Prairie River Watershed Management Plan

MDEQ #2010-0002

May 9, 2014

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1. INTRODUCTION

> A **watershed** is an area of land that drains to a common point such as a lake, stream or river.
>
> Watersheds may be identified at many different scales, depending on size of the water body to which they drain.

The Prairie River Watershed (PRW) contains all of the land draining into the Prairie River as well as its tributaries throughout two states and three counties (See Figure 1). Lakes, streams, groundwater and wetlands are all components of the Prairie River system, serving important roles in the natural function of the watershed. The Prairie River system is an especially important resource for the region and heavily used for drinking water, agriculture, commercial applications and recreation. These uses while dependent on healthy, good water quality can also pose a significant threat to water quality.

For the community of the PRW, this accessible water resource is an important feature to protect providing numerous outdoor opportunities and economic benefits to the region. Locally, farmers depend on the water for raising their crops, while liveries and avid paddlers rely upon it for recreation. The abundance of lakes and streams provide increased waterfront property values contributing to a boost in the region's overall economic value. Its scenic lakes, rivers and streams have become a playground for locals and visitors alike, who enjoy paddling its 32 miles navigable of river or fishing, boating and swimming upon its 2831 acres of lakes and ponds.

The Prairie River Watershed Planning Project began in the summer of 2011. This project was awarded to the Branch Conservation District by the Michigan Department of Environmental Quality (MDEQ), Nonpoint Source Program, and funded with federal Clean Water Act Section 319 funds from the U.S. Environmental Protection Agency (U.S. EPA). The Prairie River Watershed Plan was designed to meet the watershed planning criteria of both the MDEQ and the U.S. EPA.

The type of pollution currently impacting the PRW is known as nonpoint source pollution meaning the pollutant source cannot be directly correlated to a single point such as a pipe or smoke stack. Nonpoint source pollution originates from a broad area. As precipitation or snowmelt runs over the land it picks up sediment, nutrients and other pollutants which eventually end up in nearby rivers, lakes and streams.

Despite the presence of nonpoint source pollution, the Prairie River Watershed's overall water quality is considered to be good with the exception of the Sand Lake beach area. Sand Lake Beach, located in the western portion of the watershed has been determined to occasionally exceed or be near the water quality standards for *Escherichia coli (E. coli). E. coli* is bacteria found in the intestines of people and warm blooded animals and led to a beach closure at Sand Lake in 2004. Although the overall water quality is considered good in the PRW, past, current and potential future changes to the land can impact water quality. These changes may lead to impacts to the quantity and quality of the Prairie River water resources and are addressed herein.

The PRW Management Plan is intended to be a guide that residents, businesses, organizations and governmental units can utilize to ensure the water and natural resources in the area are protected and improved. Throughout the development of this plan, problems or potential problems were identified and prioritized with the help of stakeholders and partners. Additionally, information about pollutants and sources contributing to the watershed was gathered using a variety of assessments such as documenting land use, working with municipalities, and collecting watershed data through in-field inspections. As a result of this publicly-supported and science-based process, the plan details best management practices capable of restoring and protecting the PRW with a focus on preventing or reducing nonpoint source pollutant loads that degrade water quality.

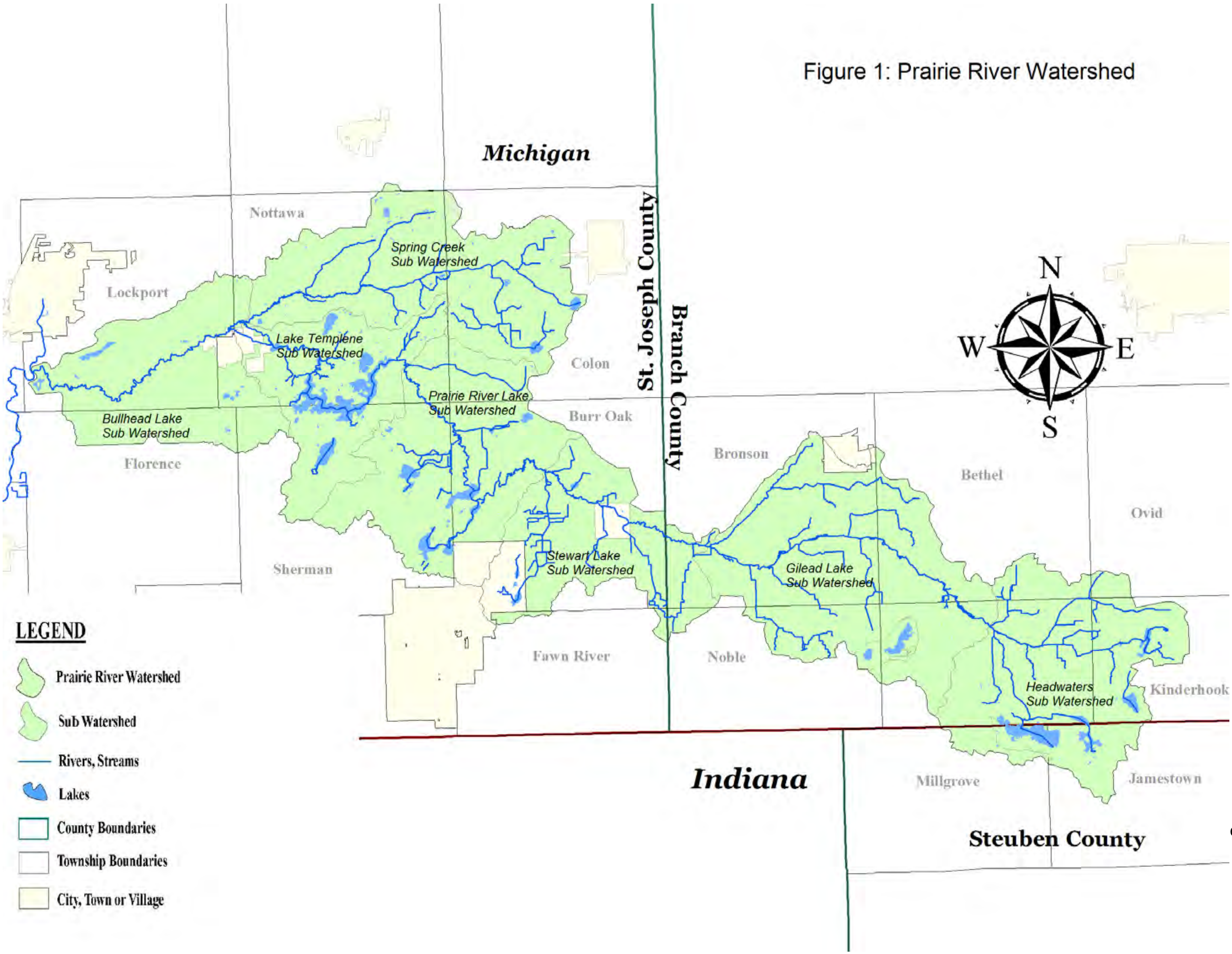


Figure 1: Prairie River Watershed

2. WATERSHED DESCRIPTION

A Hydrologic Unit Code (HUC) is a unique code consisting of 2 to 12 numbers based on the six levels of United States Geological Survey classification found below:

- 2-digit HUC – First level (region)
- 4-digit HUC – Second level (sub region)
- 6-digit HUC – Third level (accounting unit)
- 8-digit HUC – Fourth level (cataloguing unit)
- 10-digit HUC – Fifth level (watershed)
- 12-digit HUC– Sixth level (sub watershed)

The Prairie River Watershed (PRW) is located in the south central portion of Michigan's Lower Peninsula near the State of Indiana border. It encompasses 116,668.95 acres (182.30 square miles) of land that drain approximately 145 miles of rivers and streams in two states and three counties. The maintstem of the Prairie River spans 54 miles from its beginning in Branch County, MI to its end in St. Joseph County, MI. It is identified with the Hydrologic Unit Code (HUC) 0405000107.

The majority of this watershed is located in Branch and St. Joseph Counties, Michigan with a small portion extending into Steuben County, Indiana. Notably, the Prairie River directly converges and impacts one of the five major tributaries to Lake Michigan; the St. Joseph River, a significant source of Lake Michigan pollution. It is located in the middle region of the St. Joseph River Watershed. The headwaters of the Prairie River are located in the lakes of Kinderhook Township just three miles north of the Michigan-Indiana border. It flows westerly through Branch County into St. Joseph County eventually converging with the St. Joseph River south of Three Rivers, MI. As it flows westerly it encounters four impoundments one of which has a dam that could potentially be removed because it no longer serves its historic industrial function. The Prairie River is a relatively shallow river throughout the Branch County portion of the watershed and paddling is fairly limited to certain areas. Most of the accessible miles for navigation are located in St. Joseph County.

The PRW is a very large area that is broken into seven sub-watersheds (See Figure 1). Each sub-watershed hosts its own set of rivers and streams that flow into the main stem of the Prairie River or to a tributary of the Prairie River. Starting with Headwaters sub-watershed the river flows mainly north and west, contains eight tributaries with its southernmost tributary coming north out of Steuben County, Indiana. Next, heading west through Gilead Lake sub-watershed there are eight tributaries each generally flowing north and west. Stewart Lake Drain sub-watershed has five tributaries flowing northwesterly and is the sub-watershed that crosses the Branch County border. Prairie River Lake sub-watershed has only four tributaries and flows northwest before dipping south, then back northwest. Lake Templene sub-watershed has four tributaries and as it moves west it dips south then sharply back north. Spring Creek sub-watershed has the most tributaries with 10 coming from its headwater area near Colon, MI flowing southwesterly to the Prairie River main stem. Lastly, Bullhead sub-watershed has no tributaries and is home to only the main stem of the Prairie River flowing southwesterly where it eventually converges with the St. Joseph River.

2.1 CLIMATE

The Prairie River lies in the Northern Temperate Climate Zone, where due to Michigan's position between the Great Lakes, there are typically more moderate temperatures compared to other Northern and Midwestern states. The average air temperature is 47 degrees Fahrenheit, with 150 growing days and an average of 35 inches of precipitation per year. This amount is a bit higher than the average 32.25 inches for Michigan.

Historically, there have been approximately 127 rain days per year in the watershed. Of the 35 inches of yearly precipitation falling within the watershed, about 22 inches will be cycled back into the atmosphere through evaporation or transpiration. Approximately 9 inches will infiltrate the soil and recharge the ground water supply. Conservative estimates show that the remaining 4 inches will become run off to surface water. These figures are cumulative and rates of runoff will vary from location to location throughout the watershed. *(USDA-NRCS - efotg. and* USGS *Scientific Investigations Report 2005–5284)*

2.2 GEOLOGY & SOILS

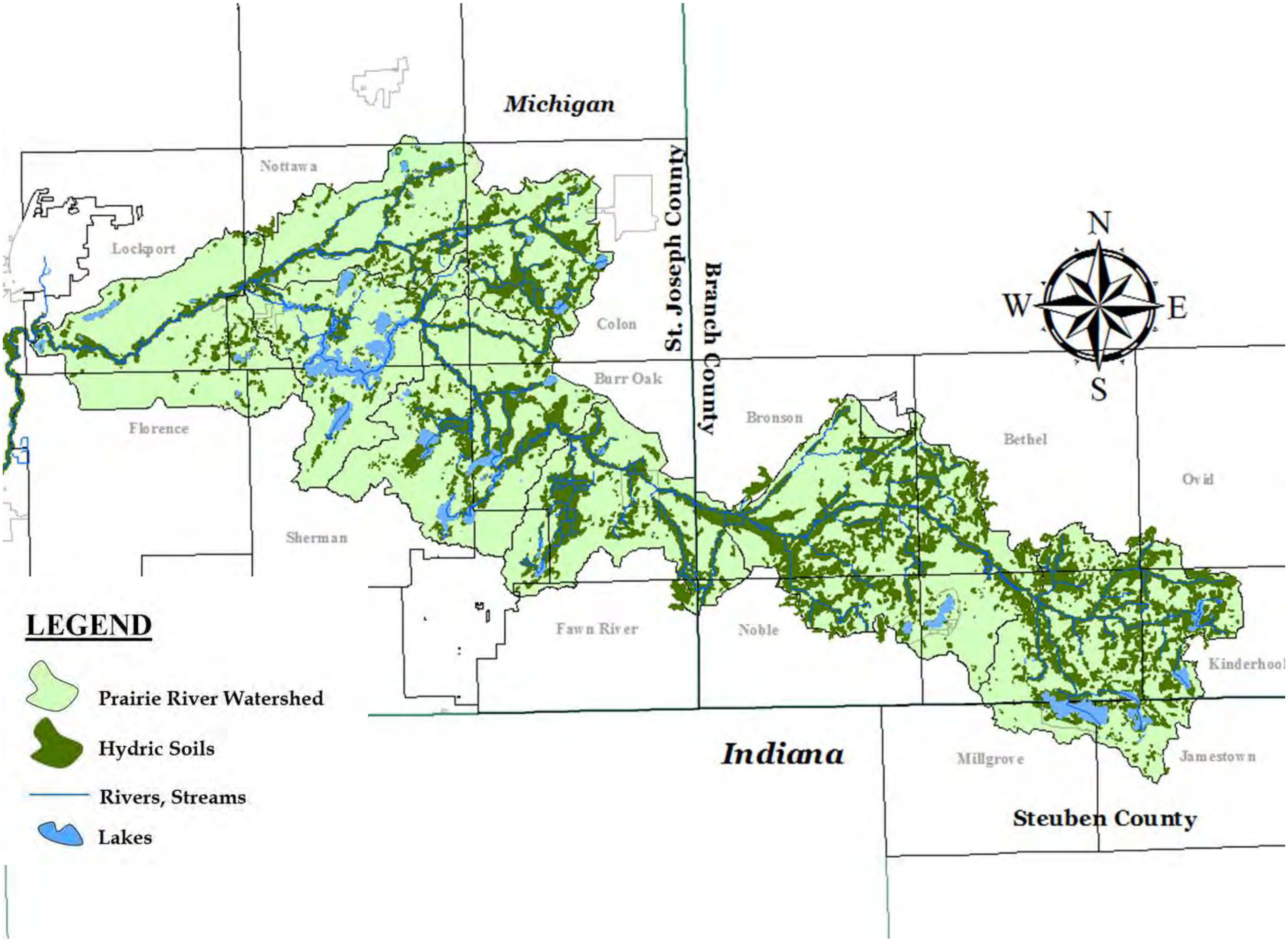
The landforms and topography of this Michigan and Northern Indiana region were formed by the extensive glacier movement during the last ice age roughly 10,000 years ago. During this time, the glaciers advanced and receded many times, but it was the last advance that formed the Prairie River Watershed. This advancement and recession of the glacier left moraines, outwash plains and till plains throughout the watershed area. The ice movement shaped patterns and distributions of different landforms such as stream valleys and melt water created the rivers, which deposited glacial material throughout the area in varying depths. The last ice recession created the ridgelines that define the watershed as well as the many lakes and wetlands that are visible today.

The soil types within the Prairie River Watershed represent the meeting point for two glacial lobes during the last ice age leaving mainly glacial outwash areas. The predominant soil of the Prairie River Watershed is moderate to well drained sandy, loamy soils (Oshtemo-Pinks, Fox-Oshtemo-Ormas, Riddles, Fox-Houghton-Edwards). These sandy, loamy type soils have low runoff potential and a high infiltration rate when they are thoroughly saturated. As a result of the coarse textured soil type, water infiltrates rapidly and recharges the groundwater supply. Groundwater inputs are important for maintaining stream temperatures and stream flow. Protection of areas with high infiltration capacity is important in order to protect the quality and quantity of groundwater which in turn maintains the hydrology and temperature regimes of the Prairie River.

Although loam soils seem to be the primary soil type, there are areas in the PRW that are poorly drained. In the St. Joseph County portion of the watershed those poorly drained soils are few and seem to be primarily in the east side of the County. As it transitions to Branch County there are larger expanses of poorly drained soils such as Matherton-Sebewa-Branch Association particularly around the Bronson, MI area.

Characteristics of soil are important especially when defined as a hydric soil. Hydric soils are poorly or somewhat poorly drained soils formed under conditions once saturated or flooded long enough to create anaerobic conditions in the top growing layer. This type of soil is an indicator of the presence of wetlands, even though many of these areas have been drained for development or agricultural uses. Hydric soils are considered poorly suited for building or development and more importantly, unsuitable for septic fields. Septic systems installed in these areas are prone to failure, which can lead to nutrient and bacteria pollution of surface and groundwater. Over 20% of the PRW consists of hydric soils. (See Figure 2: Prairie River Watershed Hydric Soil Map.) These boggy, poorly drained mucky soils (Adrian-Granby Association) hug the river banks. In the St. Joseph county portion of the watershed, they are found where the Prairie River converges with the St. Joseph River, surrounding the Stewart Lake Drain as well as the output from Beaver Lake in the Spring Creek sub-watershed. *(St. Joseph County Soil Survey)* Within the Branch County section of the PRW, poorly drained, mucky soils (Fox-Houghton-Edwards) can be found on the western side of Gilead Lake and along the mainstem of the Prairie River in the Gilead Lake sub-watershed. *(Branch County Soil Survey)*

Figure 2: Hydric Soils in the Prairie River Watershed



2.3 TOPOGRAPHY

The Prairie River Watershed is defined by topographic ridges that at their highest are 1003 feet above mean sea level. The highest point in the watershed is near the headwaters. Falling from here it gradually slopes downwards to the northwest ending where the river joins the St. Joseph River. Some of the lower elevations are located near flood plain areas as well as in the portion of the watershed near the mouth of the river. Bullhead Lake sub-watershed is flat terrain as it flows into the St. Joseph River on the western end of the PRW. The overall layout of the watershed trends downward towards the north and west. (See Elevation Map L in Appendix 1.)

2.4 LAND COVER

Pre-settlement land cover for the Prairie River Watershed consisted mainly of forested lands. In Eastern portions of the watershed, Beech-Sugar Maple and Oak-Hickory forests dominated. Moving west land covers of mixed-Oak forests, Oak-Hickory forests and mixed-Oak savannas were the dominant cover. Although land cover was mainly forested, swamps, wet prairies and grasslands were all represented as well. (See Appendix 1 Map A)

Today's land cover for the Prairie River Watershed has become converted over time by agricultural practices as well as expanding residential and commercial developments. As seen in Figure 3, Figure 4 and Figure 5, the majority of the land use is agricultural with 69% of the total watershed acres dedicated to this practice. Primarily, this is a result of the good soils of the region. Natural land cover which consists of forested land, water and wetlands make up 27% of the watershed. Lastly, although there are no major cities within the watershed borders, the developed urban land comprises 4% of the watershed.

Figure 3: Land Cover in the Prairie River Watershed 2006 *(percentages)*.

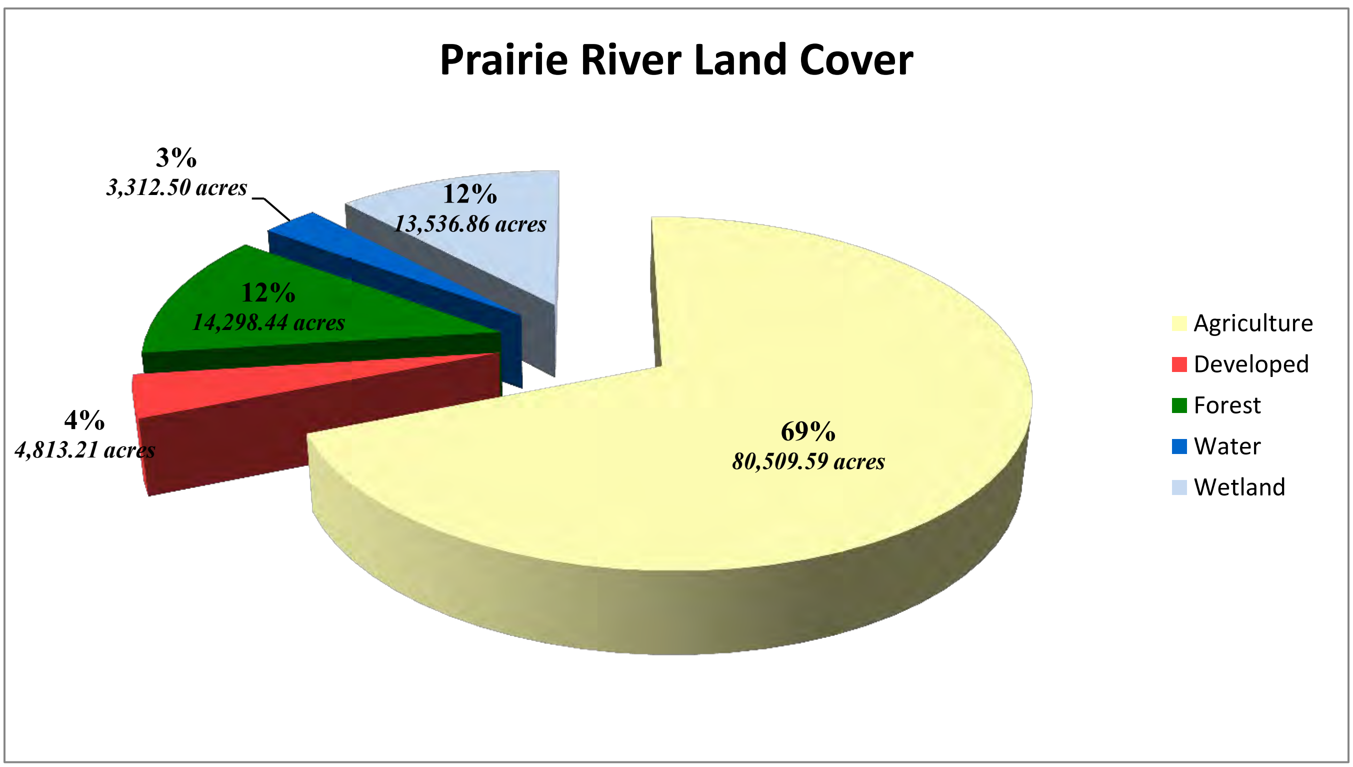
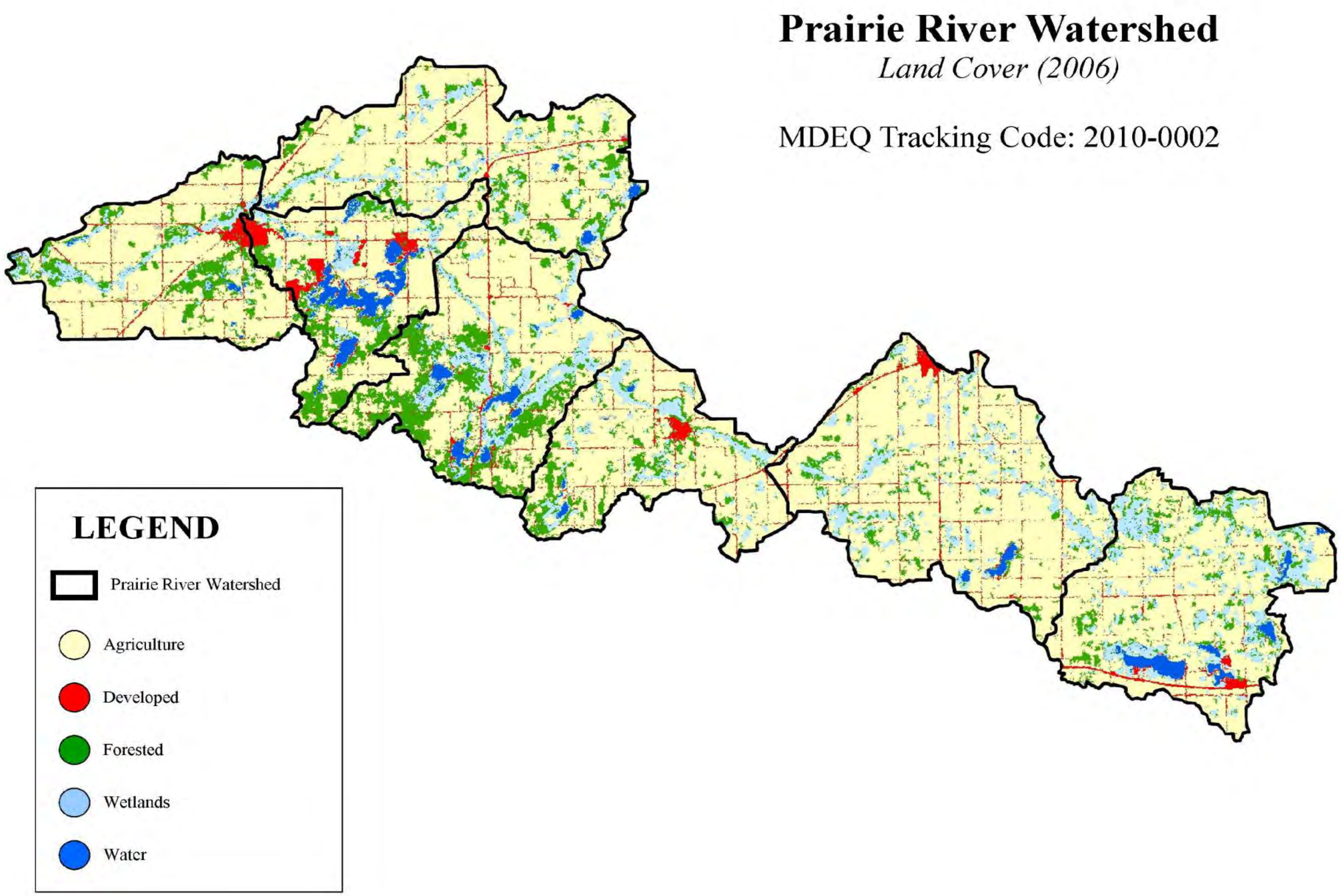


Figure 4: Total Prairie River Land Cover 2006

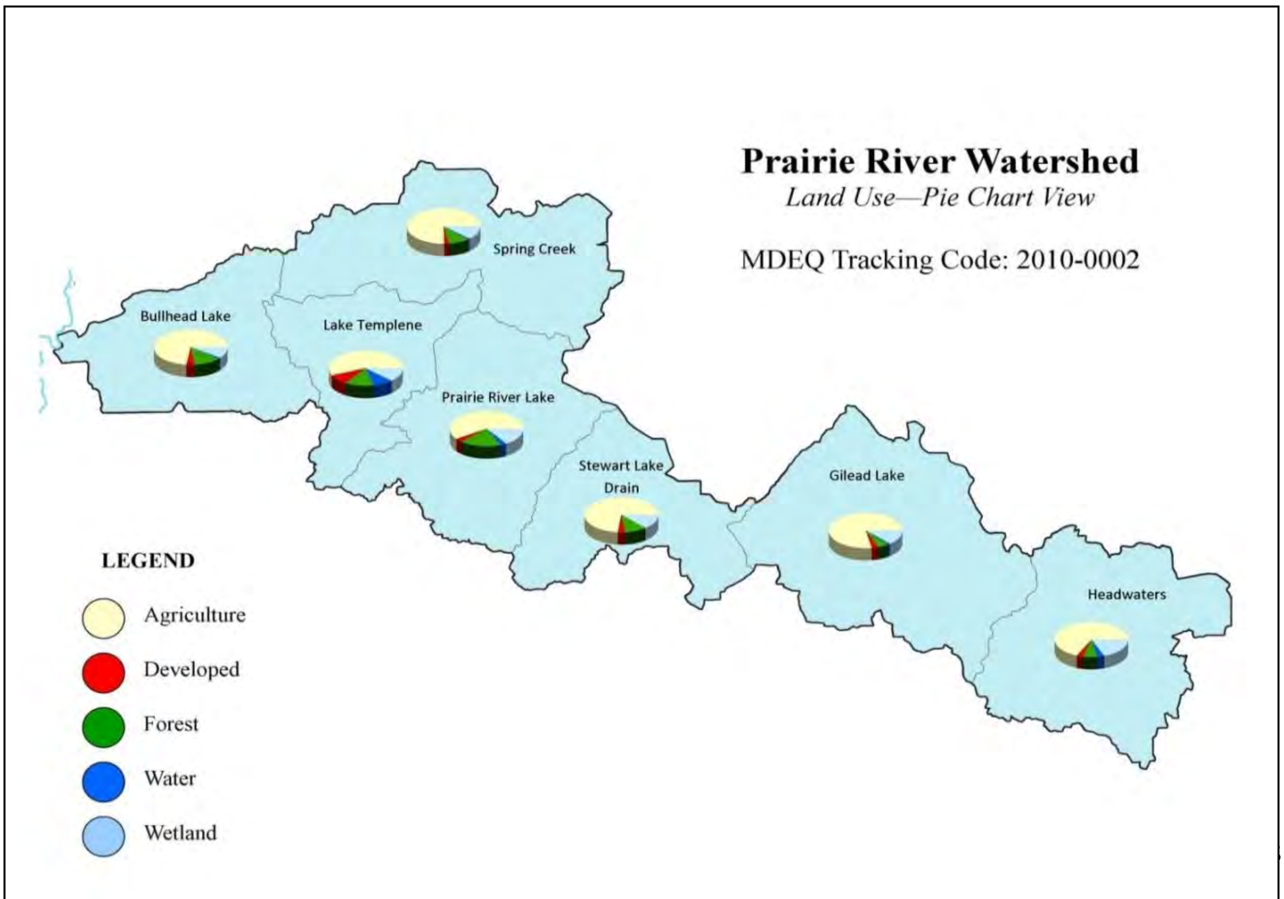


Of the seven sub-watersheds in the PRW, Gilead Lake and Spring Creek sub-watersheds have the most agricultural land cover making up a total of 32,192.7 acres (Figure 5). Each of these two sub-watersheds has 75% or more of the land cover dedicated to agricultural use. However Bullhead Lake and Stewart Lake Drain sub-watersheds come closely behind with 72% of land dedicated to agricultural use. This is consistent with the watershed character of being predominantly rural, agricultural communities. Lake Templene and Bullhead Lake sub-watersheds contain the highest amounts of developed land making up 1,662.85 acres, in part due to a large golf course development and municipalities located within the borders. Prairie River Lake and Lake Templene sub-watersheds have the highest amounts of forested land cover making up 5,938.3 acres. Lake Templene and the Headwaters sub-watersheds have the highest amount of water with 1,974 acres. Lastly the Prairie River Lake and Headwaters sub-watershed contain the highest amount of wetlands at 5,601.8 acres. Maps of each sub-watershed and their land use with acres can be found in Appendix 1: Maps B-H.

Based upon discussions with NRCS and FSA it is reasonable to believe that an increase in the amount of land being placed into agricultural production has jeopardized a fairly high percentage of natural land cover in the PRW. This increase in agricultural production is not quantifiable, but is attributed to the substantial increase in commodity prices in recent years.

Wetland loss in the watershed is at 52% since pre-settlement times due in large part to expanding agricultural lands. This increase in agricultural needs has also impacted forest loss predominantly in the St. Joseph County portion of the PRW due to the desire for center pivot irrigation and more productive cropland. Preservation and restoration of the natural land cover as well as improved agricultural practices will be critical to improving water quality.

Figure 5: Pie chart of land use in the PRW per sub-watershed



2.5 IMPOUNDMENTS

Dams and barriers have been an integral part of Michigan's history and were vital in developing the State's economy and society. Dams have allowed for transportation of goods such as logs for the timber industry, producing electricity and providing the power for the operation of many mills along the waterways. These mills were important to the towns that grew up around them and many can still be found today. Presently a small number of Michigan dams generate electricity, but they more commonly provide flood control, recreation, aesthetics, and many are utilized for fisheries and waterfowl management. *(DNR-Dam Management)*

Water quality in impounded streams may decline over time as nutrients and sediments accumulate. Downstream impacts can include decreased flow and increased flashiness, erosion, and temperatures. Dams and other barriers also limit migration of fish and other aquatic species, which can leave native or desirable fish species displaced from segments of the river (*DNR-Dam Management*). Sediment and nutrients being carried by a stream enters an impoundment and settles out as the flow rate decreases. This essentially creates a "sand trap" in the impoundment and could lead to costly dredging and management efforts. The accumulation of sediment buries important fish spawning habitats. Dams can disturb the natural fluctuations in the water flow as well as alter water temperatures. Impoundments slow flow behind the dam. Water flowing out of a dam is starved of sediment, which can lead to excessive erosion of the banks and stream beds. For recreational users, dams are more of an inconvenience and can limit the scenic enjoyment of paddling the river.

There are seven dams within the watershed boundaries, of which six are functional. Three of these dams are located on the mainstem of the Prairie River (See Figure 6). The remaining four are located on lakes in the watershed. Of the three on the mainstem, two are located within St. Joseph County and one is located just across the Branch/St. Joseph County border.

The two mainstem, St. Joseph County dams have court ordered levels that must be maintained. One of these is located downstream of Lake Templene on a privately owned waterbody. The owner did not comment on maintenance of this dam; however oversight is handled by MDEQ. The next mainstem dam is located at Lake Templene and maintained by the St. Joseph County Drain Commission. Managing these dams allows the lake level to be maintained for residents and tourists of the area to use for recreation. (Also noted in Figure 6 are two waste water lagoons found within the watershed since the levees are also regulated by MDEQ.)

