378	4.93	1.13	0.46
Two-mile Ditch	16455	4.84	1.09	0.42
Beaver Creek	22096	4.63	1.03	0.38
Stoney Creek	12391	4.82	1.09	0.43
Upper Salamonie River	**161970**	**4.78**	**1.07**	**0.41**
Value Range		**4.55 – 5.03**	**0.99 – 1.13**	**0.37 – 0.46**

7.3 Final Critical Area Determination

Critical Areas were determined using mainly the windshield survey. Windshield surveys were prioritized first in the development of the critical areas because they involve actual documentation of parameters that have been scientifically shown to cause water-quality degradation. Modeling of the watershed was completed using STEPL, but was not useful in determining critical areas (figure 59). The modeling took into account several parameters including: soil types and properties, such as erodibility and hydric qualities; land use; septic system use; and other regional properties that can be applied to the entire watershed. However, little difference was found in pollutant load per acre from sub-watershed to sub-watershed.

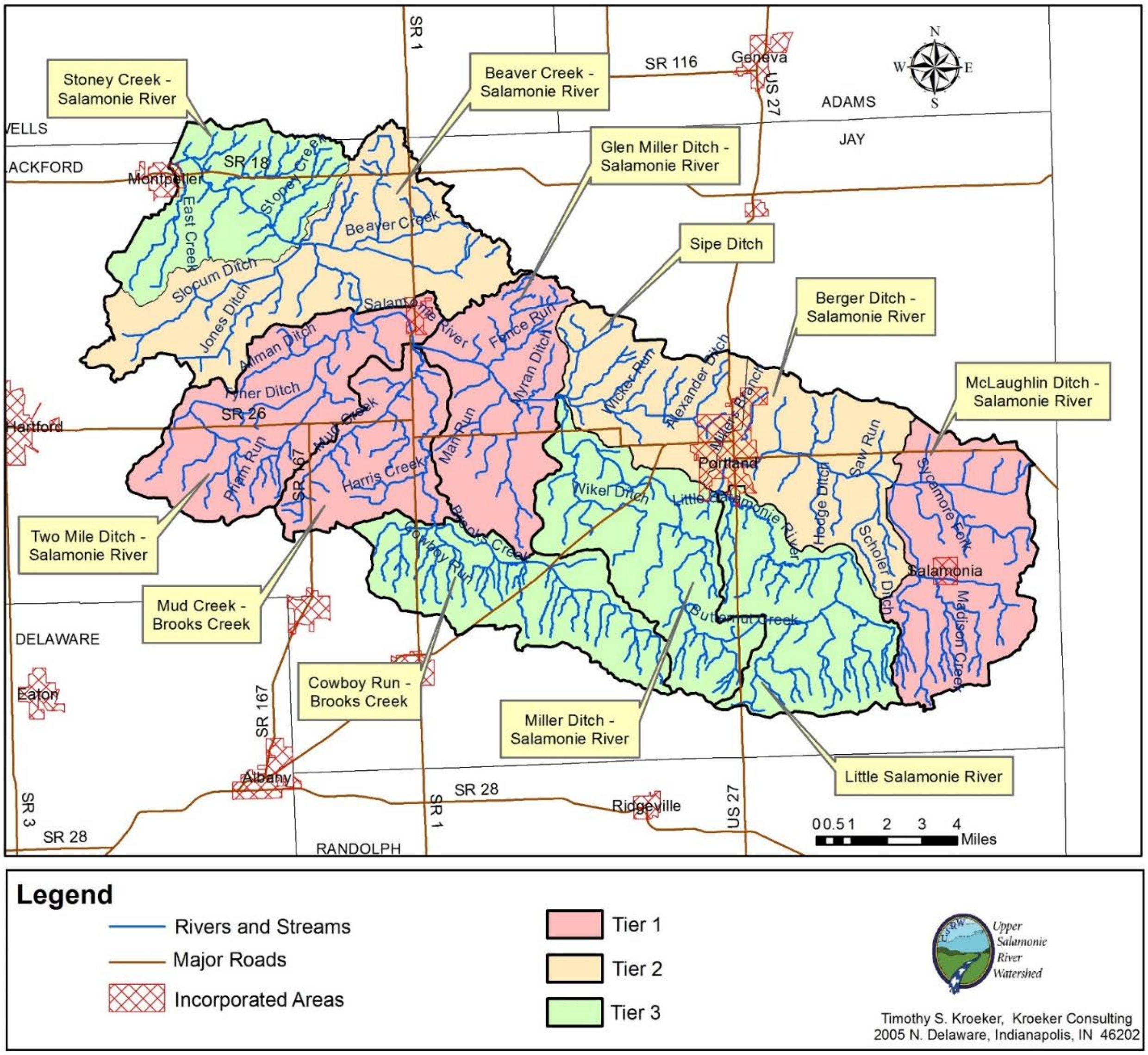
In addition, water-quality data, both chemical and biological, were evaluated to determine if the data generally supported or didn't support the critical area designations. Chemical water-quality data, unless it exists in sufficient quantity for a proper evaluation, although valuable can be transient, and site specific. Therefore it was used only to add support to the critical area assignments. The biological data collected for the project was part of a volunteer effort, and since it could not be professionally verified, was used in a supportive role. Table 45 shows each sub-watershed, the tier designations for the windshield survey, and whether or not the chemical and biological data tended to support the tier designation, or there was some question. Where differences arise may indicate where further investigation needs to take place to determine if the data is indicative of a localized problem or indeed represents the overall quality of the sub-watershed. The designated critical areas are shown in Figure 59.