Part 307, Inland Lake Levels, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, allows for establishment of a legal lake level. Legal lake levels can be initiated by a petition of two-thirds of the owners of land abutting a lake or by a motion of the County Board of Commissioners. The Circuit Court is responsible for acting upon the petition and, if appropriate, determining the level to be maintained. Authority is delegated, typically to the County Drain Commissioner, for maintaining the established legal level. Stabilized lake levels are often initiated as a cooperative effort to protect property and property values and maximize recreational benefits. There are time and financial costs in establishing a legal level, however, and potential impacts to aquatic life.

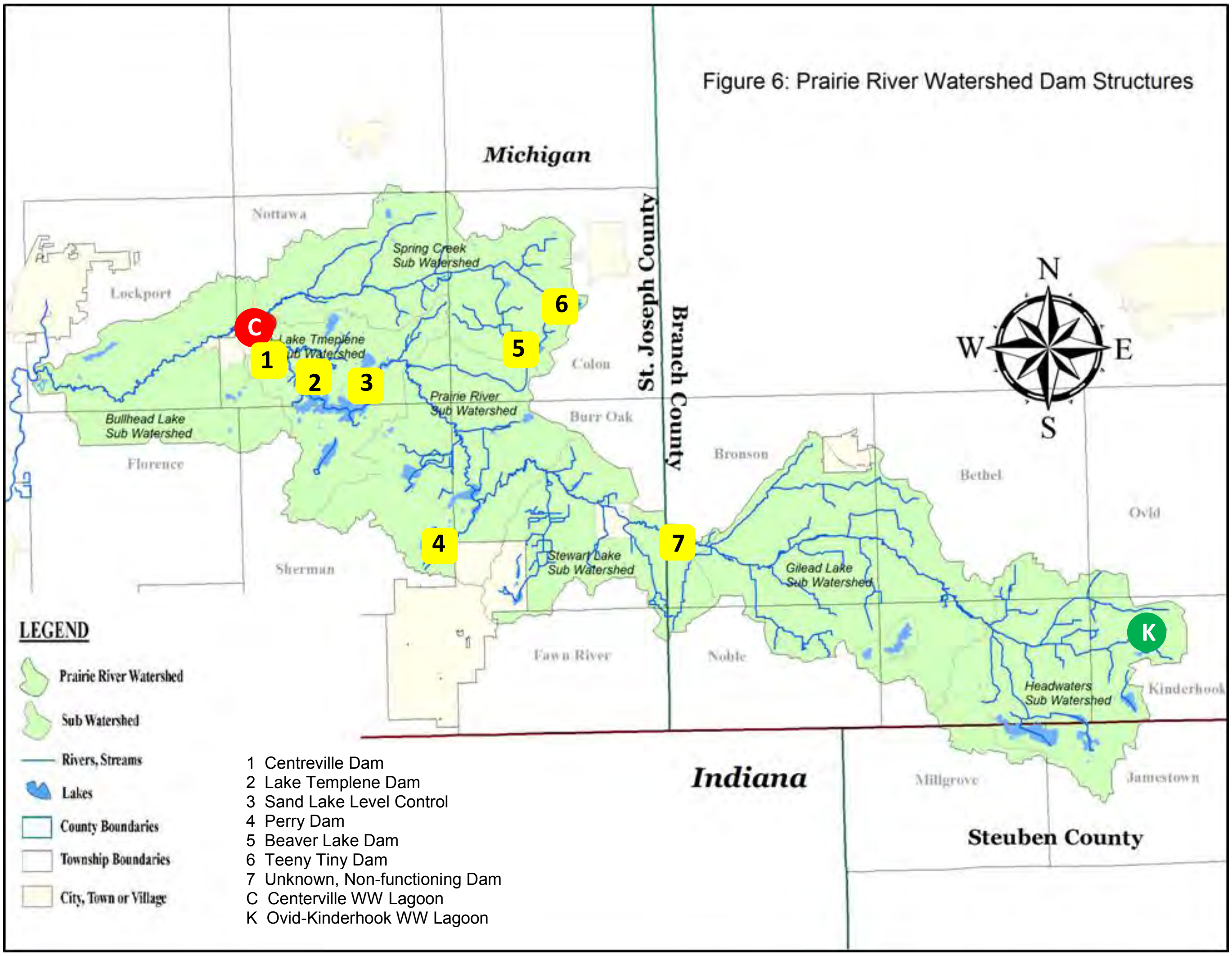


Figure 6: Prairie River Watershed Dam Structures

The third dam, just east of the Branch/St. Joseph County border is a non-functioning dam. Field inspection did not take place as drought conditions limited water access and it is not located at or near a road stream crossing. From aerial photos, it appears that the dam is not being maintained or impounding water and only consists of remnants. According to the Branch County Drain Commission this dam was privately created during the early days of Branch County. Its construction does not show in any official county records nor is it subject to any local governmental lake level control guidelines.

The Lake Templene dam was completed along the Prairie River in 1972 and a lake level of 825.5 feet above mean sea level established by the Circuit Court. An extensive expanse of wetlands and three lakes were inundated when the area was flooded to make the lake. The higher than average property values on Lake Templene as compared to other area lakes are directly contingent on this dam remaining in place. Removal of this dam is not likely as long as liability and maintenance costs remain low. The Lake Templene Property Owners Association (LTPOA) has indicated it would be interested in a fish ladder to promote a healthy fish habitat as well as implementing some basic watershed management practices. In addition, the LTPOA has shown concern over sediment accumulations in the lake. The LTPOA has completed and compiled research in the Lake Preservation – Background and Plan (*A hard copy of this plan may be viewed at the Branch Conservation District or by lake association permission at the LTPOA website*). The LTPOA has embarked on a five year strategic dredging plan starting in November 2012 that in its first phase will remove approximately 270,000 cubic yards of sediment. The larger project will be implemented over a five to seven year period, or as funds are available within the Township treasuries. The majority of the dredging activity will be in areas for recreational boat traffic. The LTPOA has also incorporated items into their management plan in the hope of improving overall water quality within the lake area including watershed management items like vegetative buffers. (See Table 1 for additional information on impoundments.)

Table 1: Functioning Dams of the Prairie River

Dam Name	Waterbody	River	Year Built	Size of Impoundment (acres)	Longitude	Latitude
BEAVER LAKE LEVEL CONTROL STRUCTURE	Beaver Lake	Beaver Drain	Unknown	166	-85.36513199490	41.91932279920
CENTREVILLE DAM	Prairie River	Prairie River	1890	37	-85.50866277460	41.92441289950
LAKE TEMPLENE DAM	Lake Templene	Prairie River	1972	950	-85.48580488420	41.91028381060
PERRY DAM	Omena Lake	Omena Lake Outlet	1967	135	-85.41753031150	41.83888220190
SAND LAKE LEVEL CONTROL STRUCTURE	Sand Lake	Prairie River	Unknown	95	-85.45145611360	41.90990007960
TEENY TINY LAKE DAM	Prairie River Tributary	Tributary to Spring Creek	Unknown	1	-85.35154070000	41.95549650000

3. COMMUNITY PROFILE

3.1 HISTORY

Given the availability of natural resources in the PRW, such as access to water sources and fertile soils, Southern Michigan was an ideal place to settle for early Native Americans. The rivers of the area lured Native Americans to the region as well as the plentiful prairie lands and forests that provided a great livelihood. These edge habitats, where two ecological habitats come together, provide biological diversity and are very productive making them desirable for those looking to settle. The Potawatomi Tribe long held its position in the region, settling in what is currently Three Rivers. That was until the Iroquois from the south fought and took the fertile lands that were cultivated from the Potawatomi. These lands and natural resources were too vital to the Potawatomi and with the aid of tribes to the north; they were able to acquire their land once again, driving the Iroquois Tribes back to the south. (*Marvin, J; www.stjosephcountymi.org*)

The soil types of the Prairie River Watershed have always lent themselves well to the agricultural nature of this area. The area once and still does predominantly produce wheat and corn. However at one point, Kellogg Company farmed the area for strawberries and a vast peppermint oil crop existed as well. Mint was introduced to the region in 1835 by Calvin Sawyer who relocated to the area from Ohio bringing a mint crop with him. Although Sawyer left his farm after only one year his introduction of mint was the beginning of this industry for the area. By the end of the Civil War, mint production in St. Joseph County had increased so much that Michigan rivaled New York as the national leader in supplying mint. At this time neighboring counties also began growing mint and by the turn of the century 90% of the world's mint oil supply came from the 90 mile radius around the City of Kalamazoo. (*Cutler, H.G.B. 1856*)

In addition to the area farming industry, another notable, long term PRW industrial presence was the Denton Sleeping Garment Mill located just south of the Prairie River in Centreville, MI. The mill was constructed in 1852 and operated as the Centreville Knitting Company under the supervision of several local business men and farmers. Amid conflicts with the owners, production was shut down in 1885. In 1891, it was purchased by W.D. Ingham and Whitley Denton who began producing sleeping garments. After Ingham's retirement and Denton's death, the company began improving the quality of the garments which resulted in a substantial increase in sales. The company is said to be the best-known manufacturer of blanket sleepers in the United States, although the "Dr." was simply a marketing strategy that is still trademarked today (Figure 7). (*Colon Community Historical Society*)

Figure 7: Dr. Denton's Sleeping Garment Advertisement

Near the center of the watershed lies the Village of Burr Oak. Burr Oak was first settled in 1835. In 1851, the village was platted and land was donated for a railroad station by William Lock on the condition the town was named after him. After five years of holding the "Locks Station" town name, the village assumed its original name and was officially incorporated as Burr Oak in 1859. By 1874 industry was growing and taking form with one flour mill, one saw mill, one foundry, one stave and heading factory (wooden barrels) and 234 farms. Due to its location just north of the Sauk Trail, it allowed for transportation of goods to Chicago and Detroit and the many villages along the way. (*Perkins, M*)

The Sauk Trail has been a major transportation route for centuries starting as a single file path used by the Native Americans. In their search for peace or war, they wore the path to a recognizable trail used by many. The early settlers were avid users of the trail and improved it to accommodate horses and wagons. During this early development of the trail way, the settlers constructed their homes near open fields along the trail in order to limit the need to clear trees for building.

The area provided a great source of water to its settlers. Along the river, mills began to be constructed drawing people to the trail side towns. Most of these towns were located near the junctions of the Sauk Trail close to a river or stream. The river or stream provided power for the mill and the trail allowed for easy import and export of goods to the area, increasing the need to improve the trail.

Each improvement of the trail resulted in a change to the original by either straightening out sections or rerouting due to a wetland, swamp or thick underbrush. The desire to improve the trail continued and surveying on the road began in 1825 to develop a roadway. Upon completion it was deemed the Detroit-Chicago turnpike or "the pike" as it became known to regular users. The completed turnpike subsequently became an important transportation route for military travel between forts in Michigan and Illinois.

Eventually, the Sauk Trail was incorporated into the Federal Highway System and paving of the road began in the 1920's. As the leader in the "good roads" movement due to the invention of the automobile, the State of Michigan was tasked with providing standardized plans and bridge construction for the trail as well as the entire State. Today the trail known as U.S. 12 is still a popular highway for regional use, even though Interstates have since been built. ***(www.US12heritage.org)***

3.2 GOVERNMENTAL UNITS

The PRW contains 25 governmental units. There are 15 townships, three counties (Branch & St. Joseph, MI and Steuben, IN), two states (Indiana, Michigan), three villages (Burr Oak, Centreville, and Colon) and two cities (Sturgis, Bronson*)* that fall either partially or completely within the watershed boundaries.

Five of the 15 townships within the PRW's boundaries have more than 50% of their jurisdiction within the watershed boundaries; Sherman, Nottawa, Burr Oak, Bronson, and Gilead. Table 2 shows the percentage of each township which is contained within the watershed. (Township locations follow Figure 1 map traveling west to east.)

Table 2: Percentage of Each PRW Township contained within the Watershed

Township	Percent of Township in Watershed
Lockport Township	42.6%
Florence Township	13.6%
Sherman Township	55.8%
Nottawa Township	84.2%
Colon Township	44.9%
Burr Oak Township	61%
Fawn River Township	3.2%
Bronson Township	56.5%
Noble Township	27.3%
Bethel Township	26%
Gilead Township	91.8%
Ovid Township	2.1%
Kinderhook Township	32.9%
Millgrove Township	10.1%
Jamestown Township	15.9%

Nottawa Township located in the western portion of the watershed hosts the Village of Centreville which is the St. Joseph County Seat. The township includes 38 square miles and features not only the Prairie River, but also the St. Joseph River within its borders. The name Nottawa is apparently derived from the Potawatomi Native Americans "Nottawa-seepe" or "prairie by a river" describing the early landscape with its oak openings and sea of prairie grasses.

Burr Oak Township is located in the center of the watershed along the border of Branch County and St. Joseph County. It encompasses 32 square miles and is home to the Village of Burr Oak.

Gilead Township is located on the eastern side of the watershed closer to the headwaters. It encompasses 21 square miles and sits along the Michigan-Indiana border.

Table 3 contains all governmental units, location and the water resources in each unit area. This includes all stretches of rivers or streams located in that governmental unit as well as surface (lake) water acres. Note that creeks and non- mapped stretches of river may have been excluded due to their limited size or impact on the overall tributary.

Table 3: Local Government Units of the Prairie River Watershed

Prairie River Governmental Units			
Governmental Unit	***County***	***River, Stream Length (miles)***	***Lake Surface Water (acres)***
Bethel Township	Branch (MI)	1.2	0
Bronson Township	Branch (MI)	23.31	0
Bronson, City of	Branch (MI)	0	0
Burr Oak Township	St. Joseph (MI)	22.05	18
Burr Oak, Village of	St. Joseph (MI)	2.81	0
Centreville, Village of	St. Joseph (MI)	0.75	0
Colon Township	St. Joseph (MI)	17.22	113.18
Colon, Village of	St. Joseph (MI)	1.5	0
Fawn River Township	St. Joseph (MI)	0	0
Florence Township	St. Joseph (MI)	0	3.2
Gilead Township	Branch (MI)	17.5	214.73
Jamestown Township	Steuben (IN)	0	154.17
Kinderhook Township	Branch (MI)	6.27	180.12
Lockport Township	St. Joseph (MI)	8.66	97.09
Millgrove Township	Steuben (IN)	0.5	299.99
Noble Township	Branch (MI)	4.82	36.6
Nottawa Township	St. Joseph (MI)	30.93	815.18
Ovid Township	Branch (MI)	0	0
Sherman Township	St. Joseph (MI)	2.4	508.51
Sturgis, City of	St. Joseph (MI)	0.5	60.7

4. WATER RESOURCES

Water is one of the most valuable natural resources and it is an essential component of all living matter. Water provides economic benefit to the residents of the PRW including water for irrigating agricultural crops, watering livestock, drinking water and water for industrial processes. Areas near surface water features are attractive locations for permanent and seasonal residents. In addition the waters provide recreational opportunities for fishing, kayaking, swimming and boating, which supports tourism for the communities within the watershed borders. There are over 145 miles of stream systems and 2831 acres of lakes and ponds within the watershed including more than 32 navigable miles for canoe and kayak enthusiasts.

4.1 SURFACE WATER AND GROUNDWATER

4.1.1 RIVERS AND STREAMS

The Prairie River begins in the lakes of western Kinderhook Township in Branch County, Michigan. From here the river flows northwesterly into St. Joseph County converging with the St. Joseph River just south of Three Rivers, MI. Many of the smaller streams in the watershed are designated county drains managed by the County Drain Commissioner. Of the 145 miles of stream systems, 53.1% of the streams are 1st order streams, 7.8% are 2nd order, 32% are 3rd order and 7.1% are 4th order streams. (Appendix 1, Map I)

> **Stream Order**
>
> Stream order is a numbering sequence which begins when two 1st order (headwater) streams join to create a 2nd order stream. When two 2nd order streams join it creates a 3rd order stream and so on. Stream order provides a comparison of the size and potential power of streams.

First order streams, or headwater streams, are vital to the health of the river and stream ecosystem. A healthy headwater area limits the amount of sediment and pollution entering the waterway, reducing negative impacts on the downstream system. With more than half of PRW streams being 1st order streams, land use changes in these headwater areas have a strong potential for impacting overall downstream water quality. In addition to potential downstream impacts, smaller headwater streams are at a greater risk of disturbance if land around them changes. These streams tend to have lower flow which can limit transport of sediment from erosion to downstream areas, thus burying vital habitat at the headwater. Stream temperature changes occurring when shade is removed or flow is limited can adversely affect the biota in that area.

The flow fluctuations found in smaller headwaters also occur in lower reaches of river systems. The Prairie River is relatively shallow throughout and can experience fluctuations in high and low flows during the year which can be devastating for habitat and movement patterns for fish and other aquatic life. The Flashiness Index for the PRW is actually quite low. (See Appendix 9, Figure 7) This index relates to the frequency and rapidity of flow changes seen in a stream especially as related to runoff events. Although heavy rain events do affect erosion, sediment input, and stream channelization in this watershed, it is perhaps more impacted by changes in groundwater levels. Impoundments with mandatory levels, irrigation and other water withdrawals and drought contribute to water level and flow issues throughout the PRW. A major example influence from these combined causes was the impact seen during the 2012 drought season when flow levels receded so substantially stream bed areas were exposed.

The PRW contains many tributaries feeding into the mainstem of the Prairie River (See Figure 8). Of significance are the two largest tributaries, the Stewart Lake Drain (SLD) and Spring Creek. Stewart Lake Drain (SLD), located just west of Burr Oak, MI along the border of St. Joseph County and Branch County. The SLD is a 1st order stream which flows north out of Stewart Lake and joins the Prairie River at the border of two sub-watersheds; the Stewart Lake Drain and the Prairie River Lake. This is a natural stream and the outlet for Stewart Lake. However the SLD has been channelized and incorporated into part of a large system used to drain a substantial complex of wetlands for agricultural production.

The second tributary, Spring Creek, is located in the northernmost part of the PRW. Spring Creek is a 3rd order stream and flows through densely populated Amish communities in St. Joseph County. It is on average 23 feet wide and 18 inches deep with ranges of depth from 0-5 feet. Spring Creek is approximately 28 miles long and falls just 50 feet through its length. It begins at Washburn Lake and is fed by several small 1st order streams. More information on trout and fisheries in the PRW can be found in Section 4.2.

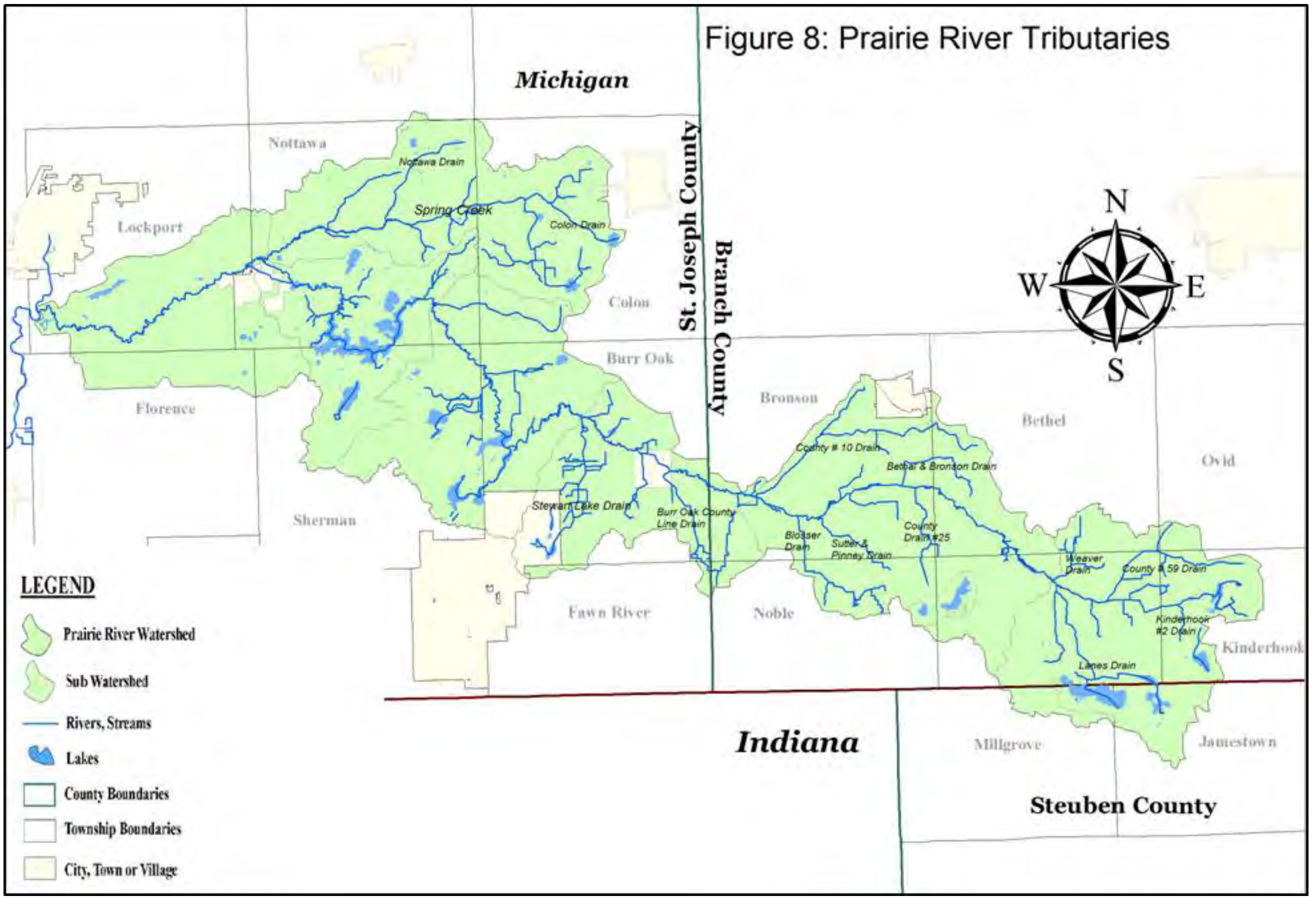


Figure 8: Prairie River Tributaries

4.1.2 POTENTIAL IMPACTS FOR RIVER AND STREAM ENVIRONMENTS

Changes in the landscape directly impact the river and stream environments. Highly Erodible Land (HEL), which is described as lands with a soil type index more prone to erosion from rain events are particularly susceptible to these changes. In the PRW, HEL regions are located primarily in southeastern most portion of Branch Co. and along most of the southern PRW in St. Joseph Co. (See Maps M through T in Appendix 1)

Along with the HEL areas of concern, agricultural runoff is a concern for the overall health of PRW waters. Removal of or inadequate buffer strips increase the impact of agricultural runoff throughout the watershed. As recent commodity prices have increased, many agricultural producers have been installing center pivot irrigation systems and putting more land into production. This results in eliminating buffer strips, wind breaks and fence rows causing increased agricultural runoff. The increased runoff may lead to higher levels of nutrients, bacteria and sediment being delivered to the stream resulting in negative impacts to water quality and aquatic life.

The installation of center pivot irrigation systems may have additional negative impacts on river systems when the river is utilized as the water source. Pump installation requires streambed disturbance as well as streambank clearing. This clearing causes instability of the streambank and could lead to erosion. More importantly, these pumps have the capacity to pull tremendous amounts of water potentially leading to fluctuations in the water levels that could impact aquatic habitats and species.

Although the impact of increased irrigation on PRW waterways is a concern within the watershed, of greater nonpoint source pollution concern is unrestricted livestock access to streams. Livestock searching out shade, cool temperatures or a drink often find what they need by wading in rivers and streams. In locations offering unlimited access, livestock may create serious bankside and in stream erosion conditions, increasing stream sedimentation, while destroying stabilizing vegetation. As they may often defecate during their in stream access, they contribute to extremely unhealthy contamination in the form of excess nutrients levels and bacteria including *E. coli*, while increasing biochemical oxygen demand (BOD.) Increased (BOD) affects available dissolved oxygen levels necessary for healthy aquatic organisms and aerobic aquatic waste decomposition. Ultimately, any humans or animals attempting to access these sites are potentially entering very unhealthy conditions, while any habitat for aquatic life is degraded. Sediment, BOD issues, excessive nutrients, and unhealthy bacteria created under these conditions may travel downstream impacting the heath of the entire waterway.

Beyond increased irrigation and livestock access, small urban areas also directly impact river and stream environments. Increased impervious surfaces from infrastructure attributes like parking lots, roofs and roads cause higher volumes of runoff. The lack of storm water management in much of the PRW can lead to polluted runoff reaching the waterways.

4.1.3 LAKES

The Prairie River Watershed is home to 26 lakes that vary in size, shape and depth (Table 4). The lake shores vary from intensely developed to more natural while lake size ranges from 3 acres to almost 900 acres (See Figure 9). This variation benefits the diversity of the watershed providing a great opportunity for residents and tourists to enjoy the waterways as well as providing a great amount of habitat for wildlife in the PRW.

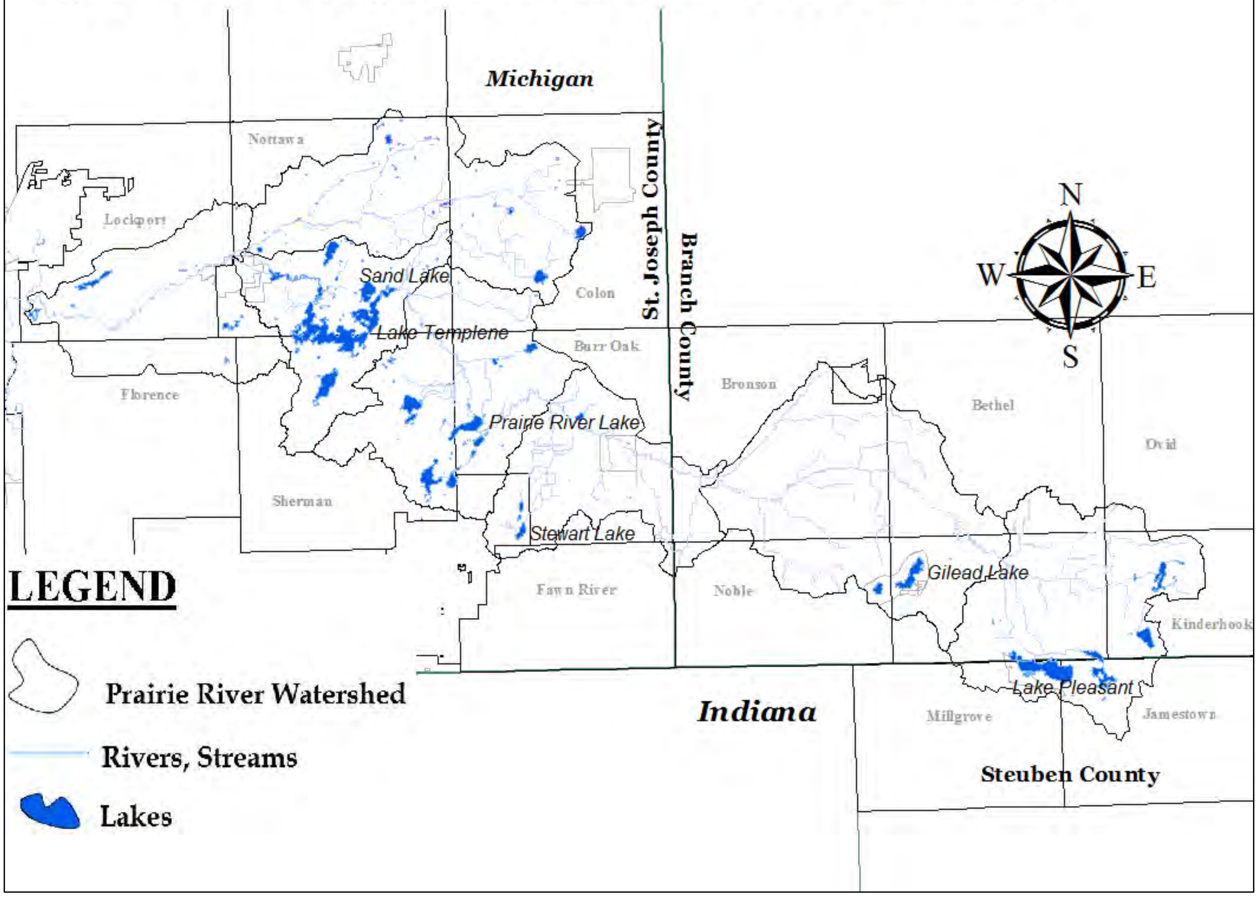
There are a total of 2831 lake acres within the Prairie River Watershed. The largest lake within the watershed boundaries is Lake Templene, which is an impoundment of the Prairie River. This 883 acre lake has a maximum depth of 35 feet and an average depth of 5 feet. It is a shallow lake with a very convoluted shoreline that spans 19 miles due to its irregular shape. In 2006, a sediment accumulation study was completed and identified areas of excessive sediment accumulation up to 7 feet in some portions of the lake (LTPOA Lake Preservation Plan). This sediment accumulation is in part due to runoff containing sediment from upstream but more so from impounding the river. Sediment being carried by the Prairie River naturally drops out of suspension as water velocity slows upon entering Lake Templene. In addition, this impoundment is creating the opposite problem downstream of the dam where the increased water velocity creates erosion. Excess nutrients and the nutrient rich wetland soils and general shallowness of the lake have led to widespread growth of aquatic plants throughout the lake and invasive species in particular. In 2000, the Lake Templene Property Owners Association hired Progressive AE to develop a management plan to deal with the excessive growth of plants and invasive species throughout the lake. They utilize this management plan and are constantly working to find new ways to address this plant growth. Lake Templene has economic benefits to the community as it is a popular location for vacation home owners coming from Chicago, Detroit and Indianapolis as well as its proximity to Island Hills Golf Course, an 18-hole golf course with a restaurant. The lake is also host to several fishing tournaments throughout the year that draws people from all over. The desired fish in the lake is largemouth bass but you can also find a healthy population of crappie, walleye, catfish and smallmouth bass.

Table 4: Lakes of the Prairie River Watershed

Prairie River Watershed Lakes				
Lake	**County**	**Governmental Unit**	**Size (acres)**	**Public Access**
Lake Pleasant	Steuben, IN/Branch, MI	Milgrove Township *(IN)* Jamestown Township *(IN)* Gilead Township *(MI)*	383	None
Barton Lake	Steuben, IN	Jamestown Township *(IN)*	91.43	None
Lake Michiana	Steuben, IN/Branch, MI	Jamestown Township *(IN)* Gilead Township *(MI)*	47.9	Free
Lake Lavine	Branch, MI	Kinderhook Township *(MI)*	89.7	Free
Dragon Lake	Branch, MI	Kinderhook Township *(MI)*	79.82	Free
Calhoon Lake	Branch, MI	Gilead Township *(MI)*	36.6	None
Gilead Lake	Branch, MI	Gilead Township *(MI)*	148	Free
Adams Lake	St. Joseph, MI	City of Sturgis *(MI)*	40.3	Free
Stewart Lake	St. Joseph, MI	City of Sturgis *(MI)*	40.3	None
Eberhard Lake	St. Joseph, MI	Burr Oak Township *(MI)*	38.55	None
Bryant Lake	St. Joseph, MI	Burr Oak Township *(MI)*	10	None
Perrin Lake	St. Joseph, MI	Sherman Township *(MI)*	129	Free
Prairie River Lake	St. Joseph, MI	Sherman Township *(MI)* Burr Oak Township *(MI)*	138.7	Free
Fish Lake	St. Joseph, MI	Burr Oak Township *(MI)*	32.1	Free
Hawkins Lake	St. Joseph, MI	Burr Oak Township *(MI)*	9.64	None
Eight Foot Lake	St. Joseph, MI	Burr Oak Township *(MI)*	5	None
Grey Lake	St. Joseph, MI	Sherman Township *(MI)*	50	None
Omena Lake	St. Joseph, MI	Sherman Township *(MI)*	131.5	Free
Evans Lake	St. Joseph, MI	Nottawa Township *(MI)*	84.5	Free
Demijohn Lake	St. Joseph, MI	Nottawa Township *(MI)*	3	None
Sand Lake	St. Joseph, MI	Nottawa Township *(MI)*	96.4	Free
Lake Templene	St. Joseph, MI	Nottawa Township *(MI)*	873	Free
Fish Lake	St. Joseph, MI	Sherman Township *(MI)*	153	Free
Washburn Lake	St. Joseph, MI	Colon Township *(MI)*	48.4	None
Beaver Lake	St. Joseph, MI	Colon Township *(MI)*	57.1	None
Bullhead Lake	St. Joseph, MI	Nottawa Township *(MI)*	13.83	None

Another popular lake for public use in the PRW is Lake Lavine, located in the south-central portion of Branch County. Lake Lavine has been managed as a rainbow trout lake for over 65 years beginning in 1947 and continuing today. The lake bottom is comprised of 90% organic matter with scatters of sand. Aquatic plants such as yellow water lily are abundant. On the southeast shoreline, a public access site allows anglers to search for pan fish and rainbow trout any time of the year. Other preferred fish species are yellow perch, brown trout and largemouth bass.

Figure 9: Some Key Lakes of the Prairie River Watershed



Gilead Lake is another popular lake located just northwest of Lake Lavine in Branch County. This lake, like Lake Lavine above is a two story fishery where warm water fish such as pan fish and bass thrive in the shallower waters, while trout can thrive in the cold deep waters. Gilead Lake has been managed as a trout lake since 1951. It has no inlets or outlets and its deep pockets have been beneficial for supporting rainbow trout. There is a public access site and park located on the southern shoreline that is leased by the County from the Department of Natural Resources. The landscape surrounding Gilead Lake is predominantly large expanses of agriculture. Agricultural runoff is a suspected contributor of pollution particularly on the southern and northern most points where crop fields and agricultural headquarters are within 500 feet of the shore. From satellite photo and inventory of accessible areas on Gilead Lake, limited vegetative buffers in residential developments are suspected of contributing excess nutrients and sediment to the lake. As defined in the inventory and education portion of this plan, residential education is needed to increase their understanding of buffer importance to their own property as well as runoff stemming from surrounding agricultural lands. (See Table 4 for additional lakes information within this watershed.)

4.1.4 POTENTIAL IMPACTS FOR LAKE ENVIRONMENTS

Potential impacts to lake environments throughout the watershed are primarily due to development along their shoreline. However, since most of the lakes in the PRW receive water from the mainstem or a tributary the river and streams impacts can certainly apply to lake environments as well.

A majority of the lakes in the watershed have developments around them with limited natural space. Some are more developed than others. Developing the shoreline typically eliminates the aquatic and terrestrial buffers that once filtered many pollutants running off the land into surface water and protected the shoreline from erosion.

Excess nutrients from lawn and turf fertilizers increase the algae and plant growth of the lakes. This plant/algae growth in the extreme can limit habitat for fish and can lead to decreased dissolved oxygen in the dark or as the excess vegetation decomposes. Excess nutrients can also spur invasive plant growth limiting biodiversity and eliminating fish habitat as well as impeding recreational activities such as swimming, boating and fishing. (See BOD discussion mentioned under Potential Impacts for River and Stream Environments page 18.)

Another concern for lake environments is the limited use of municipal wastewater treatment. The rural nature of this watershed means most of the lake homes have septic systems. A septic system is typically designed to have a life span of approximately 20-30 years in the best of conditions. At some point the soil around the absorption field will become clogged with organic material rendering the septic system unusable. In many cases a system will fail much earlier than its expected life span. Some common factors potentially leading to a failure are pipes becoming blocked by roots, a crushed tile, improper location, poor design or poor installation. However, the most widespread reason a septic system will fail is improper maintenance by the homeowner. When a system is not pumped regularly, the tank fills with sludge, which flows into the absorption field clogging it. Once the adsorption field is clogged effluent from the tank pools on the ground or flows to nearby surface waters. This overflow of septic waste commonly contains nutrients and bacteria posing not only concerns to the environment but to human health.
Lastly, an increased use of agricultural irrigation systems can impact many facets of living from humans to animals and plants. Recently, there has been a growth in the installation of large scale center pivot irrigation systems to hydrate crops within this watershed (Table 5.) Much of the time, water used for irrigation is drawn directly from a lake or river. When recharge is slow or precipitation is scarce this activity can impact that body of water by bringing the water level down. These low levels sometimes approach dangerous depths with the potential of harming the overall habitat. This combination of withdrawal and limited precipitation was experienced in 2012 with the severe drought conditions.

Table 5: Irrigation Drilling Report from MDEQ Michigan Water Use Program

Numbers of Reported Irrigation/High Capacity Wells Drilled Between 2000 - 2013		
Reporting Year	Total Numbers for Entire Counties of Branch &St. Joseph	Prairie River Watershed (Only) Combined Total for Branch & St. Joseph Co.
Prior to 2000	412	62
2000	28	8
2001	17	3
2002	17	3
2003	19	3
2004	20	5
2005	17	2
2006	26	3
2007	29	2
2008	36	8
2009	58	8
2010	49	15
2011	63	13
2012	144	31
2013	120	18

4.1.5 GROUNDWATER

Groundwater, found in tiny pore spaces in the ground between soil and rock is what we generally use for drinking water. Large underground reservoirs or aquifers are fed by water infiltrating through soil. The majority of the PRW watershed contains sandy to loam soils, which allow for good drainage and a timely recharging of the groundwater aquifers. However, much of the St. Joseph County portion of the watershed contains sandy soils, which leaves groundwater vulnerable to pollutants that leach through the soil. Sandy soils have more porous space which allow for rapid movement of liquid through the soil and can leave the groundwater at risk. Being aware of groundwater is an important facet of protecting it. The Wellhead Protection Program helps communities within the PRW in maintaining a healthy water source for their municipal drinking water supply. This program identifies areas that contribute to the drinking water supply so that it can be protected from contamination. Appendix 1: Map K shows the wellhead protection areas in the PRW.

4.1.6 *GROUNDWATER POTENTIAL IMPACTS*

Increased water withdrawal from municipal, agricultural and residential areas risk withdrawing more than nature can put back into the ground. This risk has only been increased as a result of the need for large scale agricultural irrigation in the area. Many of these systems have their own well and have a capacity to pump 70 or more gallons per minute, with a potential to utilize large amounts of water when they need to run continuously.

** Note: In Michigan all new or proposed increases in water withdrawals of over 70 gallons per minute are subject to mandatory use of the State of Michigan's Groundwater Withdrawal Tool. This tool located online at http://www.miwwat.org is designed to help determine the impact of withdrawals on the nearby waterways.*

Human activities also pose a risk to the quality of groundwater. These risks include chemical spills, septic systems, manure handling, underground fuel tanks or agricultural irrigation when using practices such as fertigation and chemigation, or chemical spills at the center pivot where the well is located. What goes on the ground can seep through the soil and turn up elsewhere in the environment such as in drinking water or a water body.

Finally, an increase in impervious surface and compacted soil can also reduce the amount of water that is infiltrated into the ground. Impervious surfaces or compacted soil cause precipitation and snowmelt to run over the land instead of soaking into the ground. Limited impervious surface would benefit infiltration rates for groundwater and is recommended in this plan.

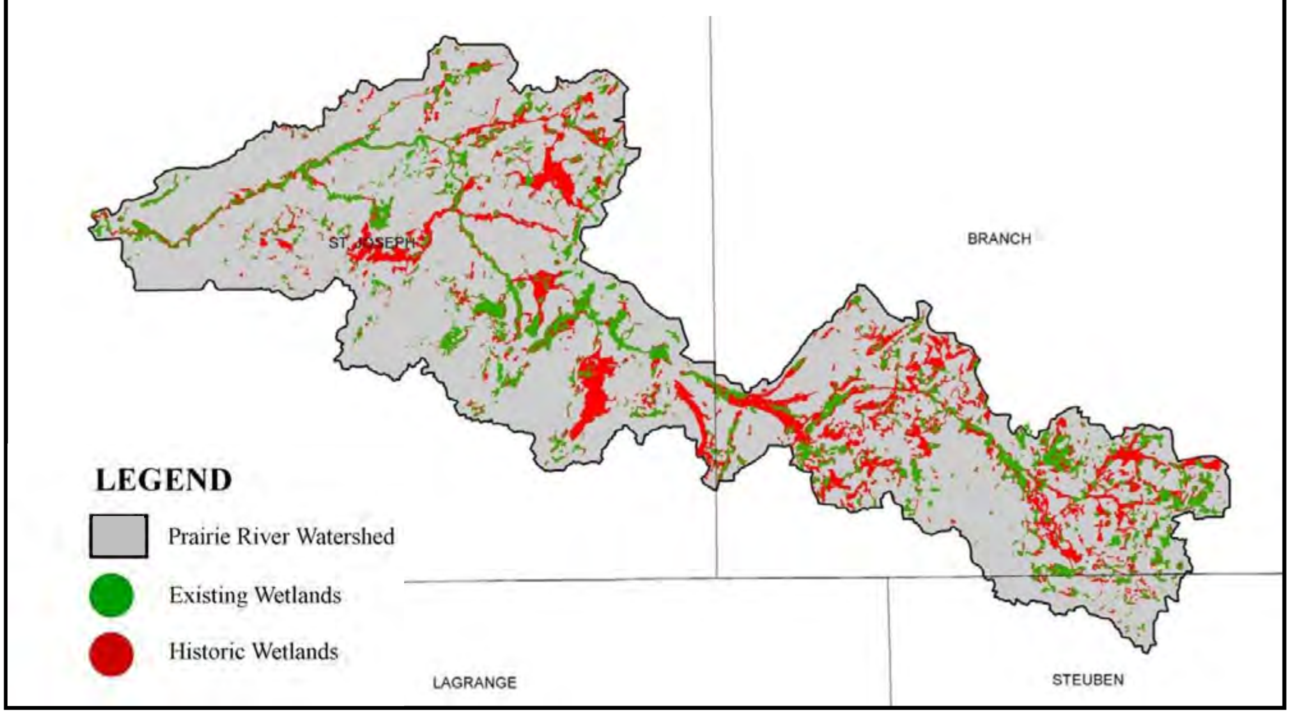
4.1.7 WETLANDS

Wetlands in Michigan are regulated by the Michigan Department of Environmental Quality if they meet any of the following criteria:

- Connected to one of the Great Lakes
- Located within 1,000 feet of one of the Great Lakes
- Connected to an inland lake, pond, river or stream
- Located within 500 feet of an inland lake, pond, river or stream
- More than 5 acres in size.
- Less than five acres in size, but determined to be essential to the preservation of the state's natural resources by the MDEQ.

Wetlands serve an important role for water resources by providing ecological functions to the ecosystem. These functions include, but are not limited to, floodwater storage, sediment retention, pathogen degradation and critical aquatic and wildlife habitat. Wetlands serve as excellent buffers to prevent sediment, nutrients and other pollutants from entering surface water bodies. The loss of these functions can have huge effects. For example, removing a wetland that provides floodwater storage could lead to downstream flooding which can be costly to the community or a landowner. Removing a wetland that provides pathogen degradation could result in rivers and lakes unsuitable for recreation.

Figure 10: Prairie River Watershed Existing and Historic Wetlands



A Landscape Level Wetland Functional (LLWFA) assessment was completed by the Michigan Department of Environmental Quality for the PRW in 2010. The LLWFA is a geographic information systems (GIS) tool used for identifying former wetlands that should be restored as well as existing wetlands requiring protection based on the functions they previously or currently provide. Methodology for LLWFA and additional results from the assessment can be found in Appendix 3.

According to the Wetland Status and Trends completed for the PRW as part of the LLFWA, there has been a total of 48% wetland loss compared to pre-settlement wetland areas. Figure 10 shows the location where the loss occurred. The green areas in the figure indicate existing wetlands and the red indicates the wetlands lost throughout the watershed. The wetland loss is mostly attributed to land being converted for cultivation of crops with some areas being lost to urban and rural development. Wetland changes like filling, draining and fragmenting have a profound effect on the recharge of groundwater as well as indigenous wildlife and aquatic life habitat. The loss of a wetland can dramatically change the dynamics of an area depending on the functions lost.

More information about this loss can be found in Section 5.5.1 and Appendix 3.

4.1.8 POTENTIAL IMPACTS TO WETLANDS
Potential impacts to wetland areas are most commonly related to filling or draining areas for industrial, residential, agricultural, recreational or commercial growth. Draining or filling a wetland can have an impact on the hydrology of the watershed. Polluted runoff containing sediments, nutrients and chemicals also pose a threat to wetlands. These excessive nutrients can lead to an overgrowth of plant life including any invasive species present in an area. Invasive species can have a profound impact on a wetland by limiting biodiversity.

4.2 OTHER LAND RESOURCES & MANANGEMENT

4.2.1 WILDLIFE
Temperate climate, diverse ecosystems, abundant food sources and close proximity to water resources provide many different habitats for wildlife within the watershed. The large amount of wetlands present in the watershed provide a great amount of diverse habitat for wildlife species and are especially important for reptile and amphibian breeding grounds.

Some of the common wildlife within the watershed includes deer, mice, beaver, skunk, rabbit, muskrat and an abundance of squirrels and other rodents. The largest native mammal within the watershed is the white-tailed deer. The deer populations have exploded in recent decades due to their adapting to agricultural land. Deer thrive in habitats that are along the edges of fields and the large amount of agriculture in the area provides a constant food source for them.

The amount of wetlands and expanses of water found in the watershed provides prime locations for migrating waterfowl to converge on their fly through. Some of the commonly occurring species found are Canada Geese, Mute Swan (an invasive species), as well as a variety of duck species. Large numbers of waterfowl can lead to water quality impacts through excess nutrients and *E. coli* contamination. Homeowner's mowing to the edge of the water encourages geese to enter yards, because geese would otherwise avoid taller vegetation that could hide predators. Utilizing a vegetative buffer can limit the desire for geese to get into a property owners yard, as well as provide a buffer for lawn runoff that may be contaminated by geese feces.

The Prairie River Watershed boasts two of the four major migrating flyways of North America. Both the Atlantic Flyway and the Mississippi Flyway overlap in Branch County making Branch County an important stopover for migrating birds on their way to or from their wintering or spring nesting grounds. Among the other bird species found in the watershed are, great blue heron, sandhill crane, wild turkey, mourning dove, ruby-throated hummingbird, downey woodpecker, cardinal, eastern blue jay, robin and the black-capped chickadee.

Figure 11: Bald Eagle resting in the Lake Templene area of the PRW

In addition to the common species in the PRW, there are several other rare species that have been sighted and documented in the Michigan National Features Inventory. Aquatic wildlife considered to be rare includes the slippershell, ellipse and rainbow mussels. Spotted and Eastern Box Turtles are also listed along with the Eastern Massasauga which is Michigan's only venomous snake (Table 6).

Over recent years, Bald Eagle sightings have become more prevalent and there have been documented sightings in the Lake Templene area. A bald eagle has been sighted several times in the area, leading residents to believe the bird is nesting nearby. Figure 11 is a photo taken by a resident of Lake Templene in fall of 2011. There have been additional sightings of trumpeter swans throughout the Prairie River Lake area, though no documentation is available to verify these reports.

Table 6 lists known special concern, endangered and threatened within the Prairie River Watershed. *(Michigan Natural Features Inventory)*

Table 6: Endangered / Threatened or Special Concern Wildlife in the PRW

SPECIES	Scientific Name	Group	STATUS		
			Michigan	US	Global
Indiana Bat	*Myotis sodalist*	Mammal	Endangered S1	Listed Endangered	G2
Northern Long-eared Bat	*Myotis septentrionalis*	Mammal		Proposed Endangered	G1G3
Henslow's Sparrow	*Ammodramus henslowii*	Bird	Endangered S2S3		G4
Grasshopper Sparrow	*Ammodramus savannarum*	Bird	Special Concern S3S4		G5
Prothonotary Warbler	*Protonotaria citrea*	Bird	Special Concern S3		G5
King Rail	*Rallus elegans*	Bird	Endangered S1		G4
Dickcissel	*Spiza americana*	Bird	Special Concern S3		G5
Spotted Turtle	*Clemmys guttata*	Reptile & Amphibian	Threatened S2		G5
Copperbelly Water Snake	*Nerodia erythrogaster neglecta*	Reptile & Amphibian	Endangered S1	Listed Threatened	G5T3
Eastern Massasauga Rattlesnake	*Sistrurus catenatus catenatus*	Reptile & Amphibian	Special Concern S3S4	Candidate	G3G4T3T4Q
Eastern Box Turtle	*Terrapene carolina carolina*	Reptile & Amphibian	Special Concern S2S3		G5T5
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	Reptile & Amphibian	Threatened S2S3		G5T5
Mitchell's Satyr	*Neonympha mitchellii mitchellii*	Insect	Endangered S1	Listed Endangered	G1G2T1T2
Tamarack Tree Cricket	*Oecanthus laricis*	Insect	Special Concern S1S2		G1G2
Douglas Stenelmis Riffle Beetle	*Stenelmis douglasensis*	Insect	Special Concern S1S2		G1G3
Slippershell	*Alasmidonta viridis*	Freshwater Mussel	Threatened S2S3		G4G5
Round Pigtoe	*Pleurobema sintoxia*	Freshwater Mussel	Special Concern S2S3		G4G5
Ellipse	*Venustaconcha ellipsiformis*	Freshwater Mussel	Special Concern S2S3		G4
Rainbow	*Villosa iris*	Freshwater Mussel	Special Concern S2S3		G5Q
Lake herring or Cisco (none documented since early 1900s; likely absent)	*Coregonus artedi*	Fish	Threatened		G5
Creek chubsucker (last documented in 1977; potentially still present)	*Erimyzon claviformis*	Fish	Endangered		Not ranked
Spotted gar	*Lepisosteus oculatus*	Fish	Special Concern		G5
River redhorse	*Moxostoma carinatum*	Fish	Threatened		G4
Starhead topminnow	*Fundulus dispar*	Fish	Special Concern		G4

4.2.2 FISH

Starting in at least 1933, Spring Creek became a managed trout stream. Brook, rainbow and brown trout were stocked by the Department of Natural Resources (DNR) in the lower eight miles of the stream until1964. Only brown trout were stocked after 1964, stocking was halted in the winter of 1991. Three management deficiencies were identified in maintaining Spring Creek as a trout stream. The first was summer temperatures in the stocked waters were found to be too high and were unable to maintain a healthy population of trout. This increased water temperature was suspected to be in part, due to active beaver populations and the associated beaver ponds along the river. Second, farm animal access had led to a degradation of riparian corridors. Lastly, high densities of competing fish were found to be limiting trout populations. A rotenone treatment was used to remove competing species following a 1969 survey and the treatment was considered successful. However, by 1971 competing fish species had repopulated the stream.

Designated Trout Steam is "any stream so designated by the state that contains a significant population of trout or salmon"

"Type" Streams determine the fishing regulations like seasons, minimum size limits, possession limits, etc.

The Prairie River is a Designated Trout Stream and a Type 4 Stream, one of few in this region

In 1991, an electrofishing survey was completed with 22 species of predominantly warm water fish collected. No trout were collected at any of the survey sites. The DNR removed Spring Creek from the trout stream list because the overall conditions of the creek were no longer conducive to supporting trout populations.

In the main stem of the Prairie River, brown trout were stocked until 1992 and have since maintained their population entirely by natural reproduction. During a survey in 2011 over 200 brown trout were caught near Orland Road. The length of these trout varied from 2 to 22 inches with 7% being over the legal size of 10 inches. In addition, rainbow darters, blacknose dace and hornyhead chubs made up the non-game species collected. This same site at Orland Road was sampled in 2012 resulting in only three brown trout collected. For more results of the 2011 and 2012 sampling done by the Michigan Department of Natural Resources Fisheries Division, see the report in Appendix 2.

The Prairie River from McKale Road upstream to Bowers Road is managed as a Type 4 trout stream. The reach from McKale Road upstream to the St. Joseph/Branch County line is also considered a designated trout stream. Trout Stream locations can be found in Appendix 1, Map J.

4.2.3 POTENTIAL IMPACTS TO FISH & WILDLIFE

Loss of habitat is the largest concern for species in the watershed. As land is converted for agricultural production or residential use, draining of lowland areas reduces wetland and aquatic habitats and clearing of woodlots eliminates forest habitats. These reductions drive the species out of the area in search for better habitat or it limits their ability to reproduce. This interruption to habitats also leaves the watershed vulnerable to the introduction of invasive species and can lead to the elimination of native species which in turn can change the habitat for wildlife. The introduction of invasive species like phragmites, eurasian milfoil, garlic mustard, and starry stonewort to name a few, can severely impact biodiversity leaving limited habitat for many native species that rely on native biota to survive. (For information directly impacting the Lake Templene area see the LTPOA Preservation Plan.)

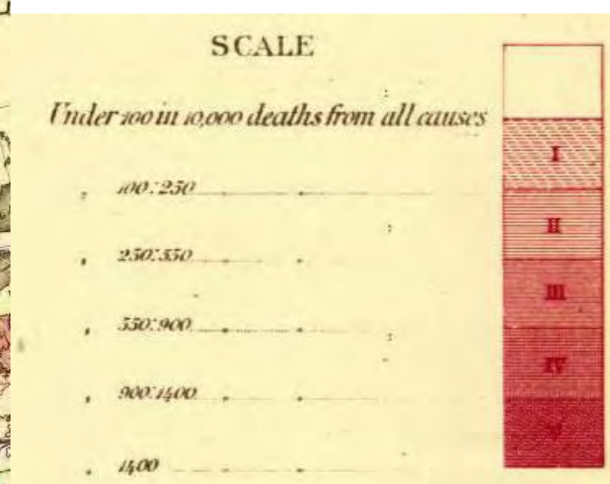
Additionally, changes in hydrology can alter the conditions supporting healthy communities, particularly aquatic communities. Landscape changes such as conversion for agriculture, draining of wetlands, riparian degradation or excess water withdrawal can result in warmer water temperature, limited flow and excess sedimentation that can severely limit habitat for aquatic species such as trout and mussels.

4.2.4 FORESTS

Forest lands provide habitat for many species as well as protecting rivers and streams by serving as buffers, reducing runoff and providing shade. Riparian trees are also an important source of organic matter (leaves and twigs) which serves as the primary food source for many aquatic insects, particularly in headwater areas. In addition, large woody debris (fallen tree limbs and trunks) provides important aquatic habitat. In the PRW, only 12% of the current land cover is forested. The Lake Templene and Prairie River Lake sub-watersheds possess the most forested land acres throughout the PRW and most of it surrounds surface water or wetland areas.

Approximately one third of the pre-settlement lands in the PRW contained prairies, grasslands and savannahs, with an additional one sixth consisting of wetlands and open water. The remaining pre-settlement forest lands accounted for approximately one half of the watershed and were comprised primarily of mixed oak savannas, mixed conifer or hardwood swamps, stands of beech and sugar maple or oak and hickory, along with areas of shrub swamp emergents. Most of these forested areas disappeared through the clearing and draining of land by early settlers, as well as modern urbanization. This region was actually quite wet in pre-settlement times and contained many wetter forest species. However, draining the land for agriculture and urbanization created major changes not only to the landscape, but to the region's hydrology. Another factor often missed in discussing the actions of the early settlers was a major health concern, that of mosquito born malaria. (See Figure 12) This debilitating and deadly disease encouraged the draining of wetlands, beyond the need for dry land and was still a concern well into the 20th century. (*One of the last cases of Malaria contracted within Michigan was in 1995. Reported by the CDC - May of 1996.*)

Figure 12: Michigan Malaria Map – US Census 1870



All of this draining and clearing of large areas of land influenced a change in many of the remaining forest types to somewhat dryer species. Modern day primary species would include mixed varieties of maple, oak, hickory, ash, along with a wide variety of shrubs. Other species include conifers like tamarack and pines as well as butternut, elm and some other less common deciduous species. This area is somewhat unique in that it sits on a border region between the northern and central hardwoods. Because of this, we also find pawpaw and Kentucky coffee tree among other species trees not normally thought of as part of this region. However, recent insect infestations and diseases have affected the current species types as well. (See Potential Impacts to follow.)

4.2.5 POTENTIAL IMPACTS TO FOREST AREAS

Fragmentation is a concern to the PRW forest lands. Development of lands, particularly around lake communities, fragments habitat for those species that depend on large expansive woodlots. Fragmentation of this land could lead to forest bird population decrease and other habitat loss that would affect forest-dependent species. Invasive species are an additional concern and are present within the PRW. Invasive species can limit growth of native plants and result in a decrease of biodiversity, which eliminates habitat for native wildlife.

Currently, there are a wide variety of somewhat localized vegetative invasive species impacting woodlots in this region, along with ongoing infestations from harmful insects and diseases. Black locust, autumn olive, Japanese barberry, multi-flora rose, and garlic mustard are only a few non-native the trees, shrubs and plants posing serious threats to PRW forests and grasslands. In addition, oak wilt, chestnut blight, sudden oak death, Dutch elm disease other exotic diseases as well as exotic insect infestations from emerald ash borer, gypsy moth and so many more have had a devastating affect killing many thousand trees in the PRW and millions throughout the region. Additional concerns are feared like the Asian longhorn beetle and thousand canker disease in the near future. This combination of invasive species, if left unchecked could potentially wipe out important forest components not only in the PWR, but across the entire state.

Conversion of land is also a very common concern for forested areas in the PRW. Increased commodity prices have driven up the desire for more land in agricultural production, which has led to the elimination of forested acreage.

4.2.6 RECREATIONAL USES

The abundant amount of surface water in the watershed is an important driver for the local economy through recreation and tourism. The recreational opportunities such as swimming, boating and fishing are readily available and accessible. Due to this availability, vacationers, hobbyists and seasonal residents flock to the watershed during the spring, summer and early fall months. Outdoor recreational venues are available year round throughout the entire span of the watershed including three golf courses, several canoe launches, public access boat launches, campgrounds, one public beach, youth camp, walking trails and public parks. The PRW also has a great game fish population and hosts a variety of fishing tournaments throughout the year. Additionally the public participates in activities that go well into the winter months like, hunting, skiing, snowmobiling, and ice fishing. These opportunities help create a sense of ownership to users but can also be a stressor on the health of the watershed.

4.2.7 POTENTIAL IMPACTS FROM RECREATIONAL USES

The high rate of use creates potential for introducing invasive species or transporting them from one water body to another. Although not an NPS issue, education to the public on how to control and reduce transporting of invasive species is recommended in this plan. Additionally, the increased boat activity can create erosive wave action and potential for fuel leaks. (Specific sites with human access related to recreational impact are noted on both inventory sheets in Appendix 6.)

4.2.8 GOVERNMENTAL/PROTECTED LANDS

Within the Prairie River Watershed, approximately 500 acres of land are currently under some form of protection. These lands include those owned by the Department of Natural Resources, cities, villages and townships being managed for recreation as well as privately owned properties protected by conservation easements.

4.2.9 LAND USE MANANGEMENT

A vital component of the Prairie River Watershed Planning Project (PRWPP) was stressing the importance of land use decisions at the local level to protect water resources. In Michigan, much of the existing protection measures are a combined effort of federal, state, county and local governments. However, even with combined efforts there are gaps in overall protection measures. These gaps can be addressed at the local level through land use planning and by establishing ordinances.

It is often found that a community's development standards and codes give little incentive to developers to conserve natural areas. Careful attention to appropriate resource management can help communities reach a level of sustainable development combining economic growth with the protection of natural resources. An examination of existing policies is crucial to provide municipal codes reflecting the desires of the communities within the watershed.

The PRWPP partnered with local governmental units to evaluate their Master Plan and Zoning Ordinances as well as encouraged the implementation of generally accepted development standards. Additionally these evaluations identified gaps in the communities' land use policies that would affect the protection of water.

Burr Oak Township, Ovid Township and Branch County all participated in having their planning documents reviewed. The complete reviews and recommendations can be seen in Appendix 4. Due to limited funding, Burr Oak Township was the only Township in a position to incorporate changes at the time of the review. Already in the process of a Master Plan review, the PRWPP was able to assist Burr Oak Township in the incorporation of nearly 100% of the recommendations made. These changes include the following items:

- Encouraging the use of conservation easements.
- Preserving natural features as parkland or open space to help alleviate problems associated with storm water runoff.
- Preserving natural features to maintain existing infiltration.
- Minimizing the use of hard surfaces in new construction and redevelopment projects.
- Restricting placement of septic system fields to 150 feet from river.
- Promoting reduction of impervious surfaces.
- Minimizing the use of pesticides, herbicides and fertilizers.
- Requiring erosion and sediment control as a mechanism to protect health, safety, and welfare of residents through protection of water and soil resources.
- Assessing future storm water needs and goals.
- Developing a storm water management plan.
- Encouraging storm water BMP's.
- Identifying suitable and unsuitable areas for septic systems.
- Encouraging the protection of wetlands.

Additional changes implemented in the Township can be found in Appendix 4.

Ovid Township located in the Branch County portion of the watershed also participated in having its Master Plan and Zoning Ordinances reviewed for water quality policies. Ovid Township had the most advanced land use documents and has been proactive in protecting water resources within their Township. This is in part due to Coldwater Lake (Hodunk-Messenger Chain of Lakes Watershed) which is highly populated and heavily used for recreation. Ovid Township was not at the time completing a full Master Plan review but by the end of our policy review, they had begun the process with McKenna & Associates. As a result, all documents created during this project were available for the Township's consideration during its full Master Plan review. Recommendations made to the Township included:

- Development of a storm water management plan.
- Policies that use storm water BMP's.

- Minimizing impervious surfaces.
- Requiring sediment and erosion mechanisms.
- Limiting high risk land use activities in groundwater recharge and wellhead protection areas.
- Encouraging riparian buffers to assist in flood control and removing pollutants.
- Identifying high quality natural areas.
- Mapping groundwater recharge areas.
- Encouraging a program for identifying and eliminating illicit discharges.
- Mapping all facilities in the sewer system.

Additional recommendations made to the Township can be found in Appendix 4.

Lastly, Branch County participated in a review of its Master Plan and Zoning Ordinances for water quality policies. Branch County was eager to incorporate changes. However, with limited funding for this type of activity they were unable to implement any changes. The Planning Commission did approve a recommendation to the County Commissioners, that most or all of the recommendations be implemented into the updated documents, when the funds become available. Some of the recommendations made to the County included:

- Recognizing watershed boundaries within the County.
- Minimizing hard surfaces in new construction as well as redevelopment to reduce runoff and improve infiltration.
- State the importance of riparian buffers for streambank erosion protection.
- Create a wetlands map.
- State the importance of wetland protection.
- Reservation of natural areas for wildlife habitat.
- Conduct woodland inventory and create existing woodlands map.
- Identify and map groundwater recharge areas.
- Create a greenways plan.
- Include policies that encourage storm water BMP's.
- Identify areas suitable and unsuitable for septic systems.
- Encourage a program for identifying and eliminating illicit discharges.
- Identify and map areas for potential wind energy.

Additional recommendations can be found in Appendix 4.

In addition to the Master Plan and Zoning Ordinance reviews, a LEED-Neighborhood Development (LEED-ND) evaluation was completed for Ovid Township and Branch County. LEED-ND is a rating system that integrates the principles of smart growth, urbanism and green building into the 1st national standard for neighborhood design. LEED-ND certification recognizes development projects that successfully protect and enhance the overall health, natural environment and quality of life. In this evaluation the governmental areas were rated with criteria that included; smart location and linkage, neighborhood pattern and design, green infrastructure and buildings, innovation and design process and regional priority credit utilizing a weighted matrix system. This evaluation mapped and identified areas that would be best for future development and growth based on the five categories. The results and mapping can be found in Appendix 4 in the Master Plan and Zoning Ordinance reviews.

5. PLAN DEVELOPMENT PROCESS

The Prairie River Watershed Management Plan was developed utilizing the best available data along with participation from the public and partner organizations. The process included:

- Soliciting public input
- Reviewing available data and resources
- Coordinating an information and education strategy
- Volunteer inventories
- Outreach
- Modeling
- Field Inventories

5.1 PUBLIC PARTICIPATION

Public participation was recognized as an important aspect in the development of the watershed management plan In order for the plan to be successfully implemented, the public needs to have ownership of the project. The project must consider the input and desires of the public, but must also rely on sound science to be successful.

A steering committee consisting of stakeholders, partner organizations and local and state agencies was created to guide the PRWPP. Tasks the steering committee members helped with included identifying, commenting on and prioritizing desired uses, designated uses, pollutants, watershed goals and the creation of an action plan. The committee also assisted in the development of workshops, provided newsletter articles and assisted with events to promote the watershed project and raise awareness regarding water quality. A full list of the steering committee members is located in Appendix 5.

Partners were essential in supplying watershed information and completing on-the-ground volunteer inventories. Key partners included the Michigan Department of Environmental Quality who completed the Landscape Level Wetland Functional Assessment; provided vital datasets such as wetland data, TMDL and non-attainment information, water quality monitoring information; and provided oversight and guidance for the project. The Michigan Department of Natural Resources served on the steering committee, conducted the mussel survey with the MDEQ and provided the fisheries data included in this plan. The Branch and St. Joseph County Drain Commissioners and Branch County Road Commission served on the steering committee and were an integral part of completing the Bank Erosion Hazard Index throughout the watershed. The Lake Templene Property Owners Association supplied data gathered through their own monitoring and management efforts. Both the Branch and St. Joseph County Conservation Districts provided oversight and participated in workshops, meetings and outreach events. The Friends of the St. Joseph River Association was an important partner for developing the Prioritization Model in this management plan. Lastly, the Southwest Michigan Land Conservancy provided a tremendous amount of effort in Township education regarding protection ordinances. These key partners have provided a remarkable amount of time completing tasks for the watershed project. They will be important to utilize in the implementation of this management plan through in-kind or other financial assistance. A full list of key agencies and their roles is found in Appendix 5.

In order to facilitate the public's input, two public meetings were held at the beginning of the planning project. These meetings were designed to generate public interest and gather their concerns for the watershed. Once the public's input began, two necessary clarifications became obvious as many residents expressed the thought that their property didn't even touch the Prairie River: the need to explain the definition of a watershed and the importance of the Prairie River ecosystem. To address this need, brochures and news articles were created to explain the project as well as define a watershed. These were distributed to the public at events, given to partners, given to the media and provided to Conservation Districts to hand out.