In summary, critical areas were evaluated and designated as either Tier 1, Tier 2, or Tier 3 watersheds depending on the severity of the problems. All three tiers were above standards for Nutrients, E. coli, and Sediment. Tier 1 watersheds are believed to be the most degraded and are thus a high priority for implementation whereas Tier 3 watersheds are considered to be in the best condition, and are a lower priority. Tier 2 watersheds are intermediate. This plan will focus on Tier 1 and Tier 2 watersheds, with preference given to Tier 1. However, it should be understood that watersheds in all three tiers would benefit from best management practices to improve water quality and protect and enhance existing natural resources.

Table 53 Critical Area Tier Designations Support

Sub-Watershed Name	Windshield Survey Rating	Supported by Chemical Data	Supported by Biological Data
McLaughlin Ditch	Tier 1	Yes	Inconclusive
Berger Ditch	Tier 2	Yes	Yes
Little Salamonie River	Tier 3	Yes	No Bio. Data Available
Sipe Ditch	Tier 2	Yes	Yes
Miller Ditch	Tier 3	Yes	Yes
Cowboy Run	Tier 3	Yes	No Bio. Data Available
Glen Miller Ditch	Tier 1	Yes	Inconclusive
Mud Creek	Tier 1	Yes	Yes
Two-mile Ditch	Tier 1	Yes	Yes
Beaver Creek	Tier 2	Yes	No Bio. Data Available
Stoney Creek	Tier 3	Yes	Inconclusive

Figure 59 Critical Areas in the Upper Salamonie River Watershed



8.0 BEST MANAGEMENT PRACTICES

8.1 Best Management Practices for Watershed Protection and Restoration

Steering Committee members identified a list of Best Management Practices which were most likely to be adopted in the USR watershed (Tables 46 – 49). It is hoped that these practices will result in the Salamonie River watershed meeting the water-quality goals outlined in this report. There are many other practices that could be used to address these issues, and these may or may not come into play as changes and improvements in technology and land management strategies develop and implementation proceeds. The list is heavily focused on practices for agricultural-based land use since this is the greatest landuse in the watershed. Many of these practices may also be used in urban and suburban areas. As implementation proceeds, more practices may be added to the list as they become effective and practical for use in this watershed.

Table 54 BMPs for Phosphorus and Nitrogen Load Reductions

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

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

Table 55 BMPs for TSS Load Reductions

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

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

Table 56 BMPs for Bacterial and Pathogen Load Reductions

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

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

Table 57 BMPs for Habitat and Biological Impairments

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

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

8.2 Outreach and Education for Watershed Protection and Restoration

Education and outreach plays a crucial role in the implantation of any watershed management plan. Various outreach strategies have been developed to help address issues in critical areas in the watershed. Table 50 shows desired outcomes and recommended strategies for achieving those outcomes in the Upper Salamonie River watershed.

Table 58 Desired Outcomes for Outreach and Education in the USR Watershed

Outcomes	Strategies
Increase general knowledge of rural BMPs	Workshops, Cover Crop Field Days, Booths and Displays at Community Events, Educational Materials on the Internet and in Brochures
Increase adoption of BMPs within critical areas	Cost-Share Monies through IDEMs 319 program, ISDA Clean Water Indiana, and the LARE Program, Technical Assistance Provided by NRCS and ISDA, Continue to Partner with Taylor University and Increase Beneficial Partnerships, Conservation Tillage Workshops, Cover Crop Field Days
Increase capacity to fund BMPs within critical areas	Cost-Share, Technical Assistance, Seek alternative funding sources such as The Nature Conservancy for 2-stage Ditches, or Possible County or Private Funding for Specific Projects

Table 50 Cont. Desired Outcomes for Outreach and Education in the USR Watershed

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

8.3 Action Register and Schedule

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

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

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

9.0 FUTURE ACTIVITIES & PROJECT TRACKING

9.1 Tracking Effectiveness

Indicators have been identified for each of the goals outlined by the steering committee and will be monitored to evaluate the level of success during implementation. Water quality data will also be collected. Temperature, dissolved oxygen, pH, total phosphorus, nitrate, turbidity, and E.coli will be sampled twice each year, once during low flow and once during high or medium flows and compared to water-quality criteria outlined in the plan. Sampling will continue as long as funding is available. It is estimated that costs for sampling over the next three to four years, not including in-kind service, would be approximately $15,000. Habitat and biological sampling will also take place once a year at each of the 6 volunteer sampling sites if conditions allow. In addition, modeling will be completed to estimate load reductions for each of the best management practices knowingly installed in the watershed during the implementation phase. Technical assistance will be provided by a watershed specialist when funded, and from ISDA, NRCS, and the local SWCDs.

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

9.2 Future Plans

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

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

Every effort to continue water-quality monitoring will be made, and future testing results might also warrant changes to the plan. A CWI grant has been obtained and will provide seed money for implementation in 2016. In addition, a 319 implementation grant is currently being pursued to continue to fund implementation when present funding ends in January of 2017. Additional possibilities for funding will be periodically pursued. The plan may also need to be altered if it will work better with other local and regional planning efforts. Finally, it is hoped that the specific partnerships established during the planning phase of the project will be carried through the implementation phase, and the outcome will be a successful implementation resulting in improved water quality, greater soil health, and a higher quality of life.

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Action Register and Schedule

5-Year Nutrient, Sediment, and Environmental Goals. (These goals will be repeated for the following 5 years unless it is determined by the s

Objectives	Anticipated Load Reductions*	Target Audience	Milestones
Plant 2,500 acres of cover crops	Sediment - 1547 t/year, Phosphorus - 2713 lbs/year, Nitrogen - 5412 lbs/year	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Identify alternate funding sources to increase participation
			Maintain demonstration plots for cover crops
			Implemant 500 acres of new cover crop acreage per year (2016 - 2020)
			Targeted mailing and personal visits with prospective landowners. Plan and host a "conservation openhouse" to educate and provide resources and technical assistance to landowners intersted in agricultural BMPs.
			Promote Soil Health
Complete Nutrient Management Plans on 8,000 acres of cropland	Unknown	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Annually implement 1,600 acres of Nutrient Management Plans (2016 - 2020)
			Targeted mailing and personal visits with prospective landowners. Plan and host a "conservation openhouse" to educate and provide resources and technical assistance to landowners intersted in agricultural BMPs.
			Identify alternate funding sources to increase participation

Exclude livestock access to streams in 4 locations, provide alternative water source.	Unknown	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Prevent cattle access to streams at 1 location per year (2015-2019)
			Provide alternate watering source where needed
			stabilize impacted stream banks through stream bank stabilization program
			Identify alternative funding sources for practices
Increase conservation tillage in the watershed by 7,500 acres	Sediment - 3539 t/year, Phosphorus - 6228 lbs/year, Nitrogen 12423 lbs/year	Agricultural Producers	Establish Cost Share Program Spring/Summer of 2015
			Promote Soil Health
			Provide funds for equipment modifications
Install 5 miles of conservation cover and buffers along streams	Sediment - 925 t/year, Phosphorus - 1519 lbs/year, Nitrogen 3024 lbs/year	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Targeted mailing and personal visits with prospective landowners. Plan and host a "conservation openhouse" to educate and provide resources and technical assistance to landowners intersted in agricultural BMPs.
			Identify alternate funding sources to increase participation
			Complete 1 mile of conservation cover or buffers per year
			Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program