As project related outreach events were scheduled, it came to our attention that the size and location of the watershed created a unique challenge. We found that if a public meeting or event was held in the St. Joseph County portion of the watershed it needed to be duplicated in Branch County. This was assumed to be the result of residents' perception, that an event was located out of their county didn't apply to them. As a result, public meetings were replicated in each county to ensure all watershed residents had an opportunity to voice their concerns. Comments from these meetings were further investigated if they involved NPS related pollutants and/or sources; however, few were discovered to have NPS water quality impacts. A frequent watershed concern was in relation to center pivot irrigation systems that withdraw from surface water. Much concern was expressed about the rights of agricultural producers and the residents that live on those affected water sources. Drought conditions in 2012 amplified these concerns as water levels dipped extremely low. Although, not a direct NPS issue, the installation, maintenance and access to these irrigation systems can lead to NPS issues such as streambank erosion and removal of vegetative buffers.

Other methods of gaining public support and participation came via a social survey and a watershed specific newsletter. The social survey was created to gain insight to the public's water quality attitudes, knowledge, and behaviors which would ultimately assist in the creation of the information and education plan for the watershed. The survey results identify areas where education is needed and the preferred methods of receiving this information. The Prairie River Community Survey was utilized to create an educational and information strategy. More information regarding the social survey as well as information and education strategy can be found in Section 10.2.

The Prairie River Connect newsletter was established as a way to educate the public on watershed related issues and general water quality concerns. Four newsletters were developed over the course of the project and mailed to a distribution list of approximately 1,200 watershed residents. The newsletter generated numerous public inquiries and the general attitude of the public was supportive in the development of this plan. A webpage on the Branch Conservation District website was created to maintain updates related to the project as well as provide water quality related information for landowners.

The PRWPP worked closely with the local media including radio and newspapers to get watershed related information to the public. The media in this region was supportive of the project and participated in nearly all workshops during the course of the PRWPP. They also published articles and press releases regarding work completed. Some examples are notifications of Township reviews and advertising workshops like the Wetland Wonders Workshop held in April 2012.

5.2 REVIEW OF AVAILABLE DATA/REPORTS

A variety of information was gathered and reviewed from existing documents relating to the PRW. This information provided the basic background and helped to prioritize significant areas in the watershed, such as high functioning wetlands. See References Section.

5.3 COORDINATING INFORMATION AND EDUCATION

In order to educate the public on the process of watershed management, a project information and education strategy was created. This strategy was to assist with the public's understanding of watershed management and raise NPS pollution awareness in the Prairie River Watershed. The elements of the information and education strategy were spread across the life of the grant and its components included:

- "Prairie River Watershed Community Survey"

- Two public meetings providing basic watershed related material as well as soliciting information from the public.
- Four school group presentations pertaining to water quality
- Lake Templene Property Owners Association Board Meetings
- BCCD Conservation Expo-Held session related to PRW planning project
- Nottawa Township Presentation that focused on the PRWPP and the Natural Resource Assessment opportunity.
- Ovid Township Presentation that focused on the PRWPP as well as Master Plan & Zoning Ordinance Review.
- Burr Oak Township Presentation that focused on the PRWPP as well as Master Plan & Zoning Ordinance Review.
- Wetland Wonders Workshop
- Prairie River Watershed Planning Project Brochure
- Four "Prairie River Connect" newsletters
- Native Plant Workshop
- PRW and Aquatic Invasive Species Workshop
- Prairie River Website Page
- 2012 Michigan Association of Conservation Districts Winter Conference presentation on approaching Townships and Counties to better manage, improve and protect water quality in their Master Plan & Zoning.
- 2013 Michigan Association of Conservation Districts Winter Conference presentation on prioritization model developed during the PRWPP.

5.4 INVENTORIES

5.4.1 Road Stream Crossing Inventory

An inventory project started in the summer of 2011, evaluated road stream crossings within the watershed boundaries. All of the inventoried road stream crossings were mapped and can be found in Appendix 6.1. Of the 144 total road stream crossings mapped, 115 sites were evaluated. The sites were selected with slight randomization; however, 25% were located in the vicinity of Sand Lake because the Sand Lake Nottawa Beach was listed in the Michigan's 2012 Integrated Report for nonattainment of full and partial body contact recreation designated uses (exceedance of pathogens water quality standard for *E. coli*). The Sand Lake Nottawa Beach data have since been re-evaluated by Michigan DEQ. The beach is no longer considered to be in nonattainment of the recreation designated uses, because there was only a single exceedance of the *E. coli* water quality standard during data collection for two sampling seasons. Even so, this area warranted a close look during the inventory to determine potential sources and causes of the exceedance. Overall, the road stream crossing inventory, which later in 2011included streambank erosion studies (see Section 5.4.2), helped identify areas of concern such as erosion/stream bank erosion, undersized culverts, fish related concerns like stream shading, and unrestricted livestock access sites, along with other issues as noted on the inventory sheets in Appendix 6.

We used a simple evaluation sheet to inspect each road stream crossing. Characteristics we examined at each site included:

- Nearest (c*rossroad*) Intersection (direction to intersection)
- Culvert size
- Stream Depth

- Make up of bottom of river
- Special animals and plants
- Farms/field (*noted practice information*)
- Roadside Runoff (*presence of*)
- Other (*items of special interest*)

Through the inventory, some sites were found to be more localized and connected to a specific source such as unrestricted livestock access. These sites have been detailed in the specific sites section, Section 8.4. In addition, several erosion sites and areas with limited or no vegetative buffers were identified but were found to be more of a watershed wide concern and have been addressed in the Information and Education strategy of this plan. Lastly, irrigation systems that directly withdraw from the river were found throughout this inventory and although not a direct NPS concern, installation and capacity can impact overall water quality. This was not a comprehensive inventory for irrigation, so the sites discovered through this process were not the only irrigation sites in the PRW. Additional information and data related to the road stream crossing inventory is found in Appendix 6.1.

5.4.2 Bank Erosion Hazard Index (BEHI)

The Rosgen Modified Bank Erosion Hazard Index (BEHI) is a process used for surveying and ranking the severity of stream bank erosion at a particular site. Several factors are applied in the BEHI to determine the erosion hazard of a site. These factors include:

- Surface protection
- Root depth
- Root density
- Bank angle
- Bank material
- Bank Stratification

Once these factors are determined, the BEHI is used to calculate a score based on the five metrics that characterizes severity of erosion. The total score of the five metrics correlate to a hazard ranking of very low, low, moderate, high or very high. The results of the BEHI identified areas within the watershed that might be considered higher risk or currently experience a higher rate of erosion. The results provide information on sites that need further evaluation of the surrounding areas and the conditions causing erosion. Detailed explanations of BEHI data collection and calculation methods, along with an example of a field collection data sheet as well as a site specific table that includes PRW - BEHI scores can be found in Appendix 6.2.

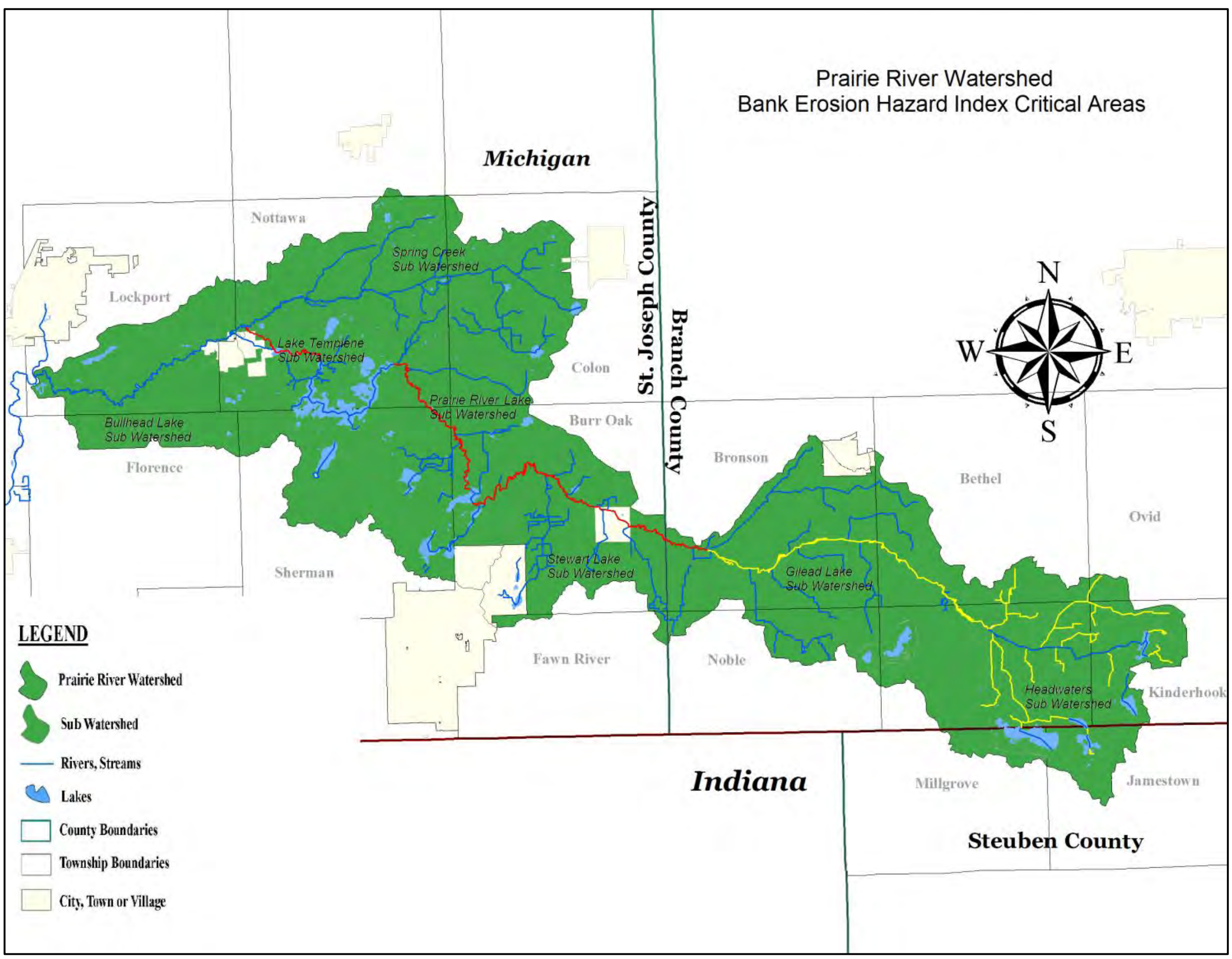
During October and November 2011, the selected sites were visited by a small group of volunteers. Utilizing a small group was important to limit variability in the evaluation. The goal was to use the BEHI to evaluate 50 road stream crossings throughout the watershed. Some site locations were adjusted as we found certain road stream crossings were not appropriate for this inventory (e.g., the stream was dry). In addition, three sites were removed from the inventory: the location of Lake Templene Dam in the Lake Templene sub-watershed, site SLD1 in the Stewart Lake Drain sub-watershed because it was a duplicate of site GL1 in the Gilead Lake sub-watershed and SC6-6 in the Spring Creek sub-watershed, a wetland. Sites were determined randomly knowing that the road stream crossing inventory would focus 25% of its inventory on the Lake Templene sub-watershed.

Of the 48 sites evaluated, one site (2%) was ranked “very low” located in the Gilead Lake sub-watershed. Five sites (14%) were ranked as “low” including three in Spring Creek sub-watershed, one in Lake Templene sub-watershed and one in Stewart Lake Drain sub-watershed. Thirteen sites (27%) were ranked “moderate” including five in Gilead Lake sub-watershed, four in the Headwaters sub-watershed, three in Spring Creek sub-watershed and one in Lake Templene sub-watershed. Twenty-three sites (42%) were ranked "high" including two in Bullhead Lake sub-watershed, five in Lake Templene sub-watershed, six in Prairie River Lake sub-watershed, three in Stewart Lake Drain sub-watershed, four in Gilead Lake sub-watershed and three in the Headwaters sub-watershed. Lastly, six sites (15%) were ranked "very high" including two in Bullhead sub-watershed, one in Prairie River Lake sub-watershed, one in Stewart Lake Drain sub-watershed, one in Gilead Lake sub-watershed and one in the Headwater sub-watershed. See Figure 13 for an overview of PRW BEHI results. Sub-watershed BEHI site maps are located in Appendix 6.2.

The results of the BEHI inventory were evaluated and areas of concern were identified throughout. These areas are addressed in other portions of this plan including the Specific Sites and the Information and Education Strategy. The priority areas defined by the BEHI are in Table 7.

Table 7: Bank Erosion Hazard Index (BEHI) Critical Areas

Bank Erosion Hazard Index Critical Areas for the Prairie River Watershed
Prairie River Mainstem in the Prairie River Lake, Lake Templene, and Stewart Lake Drain sub-watersheds ***High Priority*** *(Red in the figure below)*
Gilead Lake sub-watershed Mainstem ***Medium Priority*** *(Yellow in the figure below)*
Headwater and Stewart Lake Drain sub-watershed Tributaries ***Medium Priority****(Yellow in the figure below)*



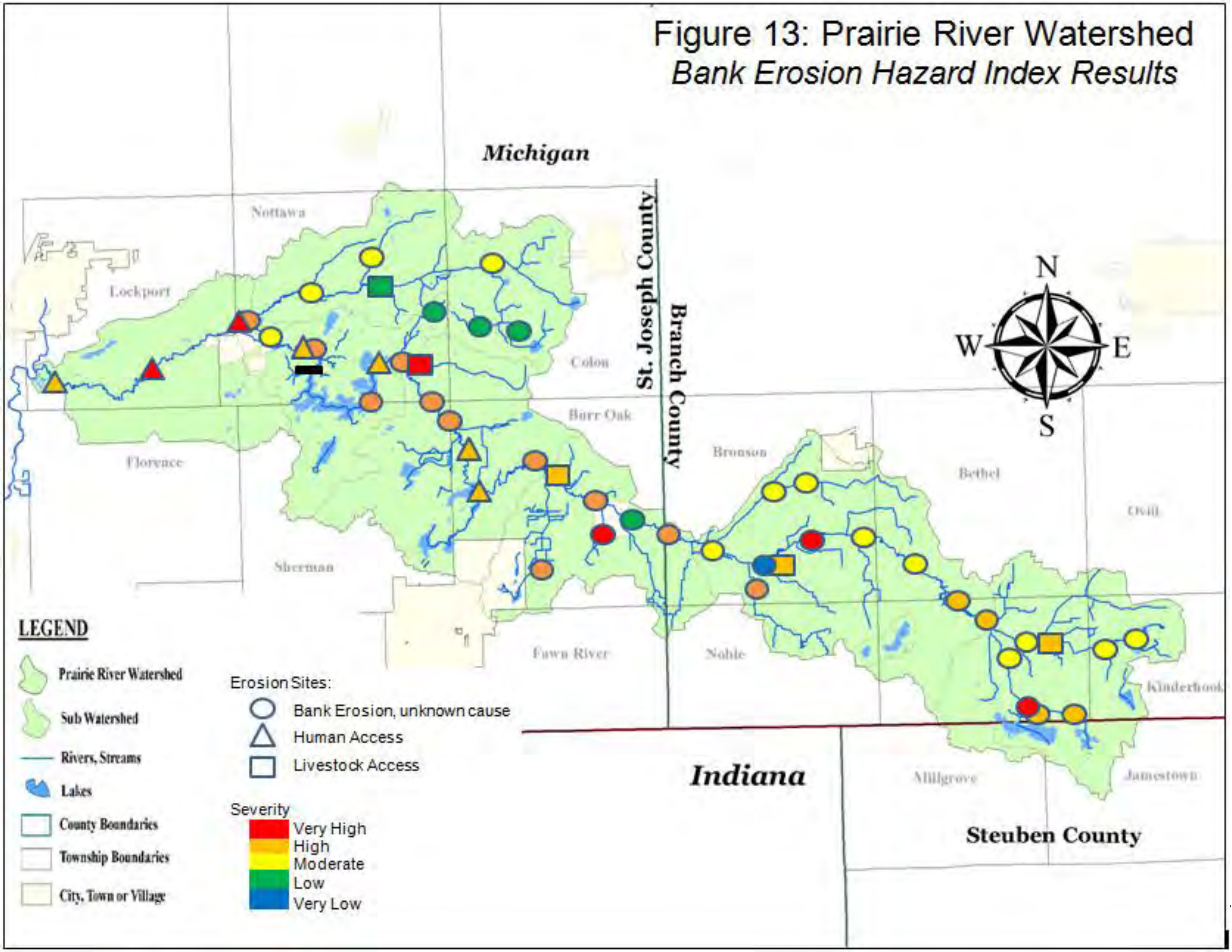


Figure 13: Prairie River Watershed
Bank Erosion Hazard Index Results
Michigan
Nottawa
Lockport
Colon
Burr Oak
Florence
Sherman
Fawn River
St. Joseph County
Branch County
Bronson
Bethel
Noble
Kinderhook
Indiana
Millgrove
Jamestown
Steuben County
N
W
E
S
LEGEND
Prairie River Watershed
Sub Watershed
Rivers, Streams
Lakes
County Boundaries
Township Boundaries
City, Town or Village
Erosion Sites:
Bank Erosion, unknown cause
Human Access
Livestock Access
Severity
Very High
High
Moderate
Low
Very Low

5.4.3 Fish Migration Inventory

An additional assessment was included to evaluate fish passage at the BEHI sites. Public input related to fish habitat and fish for food in the watershed was prevalent which led to completing an overall fish migration inventory specific to the PRW. The design of the inventory was adopted from the St. Joseph River Watershed Fish Migration Barrier Inventory completed by the Potawatomi Resource and Development Council in 2010.

The evaluation sheet used for this project was adapted from the Potawatomi RC&D project. It was customized to include the following:

- Road information (County, State/Paved, Gravel)
- Structure type (culvert, bridge, dam)
- Structure shape and material
- Structure interior (smooth/corrugated)
- Condition of structure
- Whether the structure was buried
- Structure Length
- Diameter size of structure (only for culverts)
- Whether scour pools are present
- Whether the structure is perched

One of the BEHI sites was not applicable for this evaluation, which led to a total of 49 sites being inventoried for fish passage. Of the 49 sites evaluated, 24 were metal culvert passages, 2 were concrete passages, and 20 were bridge sites. The bridge sites were evaluated for some of the criteria but didn't pose a migration issue so information regarding the passage of fish was excluded. Three additional sites were eliminated as they were either dams or found to not be suitable for evaluation (i.e. dry crossing). Culvert conditions were rated good overall throughout the watershed. Of the 26 culvert sites evaluated, 19 culverts ranked in good condition, two as in new condition, four in fair condition and only one in poor condition.

Included in the inventory was an evaluation of scour pools and perched culverts. A scour pool is defined as the removal of substrate from a stream channel by hydraulic forces. Scour pools can be formed from undersized culverts or rapidly moving water sometimes caused by channelization or man-made structures that speed up the normal flow of the river. Scour pools typically appear at the entry, exit or both ends of a culvert. There is a limited amount of water that can enter a culvert. As a result, the water that cannot fit gets pushed back against the adjacent stream bank and can cause a tremendous amount of stream bank erosion as well as scouring of the stream bed creating large, deep holes.

The inventory identified 16 scour pools throughout the PRW (Appendix 6.3).

Perched culverts were also inventoried during the course of this project. The term "perched" is defined as a culvert with a bottom elevation higher than the river bed, thus if fish were trying to migrate upstream, some species would not be able to navigate up into the culvert to continue their path. To protect fish and aquatic life as well as stream stability, culverts should match the bank full width and have an open bottom or a have substrate matching the streambed throughout the entire length of the culvert. Five of the culverts evaluated were perched (Appendix 6.3).

It should be noted that in some cases stream bed erosion or channel incision may be the cause of a perched culvert on the downstream side of a crossing. Installation of bottomless culverts in these locations may actually increase the upstream migration of the stream bed erosion, adding to downstream sediment-pollution issues. In these cases, corrections are more complicated and each site will need to be evaluated individually. However, some form of grade control and bed stabilization is typically used. The perched sites noted above and in Appendix 6.3 were not evaluated for stream bed erosion or culvert width; further investigation may be necessary before site mitigation can begin.

5.4.4 Satellite Photography
Satellite photography (2006 and 2010) was utilized in conjunction with stakeholder input, to identify areas of concern such as human or livestock access to streams or limited buffers. Recent upgrades to quality and resolution of satellite photos has enabled on-the-ground visual quality without having to be physically on the ground. In addition to identifying areas of concern, satellite photography helped pinpoint causes from surrounding land uses. Satellite photography also helped in the case of 2012 when physically paddling the river was impossible in some stretches due to dry conditions and helped identify concerns such as a nonfunctioning dam and in-stream field crossings from vehicles.

5.4.5 Field Inspections
Field inspections were conducted on sites that were identified as potential NPS sources. These sites were determined from stakeholder information, aerial photography, BEHI and road stream crossing surveys; however, the majority of stakeholder concerns were deemed to not be NPS related. Field inspections by water body navigation were conducted on approximately 18 miles of the 32 navigable miles in the PRW. These stretches of river were primarily identified by using satellite photography and the High Impact Targeting (HIT) data found later in this section. Using this information allowed for focusing efforts on areas of concern such as riparian corridors with limited to no vegetative buffers, highly erodible land located near streams or areas of high agricultural or urban use. More miles were planned; however, drought conditions in the summer of 2012 hindered the ability to paddle the river. Due to this, the project utilized more satellite imagery, walking the river and already completed inventory results to evaluate areas of concern.

In addition to paddling the river, Sand Lake, Prairie River Lake, Gilead Lake and Perrin Lake were inspected via kayak. Some critical sites were identified including earth moving at riverbanks without a silt fence as well as unrestricted livestock access. Other observations included lack of vegetative buffers, stream bank erosion from livestock access, irrigation systems, construction site erosion as well as negative shoreline practices like mowing to the water's edge.

Figure 14: A September 2012 pollution event into the mainstem of the Prairie River is shown here by the clouded water

Surprisingly, during a site inspection in the fall of 2012, it was discovered that a pollution event was taking place in the Branch County portion of the PRW. The mainstem of the Prairie River was experiencing an influx of excess sediment from upstream. Approximately two and a half miles of river in the Gilead sub-watershed were walked to observe riparian corridor condition, erosion and potential source of the pollution event. See Figure 14. There was a distinct beginning and end to the sediment plume, starting at Orland Road just south of Bronson, MI all the way upstream to Parham Rd. This area is predominantly agricultural and has experienced channelization and clearing of riparian areas; however, it contains some stretches of natural meanders with good stream canopy. The source of the sediment was suspected to be recent unauthorized dredging or stream bank earth moving, potentially for an irrigation system pump.

5.4.6 Prairie River Mussel Survey

In July 2013, staff from Michigan Department of Environmental Quality Water Resources Division, Department of Natural Resources Fisheries Division, Department of Natural Resources Wildlife Division and University of Michigan completed a mussel population survey on four locations in the St. Joseph County portion of the PRW (Appendix 3). The Prairie River is subject to water withdrawals for row crop irrigation, which could adversely affect mussels and/or their host fish (mussel larvae are temporarily parasitic on certain species of fish). Dams in Centreville and on Lake Templene may also impact mussel populations by interfering with host fish migration. The last known mussel survey on the Prairie River was in 2005 when the Michigan Natural Features Inventory did a survey at Neaman Road. Results of both surveys are found in Table 8.

The four survey locations of the 2013 survey included Findley Road, Truckenmiller Road, Covered Bridge Road and Strobel Road. No sites were surveyed in the Branch County portion of the Prairie River because few mussels were expected to be found in the cold water temperatures.

Species	Findley Rd Downstream ~ 250 ft		Truckenmiller Rd Downstream ~ 200 ft		Covered Bridge Rd Downstream ~3,900 ft		Strobel Rd Upstream ~ 2,000 ft		Neaman Rd (2005)	
	#/site	#/100 m^2	#/site	#/100 m^2	#/site	#/100 m^2	#/site	#/100 m^2	#/site	#/100 m^2
Mucket *(Actinonaias ligamentina)*	3	2.34							16	12.50
Spike *(Elliptio dilatata)*							2	1.56	1	0.78
Wabash pigtoe *(Fusconaia flava)*			10	7.81	18	3.56	1	0.78	10	7.81
Pocketbook *(Lampsilis ventricosa)*			4	3.13	1	0.20			3	2.34
Fluted-shell *(Lasmigona costata)*			1	0.78					1	0.78
Round pigtoe *(Pleurobema sintoxia)*	1	0.78								
Strange floater *(Strophitus undulatus)*			2	1.56	1	0.20	1	0.78		
Ellipse *(Venustaconcha ellipsifomis)*	1	0.78			1	0.20				
Total Species	3		4		5		3		5	
Total Individuals	5	3.91	17	13.28	21	4.16	4	3.13	31	24.22

Table 8: 2013 & 2005 Mussel Survey Results provided by Joe Rathbun, MDEQ

Eight mussel species were found alive (Table 8). Two species are Michigan Species of Special Concern. The round pigtoe (*Pleurobema sintoxia*) was identified at the Findley Road site. The ellipse (*Venustaconcha ellipsiformis*) was located at the Findley Road site as well as the Covered Bridge Road site. These are significant finds as neither of these species has been found in the river since the 1930's. Dead shells of the elktoe (*Alasmidonta marginata*) were also collected however no live mussels were found. The elktoe is also a species of special concern (Table 6).

Most of the mussel communities were small in size and density. However, the Wabash pigtoe (*Fusconaia flava*) was found in varying year classes indicating the species is reproducing. It was also the species collected in highest quantity during the survey.

5.5 WATERSHED RESEARCH/MODELING

5.5.1 MDEQ Landscape Level Wetland Functional Assessment

The Landscape Level Wetland Functional Assessment (LLWFA) is a GIS based tool that can be used to identify and prioritize existing wetlands for protection or enhancement based on the water quality or ecological functions they provide. Similarly, the tool can be used to prioritize historic wetland areas for restoration based on the functions they would then provide. This allows wetland restoration or protection to be compared to other BMPs to help meet specific local water quality or ecological needs. Methodologies to conduct a LLWFA of existing and historically lost wetlands were developed by the United States Fish and Wildlife Service. The Michigan Department of Environmental Quality has modified and refined the LLWFA process to reflect Michigan conditions and applied these protocols to the PRW.

The LLWFA uses pre-European settlement data, an update of the original National Wetlands Inventory (NWI) data, soils data and high resolution aerial photography to identify existing wetlands and areas with potential for wetland restoration (areas identified as pre-settlement wetland that do not appear on the updated NWI maps). The database associated with the mapping provides hydro-geomorphic information for each wetland area such as: landscape position, landform, water flow direction, and pond classification. This information is then interpreted to derive the specific functions (see list below) each wetland area provides. The level of significance of performance for each function (high, medium, or base line) is also derived. Additional information about the LLWFA process and a summary of findings for the PRW is included as appendix 3. Evaluated Wetland Functions:

<u>Water Quality Related Functions</u>

- Flood Water Storage
- Streamflow Maintenance
- Nutrient Transformation
- Sediment and Other Particulate Retention
- Shoreline Stabilization
- Stream Shading
- Conservation of Rare and Imperiled Wetlands
- Pathogen Retention

<u>Habitat Related Functions</u>

- Ground Water Influence
- Fish Habitat
- Waterfowl/Waterbird Habitat
- Shorebird Habitat
- Interior Forest Bird Habitat
- Amphibian Habitat
- Carbon Sequestration

Pathogen Retention Results from the LLWFA were included in the scoring criteria to determine the priority areas for preservation (Section 8.1) as well as the Agricultural and Urban critical areas for restoration (Sections 8.2 and

8.3 respectively). Areas identified through the LLWFA as performing select wetland functions at the moderate or high significance level were scored higher. For example, in the agricultural area, quarter/quarter sections were given 0.05 points for each acre of potentially restorable wetland at the moderate significance level and 0.1 points for each acre of potentially restorable wetland at the high significance level. The figure in appendix 3 (3-39) shows the current and historic wetlands performing "Sediment/Particulate Removal" at the high and medium significance level in the mid- section of the PRW. The complete methodology and specific scoring criteria for determining the priority and critical areas is included as Appendix 10.

The MDEQ also prepared a Wetland Status and Trends Report for the PRW which consists of an analysis of changes in the area, type and function of wetlands. This information is derived from the updated 2005 National Wetland Inventory (NWI) and Hydric soils (used to approximate Pre-Settlement Wetlands) to determine the location, type, function and area of past and current wetlands. Changes over time in the status of individual wetlands are compared and emerging trends are noted (Appendix 3). Results from the status and trends report indicate a 48% loss of pre-settlement wetland resources or 11, 243 acres compared to 2005 wetlands in the PRW. This relates to a loss of 56% of the floodwater storage capacity, 43% nutrient transformation, 51% sediment and other particulate retention, 49% streamflow maintenance, 63% fish habitat, 83% stream shading and 57% of the historic shoreline stabilization capacity in the PRW. All of these functions are considered important, current impediments addressed within the PRW goals.

The LLWFA and Status and Trends Report were used to help determine wetland protection goals (250 acres) and wetland restoration goals (1100 acres) for the watershed (Tables 14, and 15). Due to the high rate of wetland and wetland function loss in the PRW, all opportunities for wetland restoration and protection should be pursued as they present themselves. However, the priority and critical areas and the LLWFA should be used to focus outreach efforts and to identify wetlands areas for proactive funding proposals based on specific watershed needs.

5.5.2 Michigan State University High Impact Targeting (HIT) Model Version 2.0

The High Impact Targeting (HIT) tool was used to assess sedimentation loads, the rates of loading and the cost benefit of best management practices in the PRW. HIT incorporates land cover data, soil texture, soil clay content, elevation, surface roughness and distance to the stream channel to estimate the sediment load that will be delivered to a river or stream. The HIT tool identified areas in the watershed that have the potential to contribute high sediment loads. These areas should be further investigated either through field surveys or aerial/satellite photography analysis.

The entire watershed was assessed to identify areas with potentially high sediment contributions. By using the tool to pinpoint target areas that would need further investigation, it was determined that Gilead Lake sub-watershed contributes the largest amount of sediment throughout the watershed at 1,246 tons per year. Gilead Lake also has the most agricultural land cover of the entire PRW leading to agricultural runoff and stream bank erosion as the suspected sources of sediment in this sub-watershed. This is supported by field inventories that observed limited vegetative buffers and unrestricted livestock access. However, when sediment loading is considered on a tons/acre/year basis the Headwaters sub-watershed ranks highest by a slight margin (131.2 versus 127.5 pounds/acre/year). This sub-watershed therefore deserves a focus for installing sediment reducing BMPs. Table 9 contains the HIT results for the each sub-watershed in the PRW.

Table 9: Results from the HIT model for the PRW

HUC 12	Sub-Watershed	Acres	Sediment Total (tons/year)	tons/acre/year
040500010701	Headwaters - Prairie River	18,780.16	**1232**	**0.06560**
040500010702	Gilead Lake - Prairie River	23,367.23	**1246**	0.05332
040500010703	Stewart Lake Drain - Prairie River	12,862.69	820	**0.06375**
040500010704	Prairie River Lake - Prairie River	17,702.09	**1066**	0.06022
040500010705	Spring Creek - Prairie River	18,304.84	947	0.05173
040500010706	Templene Lake - Prairie River	11,685.73	645	0.05520
040500010707	Bullhead Lake - Prairie River	13,900.33	859	**0.06180**
	Total	116,603.1		
			Highest	
			2nd	
			3rd	

In addition to the above calculations, sediment reduction estimates associated with implementing mulch till and no till on cropland within the PRW were assessed. The HIT model estimates sediment reductions by applying BMPs to the 5% or 10% of cropland generating the greatest sediment load. The model also compares the cost effectiveness of BMPs by estimating the cost per ton of sediment reduced. These estimates are hypothetical given BMPs are implemented within a particular field and only a small portion of a given field may be defined as the greatest 5% or 10% sediment producing cropland.

When applied to Gilead Lake sub-watershed the result of mulch till on 5% of the worst land brings a sedimentation reduction of 223 tons per year (18%) and on 10% of the worst land has a reduction of 270 tons per year (22%). If we apply a no till on 5% of the worst land the reduction is 520 tons per year (42%) and for 10% of the land results in 630 tons per year (51%). Adding grass to the worst 5% of land would generate a reduction of 761 tons per year (61%) and on 10% of the worst lands would be a reduction of 922 tons per year (74%).

Complete results including loads, reduction estimates, costs per acre, and cost benefit are included in Appendix 6.4

5.5.3 STEPL

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) uses simple algorithms to generate sediment and nutrient load calculations based on different land uses. These land uses include cropland, urban land, pastureland, feedlot, forest, and a user defined land use for specific watershed needs. Watershed nutrient loads (Phosphorus and Nitrogen), surface runoff, biological oxygen demand and sediment delivery to waterways can be calculated. The annual nutrient loads are calculated using the volume of runoff, and the concentration of pollutants stemming from the land use and any management practices for the specified land use. The annual sediment load calculations are a result of utilizing the Universal Soil Loss Equation and sediment delivery ratio. Additionally, this model can calculate load reductions based on BMP's applied to the land. These calculations are created by utilizing the BMP efficiencies in the STEPL program which represent results from implementation of

BMP's. The latter is the way in which STEPL was used in this project. *(Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.1 User Guide)*

Utilizing STEPL model version 4.1, sediment and nutrient loads were calculated for specific sites throughout the PRW. The results of the calculations can be found in Section 8.4. These calculations were completed utilizing the default rates due to limited available data.