Install 10 water and sediment control basin (WASCOBs)	Sediment - 189 t/year, Phosphorus - 189 lbs/year, Nitrogen 378 lbs/year	Agricultural Producers	Targeted mailing and personal visits with prospective landowners. Plan and host a "conservation openhouse" to educate and provide resources and technical assistance to landowners intersted in agricultural BMPs.
			Identify alternate funding sources to increase participation
			Install 2 WASCOBs per year (2015-2020)
Increase awareness of septic system problems and solutions	Unknown	Rural Homeowners and unincorporated areas without public sewage	Hold 1 workshop on rural/residntial septic operation and maintenance
			Create Septic System Informational Brochure
			Create Septic System Informational Refrigerator Magnet to pass out at events
Increase awareness of Agricultural BMPs	Unknown	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Promote Soil Health
Increase prescribed grazing and pasture management by 100 acres	Sediment - 93 t/year, Phosphorus - 150 lbs/year, Nitrogen 612 lbs/year	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
Complete 1000 feet of streambank stabilization	Sediment - 306 t/year, Phosphorus - 306 lbs/year, Nitrogen 612 lbs/year	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Install 1000 feet of streambank stabilization
Install a demonstration rain garden in a prominent urban setting	Unknown	Residential landowners and local governments	Establish Cost Share Program Spring/Summer of 2015
			Install one rain garden
			Develop marketing materials

Increase awareness of cost share programs	Unknown	Agricultural Producers	Implement Cost Share Program through Clean Water Indiana Grant - Spring 2016. Seek 319 Grant Funding for 2017 - 2019 for Cost-Share Funds and establish IDEM approved Cost-Share Program
			Targeted mailing and personal visits with prospective landowners. Plan and host a "conservation openhouse" to educate and provide resources and technical assistance to landowners intersted in agricultural BMPs.
Work with County Surveyors and landowners on environmentally sound alternatives to standard ditch maintenance practices	Unknown	Agricultural Producers and Land Owners	Promote the use of two stage ditches, especially where ditch maintenance is needed frequently
			Promote the use of drainage management
			Work with County Surveyors to adopt more environmentally sound drainage practices
Promote Wetlands for water storage and water-quality	Unknown	Agricultural Producers and Land Owners	Promote WRP cost share program to enhance water storage and
			Promote wetland restoration
			Identify alternative funding sources for practices

*Numbers based on US EPA Region 5 Model.

teering committee that they should be changed.)

Estimated Costs	Potential Partners/Technical Assistance	Potential Funding Sources
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants
$4000 10% coordinator salary		
$1,250		
$28,000		
$4000 10% coordinator salary		
$4000 10% coordinator salary		
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants
$21,200		
$4000 10% coordinator salary		
$4000 10% coordinator salary		

$20,000 50% coordinator salary $5,000 $50,000 $4000 10% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants
$20,000 50% coordinator salary $4000 10% coordinator salary $10,000	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants
$20,000 50% coordinator salary $4000 10% coordinator salary $4000 10% coordinator salary $1,800	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors,	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants
$20,000 50% coordinator salary		

$4000 10% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors,	IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants
$4000 10% coordinator salary		
$500	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors, Local Government	IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants
$500		
$500		
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants
$4000 10% coordinator salary		
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors,	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants
$50,000		
$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, Local Government, Volunteers	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants
$3,000		
$500		

$20,000 50% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, ISDA Clean Water Indiana Grants
$4000 10% coordinator salary		
$4000 10% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts, County Surveyors,	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants
$4000 10% coordinator salary		
$1,000		
$4,000 10% coordinator salary	NRCS, Purdue University Extension, Taylor University, ISDA, IDNR, IDEM, Soil and Water Conservation Districts	IDEM Non-Point Source Grants, NRCS Farm Bill Conservation Programs and Initiatives, ISDA Clean Water Indiana Grants, IDNR Lake and River Enhancement Grants
$4,000 10% coordinator salary		
$4,000 10% coordinator salary		