6. DESIGNATED USES IN THE WATERSHED

Under Section 303(d) of the Federal Clean Water Act, all states, territories, and authorized tribes are required to develop lists of impaired surface waters. Impaired surface waters are defined as water bodies that are highly polluted or otherwise degraded to the point they no longer meet the surface water designated uses set by states, territories or authorized tribes. Michigan's water quality standards were established and adopted through the passage of Public Act 451 (NREPA) in 1994. Rule 323.1100 of Part 4 of Part 31 of PA 451 states that all surface water bodies in Michigan are required to support the following Designated Uses:

6.1 Designated Uses

1. Warm water fishery – supports reproduction of warm water fish species
2. Other indigenous aquatic life/wildlife – supports reproduction of indigenous animals, plants, and insects
3. Partial body contact recreation – water quality standards are maintained for fishing, canoeing and wading
4. Total body contact recreation from May until October – water quality standards are maintained for swimming
5. Navigation – waters are capable of being used for shipping, travel or other transport by private, military or commercial vessels
6. Public water supply – surface intake point (public drinking water source)
7. Industrial Water supply – water utilized in industrial processes
8. Agriculture – water supply for cropland irrigation and livestock watering
9. Cold water fishery – supports reproduction of cold water fish species

Eight of the nine required designated uses are relevant in the Prairie River Watershed; total and partial body contact recreation, navigation, industrial water supply, agriculture, warm water fishery, other indigenous aquatic life/wildlife and cold water fishery. The communities within the watershed do not draw their public water supply from surface water therefore the public water supply designated use is not relevant to the PRW at this time.

In addition to the designated uses above, the MDEQ uses fish consumption advisories established by the Michigan Department of Community Health to evaluate whether a fish consumption designated use is met. Fish consumption in the Prairie River Watershed is currently not supported due to accumulations of PCB's found in fish tissue. PCB's are typically a result of atmospheric deposition, localized issues from contaminated sediments, or historical industrial municipal practices. PCB's were not addressed as part of the scope of this project.

Table 10 outlines the status of Michigan's designated uses as well as potentially impacted uses within the PRW. The designated uses are currently considered to be met; however, the watershed planning process revealed several areas that are potentially impacted. The "potentially impacted" uses indicate areas within sub-watersheds that have been found to potentially contribute pollutants to the PRW. These were developed as the inventory of the watershed commenced and additionally from aerial photo evaluation.

Table 10: Impaired and potentially impacted uses for the PRW

Prairie River Watershed		
Sub-watershed	**State Impaired Uses**	***Potentially Impacted Uses**
Bullhead Lake	No waterbodies in the PRW are currently identified by the MDEQ as having impaired designated uses that can be addressed by the NPS Program.	Other indigenous aquatic life and wildlife; Warm water fisheries
Spring Creek		Other indigenous aquatic life/wildlife; Partial body contact recreation**; Total body contact recreation**; Warm water fisheries
Lake Templene		Other indigenous aquatic life/wildlife; warm water fisheries
Prairie River Lake		Other indigenous aquatic life/wildlife; Partial and total body contact recreation; Cold and warm water fisheries
Stewart Lake Drain		Coldwater fisheries; Partial and total body contact recreation; Warm water Fisheries; Other indigenous aquatic life/wildlife
Gilead Lake		Coldwater fisheries; Partial body contact recreation; Other indigenous aquatic life/wildlife; Total body contact recreation Warm water fisheries
Headwaters		Warm water fisheries; Coldwater fisheries; Other indigenous aquatic life and wildlife
		*Identified through project inventories and evaluations **Michigan's 2012 Integrated Report listed Sand Lake Nottawa Beach as not attaining the full and partial body contact recreation designated uses (exceedance of pathogens water quality standard for *E. coli*); however, subsequent evaluation by MDEQ has determined that the available data do not support a nonattainment listing or scheduling of a TMDL at this time. This site; however, is described as potentially impacted due to a previous beach closure that occurred from a sample result that exceeded water quality standards (Appendix 8)

To meet the levels of water quality necessary for sustaining the nine designated uses defined above, the State of Michigan has defined water quality standards for certain pollutants. The following sections define the rules of water quality standards set by the State.

<u>*Rule 60 of Part 4 of PA 451*</u>
-- limits phosphorus concentration in point source discharges to 1mg/l of total phosphorus as a monthly average. The rule states that other limits may be set in permits when deemed necessary. Additionally, the rule requires that nutrients be limited as necessary to prevent excessive growth of aquatic plants, fungi or bacteria, capable of impairing designated uses of the surface water.

<u>*Rule 62*</u>
--describes the water quality standards that limit the concentration of bacteria in surface water and surface water

discharges of the state. Water bodies of the state which are protected for total body contact recreation must meet the limits of 130 Escherichia coli (E. coli) per 100 mL water as a 30-day geometric mean and 300 E. coli per 100mL water at any time. Water bodies protected for partial body contact recreation are limited to 1,000 E. coli per 100 mL water. Point source discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 mL water as a monthly geometric mean and 400 fecal coliform bacteria per 100 mL water as a 7-day geometric mean. For infectious organisms which are not addressed by Rule 62, MDEQ has the authority to set limits on a case by case basis to assure that uses are protected.

Rule 53
--Chemical contamination is assessed through a water body's hydrogen ion concentration expressed in pH. While there are natural variations of pH, most pH variations in surface water are due to human influences. Fossil fuels and other human introduced chemicals that get deposited into surface water have a tendency to offset the neutral balance between hydrogen (H+) and hydroxyl (OH-) ions. This alteration of surface water pH is extremely important for fish and other aquatic life that rely on a fairly neutral pH level. Waters with a pH level below 7 are considered "acidic" and those with a pH level above 7 are considered "basic" or "alkaline". For every unit changed there is a ten-fold change in acidity or alkalinity. The rule states that pH shall be maintained within a range of 6.5 to 9.0 in all waters of the state.

Rule 50
--This rule sets standards for total suspended solids (TSS) by stating, "Waters of the state shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use; turbidity, color, oil films, floating solids, foam, settle able solids, suspended solids and deposits." This type of rule does not establish a numeric level known as a "narrative standard". Still, most authorities consider water with a TSS concentration less than 20 mg/l to be clear. Water with TSS levels between 40-80 mg/l tends to appear cloudy, while water with concentrations over 150mg/l usually appears dirty.

If a water body is no longer attaining one of the nine designated uses, it is placed in MDEQ's 303(d) list or non-attainment list as well as within the MDEQ's biennial Integrated Report until the designated use is restored to a functional level. This is usually accomplished by reducing the impairing pollutant(s) to a Total Maximum Daily Load threshold.

The Total Maximum Daily Load or TMDL is the total amount of a pollutant that a water body can take and still maintain water quality standards. TMDL's are set by the MDEQ and are usually developed on a case by case basis. Once a TMDL is in place, it is implemented through existing programs such as National Pollutant Discharge Elimination System (NPDES) permits for point source discharges and nonpoint source control programs to achieve the necessary pollutant reductions. No TMDLs are scheduled for the Prairie River Watershed.

7. WATER QUALITY SUMMARY

A water quality analysis was compiled for each sub-watershed in the PRW. This analysis summarizes watershed inventories completed throughout the life of the project and how the information gathered potentially affects the designated uses in each sub-watershed. This analysis accurately characterizes a sub-watershed's strengths and weaknesses in order to produce a better understanding of NPS pollutants in the PRW.

This summary includes the results from all inventories located in Section 5 and a description of the pollutants that are causing or potentially impacting water health, the causes of those pollutants as well as the sources for the pollutants.

The water quality summary by sub-watershed can be found in Appendix 7.

7.1 Pollutants of Concern

Through the inventory process, areas within the PRW were identified to be impacted or potentially impacted by multiple pollutants while other areas could only be identified with what were suspected pollutants. The focus of data collection was through on the ground efforts with the intent of evaluating the watershed for suspected and known pollutants as well as the contributing sources. These data are reflected in Table 11, where the pollutants are listed in prioritized order by what was physically observed and the potential ability to impact water quality. Also, Table 12 and Table 13 list pollutant sources and causes for each of the seven sub-watersheds.

Table 11: Pollutants of Concern in the Prairie River Watershed

NPS Pollutant	Suspected/Known
Sediment	Suspected
Bacteria and Pathogens	Both Known and Suspected
Nutrients	Suspected
Hydrologic Flow	Suspected
Temperature	Suspected
Pesticides	Suspected

7.1.1 *Sediment*

Sediment in the quantities estimated throughout the watershed is at a capacity where it can impact aquatic habitats, disrupt natural hydrology and limit navigation. Sediment load calculations that resulted from the HIT model indicate that all sub-watersheds are contributing sediment at a rate of between 645 and 1,246 tons/year. Accumulations of sediment can result in water bodies becoming shallow, increasing a water body's temperature, resulting in a change to water flow and impacting aquatic life habitats. In addition to the large amounts of sediment, substances such as nitrogen, phosphorus and *E. coli* often bond to sediment particles and are easily transported throughout a watershed.

Figure 15: Erosion at the Nottawa Boat Launch

Sediment accumulations have become a large problem in some areas of the watershed. A 2006 bathymetric study on Lake Templene included a sediment accumulation survey that indicated high accumulation where the Prairie River enters Lake Templene. This is also the location of the Nottawa Township Boat Launch that was newly constructed in 2011. Prior to this construction the site served as an unauthorized boat launch bringing an abundance of traffic into the area. Sediment accumulations were recorded up to seven feet deep in this area. This is due in part to the boat launch activity, with additional sediment derived from runoff upstream. Furthermore, design issues with the new boat launch area have created additional gully erosion conditions (See Figure 15) amplifying the sediment issues in this location. While the boat launch is a site that merits repairs, the bulk of the sediment is most likely coming from upstream erosion and runoff. (*For examples see sites LT7 and PRL7 in the Appendix 7.2 BEHI report*). Still, as an impoundment, Lake Templene can be viewed as a sediment trap. Whether circulating through the lake from areas like the boat launch or more likely flowing in from upstream, once the sediment filled waters enter the slower regions of the impoundment, water velocity drops. As the water slows, sediment begins to fall and accumulate on the bottom of the lake. In 2012, residents of Lake Templene were assessed a property fee to begin a five year management program which will result in the removal of approximately 270,000 cubic yards of soil.

Agricultural erosion sites were identified in several areas throughout the watershed. These sites had minimal or no vegetative buffers along riparian corridors, thus allowing for direct contaminated runoff from surrounding areas and risking stream bank degradation. In addition, there were two sites identified through aerial imagery that contained tracks crossing through the river. It is assumed that these areas are utilized as field passages for farm equipment since they are surrounded by cropland with no road crossings nearby.

PRW sites where irrigation systems were identified are prone to intensified farm related runoff due to the complete clearing and or mowing of the land up to the water's edge. This lack of vegetative buffering allows for erosion and stream sediment input. When combined with the installation of irrigation pumps below the surface of the waters it creates additional disturbances to both the stream banks and beds.

Figure 16: Graded riverbank on the mainstem of the Prairie River. This site is an example of some of the soil erosion found.

Sites in the PRW that contribute to sediment-related impacts include parks, construction sites and a key area in the Village of Burr Oak. Heavy foot traffic has led to soil compaction and mowing to the edge of the river is a common practice in these areas. Some of the areas that are popular for fishing are littered with debris from users and isolated erosion sites have been identified as well.

Construction sites and private landowner property modifications also play a role in the sediment impact throughout the watershed. Field inventories showed sites where soil erosion was either a potential risk or known contributor of sediment to the waterways (For an example see Figure 16, where site smoothing and grading was completed to the water's edge.) These sites were identified in isolated areas of the watershed where the average traffic volume is low. The general consensus was that involved individuals need further education; therefore this topic has been incorporated into the information and education strategy.

In addition, in-stream changes have contributed to erosion of stream banks in the Village of Burr Oak. A bridge constructed in 1998 on Burr Oak Rd just north of U.S. 12 included a rock structure beneath the bridge which ultimately increased water velocity. This resulted in extreme soil loss and a deep scour pool on the west (downstream) side of the bridge (See Figure 17). This has impacted approximately 200 yards of stream bank ending where the river bends to the north.

Figure 17: Burr Oak Road Bridge, erosion and scour pools created from increased water flow

7.1.2 *Bacteria & Pathogens*

Bacteria and pathogens are a growing concern throughout the watershed. Although, at this time it is not known to be a widespread problem in the watershed, 2004 monitoring at Sand Lake's Nottawa Beach indicated an *Escherichia coli (E. coli)* level of 183 *E. coli*/100 mL in a 30 day geometric mean (Appendix 8). To meet water quality standards levels must be 130 *E. coli*/100 mL or less as a 30 day geometric mean. *E. coli* is an indicator of pathogens from human waste, or other warm blooded animal waste or a combination of both. Although investigation is still necessary, high numbers of wildlife may also be contributing to watershed contamination levels, particularly along the waterways with unfiltered and unlimited shoreline access. Inventories of Sand Lake indicate that historically there was livestock access to the lake; however, it has been decades since the removal of this access point. A stronger possibility is unmaintained or failing septic systems are contributing the pollutants. Most homes around the lake are over 50 years old leading to the assumption that the majority of septic systems are below current standards and beyond the typical operational lifespan of 25 years. More information regarding Sand Lake is found in Section 8.4.

Bacteria and pathogens are a suspected problem around Sand Lake and other lakes that do not have municipal sewer systems. Lakes with development such as Omena Lake, Sand Lake, Lake Templene, Lake Pleasant and Fish Lake are all suspected to contribute bacteria and pathogen loads due to under designed, unmaintained or failing septic systems. When septic systems are improperly designed, not maintained or are failing, bacteria and pathogens can leach into the surrounding areas, including water bodies. The development on most lakes is decades old so it is suspected that septic leakage could be a common problem in the older septic systems as well as those that are improperly maintained.

Unrestricted livestock access points only further *E. coli* pollution and several sites have been identified in the PRW. Livestock are known to wade in unrestricted waters for long periods of time adversely impacting the water quality. Without restrictions, the livestock can spend hours enjoying the water while their waste and movement impacts the water health as well as the habitat along the water body. Field inventories have shown that livestock access to the river is more prevalent than originally suspected. Additional widespread *E. coli* testing would determine the impact of these sites along the Prairie River and its tributaries.

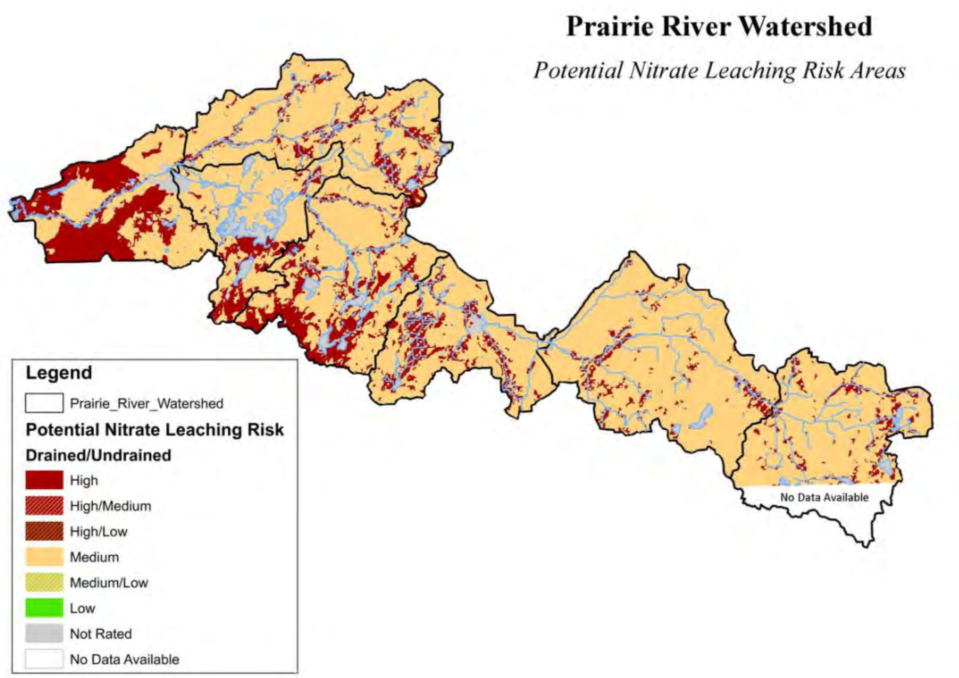
Another concern for nutrients, bacteria and *E. coli* contamination would be the large numbers of waterfowl and wildlife that are generally utilizing areas mowed to the water's edge. Areas lacking vegetative boarders encourage waterfowl in particular to enter yards, where accumulating feces contribute contaminated water runoff directly into the waterway as noted in Section 4.2

Since few actual sites of failed septic systems were actually identified and other possible sources of contamination have been noted, additional water monitoring and testing is highly recommended. Monitoring and testing will identify / locate currently unknown contamination sites for PRW protection and restoration. Public education encouraging increased vegetative borders utilizing native plants and other protective landscape methods should be implemented.

7.1.3 *Nutrients*

Excess nutrients are additional concerns for the PRW. Excess nutrients deposited in the environment can result in costly negative effects. Common ways excess nutrients find their way into the environment are through over application (intentional or unintentional) of organic (manure) or mineral fertilizers to lawns or crops or the leaching of sewage or wildlife or animal waste. In surface water bodies, excess nutrients can expedite algae and aquatic plant growth creating concerns for the water users and resulting in aquatic habitat degradation

Figure 18: Potential Nitrate Leaching Risk Areas *(Stinson, Brent, NRCS)*



Nutrients in water can lead to excess growth including the growth of invasive species. There are three golf courses within the watershed and all are substantial in size. Inventories of these golf courses have shown that vegetative buffers are not utilized in the landscape leading to the potential for nutrient rich runoff from the courses. A fertilizer applied to the surface that is not absorbed by the plant is easily washed into the waterways due to limited turf infiltration and lack of buffers. Investigations into fertilizer/chemical application rates led to little information so it cannot be concluded as a known source of pollution.

Limited vegetative buffers, filter strips, grassed waterways and lack of conservation tillage practices are leading to nutrient runoff on agricultural fields in the PRW. As commodity prices rise, we see buffers being removed throughout the watershed. Lands that were once fallow or wooded are now becoming row crops. This activity is more prevalent in the St. Joseph County side of the watershed where large center pivot irrigation systems are needed due to high infiltration rates of the soil types. Over application of chemicals such as nitrogen can leach through the coarse soils and run off the land into water bodies particularly when no vegetative buffers are present. Nitrates (a form of nitrogen) are commonly found in chemicals for agricultural use and are easily absorbed by crops. However, in an occurrence of over application, not all the applied nitrogen can be absorbed and can leach through the soil into groundwater or run off the land into water bodies. The U.S. Environmental Protection Agency and the Michigan Department of Environmental Quality has determined that anything over 10mg/L is considered excessive nitrate levels. Excessive nitrate levels can cause a blood disorder that limits the ability of red blood cells to carry oxygen and is particularly concerning for infants under six months of age. (*Nitrates in Drinking Water, MDEQ*) In Michigan, the MAEAP program performs tests upon request for the public on nitrates and nitrites through litmus strips as an indicator for additional testing. Readings exceeding the threshold of 1mgL for nitrites and 10 mgL for nitrates are referred out for more definitive testing. Since this is a voluntary program, no accurate data was available on actual nitrate and nitrite readings. However, 11 of 115 PRW samples between 2012 and 2913 were referred for additional nitrate testing. See Figure 18 for potential nitrogen leaching areas within the PRW.

Nutrient runoff is also a concern for waterfront properties. This watershed has several very populated lakes, where a common practice is mowing to the water's edge. Over application of lawn fertilizers under these conditions can lead to runoff into surface water causing nutrient loading.

7.1.4 *Hydrology & Temperature*

A growing concern for the PRW is hydrologic change, although there are no current designated use impairments related to hydrology. Removal of wetlands; vegetative buffers; loss of forest cover; installation of dams; water withdrawal for industrial, agricultural and home use; and an increase in impervious surfaces all result in changes to the hydrology. Changes in flow can have adverse effects on lake and stream levels, sediment movement and water temperature. Altered hydrology can result in flashy flows and flooding, stream bank erosion, and sedimentation. Streams that experience quick fluctuations in water elevation are considered "flashy." Flashiness can lead to stream channel instability and increased erosion.

Stable hydrology and temperature are important for the PRW due to its coldwater sections and self-sustaining trout populations. Public input during the planning process showed that maintaining coldwater trout populations was important to watershed residents. While base flow is normally the influential factor for stream temperature control, shade in more channelized locations is also important. Many upstream locations in the PRW have been greatly channelized and often have little cover to help maintain cooler stream temperatures. Wider, slow-flowing channels are susceptible to temperature increases when the shade canopy is minimal or removed. The coldwater trout stream areas are experiencing the same removal of vegetative buffers and shade trees in order to increase crop production and facilitate more urban activities. When the warmed upstream waters enter the trout stream area, temperature sensitive species and the trout stream are endangered. Additionally, an increase in impervious surfaces results in warmed runoff and increased flow in sections of the river due to limited infiltration rates.

Changes in hydrology should be on the radar screen for the PRW; however, over time PRW flows have been fairly stable. The MDEQ has calculated Richards-Baker Flashiness Index (R-B Index) values for several hundred streams with USGS gages throughout Michigan (*Application of the Richards-Baker Flashiness Index to Gaged Michigan Rivers and Streams*, MDEQ Water Resources Division, May 3, 2012) (See Appendix 9). The R-B Index is used to evaluate changes in stream flow with respect to how frequently and rapidly short-term changes occur. The R-B Index value for the Prairie River (based on the USGS gage station near Nottawa, MI) fell within the lowest quartile of stream flashiness statewide, indicating low flashiness. The R-B index value for the Prairie River was based on gage data from 1960 to 2010.

Hydrology as previously stated is affected by many factors including changes in slope, land cover, land use or vegetative alterations and soils types. Despite an overall stable flow pattern for the PRW, many of these types of changes are known or suspected to be occurring in the PRW, and are likely resulting in some degree of impact to hydrology and temperature.

Although there are areas of poorly drained hydric soils, especially towards the eastern side of the PRW, much of the watershed contains soils conducive to rainwater infiltration. Approximately 8.9 inches of an estimated 35 inches of annual rainfall is accumulated as groundwater; the main supply of water to PRW waterways. (See Section 2 and *USGS - Scientific Investigations Report 2005–5284*). Since the overall watershed's slope and soil types favor water infiltration, changes on the landscape which influence slope or soil compaction have the potential to impact the balance between infiltration and stormwater runoff. Removal of grasslands, forests and other vegetation in the watershed has increased along with the pressure to farm more land and are suspected to be a source of increased storm water runoff which may impact hydrology.

The natural pre-settlement landscape, (See Appendix 3-4) maintained a stable PRW hydrology as it filtered, slowed and absorbed rainwater into the ground, while using the numerous wetlands to hold excess water. Water delivery into streams, lakes and rivers was more controlled, slower and erosion less likely (Section 2). This also assisted with groundwater/baseflow recharge. The PRW has experienced a 48% loss of pre-settlement wetlands over time, accounting for a 49% loss of stream flow maintenance function and 56% of floodwater storage capacity (See Section 5.5.1 and Appendix 3- LLWFA data). This known loss of wetlands, in large part due to land drainage for agricultural use, plays a role in the current PRW hydrology and water temperature. Continued loss of wetlands may jeopardize the still fairly stable flows of the PRW.

PRW forestland coverage has declined from about half of the PRW during pre-settlement to approximately 12% currently. Forestlands provide tremendous assets to the watershed. Trees intercept rain fall reducing the amount reaching the ground, slow and filter storm water runoff, and cycle water back to the atmosphere through transpiration and evaporation. In forests, like grasslands or other areas with vegetative covers, there is less erosive action once rainwater reaches the forest floor, intercepting and infiltrating rainwater more so than in agricultural lands or maintained turf or lawns. However in forestlands, the base flow recharge to waterways is slightly faster than grassland which tends hold water longer. When combining the additional shade and slightly higher groundwater base flow into waterways, restoration of forested lands would be an important addition to maintaining and improving PRW water conditions. This would be especially true upstream of sensitive areas like the designated PRW trout stream, providing not only improved water quality, but cooler water input from higher base flow and additional shading to help maintain cooler temperatures.

Dams and the impoundments created by them impact the flow of water and sediment as well as water temperature (See Section 2.5 for a discussion of dams and impoundments in the PRW). This is especially true for large dams, such as the Lake Templene dam, which impounds approximately 950 acres on the Prairie River. Impoundments slow flow on the upstream side of the dam where waters warm and sediments drop out and accumulate. Water flowing out of a dam subsequently lacks sediment, and often compensates by eroding banks and stream beds on the downstream side of the dam. The degree of alteration of natural downstream flow and water temperature is dependent on a dam's purpose, structure, and release mechanisms. The exact impact of dams in the PRW is unknown, but is assumed to impact natural hydrology and water temperature to some extent.

In addition to land use changes and stream alterations, weather conditions and other factors, such as water usage, may have temporary and/or long-term impacts on flow rates. Of note, in 2012 lake levels were reported to be down feet in some areas, and the Prairie River itself experienced extremely low water levels. Appendix 9 shows USGS data for the Prairie River gage near Nottawa, MI (just north of Sturgis at the highway M-66 river crossing). Included in this data are summer 2012 discharge rates which indicate especially low discharge rates throughout the months of July and August. A period in early July showed no recorded discharge rate. It is unknown whether this was due to equipment malfunction or a lack of sufficient flow to register a measurement by the gage.

While excessive lack of rainfall and therefore low water recharge was most likely the largest cause of 2012 PRW flow rate changes, flow rates may also have been and continue to be influenced by increased water withdrawal from additional installations of large scale irrigation systems. The PRW experienced an increase in the use of high capacity irrigation systems between 2010 and 2013 as noted in Table 1. This became more noticeable during the drought of 2012. Some irrigation systems in the PRW draw water directly from surface water, which includes areas on the main stem of the Prairie River, as well as the lakes in the PRW. (*Observed during PRW survey and noted in Appendix 9 USGS data.*) These large capacity in-stream irrigation systems can impact the stability of the streambank /shoreline and create a potential for contaminating spills (chemicals and fuel). Other PRW irrigation systems take water from subsurface wells. Both, whether in-stream or subsurface, can pull a tremendous amount of water for long periods of time.

Although individual wells may have little effect on streamflow depletion, USGS Circular 1376 discussing well depletion, concluded that the combined effects of many small wells pumping in a basin can have a substantial effect on aquatic habitats and stream flow. These cumulative effects may not be fully realized for years as the typical basinwide groundwater development alone, can occur over decades. The study also concluded that post pumping recovery from streamflow depletion may take decades to centuries to fully recover after the pumping ends. As discussed here, it is very likely that the PRW, which is a long term development stage, has the potentially to be greatly damaged now or in the future, without further testing and monitoring of all related factors related to hydrology and temperature alone.

7.1.5 *Pesticides*

The degradation of water quality may be partially contributed to pesticides, as the result of intense agricultural practices. Due to high commodity prices, the watershed has seen riparian vegetation removal to allow for more crop production, which could potentially contribute to increased runoff from fields with direct access to surface water. However, residential and commercial pesticide use are indicted as high contributors playing an important role in contributing to pollutants in the watershed. No monitoring has been completed and the level of pesticide contamination in the PRW has not been determined, but pesticides are still listed as a suspected pollutant due to known use practices within the watershed.

In prior years, atrazine, a powerful agricultural herbicide, was tested for annually in groundwater by the Michigan Agricultural Environmental Assurance Program (MAEAP). According to the local MAEAP technician, in recent years, increased cost of atrazine has limited its use by producers. Limited program funding resulted in the removal of atrazine testing from the program. However MAEAP still actively works to promote proper chemical handling among many other positive agricultural practices. More information on MAEAP can be found at: http://www.maeap.org/

Table 12: Prioritized Pollutants and Pollutant Sources

Pollutant of Concern	Pollutant Source *(known(k) or suspected (s))*
Sediment	1. Agricultural Runoff (k)
	2. Streambank Erosion (k)
	3. Stormwater Runoff (k & s)
	4. Livestock, Agricultural Wildlife, and Public Crossings (k)

Bacteria and Pathogens	1. Septic Systems (s)
	2. Animal Waste (k)
	3. Wildlife (s)
Nutrients	1. Agricultural Fertilizer Use (s)
	2. Septic Systems (s)
	3. Golf Course Fertilizer Use (s)
	4. Animal Waste (s)
	5. Wildlife (s)
	6. Residential Fertilizer Use (s)
Hydrologic Flow	1. Wetland Loss (k)
	2. Stormwater Runoff (s)
	3. Drainage for Agricultural Use (k)
	4. Irrigation Surface Withdrawal (s)
Temperature	1. Loss of groundwater recharge from draining wetlands (k)
	2. Large impoundments (k)
	3. Lack of Streambank Vegetation (s)
	4. Stormwater Runoff (s)
	5. Irrigation Surface and Sub-surface Withdrawal (s)
Pesticides	1. Agricultural Use (s)
	2. Residential/Commercial Use (k)

Table 13: Prioritized Pollutants, Pollutant Sources and Pollutant Causes

Sub-watershed	Pollutant	Pollutant Source	Pollutant Cause (k) Known (s) Suspected
Bullhead Lake	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k) 2. Lack of buffer strips (k)
		Streambed Erosion	1. Limited riparian vegetation (k) 2. Human Access sites (k) 3. Flow Fluctuations (impervious surface, loss of wetlands, etc.) (k)
	Bacteria and Pathogens	Septic System	1. Unmaintained/Failing Septic Systems (s)
	Nutrients	Animal Waste	1. Mismanaged application to agricultural fields (s)
		Wildlife	1. Unlimited water access (s)
		Agricultural Fertilizer Use	1. Mismanaged Applications (s)
		Golf Course Fertilizer Use	1. Mismanaged Applications (s)
		Residential Fertilizer Use	1. Mismanaged Applications (s)
	Pesticides	Agricultural Use	1. Lack of riparian vegetation (k) 2. Mismanaged Applications (k) 3. Lack of IPM practices (k)
Spring Creek	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k)
		Streambank erosion)	1. Livestock Access (k) 2. Removal of riparian vegetation(k)
	Bacteria and Pathogens	Septic System	1. Unmaintained/Failing Septic Systems (s)
		Animal Waste	1. Unrestricted livestock access (k)
		Wildlife	2. Unlimited water access (s)
	Nutrients	Septic Systems	1. Unmaintained/Failing Septic Systems (s)
		Animal Waste	1. Mismanaged Applications to agricultural fields (s) 2. Livestock Access (s)
		Wildlife	3. Unlimited water access (s)
		Agricultural Fertilizers	1. Mismanaged Applications (s)
	Pesticides	Agricultural Use	1. Mismanaged Applications (k) 2. Lack of IPM practices (k)
Lake Templene	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k) 2. Lack of buffer strips (k)
		Streambank Erosion	1. Removal of riparian vegetation (k) 2. Human Access Sites (k) 3. Flow fluctuations (k) 4. Dams/Impoundments (k)
	Bacteria and Pathogens	Septic System	1. Unmaintained/Failing Septic Systems (s)
		Wildlife	2. Unlimited water access (s)
	Hydrologic Flow	Impoundments	1. Dams(k)
	Nutrients	Golf Course Fertilizer Use	1. Mismanaged Applications (s) 2. Limited vegetative buffers (s)
		Agricultural Fertilizer Use	1. Mismanaged Applications (s)
		Residential Fertilizer Use	1. Mismanaged Applications (s)
		Septic System	1. Unmaintained/Failing Septic Systems (s)
		Wildlife	2. Unlimited water access (s)
	Pesticides	Agricultural Use	1. Mismanaged Applications (k) 2. Lack of IPM practices (k)

Sub-watershed	Pollutant	Pollutant Source	Pollutant Cause (k) Known (s) Suspected
Prairie River Lake	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k) 2. Lack of buffer strips (k)
		Streambank Erosion	1. Removal of riparian vegetation (k) 2. Human Access Sites (k) 3. Flow fluctuations (k)
	Bacteria and Pathogens	Animal Waste	1. Unrestricted Livestock Access to Surface Water (k)
		Wildlife	2. Unlimited water access (s)
		Septic Systems	1. Unmaintained/Failing Septic Systems (s)
	Nutrients	Septic Systems	1. Unmaintained/Failing Septic Systems (s)
		Residential Fertilizer Use	1. Mismanaged Applications (s)
		Agricultural Fertilizer Use	1. Mismanaged Applications (k)
		Animal Waste	1. Unrestricted Livestock Access to surface water (s)
		Wildlife	2. Unlimited water access (s)
	Pesticides	Agricultural Use	1. Mismanaged Applications (k) 2. Lack of IPM practices (k)
		Residential/Commercial Use	1. Mismanaged Applications (k)
	Hydrologic Flow	Irrigation Surface Water Withdrawal	1. Loss of baseflow to irrigation (s)
Stewart Lake Drain	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k)
		Streambank Erosion	1. Removal of riparian vegetation (k) 2. Flow fluctuations (impervious surface, no buffers) (k) 3. Human Access Sites (k) 4. Construction Sites/Human Impact through soil erosion (k) 5. Dams/impoundments (k)
	Bacteria and Pathogens	Septic System	1. Unmaintained/Failing Septic Systems (s)
	Nutrients	Agricultural Fertilizer Use	1. Mismanaged Applications (s)
		Wildlife	2. Unlimited water access (s)
	Pesticides	Agricultural Use	1. Lack of riparian vegetation (k) 2. Mismanaged Application rates (k) 3. Lack of IPM practices (k)
		Residential/Commercial Use	1. Lack of riparian vegetation (k) 2. Mismanaged Applications (k)
	Hydrologic flow	Wetland Loss	1. Land conversion for agricultural use (k)
		Stormwater	1. Increased impervious surface leading to increased peak flow (s) 2. Lack of stormwater practices (s)
		Drainage for Agricultural Use	1. Channelization of streams (k) 2. Agricultural Field tiling (k) 3. Wetland conversion for agricultural use (k) 4. Removal of riparian vegetation (k)
	Temperature	Lack of streambank vegetation	1. Removal of vegetation for agricultural use (s)
		Loss of base flow	1. Drainage of recharge areas (s)
		Stormwater	1. Increase impervious surface (s)

Sub-watershed	Pollutant	Pollutant Source	1. **Pollutant Cause** (k) Known (s) Suspected
Gilead Lake	Sediment	Agricultural Runoff	2. Erosion from conventional tillage practices (k) 3. Lack of buffer strips (k)
		Streambank Erosion	1. Removal of riparian vegetation (k) 2. Flow fluctuations (no buffers) (k) 3. Human Access Sites (k) 4. Livestock and agricultural crossings (k)
	Bacteria and Pathogens	Animal Waste	1. Unrestricted access to surface water (k) 2. Mismanaged applications (k)
		Wildlife	1. Unlimited water access (s)
		Septic Systems	1. Unmaintained/Failing (s) septic systems
	Nutrients	Septic Systems	1. Unmaintained/failing septic systems (s)
		Golf Course Fertilizer Use	1. Mismanaged Applications (s)
		Animal Waste	1. Unrestricted access to surface water (s) 2. Mismanaged applications (s)
		Wildlife	1. Unlimited water access (s)
		Agricultural Fertilizer Use	1. Mismanaged Applications (s)
		Residential Fertilizers Use	1. Mismanaged Applications (s)
	Pesticides	Agricultural Use	1. Lack of riparian vegetation (k) 2. Mismanaged application rates (k) 3. Lack of IPM practices (k)
	Hydrologic Flow	Wetland Loss	1. Land conversion for agricultural use (k)
		Drainage for agricultural use	1. Channelization of streams (k) 2. Agricultural field tiling (k) 3. Wetland conversion (k)
	Temperature	Irrigation Surface Water Withdrawal	1. Loss of baseflow to irrigation (s)
		Lack of streambank vegetation	1. Removal of riparian vegetation (s)
		Drainage of Recharge Areas	1. Loss of baseflow
Headwaters	Sediment	Agricultural Runoff	1. Erosion from conventional tillage practices (k)
		Streambank Erosion	1. Human Access Sites (k) 2. Removal of riparian vegetation (k) 3. Flow fluctuations (no buffers) (k) 4. In-stream field crossing (k)
	Bacteria and Pathogens	Septic Systems	1. Unmaintained/failing septic systems (s)
		Animal Waste	1. Unrestricted Livestock Access (k) 2. Mismanaged Applications (k)
		Wildlife	1. Unlimited water access (s)
	Nutrients	Agricultural Fertilizer Use	1. Mismanaged Applications (s)
		Septic Systems	1. Unmaintained/failing septic systems (s) 2. Lack of municipal sewer systems to populated lake areas. (s)
		Wildlife	1. Unlimited water access (s)

Sub-watershed	Pollutant	Pollutant Source	Pollutant Cause (k) Known (s) Suspected
Headwaters	Pesticides	Agricultural Use	1. Mismanaged applications (k) 2. Lack of riparian vegetation (k) 3. Lack of IPM practices (k)
	Hydrologic Flow	Loss of base flow	1. Drainage of recharge areas (k)
		Drainage for Agricultural use	1. Channelization of streams (k) 2. Agricultural field tiling (k) 3. Wetland conversion (k)
	Temperature	Lack of streambank vegetation	1. Removal of riparian vegetation (s)
		Irrigation surface water withdrawal	1. Loss of baseflow to irrigation (s)

8. PRIORITY and CRITICAL AREAS

Priority (for protection) and critical (for restoration) areas in the watershed were determined by reviewing land types that are known or suspected to contribute a majority of the PRW's water quality pollutants. The prioritization model utilized basic concepts from the Paw Paw Watershed Management Plan (2008), while incorporating updated data variations. In this approach, a set of criteria was created for three separate land concerns; agricultural, urban and preservation. These criterions were determined with the help of the steering committee and partnering organizations as well as knowledge gained throughout the project.

The process of prioritization in the watershed began by splitting the watershed into 40 acre (quarter-quarter, QQ) sections and applying the criteria to each 40 acre section. The criteria for each area listed in Appendix 10 were then given a number (weight) in order to calculate and rank each QQ. Based on scores, the QQ were then ranked as high, medium or low in regard to their impact on the land concern. The high ranking QQs were further divided into 6 classes (based on natural breaks in the data). The three top scoring classes are designated as the priority or critical areas of the watershed.

Prioritizing the watershed this way allows the limited funding to be focused on the highest priority areas, making the largest water quality impact.

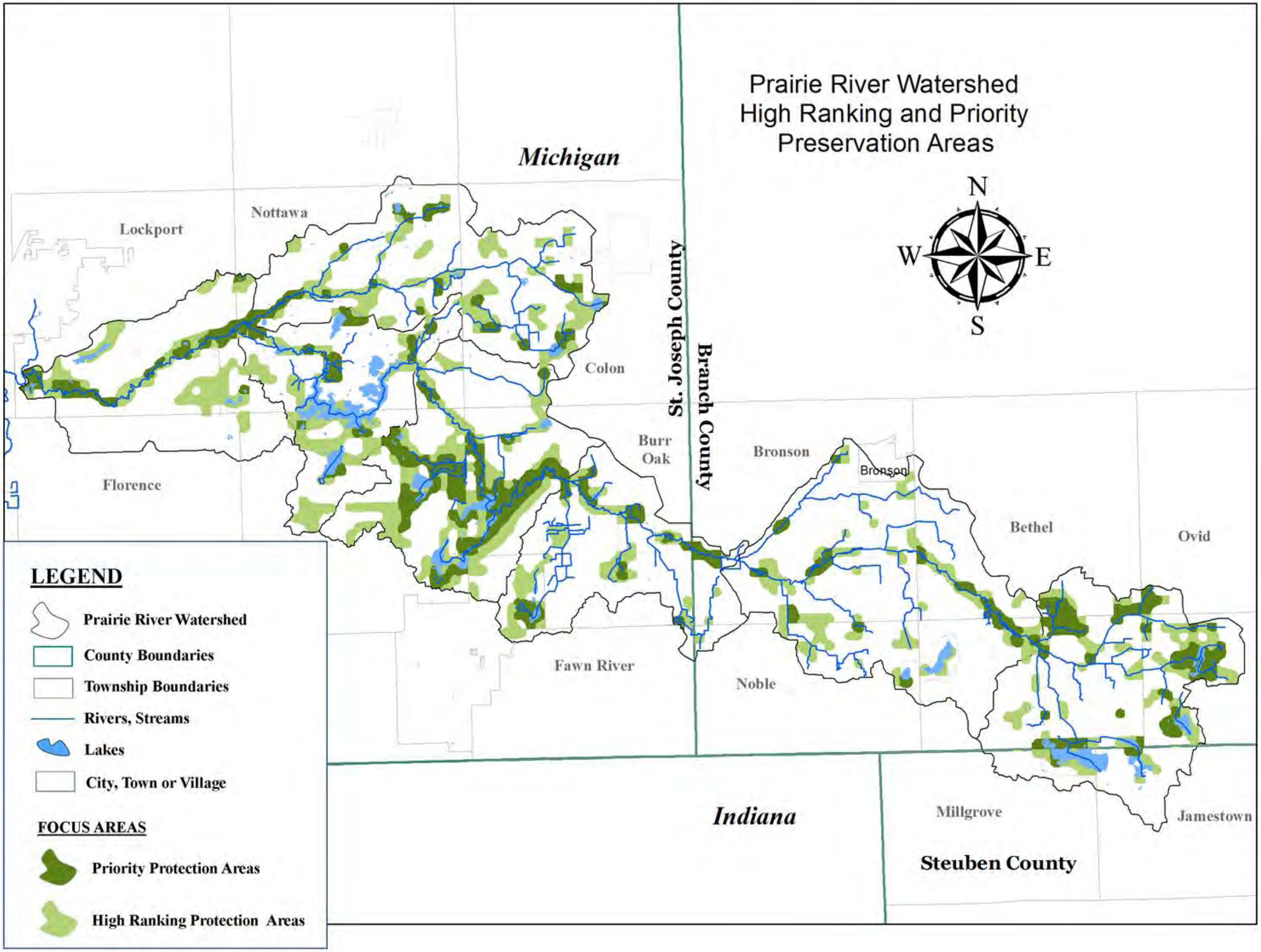
8.1 PRIORITY PRESERVATION AREAS

Prioritization of the watershed's preservation priority areas were based upon the amount of natural land cover (habitat), presence of water bodies, high quality fisheries, existing wetlands and the importance of maintaining natural corridors for social, economic and wildlife benefit (Appendix 10). The high ranking and priority preservation areas are shown in Figure 19.

The PRW's priority preservation areas were generally located surrounding the mainstem of the Prairie River. Within the Headwaters sub-watershed, priority areas were found near the actual headwaters of the Prairie River as well as in the northern and western portion of Lake Pleasant and the west side of Lake Lavine. In the Prairie River Lake sub-watershed, the priority areas were primarily located in the southwest portion near Omena Lake, Grey Lake, Prairie River Lake and Perrin Lake. In the Lake Templene sub-watershed, the priority areas are sporadic however there was a section near Evans Lake and near the millpond dam just downstream from the Lake Templene dam. Priority areas in the Spring Creek sub-watershed were found in the headwaters of Spring Creek near Colon, MI with some sporadic sites in the sub-watershed's north and southwest portion. Lastly, priority areas in the Bullhead Lake sub-watershed generally clustered around the mainstem. See Figure 19 for more details.

High ranking and priority areas are in generally good shape, yet sensitive and very important to preserve for the overall health of the watershed. They contain important natural areas including some of the few trout streams found in the far southern tier of Michigan. Proper protection and management of these high priority areas, along with restoration of adjacent lands could go a long way towards protecting and enhancing water quality, the natural habitats and hydrology of the Prairie River. The remainder of the watershed is ranked as medium or less as a priority for preservation efforts. However, since this analysis is at the landscape level, specific sites outside of the high ranking and priority areas may need just as much attention for maintaining long term water quality in the watershed.

Figure 19: Preservation Priority Areas



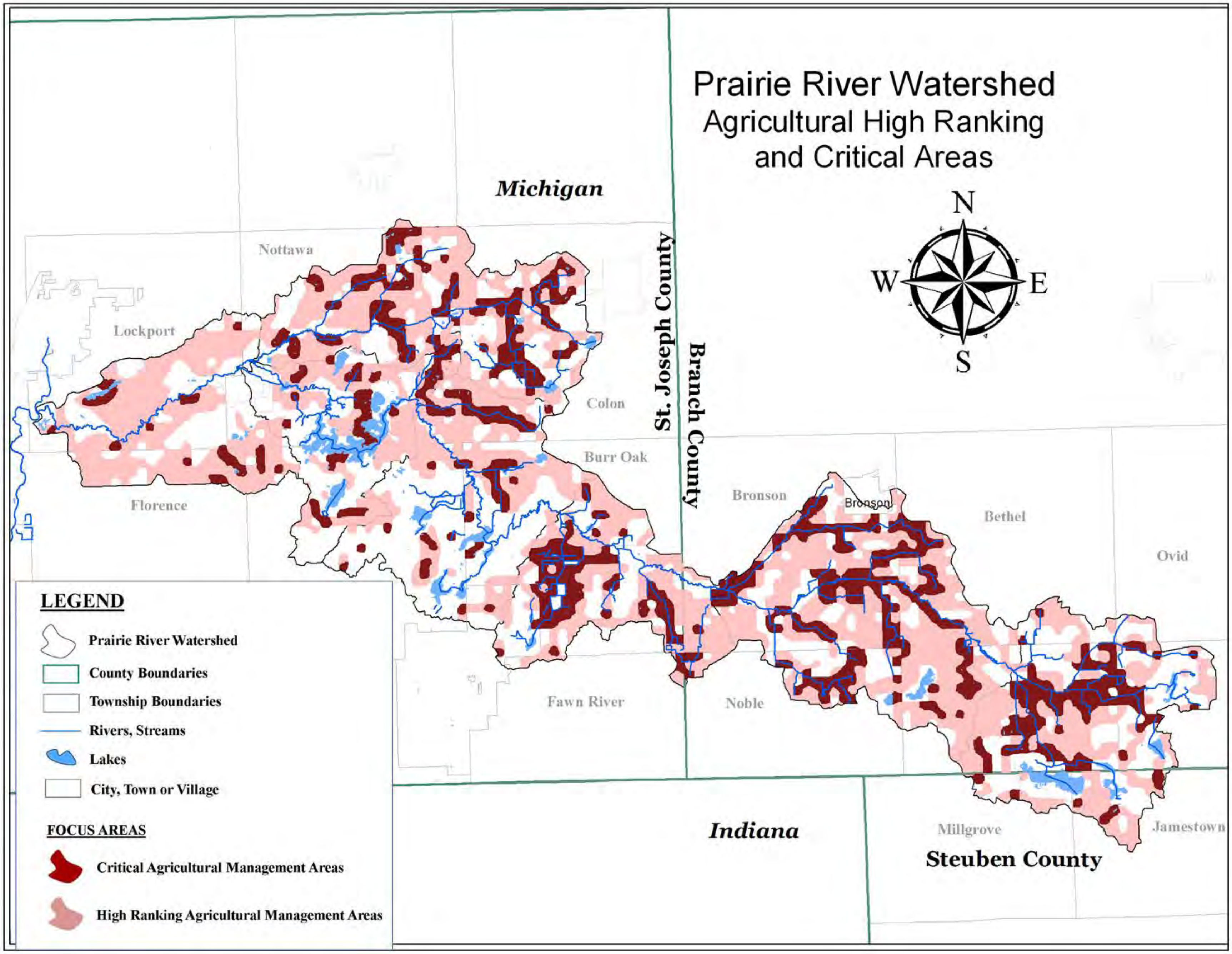
8.2 CRITICAL AGRICULTURAL MANANGEMENT AREAS

The prioritization for agricultural management areas is based upon the amount of agricultural land cover, presence of water bodies, high quality fisheries, potentially restorable wetlands and amount of sediment being delivered to the waterways (Appendix 10). The PRW agricultural management critical areas consist roughly of the three highest ranking impact classes (see Table 4, Appendix 10). Impact classes 4 through 6 are considered high ranking areas, with the remaining portions of the watershed (impact class 7) having a priority of medium or less (Figure 20). It should be noted that the medium or less ranked areas may include individual sites of higher priority requiring additional attention to improve overall watershed quality.

The PRW's critical agricultural management areas are areas where agricultural BMP's would most benefit overall water quality of the watershed. Within the Headwaters sub-watershed the high priority agricultural areas are predominantly in the central region around the Prairie River mainstem. In the Gilead Lake sub-watershed the critical agricultural areas are found along the mainstem and larger tributaries. In Stewart Lake Drain sub-watershed, the critical areas are found primarily along the Stewart Lake Drain tributary as well as the un-named tributary near the Gilead Lake sub-watershed border. Critical agricultural areas for the Prairie River Lake sub-watershed are located in the northern portion of the sub-watershed. Lake Templene sub-watershed has small scattered clusters of critical areas. Critical areas in the Spring Creek sub-watershed are predominantly along the mainstem and tributaries of Spring Creek. Only a small portion of this subwatershed was identified for preservation, the majority is high ranking or critical for agricultural or urban management. The Bullhead Lake sub-watershed critical areas are located in the southeast portion and northwest of the Prairie River mainstem.

The agricultural high ranking and critcal areas are suspected of containing the majority of agricultural-related pollutants which may impact overall water quality within the watershed. In these areas it is important to focus agricultural best management practices, such as cover crops or alternative tillage practices in an effort to reduce agricultural impacts.

Figure 20: Agricultural Management Critical Areas



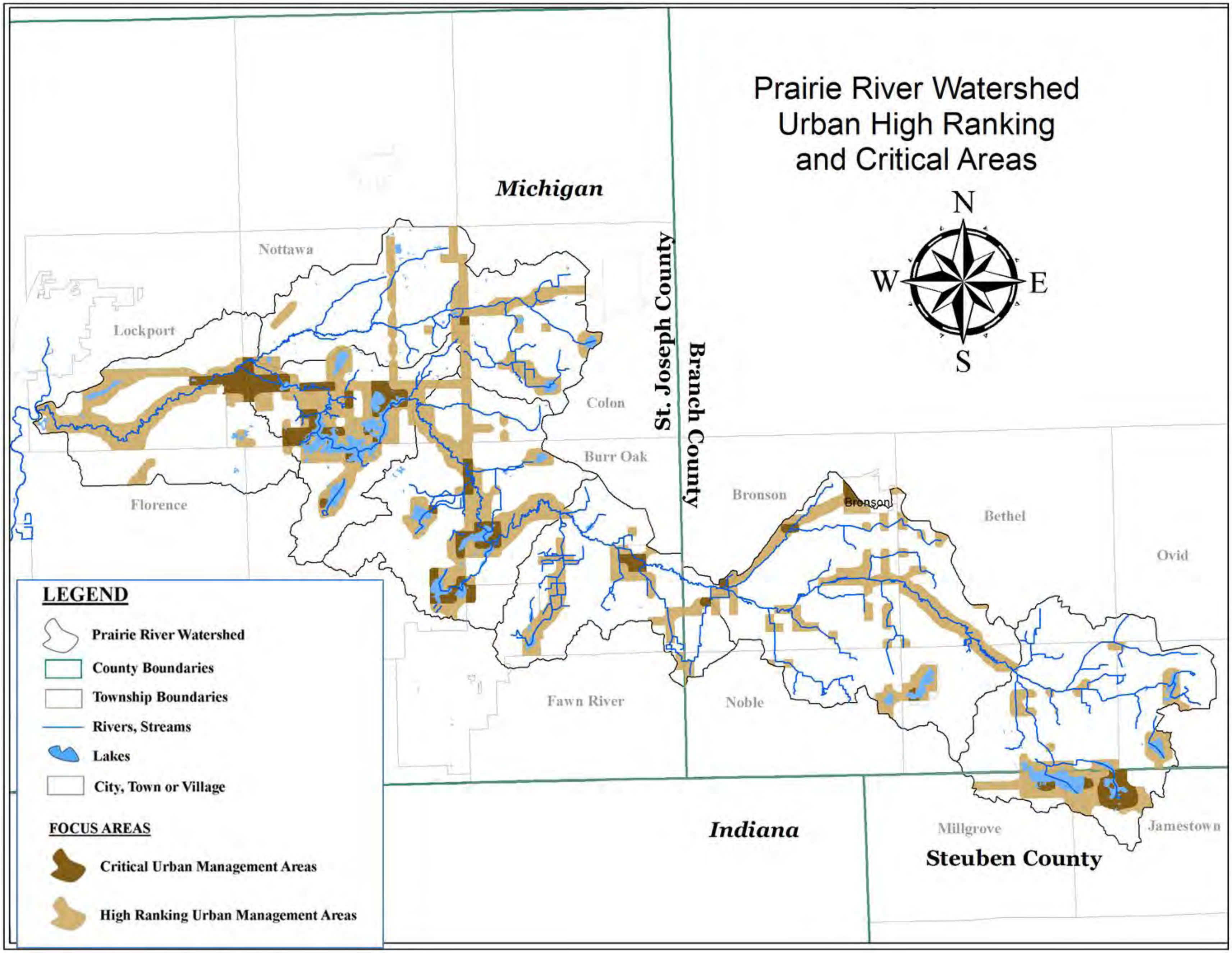
8.3 CRITICAL URBAN MANAGEMENT AREAS

Prioritization of urban management areas is based on the amount of urban land cover, presence of water bodies, high quality fisheries, development pressure to waterfront properties and major road systems as well as lost wetlands (Appendix 10). The PRW Urban Management high ranking and critical areas are shown in Figure 21. The remaining areas of the watershed are medium or less priority for urban management, although some locations outside those noted may also be important focal points.

The PRW's critical areas for urban management include cities, villages, portions of the road network and concentrated riparian developments. In Bullhead Lake sub-watershed the high ranking and critical areas predominantly follow the Prairie River mainstem and highway 86 also including the Village of Centreville. Other critical urban management areas are distributed across the watershed in small pockets along major highways and in association with some lakes. The Spring Creek sub-watershed high ranking areas follow primary road corridors with the potential to see an increase in development pressure. In the Lake Templene sub-watershed the critical areas dominate the central region of the sub-watershed. This is a result of Lake Templene, Sand Lake, the Village of Centreville and the associated road network. In the Prairie River Lake sub-watershed the critical areas surround Omena and Prairie River lakes as well as the section of highway 66. In the Stewart Lake Drain sub-watershed the critical area is primarily the Village of Burr Oak which contains a section of the Prairie River mainstem. In the Gilead Lake sub-watershed the northern border is high ranking or critical due to U.S. 12 highway and the City of Bronson. In the Headwaters sub-watershed the regions around Lake Pleasant and Barton Lake are the critical areas. These areas are critical due to development pressure of the waterfront.

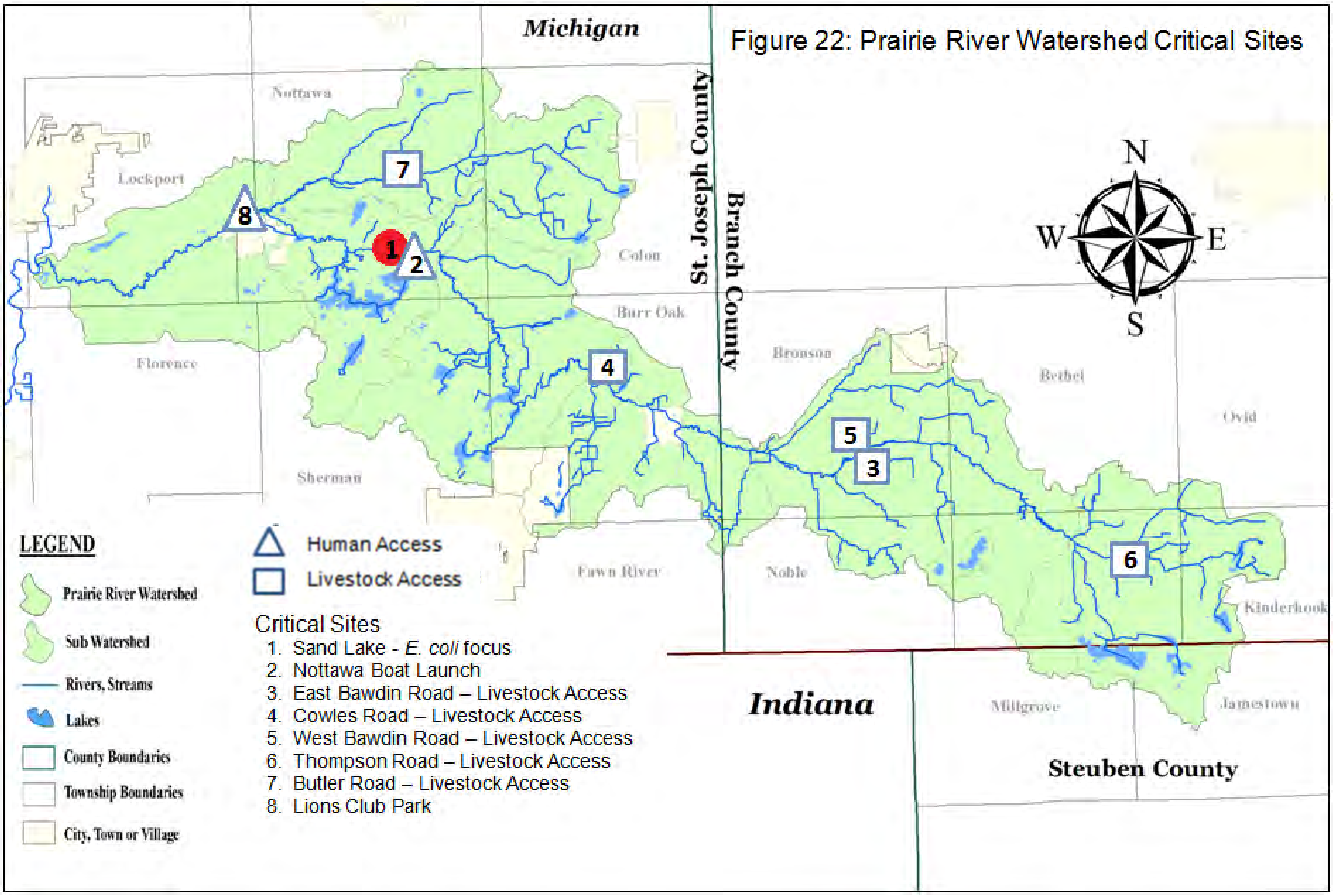
The high ranking and critical urban areas are or have the potential of contributing higher loads of nonpoint source pollution as well as disrupting the hydrologic patterns if not managed properly. However, since this analysis is at the landscape level, specific sits in this category may need just as much attention as the high ranking and critical areas for maintaining long term water quality in the watershed.

Figure 21: Urban Management Critical Areas



8.4 SPECIFIC SITES

In addition to the priority areas determined through modeling, a number of specific problem sites exist throughout the watershed. These specific sites were identified by stakeholders and partners as well as through field inventories. These sites include the Sand Lake Beach (known to exceed water quality standards for *E. coli*), erosion sites and unrestricted livestock sites. These sites are a priority to remedy because they are known isolated instances of pollution introduction, potentially impacting water quality in the watershed. For most of these sites, a specific pollutant source has been identified. The sites are described below and locations are shown in Figure 22. In most cases, a pollutant load reduction estimate is provided for each site. The estimates were calculated using the STEPL methodology previously described in Section 5.5.3.



Site 1 - Sand Lake (Lake Templene Sub-watershed)

The Sand Lake area, in particular, was field-inspected to seek potential sources responsible for the beach closure at Nottawa Beach in 2004. A small farm is located on the southwest side of the lake. A review of historic aerial photos revealed that for a period of time a concrete platform was located on the property to allow cattle access to the lake. This has since been removed but appeared to be at the location for a long period of time. The remnants of the platform can still be seen along the shoreline. However, it has been broken up and vegetation has grown around it.

In addition, it appears that at one point in this property's history a wetland had been converted. There is a distinct change between the 1938 and 1967 aerial photos; in fact, the 1938 photo utilized a wetland symbol on this site (Figure 23). In the 1967 photos there is a distinct change to the wetland area and it appears to have transformed into more of a pond. It is understood this site underwent construction with the assistance of Michigan State University Extension, in designing this location as the farm manure lagoon. The assumption is that it was installed prior to or was exempt from any regulations at the time. Due to Right to Farm complaints made several years ago, the property previously implemented conservation practices to rectify resource concerns on the property. Currently, this is the only farm located on Sand Lake and has approximately 50 head of cattle. There were no resource concerns visible at the farm during the project inventory.

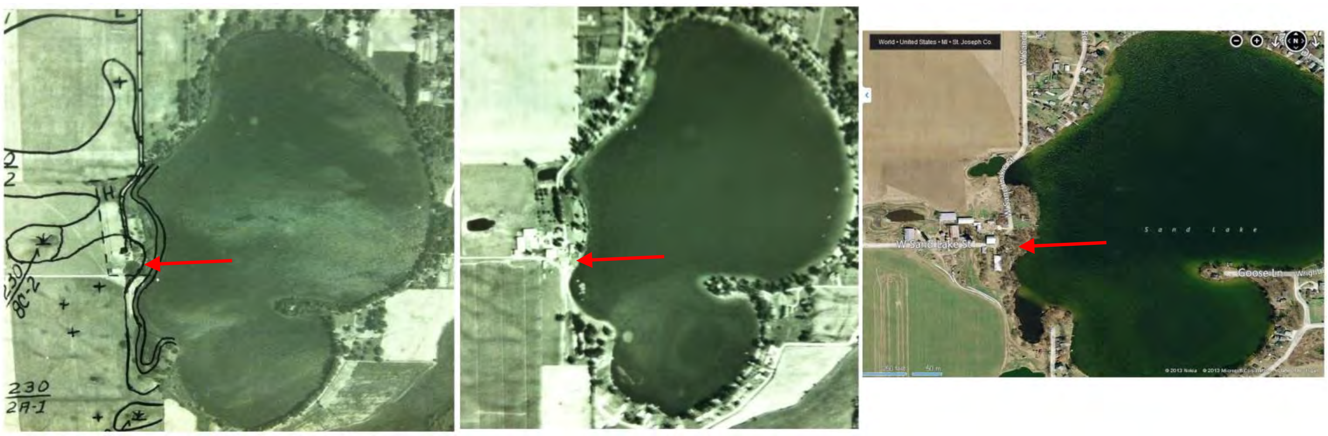


Figure 23: Sand Lake Aerial Photography 1938, 1967, 2013

Sand Lake is also populated with an abundance of older constructed homes. Unfortunately, no septic system data were available for this area but based on the design and type of structure it was concluded that the majority of homes were likely constructed in the 1950's and 1960's. With the estimated age of the homes, it is suspected that under designed, unmaintained or failing septic systems can be contributing the *E. coli* found in the lake. Although waterfowl are present in the Sand lake area, it doesn't appear to be at a rate that would raise concerns for pollution. Inventories completed on and around the lake never identified more than a handful of waterfowl at a time. However, when waterfowl were identified, at least part of them gathered on the beach swimming area.

Site 2 (LT33) - Nottawa Boat Launch (Lake Templene Sub-watershed)

At the beginning of this project, it was discovered Nottawa Township had started a construction project to create the Nottawa Township Boat Launch. This popular fishing spot has always struggled with space and traffic as there was no dedicated parking or launching areas. When boats launched into the river at this site they would sometimes be out in the road blocking traffic or creating other safety hazards. Members of the community would sit at the bridge and fish over the edge creating a dangerous situation with traffic passing over the bridge.

Construction of the launch area created a parking lot and designated launching point. Although the issue of traffic was resolved, a new issue became apparent during the first autumn after construction. The rainy season led to gully erosion in areas with no vegetation. See Figures 24 and 25.

Due to the slope of the approaching road and the gravel parking area, concentrated stormwater runoff flows directly to the river through the launch area, picking up sediment from the parking area as well as causing erosion of the launch area. This site is ranked "high" priority as a result of the completed BEHI inventory indicating a potentially substantial contribution to PRW sediment load based upon both its location on the Prairie River mainstem and within the Lake Templene sub-watershed.

Figure 24: Looking North at the Nottawa Boat Launch

Figure 25: Gully erosion at Nottawa Boat Launch

STEPL LOAD ESTIMATE				
Nottawa Boat Launch Gully Erosion	*Load Reductions with Gully Stabilization BMP on Nottawa Site*			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
	88.2	33.9	176.4	64.8

Site 3(GL47) – Unrestricted Livestock Access - Bawden Road (east) (Gilead Lake Sub-watershed)

This site is located north of Kosemrick Rd. This was discovered during a windshield survey which identified several livestock wading in the stream on both the north and south side of the river. There were no restrictions for the livestock and erosion was visible along streambanks. This is the largest unrestricted livestock access site identified in the PRW. Length and height measurements were estimated for calculating load reduction estimates. The length spans west and was measured using satellite photography until it was noticeable that access was limited due to large volumes of vegetation.

STEPL LOAD ESTIMATES				
	Load Reductions w/ Streambank Stabilization, Fencing BMP (lbs/year)			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
Site 3	527.8	114.3	272.6	61.8

Site 4 (SLD 70) – Unrestricted Livestock Access – Cowles Road (Stewart Lake Drain Sub-watershed)
This site is located on the south side of Cowles Road west of Needham Road. During a windshield survey, livestock were identified wading in the stream at this site. The terrain of this farm is heavily sloped with all farm runoff going down slope to the stream. There were fences located parallel to the road but not creating exclusion to the water for the animals. Length and height measurements were estimated for calculating load reduction estimates.

STEPL LOAD ESTIMATES				
	Load Reductions w/ Streambank Stabilization, Fencing BMP (lbs/year)			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
Site 4	369	106.1	238.4	39.5

Site 5 (GL4) – Unrestricted Livestock Access – Bawden Road (west) (Gilead Lake Sub-watershed).
South of, yet adjacent to GL47, this site also located north of Kosmerick Road. During a windshield survey it was noted that there appeared to be access for livestock into the river. From the road it appeared to be too steep for any livestock but looking to the west end (back) of the property, it tapered and appeared to have slight compaction and erosion. Height and length were estimated for calculating load reduction estimates.

STEPL LOAD ESTIMATES				
	Load Reductions w/ Streambank Stabilization, Fencing BMP (lbs/year)			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
Site 5	485.2	98	188	30.7

Site 6 (HW7) – Unrestricted Livestock Access - Thompson Road (Headwaters Sub-watershed).
This site is located on the south side of Thompson Road, east of the Block Road intersection. While completing the Road Stream Crossing inventory this access site was discovered. This unrestricted livestock access site is the second largest access site identified in the PRW. Due to private property and fencing, length and height measurements were estimated for calculating load reduction estimates.

STEPL LOAD ESTIMATES				
	Load Reductions w/ Streambank Stabilization, Fencing BMP (lbs/year)			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
Site 6	365.5	80.5	200.9	45.5

Site 7 (SC18) – Unrestricted Livestock Access - Butler Road (Spring Creek Sub-watershed).
This site is located on the south side of Butler Road near the corner of Nottawa Road. During an on the ground inventory it was identified that livestock had unrestricted access to the stream (Nottawa Ditch) at the south end of the property. Due to no road crossings in this area, satellite photography was utilized in identifying compaction and a clearing to the river that was determined to be the area of access. The opening was the only portion of the property that was evaluated with STEPL because the rest of the property lining the river was vegetated and did not appear to be impacted by access. The size, length and height of the crossing used in the load reduction calculations are estimates.

STEPL LOAD ESTIMATES				
	Load Reductions w/ Streambank Stabilization, Fencing BMP (Lbs/year)			
	N Reduction	**P Reduction**	**BOD Reduction**	**Sediment Reduction**
	Lbs/year			*t/year*
Site 7	376	74.8	135.7	24.5

Site 8 - Lions Club Park (Bullhead Lake Sub-watershed)
This park, located within the Village of Centreville, is popular for boaters, recreationists and people enjoying the scenic beauty. It is a popular kayak and canoe launch point for individuals and local liveries and commonly used for residents enjoying lunch outdoors. Changes to the flow of the river in this area are readily noticeable all year and suspected to contribute to the “very high” ranking that resulted from the BEHI inventory. At least eight irrigation systems were counted upstream from this point with more believed to be in operation. While possibly due to other unknown sources in the waterway, these systems are suspected of contributing to flow changes and the resulting BEHI ranking at this site. Additionally, the high amount of traffic at this site has led to substantial soil compaction and limited growth of vegetation in certain parts of the park, which is leading to runoff during wet conditions due to lack of infiltration.

Sites one through eight are presented in order of priority based on estimated pollutant loads, water quality data, bank erosion hazard index result, high impact targeting areas and willingness of property owners to make improvements. Sand Lake Beach area is ranked highest in priority due to its previous beach closure. Nottawa Township has expressed interest in rectifying the gully erosion present at the boat launch and has community and 4H members available for volunteering. The unrestricted livestock access site located on Cowles was considered higher priority than most of the other unrestricted livestock sites due to the steep terrain at this location. All other sites were prioritized by estimated load calculations.

9. WATERSHED GOALS

The goals for the watershed were developed based on stakeholder input, analysis of existing information, field inspections and modeling results. Designated use goals for the watershed are designed to address restoration or improvements to water quality and are reflective of the pollutants, sources and causes identified or suspected. Desired use goals address uses that may not directly relate to water quality, but are recognized as desired improvements to the watershed. Goals were further broken into more specific objectives as a framework for achieving each goal.

9.1 GOALS FOR DESIGNATED USES

Designated use goals are those that address impairments or impacts to the uses regulated by the state (See section 6 and Table 10). The goals reduce pollution by establishing management and protection practices in order to meet the designated uses through implementation. The goals and objectives supporting designated use improvements are outlined in Table 14.

Table 14: Prairie River Watershed *DESIGNATED Use* Goals

	PRW DESIGNATED USE GOALS	
	***DESIGNATED USE** GOALS*	*OBJECTIVE*
DG-1	Maintain and enhance warmwater / coldwater fisheries and other indigenous aquatic life and wildlife.	❖ Reduce sediment and nutrient loading to surface water: o Encourage the installation and use of restricted livestock access and alternative livestock watering facilities o Promote the use of cover crops and other agricultural BMP's, particularly on highly erodible areas adjacent to surface water o Encourage native plantings in riparian corridors o Stabilize identified erosion sites at public park and boat launches o Provide education to encourage implementation of BMP's that reduce sediment and nutrient loading o Work with local governments on developing and implementing land use planning and incorporate measures to protect water quality and minimize nonpoint source pollution o Establish stormwater management quality and quantity criteria minimally at the County level, but preferably at the Township level o Develop a strategy for involving all levels of local government (mayors, city managers, county government, etc.) in addressing nonpoint source pollution through implementation of BMP's o Use the LLWFA to protect, maintain and restore wetlands within the watershed boundaries with emphasis on wetlands with water quality functions (floodwater storage, streamflow maintenance, shoreline stabilization, pathogen retention, sediment retention and nutrient transformation) o Incorporate Low Impact Development in urban areas ❖ Reduce pesticide runoff to surface water: o Improve agricultural chemical handling and application practices

		○ Improve residential pesticide handling and application practices ○ Encourage the use of Integrated Pest Management through outreach/education to agricultural producers ❖ Encourage stabilization of flow ○ Use the LLWFA to protect, maintain and restore wetlands within the watershed boundaries with emphasis on wetlands with water quantity functions (floodwater storage, stream flow maintenance, and shoreline stabilization)
DG-2	Protect Coldwater Fisheries	❖ Maintain surface water temperatures suitable for coldwater fish in designated coldwater areas. ○ Maintain base flow - LLWFA to protect restore wetlands for water quantity ○ Use natural channel design for drain improvements ○ Protect/restore tree canopy on tributaries and head waters ○ Protect wetlands from sediment/other contamination ○ Protect in-stream water tables by addressing irrigation withdrawal
DG-3	Maintain and Enhance Partial and Total Body Contact Recreation (Improve safe water recreation)	❖ Inventories indicate high numbers of unrestricted livestock access sites throughout the watershed. In addition, the source of *E. coli* at the Sand Lake Nottawa Beach Park was not confirmed through the inventory. Establish a water quality monitoring program that builds on existing *E. coli* data to identify problems, document impairments and guide future management decisions. ❖ Encourage the installation and use of restricted livestock access and alternative livestock watering facilities at identified unrestricted livestock access sites ❖ Reduce risk of human fecal contamination to surface waters from septic systems with a focus near highly developed lakes. ❖ Reduce risk of wildlife fecal contamination to surface waters from overpopulation along shorelines through distribution of lake shore owner literature, education and natural lake level landscape assistance.

9.2 GOALS FOR DESIRED USES

In addition to state-regulated designated uses, desired uses were identified in the watershed throughout the planning process. This was the result of public input received from survey results and other events. Desired uses reflect benefits desired for the watershed that may be unrelated to water quality or only indirectly related to reducing NPS pollutants in the watershed. Desired use goals and objectives are identified in Table 15.

Table 15: Prairie River Watershed *DESIRED* Use Goals

	PRW DESIRED USE GOALS	
	DESIRED USE GOALS	***OBJECTIVE***
DS-1	Protect Habitat	• Increase stream habitat by maintaining or creating high quality vegetative riparian buffers • Establish in-stream habitat to provide shelter utilizing woody debris and other techniques • Maintain and enhance overall fish habitat and spawning areas • Address perched culverts, stream bed erosion, channel incision affecting fish passage. • Protect habitat for threatened and endangered species • Assist conservation organizations, local governments and landowners to preserve and manage habitats • Educate and promote the importance of healthy riparian corridors and how they relate to important habitat • Establish protective easements along corridors • Reduce invasive species population
DS-2	Protect Groundwater	• Protect groundwater recharge areas from contamination and over drafting • Limit increased amounts of impervious surfaces in high recharge areas
DS-3	Support sustainable agriculture	• Develop sustainable practices throughout the watershed while maintaining the viable agricultural economy and rural character of the communities • Emphasize conservation practices on irrigation
DS-4	Protect Open Space	• Protect and maintain natural ecosystems provided by woodlands, wetlands and other areas • Protect ecologically sensitive areas in the PRW

10. RECOMMENDED IMPLEMENTATION STRATEGY

The implementation strategy is designed to be a course of action that would achieve necessary pollutant load reductions to restore potentially impacted designated uses and protect or enhance good surface water quality within the Prairie River Watershed. This strategy addresses the goals and objectives outlined in this plan which was developed with guidance from the steering committee, stakeholders and project partners. In addition, it recommends tasks to be implemented, potential partners and cost estimates to complete the recommendations. Furthermore, this section outlines expected milestones for implementation with an overall target for each task that if implemented at the suggested amount would achieve watershed objectives.

Activities throughout this strategy are prioritized into four categories (specific sites, agriculture, preservation, urban) according to the prioritization results from Section 8. Tasks within each category are prioritized as high (H) which are to be addressed first, followed by those areas of medium (M) prioritization and finally low (L).

Milestones for the recommended best management practices for agricultural areas were determined with the assistance of two District Conservationists from the Natural Resources Conservation Service. These milestones were based on agricultural land acres in the Prairie River Watershed and what would be achievable goals for this land base. Preservation priority area milestones were determined by incorporating community input, with the general expertise of Southwest Michigan Land Conservancy utilizing land use acres and restorations desired for positive outcomes in the watershed. Cost estimates were derived from a number of sources including the Michigan Natural Shoreline Partnership, Michigan's Nonpoint Source Grant Project database, Big Otter Watershed (Virginia) Total Maximum Daily Load Implementation Plan Summary, and the U.S. EPA's Greenacres Landscaping with Native Plants website.

Implementation of best management practices is dependent on potential funding sources. To help assure that the maximum amount of load reductions and watershed goals are being implemented several funding sources have been compiled in the list below. This list is not comprehensive but will provide a great starting place when seeking possible funding sources.

- Branch County Community Foundation Grant
- Clean Water Act – Section 319 Grants
- Great Lake Restoration Initiative Grants
- Great Lakes Commission Grants
- Michigan Department of Natural Resources
- Michigan Agriculture Environmental Assurance Program
- MiCorps Volunteer Stream Monitoring
- USDA Conservation Reserve Program
- USDA Environmental Quality Incentives Program
- USDA Wetlands Reserve Program
- USDA Wildlife Habitat Improvement Program
- US Fish and Wildlife Service

It should be noted that the PRW watershed is generally in good shape. However, specific sites (not inclusive) listed in (Tables 16 through 19) need attention as described. Additional testing and monitoring system wide is recommended due to a lack of available information as previously discussed concerning sources of bacterial and pathogenic contaminants possibly affecting the PRW. However, protection of sensitive areas described in this plan as well as restorations and BMP implementations on impaired sites should be major focal points for this watershed.

10.1 ACTION PLAN BY PRIORITY AREAS

Table 16: Specific Sites (See Figure 22)

Site	Task	Pollutant	Source	Cause	Priority H-High M-Medium L-Low	Potential Lead Partners	Cost	Estimated Pollutant Load Reductions	Milestones*
Site 1-Sand Lake	Identify and Correct Failing Septic Systems	Nutrients, Bacteria/Pathogens	Seepage Waste	Improper design/maintenance of septic systems	H	Health Dept., Conservation District, Landowners	\$2000-\$10000 dependent on need for site	Reduction of bacteria/pathogen and nutrient contamination	**2015:** Evaluate sites for failing septic systems **2017:** 2 systems improved **2019:** 3 systems improved **2020:** 5 systems improved **Target:** 15 systems improved
	Incorporate Native Plant Buffers/Natural Shorelines	Nutrients, Sediment, Pesticides	Runoff	Mowing to water's edge, Lack of vegetative buffers	H	Conservation District, Michigan Natural Shoreline Program (MNSP), Landowners	\$10-\$20/linear foot dependent on site needs	Reductions of nutrients, sediment, and pesticides from vegetative buffers up to 80%-90%	**2015:** Promote native landscapes (See I/E plan) **2017:** 1 site with native landscape **2019:** 3 sites with native landscape **2020:** 5 sites with native landscape **Target:** 8 sites with native landscape
Site 2-Nottawa Boat Launch	Divert runoff from road and parking area to a location that reduces direct flow to river (i.e. divert to vegetative swale prior to reaching river and stabilize boat launch); Incorporate Vegetative Swale	Sediment	Runoff	Slope from roadway and parking lot concentrates flow in launch area; general design of site and lack of vegetation	H	MDEQ, Conservation District, Nottawa Township	Grading landscape: \$2000-\$3000 Boat launch reinforcements Swale: \$8.50-\$50/linear foot Maintenance: \$0.58/linear foot	N: 88.2 lbs/yr P: 33.9 lbs/yr BOD: 176.4 lbs/yr Sediment: 64.8 t/yr	**2015:** Educate public/Township on designs that benefit water quality and reduce erosion (See I/E plan) 2015: Promote the use of vegetative swale for runoff capture (See I/E Plan) **2017:** Complete launch and swale designs to stabilize site and accommodate runoff **2019:** Begin Implementation **2020:** Complete installation of erosion reduction BMP:s and swale
Site 3-Livestock access (Bawden Rd-east)	Restrict access to surface water (fencing, controlled crossing, crossing structures, alternate water source), streambank stabilization	Sediment, Nutrients, Bacteria/Pathogens	Streambanks, Runoff	Unrestricted access/Lack of riparian buffers	H	Conservation District, NRCS, Landowners	Fence: \$1.70/foot (NRCS # 382), Heavy Use Protection: varies on materials (NRCS#561), Watering Facility: up to \$1100 depending on need (NRCS #614)	N: 527.8 lbs/yr P: 114.3 lbs/yr BOD: 272.6 lbs/yr Sediment: 61.8 t/yr	**2015:** Build relationships with landowners **2020:** Implement restricted/limited livestock access **Target:** Restricted/Limited access completed
Site 4-Livestock access (Cowles Rd)	Restrict access to surface water (fencing, controlled crossing, crossing structures, alternate water source), streambank stabilization	Sediment, Nutrients, Bacteria/Pathogens	Streambanks, Runoff	Unrestricted access/Lack of riparian buffers	H	Conservation District, NRCS, Landowners		N: 369 lbs/yr P: 106.1 lbs/yr BOD: 238.4 lbs/yr Sediment: 39.5 t/yr	**2015:** Build relationships with landowners **2025:** Implement restricted/limited livestock access **Target:** Restricted/Limited access completed
Site 5-Livestock Access (Bawden Rd-.west)	Restrict access to surface water (fencing, controlled crossing, crossing structures, alternate water source), streambank stabilization	Sediment, Nutrients, Bacteria/Pathogens	Streambanks, Runoff	Unrestricted access/Lack of riparian buffers	H	Conservation District, NRCS, Landowners		N: 485.2 lbs/yr P: 98 lbs/yr BOD: 188 lbs/yr Sediment: 30.7 t/yr	**2015:** Build relationships with landowners **2020:** Implement restricted/limited livestock access **Target:** Restricted/Limited access completed
Site 6-Livestock Access (Thompson Rd)	Restrict access to surface water (fencing, controlled crossing, crossing structures, alternate water source), streambank stabilization	Sediment, Nutrients, Bacteria/Pathogens	Streambanks, Runoff	Unrestricted access/Lack of riparian buffers	H	Conservation District, NRCS, Landowners		N: 365.5 lbs/yr P: 80.5 lbs/yr BOD: 200.9 lbs/yr Sediment: 45.5 t/yr	**2015:** Build relationships with landowners **2020:** Implement restricted/limited livestock access **Target:** Restricted/Limited access completed
Site 7-Livestock Access (Butler Rd)	Restrict access to surface water (fencing, controlled crossing, crossing structures, alternate water source), streambank stabilization	Sediment, Nutrients, Bacteria/Pathogens	Streambanks, Runoff	Unrestricted access/Lack of riparian buffers	H	Conservation District, NRCS, Landowners		N: 376 lbs/yr P: 74.8 lbs/yr BOD: 135.7 lbs/yr Sediment: 24.5 t/yr	**2015:** Build relationships with landowners **2025:** Implement restricted/limited livestock access **Target:** Restricted/Limited access completed
Site 8-Lions Club Park	Restoration of native plants	Sediment	Runoff	Lack of vegetation	L	Conservation District, Nottawa Township, Village of Centreville	Native Prairie Grasses/Forbs: \$2000-\$4000/acre	Sediment Reductions expected but dependent on design structure of site	**2015:** Promote native plantings for runoff control (See I/E plan) **2017:** Design native landscaping **2019:** Implement Designed Landscape **2020:** Complete Native Plantings

* Dates indicate a completed by date (i.e. 80 acres of wetlands restored by 2017)

Table 17: Preservation Priority Areas Action Plans (See Figure 19)										
Task	**Pollutant**	**Source**	**Cause**	**Priority H-High M-Medium L-Low**	**Location (in order of priority)**	**Potential Lead Partners**	**Cost**	**Goal Addressed**	**Estimated Pollutant Prevention**	**Milestones***
Protect Wetlands	Sediments Nutrients Bacteria/Pathogens	Streambanks, Runoff	Increased Flow	H	1.) Wetlands in Priority Preservation Areas high functioning for sediment retention and streamflow maintenance by the LLWFA 2.) Wetlands in High Ranking Preservation Areas high functioning for sediment retention and streamflow maintenance by the LLWFA 3.) Wetlands in Priority Preservation Areas high functioning for Nutrient Transformation and Pathogen Retention.	Landowners, SWMLC, USFWS	Easement or purchase:$2000-$3340/acre	DG-1 DG-2 DS-1	**50 acres:** N: 238 lbs/yr; P: 24 lbs/yr; BOD: 770 lbs/yr, Sediment: 14.9 t/yr **100 acres:** N: 362 lbs/yr; P: 29 lbs/yr; BOD: 955 lbs/yr; Sediment: 18.6 t/yr **250 acres**: N: 1128 lbs/yr; P: 108 lbs/yr; BOD: 3450 lbs/yr; Sediment: 61.6 t/yr	**2015:** Educate on the benefits of wetlands and their functions in the ecosystem **2017:** 50 acres protected **2020:** 100 acres protected **Target:** 250 acres protected
Improve/Enact local riparian setback ordinances	Sediment, Nutrients, Bacteria/Pathogens	Runoff, Streambanks	Lack of /removal of riparian buffers	H	1.) Nottawa, Burr Oak, Bronson, Sherman, Gilead and Lockport Townships (based on shoreline and streambank length) 2.) Colon, Kinderhook, Bethel, Noble 3.) Other Watershed Communities	Local Governments, Local Planning Commission (SWMPC, SCPC)	$2,500/municipality	DG-1 DS-1	Prevention of further riparian degradation and potential reduction in pollutant loads	**2015:** Promote riparian buffer updates to local governments **2017:** 2 Governmental Units improving buffer ordinances **2019:** 5 Governmental Units improving buffer ordinances **2020:** 8 Governmental Units improving buffer ordinances **Target:** 10 Governmental Units improving buffer ordinances
Enact/Improve Water Quality Ordinance	Sediment, Bacteria/Pathogen, Nutrients, Pesticides, Temperature	Runoff	Limited land use planning	M	1.) Sherman, Kinderhook, Lockport, Gilead and Nottawa Townships 2.) Colon, Bronson, Bethel and Noble Townships 3.) Other Watershed Communities	Local Governments, Local Planning Commission (SWMPC, SCPC)	$10,000/municipality	DG-1	Prevention of further watershed degradation and potential reduction in pollutant loads	**2015:** Promote updates in water quality ordinances (See I/E Plan) **2017:** 2 Governmental Units improving water quality ordinances **2019:** 5 Governmental Units improving water quality ordinances **2023:** 8 Governmental Units improving water quality ordinances **Target:** 10 Governmental Units improving water quality ordinances
Improve Soil Erosion & Sedimentation Practices and Regulations	Sediment	Runoff, Building/Road/ Construction Sites	Lacking use of practices, limited enforcement on regulations	L	Priority Preservation Areas	Road Commission, Drain Commission, Conservation District	$5,000/agency	DG-1	Prevention and reduction of sediment contamination expected	**2015:** Promote and inform on regulations that can benefit water quality (See I/E Plan) **2020:** 1 County enforcement agency improving practices **Target:** 2 County enforcement agencies improving practices
Identify & Correct failing Septic Systems	Nutrients, Bacteria/Pathogens	Septage Waste	Improper design/maintenance septic systems	H	1.) Prairie River Lake, Omena Lake, Lake Templene, Dragon Lake, Prairie River Mainstem *(Populated Lakes over 25 acres, utilized QQ map for Lakes ranked high for preservation)* 2.) All High Priority Preservation Areas	Landowners, Health Department	$2,000 to $10,000 dependent upon need for site	DG-3 DS-2	Reduction in potential bacteria/pathogen and nutrient contamination	**2015:** Complete evaluation on priority areas **2017:** 2 systems Improved **2019:** 8 systems Improved **2023:** 15 systems Improved **Target:** 25 systems Improved
Improve/Enact Time of Sale Septic Inspection	Nutrients, Bacteria/Pathogens	Septage Waste	Improper design or maintenance for septic system	M	Areas with high amounts hydric soils (figure 2) and/or concentrations of older homes (figure 31).	Local Governments, Counties, Health Department, Local Planning Commission (SWMPLC, SCPC)	$2,500/municipality to write ordinances but could be over $25,000/ municipality to campaign (including education to County Commission and Real Estate Boards)	DG-3	Reduction in pollutants loads as well as prevention of further watershed degradation	**2015:** Promote and inform governments on benefits (See I/E plan) **2020:** 1 County enacting time of sale inspection **Target:** 2 Counties enacting time of sale inspection

* Dates indicate a completed by date (i.e. 80 acres of wetlands restored by 2017)

Table 18: Agricultural Management Priority Areas Action Plan (See Figure 20)										
Task	**Pollutant**	**Source**	**Cause**	**Priority H-High M-Medium L-Low**	**Location (in order of priority)**	**Potential Lead Partners**	**Cost**	**Goal Addressed**	**Estimated Pollutant Load Reductions**	**Milestones***
Restore Wetlands	Sediment, Nutrients, Hydrologic Flow	Streambanks, Runoff	Increased Flow	H	**1**.) Historic wetlands within the Critical Agricultural areas that are high functioning for sediment retention and streamflow maintenance according to the LLWFA **2.)** Historic wetlands within the High Ranking Agricultural areas that are high functioning for sediment retention and streamflow maintenance according to the LLWFA 3.) Wetlands in Critical Agricultural Areas high functioning for Nutrient Transformation and Pathogen Retention.	NRCS, USFWS, Landowners	WRP Easement= $3340/acre USFWS=variable, $500 to $5,000/acre depending on project	DG-1	Reduction of N and P expected, but actual load reductions dependent on size and location of wetland restoration	**2015:**Provide education on water quality benefits and promote assistance programs(See I/E Plan) **2016:** Identify prime sites for restoration utilizing LLWFA **2017:** Restoration of 80 acres completed **2019:** Restoration of 160 acres completed **2020:** Restoration of 220 acres completed **Target:** Restoration of 1100 acres
Develop Comprehensive Nutrient and Integrated Nutrient Management Plans	Pathogens/Bacteria, Nutrients	Livestock Waste, Field applications	Mismanaged Applications	M	**1**.) Identified Livestock sites (See specific sites table) **2**.) Critical Agricultural Areas where livestock are present	NRCS, Conservation District, Landowners	Nutrient Mgt.: $15/acre (NRCS#590) CNMP: $7000/each (MRCS#102)	DG-1 DG-3 DS-3	N and P Reductions between 25%-61%	**2015:** Promote CNMP/ Nutrient Mgt. and associated benefits (See I/E Plan) **2018:** Promote sign-up opportunities to landowners **2020:**20 Plans Completed **Target:** 65 CNMP/INMP Plans Completed
Restricted/Limited Livestock Access	Bacteria/Pathogens, Sediment, Nutrients	Livestock in stream, Streambanks	Unrestricted access to water bodies	H	**1**.) Identified Livestock sites (See specific sites table) **2**.) Critical Agricultural Areas where livestock are present	NRCS, Conservation District, Landowners	Fence: $1.70/foot (NRCS # 382), Heavy Use Protection: varies on materials (NRCS#561), Watering Facility: up to $1100 depending on need (NRCS #614)	DG-1 DG-3	See Specifics Sites Table	**2015:** Develop relationships with landowners provide I/E on restricted access (See I/E Plan) **2020:** Implement BMP crossing/alternate water source at 5 sites **Target:** Address any livestock site within 5 years of being documented
Irrigation Water Management	Temperature, Hydrologic Flow	Irrigation Systems – Reduced shading and diminished baseflow	Runoff	L	**1**.) Critical and High Ranking Agricultural areas in Gilead, Prairie River Lake and Stewart Lake Drain Sub-watersheds *(based on number of irrigation surface withdrawal sites documented in the inventory)* **2**.) Coldwater Streams within Critical and High Ranking Agricultural Areas **3**.) Other Critical Agricultural Areas	NRCS, Conservation District, Landowners	$12/acre (NRCS # 449)	DG-2 DS-3	--Reductions in temperature and stabilization of flow are expected but not currently quantifiable --Sediment Load Reductions when irrigation management, sediment control measures and conservation are combine: 61%-95% reduction --Sediment Load Reductions when irrigation management and vegetative filters combined: 35%-70% --Sediment Load Reductions when irrigation management and sediment basin are combined: 75%-95%	**2015:** Promote the use of well driven irrigation systems over surface withdrawal to landowners (See I/E Plan) **2016:** Work with NRCS to promote sign-up opportunities **2017:** 3 Plans Completed **2019:** 10 Plans Completed **2023:** 15 Plans Completed **2020:** 25 Plans Completed **Target:** 50 Plans Completed
Restore riparian buffers	Sediment, Pesticides, Nutrients, Hydrologic Flow	Runoff, Streambanks	Lack of & removal of buffers	H	**1**.) Critical and High Ranking Agricultural areas in Headwaters, Stewart Lake Drain and Bullhead Lake Sub-watersheds *(based on HIT results)* **2**.) Critical and High Ranking Agricultural Areas along the mainstem in Prairie River Lake and Lake Templene Sub-watersheds *(based on Inventory results)* 3.) Other Critical Agricultural areas.	NRCS, Drain Commission, Landowners, Conservation District	Riparian Forest Buffer: $950/acre (NRCS #391), Vegetative Buffer: $250/acre	DG-1 DS-1	Riparian Forest Buffer: Average reduction of sediment is 43% and N is 27% Vegetative Buffers: Reductions potentially substantial at 80%-90% pesticides	**2015:** Promote riparian buffers and why they are important to water quality (See I/E plan) and initiate implementation **2017**: 289.2 acres of buffers implemented **2019**:578.5 acres of buffers implemented **2020:** 1735.4 acres of buffers implemented **Target:** 2892.3 acres of buffers implemented
Install Ag BMP's (filter strips, Reduced Tillage, grassed waterway)	Sediment, Nutrients, Pesticides	Runoff, Streambanks	Use of Conventional Tillage/Lack of BMP's	H	**1**.) Critical and High Ranking Agricultural areas in Gilead, Headwaters and Spring Creek Sub-watersheds *(based on HIT results and inventory)* **2**.) Other Critical Agricultural Areas	NRCS, Conservation District, Landowners	Filter Strip: $200-$250/acre (NRCS #393) Reduced Tillage: $30/acre (NRCS #344-346), Grassed waterway: $4,000/acre (NRCS #412) Cover Crops: $40/acre	DG-1 DS-3	Expected reductions through use of: Filter Strips (%): N: 70% - P: 75% - Sediment: 65% Reduced Tillage (%): N: 55% - P: 45% - Sediment: 75% Grassed Waterway: N: 10% - P: 45% - Sediment: 35%	**2015:** 2 Landowners implementing one or more BMP's **2017:** 5 Landowners implementing one or more BMP's **2019:** 10 Landowners implementing one or more BMP's **2020:**15 Landowners implementing one or more BMP's **Target:** 30 Landowners implementing one or more BMP's

Continued Table 18: Agricultural Management Priority Areas Action Plan (See Figure 20)										
Task	**Pollutant**	**Source**	**Cause**	**Priority H-High M-Medium L-Low**	**Location (in order of priority)**	**Potential Lead Partners**	**Cost**	**Goal Addressed**	**Estimated Pollutant Load Reductions**	**Milestones***
Stabilize eroding streambanks	Sediment, Pesticides, Nutrients	Runoff, Streambanks	Lack of BMP's/Removal of buffers	M	**1**.) Critical Agricultural Areas in Bullhead, Headwaters, Stewart Lake Drain, Lake Templene and Prairie River Lake Sub-watersheds *(based on by HIT and BEHI results)* **2**.) Other Critical Agricultural Areas	NRCS, Drain Commission, Landowners, Conservation District	Streambank Protection: $30/linear ft. (NRCS #580)	DG-1 DS-1	Sediment, N and P reductions are expected but depend on BMPs adopted: not currently quantifiable	**2015:** Work with parks, golf courses, landowners to identify specific sites for improvement **2017:** 100 Feet of streambank stabilization **2019:** 200 Feet of streambank stabilization **2020:** 500 Feet of streambank stabilization **Target:** 1000 Feet of streambank stabilization completed
Verify Farms utilizing MAEAP	Temperature, Sediment, Pesticides, Bacteria/Pathogens	Runoff, Livestock Waste, Streambanks	Lack of BMP's	M	1.) Critical Agricultural Areas 2.) High Ranking Agriculture areas	Local MAEAP Technician, Conservation District, NRCS, Landowners	Varies on needed BMP's identified, landowner assumes costs but NRCS practices available to assist in cost	DG-1 DG-3 DS-2 DS-3	Reductions expected, however dependent on change of practices, size, location of site therefore not currently quantifiable	**2015:** Promote MAEAP and its water quality benefits and build positive relationships with landowners **2017:** 2 Verifications Completed **2019:** 4 Verifications Completed **2020:** 6 Verifications Completed **Target:** 25 Verifications Completed
Utilize soil testing and integrated pest management to ensure proper pesticide and fertilizer applications	Nutrients, Pesticides	Runoff	Mismanaged Applications	M	1.) Critical Agricultural Areas 2.) High Ranking Agriculture areas	MSUE, Landowners	MSUE Soil Test: $25/kit Lab Soil Test: Varies on what is tested	DG-1 DS-3	N & P Reductions expected but depend on BMPs adopted; not currently quantifiable	**2015:** 2 Soil Tests Completed **2020:** 25 Soil Tests Completed **Target:** 75 Soil Tests Completed

Table 19: Urban Management Priority Areas Action Plan (See Figure 21)										
Task	**Pollutant**	**Source**	**Cause**	**Priority H-High M-Medium L-Low**	**Location (in order of priority)**	**Potential Partners**	**Cost**	**Goal Addressed**	**Estimated Pollutant Loads Reductions**	**Milestones***
Utilize Low Impact Development practices (raingardens, rain barrels, vegetative swale, green roof, etc.)	Sediment, Pesticides, Nutrients, Temperature	Runoff	Lack of BMP's	M	1.) Critical Urban Management Areas 2.) High Ranking Urban Management Areas	Conservation District, Local Governments, Road Commissions	Raingardens: Dependent on location (Residential $1000-$4000, Commercial up to $10,000 on average) Vegetative Swale: Swale: $8.50-$50/linear foot Maintenance: $0.58/linear foot Green Roof: $15-$20/sq ft	DG1,D23,DS1, DS2	Rain Barrel: N: 0.41 lbs/yr; P: 0.07 lbs/yr; Sediment: 0.11 t/yr* Vegetative Swale: N: 2.4 lbs/yr; 0.4 lbs/yr; Sediment: 0.11 t/yr* Green Roof: N: 11 lbs/yr; P: 1 lbs/yr; Sediment: 0.66 t/yr* Reductions on a per acre basis	**2015:** 5 LID practices implemented **2020:**20 LID practices implemented **Target:**30 LID practices implemented
Enact Stormwater Ordinances	Sediment, Nutrients, Temperature, Pesticides	Runoff	Lack of stormwater management	H	1.) City of Bronson, and Millgrove, Nottawa, Bronson, Jamestown, Burr Oak Townships 2.) Sherman, Colon, Lockport, Gilead and Kinderhook Townships 3.) Village of Centerville, Burr Oak, and Colon, Townships of Fawn River, Florence, Noble, and Ovid	Local Governments, Conservation District, SWMPLC/SCPC	Stormwater ordinance: $10,000 for county wide level plan	DG1,DG2,DS1 ,DS2	Prevention of pollutant loads and further watershed degradation	**2015:**3 Governmental Units improving ordinances **2020:** 6 Governmental Units improving ordinances **Target:** 10 Governmental Units improving ordinances
Shoreline & Streambank Naturalization	Sediment, Nutrients	Runoff	Lack of shoreline & streambank vegetation	M	1.) Critical Urban Areas 2.) High Ranking Urban Areas	Conservation District, MNSP, Lake Associations	$10-$20/linear foot dependent on site needs	DG1,DG3,DS1 ,DS2	Reductions from vegetative buffers up to 80%-90% pesticides	**2015:** 2 sites of riparian naturalization **2020:** 5 sites of riparian naturalization **Target:** 10 sites of riparian naturalization

* Dates indicate a completed by date (i.e. 80 acres of wetlands restored by 2017)

10.2 INFORMATION AND EDUCATION STRATEGY

Successful implementation of this watershed management plan requires the promotion, understanding and acceptance of the plan's recommendations, while encouraging residents to take pride in their watershed. As part of this plan, an information and education strategy (I&E) was developed for the PRW with the goal of effectively delivering watershed information to the community. The I & E strategy includes establishment of education outreach programs as well as specific information products (newsletters, brochures, other materials including the use of social media outlets) intended to support and encourage broad watershed implementation of identified watershed management plan tasks.

The plan addresses the need to increase community understanding of watershed related issues, raise public awareness of NPS pollution risks in the watershed and communicate appropriate actions. It also encourages public involvement in water quality related events, with the purpose of increasing landowner buy-in for implementation practices that impact water quality. Development of the watershed I&E plan utilized assistance from the steering committee and partners as well as social survey results to determine information and education needs.

Several opportunities for public input occurred during the course of this project. Included among these were lake association meetings, open public meetings, and watershed events. Additional input was derived from a social survey conducted as part of the planning effort to collect baseline information on environmental awareness and attitudes of watershed residents. The survey used the Social Indicator Planning and Evaluation System (SIPES) methodology and the Social Indicators Data Management and Analysis (SIDMA) tool developed by the Great Lakes Regional Social Indicators Team (a collaboration of EPA Region 5 and the Region 5 State Nonpoint Source Programs and the Region 5 Land Grant Universities). This allowed calculation of specific social indicators of awareness, attitudes, capacity, constraints, knowledge, norms, and values as well as the collection of demographic information and information concerning selected best management practices. This information can be used to measure future changes in the social indicators or to compare the PRW results with other watersheds.

The survey was administered through the mail to a randomly selected group of watershed residents and included the option to complete the survey online. The sample size of 366 needed for a 95% confidence level and a 5% margin of error was narrowly missed with over 340 returns (resulting in 95% confidence and a 5.2% error level). Elimination of largely incomplete surveys resulted in 337 valid returns including 73 farm households.

Social Survey Results

Generally, survey respondents agreed their personal yard/land management practices impacted water quality (75.3 to 87.3% agree or strongly agree depending on the specific question – as an example see Figure 26 and that the quality of life in their community depends on good water quality (Figure 27). They were, however, slightly less willing to actually make changes to their yard/land management practices (Figure 28) and were more likely to disagree with the statement "I would be willing to pay more to improve water quality" (Figure 29). The willingness to pay was also echoed in questions asking about the constraints of implementing BMPs. While the overall constraints were low, cost was always the highest ranked reason for not making changes.

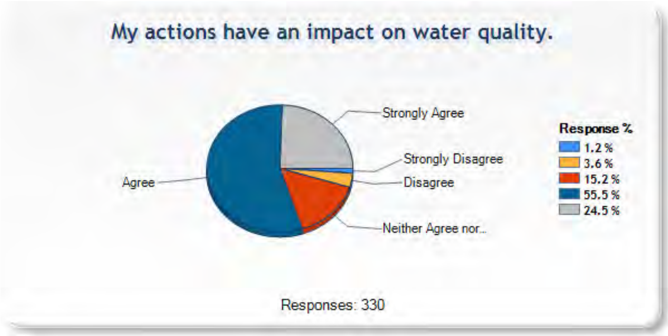


Figure 26

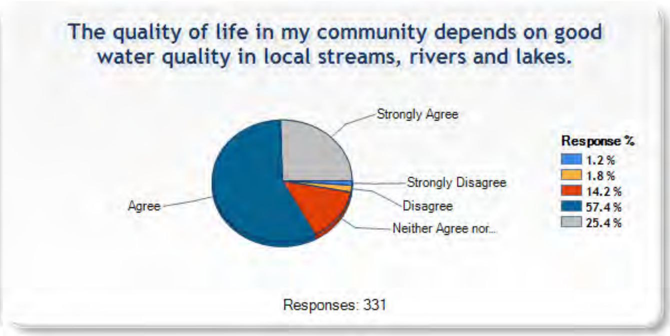


Figure 27

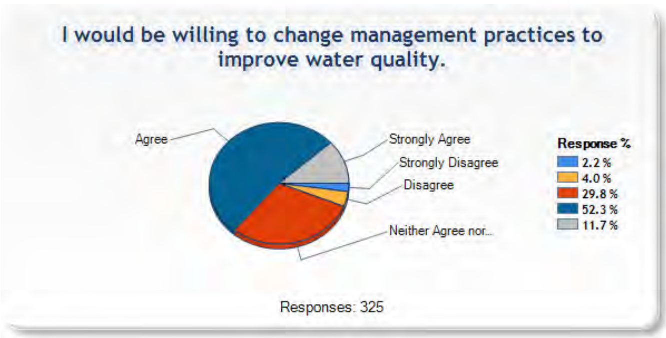


Figure 28

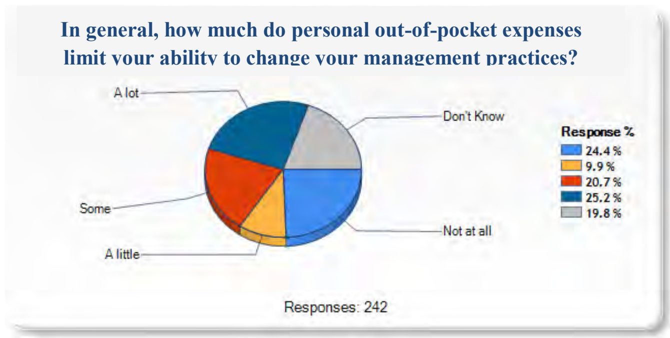


Figure 29

Indicator scores for Awareness were clustered near the mid-point (1.5 on a scale of 1.0 to 2.0, less aware to more aware) indicating an acceptable understanding of NPS issues, but with room for improvement. Awareness of pollutant sources was at the mid-point (1.53) while awareness of the consequences of NPS pollution was slightly below the mid-point (1.44). Awareness scores were higher for both the types of pollutants impacting the Prairie River (1.66) and the appropriate BMPs to improve water quality (1.64). Attitude scores were high indicating both a positive water-quality related outlook and a willingness to take action to improve water quality. The agricultural audience was slightly more likely to have actually implemented BMPs. Scores for constraints indicate low impediments to implementing BMPs and acceptance of changing behaviors.

Water Impairments

"Invasive aquatic plants and animals" were seen as the biggest problem in the PRW (ranked as a moderate or severe problem by 54.5%) while "bacteria and viruses in the water" ranked the lowest (14.3%) as shown in Table 20. The survey results are similar to the pollutants of concern rankings for the PRW (Table 12). The high rate of "Don't Know" responses (24 to 53%) as well as differences between known conditions and the conditions perceived by the survey respondents indicate the need for outreach and education focusing on the current condition of the PRW. In particular outreach and education efforts should focus on nutrients, pathogens (bacteria and viruses – with an *E. coli* focus), and temperature.

Table 20: Problem Severity as Indicated by SIDMA Survey of Prairie River Watershed Residents

Problem in Ranked Order (high to low) from Survey Results	Significance		
	Slight or Less	Moderate or More	Don't Know
Invasive aquatic plants and animals	21.3%	54.5%	24.1%
Sedimentation	34.9%	41.1%	24%
Algae in water	37.5%	36.6%	25.8%
Pesticides	24.6%	31.2%	44.1%
Nutrients (N and P combined)	21%	27.4%	52.8%
High water temperature	42%	18.7%	39.3%
Bacteria and viruses in the water	33.2%	14.3%	52.6%%

As an interesting side note the high ranking of "Invasive aquatic plants and animals" may be due to successful national and regional outreach campaigns and news stories focused on invasive species such as Asian carp and zebra mussels as well as recent local attention on Eurasian milfoil. It should also be noted that responses for "Algae in water" are evenly split as to significance and it is ranked higher than the nutrients. Since nutrients would be the root cause of an algae problem, this indicates a need for education and outreach on the role of nutrients in the environment. The even split as to severity is likely reflective of the condition of water bodies near each respondent (deep lakes and main stem river versus shallow lakes ponds and impoundments).

Sources of Water Pollution

Irrigated crop production, by a narrow margin, was the highest ranking source of water pollution in this survey followed closely by: littering/illegal dumping, excessive use of lawn fertilizers/pesticides, and soil erosion from farm fields. Differences between all four are within the margin of error and they are therefore statistically tied. Farmers were more likely to view "irrigated crop production", "soil erosion from farm fields" and "excess lawn fertilizers and/or pesticides" as slight or less problems compared to non-farmers.

Improperly maintained septic systems were seen as a slight or less problem by 39.7% and as a moderate or higher problem by 19.7%. The remaining 40.6% indicated they didn't know (Figure 30.). However, when asked about regular septic maintenance 62.6% of the respondents said they knew how to maintain their septic system and/or currently were maintaining their septic system and an additional 16.6% were on a municipal sewer system. Only 11.4% responded that they were not willing to conduct regular septic system servicing and almost all of these were on municipal systems. This indicates that outreach and education on the impacts of failed and failing systems is needed watershed wide but information on septic management should be more targeted to riparian corridors, areas with unsuitable soils (Figure 2), and the unsewered areas with older homes near Centreville and the Village of Burr Oak (Figure 31). Education and outreach is also needed for the impacts of: removal of riparian vegetation, impoundments, and stream bank and shoreline modification.

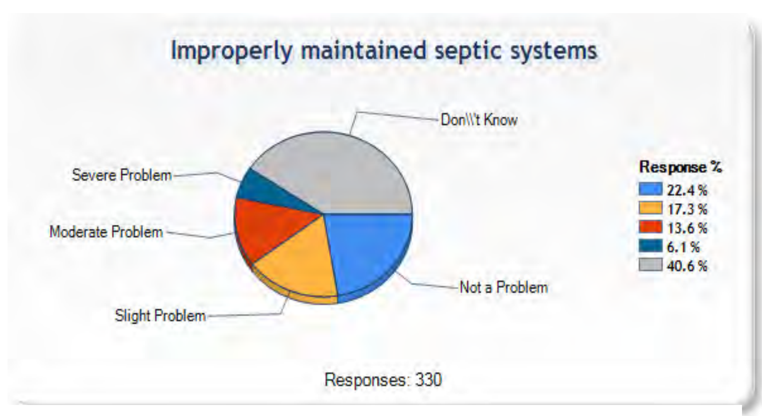


Figure 30

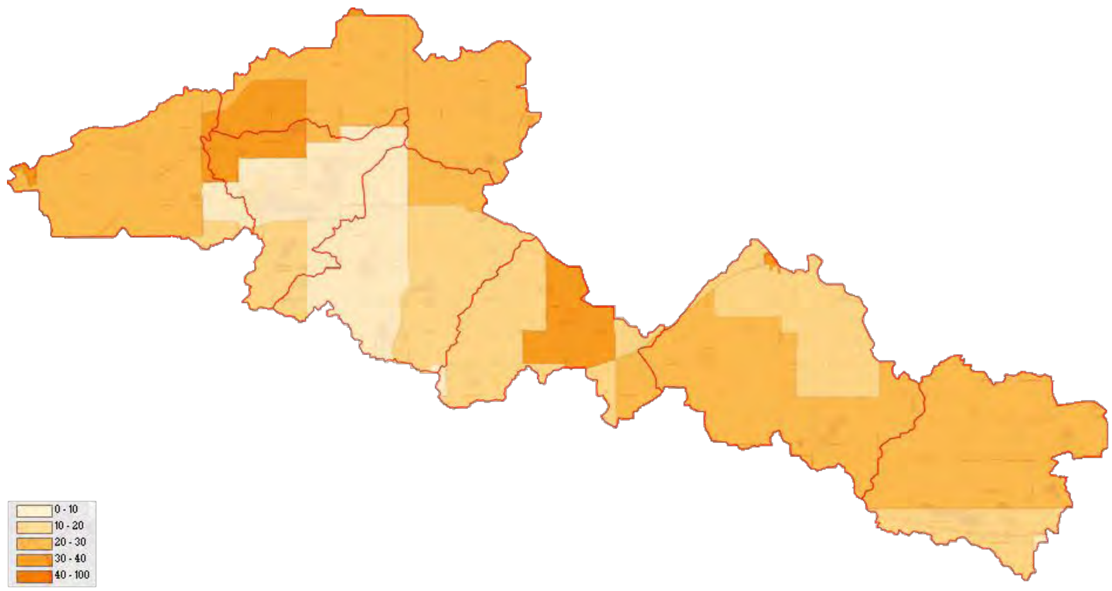


Figure 31: Percent Pre-1950 Homes by Blockgroup (2000 Census) in the PRW.

Practices to Improve Water Quality

General Respondents were generally unfamiliar with the practices listed especially for planting riparian buffers, restoring compacted soils, and restoring native plant communities (for example Figure 32). Additional outreach on BMPs is warranted. In addition, the “Not relevant for my property” response was unusually high for “Keeping grass clippings and leaves out of the roads, ditches and gutters” and “Use of rain barrels”. This may indicate a lack of knowledge about these two BMPs and their applicability.

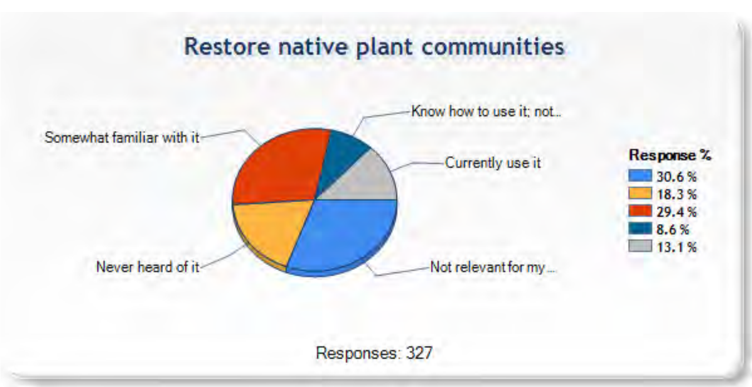


Figure 32

Specific Constraints - Additional detail was requested for two specific BMPs, “Regular Septic System Servicing” and “Wetlands Restoration/Enhancement”. The septic BMP was discussed briefly above. Most respondents are aware of the need and believe they are maintaining their septic system. However, the average reported age of septic systems from the survey was 24 years which is at the end of the typical lifespan of septic systems (the typical life span of a septic system is considered 20 to 25 years). One or more signs of failure were reported for 11.1% of all septic systems. Where the system age was given, the rate is slightly less for systems up to 20 years old (8.6%) but substantially higher (18.5%) for systems more than 40 years old. The majority of respondents reported no signs of failure.

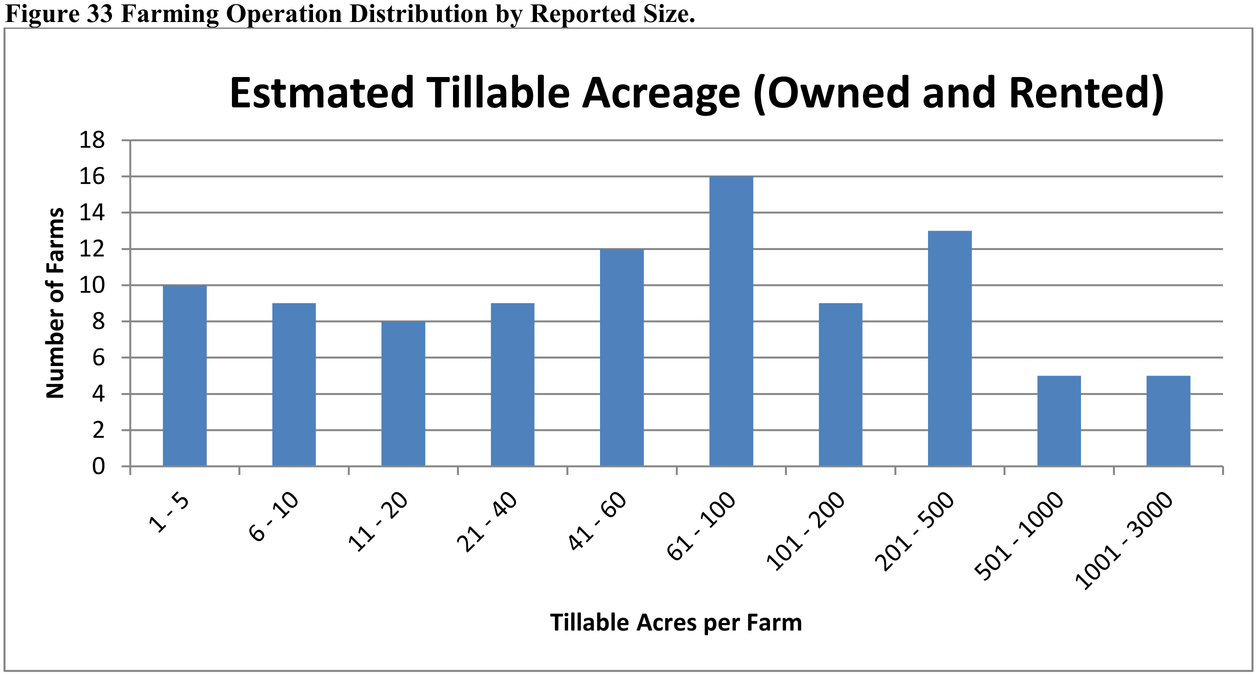
About 75% of all respondents indicated interest in restoring or enhancing wetlands on their property. Those with working farms (reported tillable acreage) were more likely to be interested in wetland restoration or enhancement and that interest tended to increase with increasing farm size. However, interest remained high for urban and small lot owners as well. While wetland restoration or enhancement may not be practical in urban areas or generally on small lots, rain gardens may be an acceptable alternative for this audience. As with other BMPs, cost was the biggest obstacle to implementation.

About your Farm Operation

Farm management in the Prairie River watershed is primarily family based with decision making being done by the farmer alone or with their spouse (70.2%) or with family partners (7.0% including siblings, parents and/or children). An increase in the size of their farming operation was projected over the next 5 years by 23% while the majority (75%) projected their farming operation would be about the same in 5 years' time.

While the average farm size (based on reported tillable acres for 97 farming operations) is about 225 acres, the median size is 61 acres (half the farms are larger than this, the other half are smaller). The difference between the average and median size is due the size of the largest farming operations. The largest 5 farms account for 48.3% of the reported tillable acreage. The distribution of farm operations by size is shown in Figure 33.

Figure 33 Farming Operation Distribution by Reported Size.



Survey results indicate that 58.8% of the farming operations are riparian (i.e. they touch a stream, river, lake, or wetland). However, this percentage would likely be larger if ditches and drains had been included in the survey definition. Livestock were reported to be part of 45% of the farm operations. Information about the livestock number and type was not requested.

The average responding farmer was 54 years old, male (81%) and had been farming 24 years. High school graduates accounted for 26.5% of this group and an additional 51.8% attended college with 33.7% earning an Associate's degree or higher.

About You
The following section is based on information from all respondents including the agricultural responses reported above.

The average respondent was 58 years old, most were male (75.7%) and slightly better educated than the agricultural sample. Almost 98% owned their residence (an artifact of the survey methodology) and had lived there for over 20 years. Residents of a town, village, city or rural subdivision accounted for 41% of the sample and the rest consisted of those living on a farm (22.8%) or in an isolated rural non-farm residence. The use of a professional lawn care service was not common (less than 15%).

Information Sources
The survey asked where people were likely to seek information about soil and water conservation issues as well as water quality issues. Similar choices were given to both the agricultural and residential groups. The top three selections for both surveys were identical and are, by rank:

1. Newsletters/brochure/factsheet
2. Conversations with others
3. Internet

Just over 65% responded that they regularly read a local newspaper. However, readership tends to be age dependent with the percentage of readers increasing with age. The percentage reading the local paper is good (about 50%) even for those under the age of forty. While the trend is clear, results for specific age groups can't be totally relied on due to the small sample size of the oldest and youngest age groups

The survey also asked to what level different organizations were trusted as a source of water quality information. Soil and Water Conservation Districts were most trusted (68.7% ranked them as moderately or very trustworthy) followed by the Natural Resources Conservation Service and Michigan State University Extension. Environmental groups, local government, and neighbors/friends ranked lowest for trustworthiness. The Prairie River Watershed Project was not familiar to 43% and trusted moderately or more by about 39%.

Comments
The survey included an optional comment section where questions, concerns and suggestions could be added to the survey response. Water levels were by far most frequently mentioned due primarily to the drought conditions occurring during the survey period. Comments often blamed low water levels specifically on excessive irrigation. Concerns about chemicals were noted a little less frequently and were divided between chemical applications for agricultural use and aquatic vegetation control. Sedimentation, bank erosion, septic systems, and support for dredging area drains were also fairly common. It should be noted as a regional challenge to project implementation, that many survey comments expressed distrust of all levels of government officials and programs.

I & E Strategy
For plan I & E strategy purposes, target audiences identified as having the greatest impact on water quality in the PRW include: residential homeowners, agriculture industry, governments, riparian landowners, recreation users

and students and educators. The following overall I & E strategy for these target audiences does not follow any particular rank order.

Residential Homeowners

Homeowners as a target audience in the watershed, present a substantial potential for assisting in restoration efforts concerning NPS pollution risks. Risks would include runoff from turf or impervious areas, improper handling of yard waste, improper hazardous material disposal, mismanaged applications of fertilizers and pesticides as well as pollutants leaching from individual septic systems. Specific pollutants associated with residential areas include sediment, pesticides, bacteria/pathogens/algae, as well as changes to hydrologic flow and water temperature.

In an effort to reduce these watershed pollutants, the residential I&E should include educational materials further explaining pollutant causes as well as clearly covering at least the following topics to promote better water quality: proper septic system maintenance; lawn care practices including disposal of yard waste; proper chemical disposal; use of rain gardens and similar water runoff landscape practices; natural shoreline BMPs. As cost is a major factor, I & E should also include resource information for financial assistance to implement practices.

Agricultural Industry

As a predominantly agricultural watershed it is extremely important to provide resources related to best management practices for farming directed at reducing soil loss and polluted runoff into agriculturally connected waterways. Pollutant reduction I & E for this group should be concentrated on causal information and reduction education geared towards using BMP's and BMP calculator tools. This should include available web-based assistance tools to reduce sediment, nutrient, pesticide pollutants as well as changes in hydrologic flow. As cost is a major factor, I & E should also include resource information for financial assistance to implement practices.

Governments

Local governments were considered a target audience because they have the ability to provide policy regulations which are specific to their local communities. In this way, they can influence positive watershed stewardship through beneficial water quality policies. Targeting governmental audiences for watershed awareness and stewardship will impact sediment, nutrients, pesticides, bacteria/pathogen pollution as well as changes in hydrologic flow and temperature. The I&E plan for governments should include education focused on land use planning and how watershed concepts can be integrated in local planning as well as providing resources to incorporate those concepts into the current land use planning. Due to attitudes noted in the social survey concerning trust of government agencies, consideration should be given to using local trusted partners like the Conservation District to facilitate communications with other target groups.

Riparian Landowner

Waterfront and riparian property owners are an important target audience as like many agricultural landowners, their land serves as the last barrier before runoff enters waterways. This group can pose a great risk to water quality degradation as a result of their proximity to surface water. Due to the desire for living in riparian areas land clearing, draining and construction often lead to exposure for pollutants to enter surface water. In addition, the desire for water views leaves limited to no vegetative buffer which would otherwise help filter runoff containing sediment, nutrients and pesticides. The I &E plan objective for riparian landowners is to establish native vegetation along waterfront areas, particularly on the mainstem and populated lakes. Establishing native buffers will improve runoff rates while filtering pollutants, reducing erosion, creating habitat and absorbing excess nutrients prior to entering the waterway. Since many of these landowners are residential they should be included in the Residential Homeowners Target Audience as well.

Recreation

The PRW sees a large quantity of both local and out of town recreational users throughout the year. Its abundance of navigable waterways, recreational lakes as well as warm and coldwater fisheries draws in both residents and tourists alike. The economic health of PRW communities is directly related to a healthy recreational environment, which includes clean safe waterways. However, this influx of users can also be detrimental if users are not aware of their impacts on the health of the watershed. The watershed I&E plan for recreational users consists of raising watershed awareness and encouraging watershed stewardship. Efforts directed at recreational users will include reducing pollutants at recreational sites like golf courses, campgrounds and public access sites. Additionally, raising invasive species awareness will help reduce introduction or continued growth of invasive aquatic plants/animals/insects impacting recreational enjoyment. Targeted pollutants commonly associated with recreation include sediment, nutrients, bacteria/pathogens/algae and pesticides.

Students and Educators

Investing time into I & E for students and educators may or may not directly impact current pollutant concerns in the PRW. However it can be utilized to prevent future degradation of the watershed as well as recruit watershed volunteers. By working with educators and the local school systems, concepts of NPS, watershed management and water quality can be integrated into current curriculum which in turn increases functional watershed understanding. The hope is to instill these concepts at a young age encouraging a lifelong awareness and positive behavioral changes in watershed stewardship.

Table 21: Information and Education Strategy Action Plan for the PRW

Information/Education Strategy								
Audience	**Targeted Pollutant(s)**	**I/E Message**	**Task**	**Priority H-High M-Medium L-Low**	**Lead Partners**	**Goal Addressed**	**Cost**	**Evaluation**
All	All	Watershed Awareness	1. Develop and distribute articles, brochures, newsletters, factsheets that cover a variety of watershed topics including source list of possible financial assistance. 2. Maintain webpage and supply social media sources with watershed related materials 3. Hold 1 workshop per year that discusses watershed & NPS related topics (invasive species, wetlands, stormwater)	M	Conservation District	DS1,DS2, DS3, DS4, DG1, DG2, DG3	1. 10-20 hrs. staff time/item - $0 to $2,000/item. 2. $200/workshop, 30 hrs. staff time 3. $20/month webhosting, 20hrs. staff time/month	1. Number of readers in circulation 2. Number of attendees or inquiries 3. Number of webpage visitors
Residential (homeowners)	Sediment, Pesticides, Bacteria/Pathogens/Algae , Water Temperature, Hydrologic Flow	Septic System Maintenance and Design	1. Complete 1 article per year related to septic system maintenance that will appear in Lake Associations newsletters or similar publication 2. Hold 1 workshop per year that discusses proper septic system maintenance and the risks failing systems can have on the watershed	H	Health Dept., Conservation District	DS2 & DG3	1. 40 hrs. staff time $200-$300/workshop 2.12 hrs. staff time/article	1. Number of attendees 2.Number of readers in circulation, increased inquiries
		Lawn care practices that benefit water quality	1. Develop and distribute informational resources that relate to water quality friendly lawn care practices and alternative designs and native planting options	M	Conservation District	DS1, DS2, DG1, & DG3	10 hrs. staff time	1. Increased use of practices
		Benefits of Natural Shorelines	1. Complete article that discusses natural shoreline possibilities and programs available 2. Hold workshop that promotes MNSP	L	Michigan Natural Shoreline Program, Conservation District	DS1,DS2, DS3, DS4, DG1, DG2, DG3	1. 20 hrs. staff time for workshop 2. 10 hrs. staff time/article	1. Number of Attendees 2. Number of readers or increased use of practices
Agricultural Industry	Sediment, Nutrients, Pesticides, Hydrologic Flow	Benefits of and opportunities for agricultural conservation practices	1. Develop and distribute 2 articles per year that promote conservation practices to be published in farm related media 2. Hold on farm field day that promotes use of agricultural conservation practices 3. Participate in MAEAP related event to promote verifications	H	NRCS, Conservation District, MDA	DS1,DS2, Ds3, DS4, DG1,DG2, DG3	1. 8 hrs. staff time/article 2. $500/Farm Field day, 30 hrs. staff time 3. 16 hrs. staff time for MAEAP event	1. Number of readers in circulation 2. Number of attendees 3. Number of MAEAP leads
		Environmental and Economic Benefits to Pest and Nutrient Management	1. Develop and distribute one article per year in farm related media related to the benefits of implementing pest and nutrient management	H	NRCS, Conservation District	DS1,DS2, DS3, DS4, DG1, DG2, DG3	1. 10 hrs. staff time/article	1. Number of readers in circulation
		Benefits of and opportunities for Restricted/Limited Livestock access	1. Develop informational resources for livestock owners identifying opportunities for improved livestock management 2. Develop 3 articles that promote restricted livestock access to be published in farm related media 3. Hold 2 workshops that build landowner relationships, support and explain why exclusion of livestock is beneficial to watershed	H	NRCS, Conservation District	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. $500/workshop, 50 hrs. staff time 2. 20 hrs. staff time 3. 10 hrs. staff time/article	1. Number of attendees, inquiries 2. Increased amount of inquiries 3. Number of readers in circulation
		Environmental benefits to well driven irrigation systems	1. Develop and distribute informational resources related to irrigation systems. 2. Develop 2 articles that describe the benefits to well driven irrigation systems over surface water withdrawal	L	Conservation District, NRCS, MDA, MAEAP	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 15 hrs. staff time 2. 8 hrs. staff time/article	1. Increased inquiries or practices 2. Number of readers in circulation
		Importance of vegetative buffers in agricultural areas	1. Develop and distribute articles related to vegetative buffers and cost share opportunities	H	NRCS, Conservation District	DS1,DS2, DG1,DG2	1. 10 hrs. staff time	1. Increased inquiries, number of readers in circulation

Audience	Targeted Pollutant(s)	I/E Message	Task	Priority H-High M-Medium L-Low	Lead Partners	Goal Addressed	Cost	Evaluation
Governments	Sediment, Nutrients, Pesticides, Bacteria/Pathogens, Hydrologic Flow, Temperature	Water Quality friendly designs for boat launches and public parks	1. Develop and distribute informational resources designed to highlight alternative design methods that promote healthy water quality 2. Provide in-person presentations to governmental units to promote practices for public parks or access sites	M	Townships, Villages, Cities, Conservation District	DS1,DS2, DS4 DG1, DG2, DG3	1. 15 hrs. staff time 2. 20-50 hrs. staff time (dependent on number of presentations)	1. Increased inquiries, implementation of healthy practices 2. Number of attendees or units presented to
		Benefits of implementing riparian buffers ordinance	1. Attend Township meetings to promote riparian buffers and the importance of maintaining them for the health of the watershed 2. Provide documentation of successfully implemented riparian buffers from surrounding areas	M	Conservation District, Townships/ Villages/ Cities. SWMPC, SCPC	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 15 hrs. staff time 2. 8 hrs. staff time	1. Increased interest, implementation of buffers 2. Number of units provided
		Improving Water Quality ordinances	1. Present at Township/City/Village meetings that highlight options for ordinances that relate to water quality 2. Develop and distribute informational resources that help guide an interested governmental body with examples of ordinances 3. Provide training on LID methods	H	Conservation District, Townships/Villages/ Cities. SWMPC, SCPC	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 15-20 hrs. staff time 2. 8 hrs. staff time 3. 25-30 hrs. staff time	1. Increased interest, inquiries 2. Number of units provided 3. Number of attendees at training events
Governments, continued	Sediment, Nutrients, Pesticides, Bacteria/Pathogens, Hydrologic Flow, Temperature	Benefits of Time of Sale Septic Inspections	1. Provide informational information to governmental units related to TOS 2. Provide successful examples of surrounding areas that implemented TOS and how they are benefiting the communities	M	Health Dept., Counties, Conservation District	DS2,DG1	1. 20 hrs. staff time 2. 8 hrs. staff time	1. Number of units provided 2. Increased number of participants
		Water quality road management practices	1. Provide education on proper road salt and sand applications and snow disposal	M	Road Commission, Townships, Villages, Cities, Conservation District	DG1, DS1, DS2	1. 20 hrs. staff time	1. Drop in number of tons of road salt used
		Proper soil erosion and sediment practices	1. Provide informational resources about improved soil erosion and sediment practices to reduce erosion	L	Drain Commission, Conservation Districts	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 5-10 hrs. staff time	1. Number of units provided, increased use of practices
Riparian Landowners	Sediment, Nutrients, Pesticides	Benefits of riparian buffers	1. Develop and distribute informational resources that focus on benefits of riparian buffers and native plants	M	Conservation District	DS1,DS2, DS4, DG1, DG2, DG3	1. 10 hrs. staff time	1. Number of units provided, number of readers in circulation, increased implementation of practices
		Benefits of Natural Shorelines	1. Develop and distribute 2 articles related to natural shorelines and how they benefit water quality 2. Host workshop related to the MNSP to promote the use of natural shorelines throughout the watershed targeting riparian landowners	L	Michigan Natural Shoreline Program, Conservation District	DS1,DS2, DS4,DG1, DG2, DG3	1. 20 hrs. staff time, $200/workshop 2. 8 hrs. staff time/article	1. Number of attendees 2. Number of readers in circulation
		Lawn care practices that benefit water quality	1. Develop and distribute informational resources that relate to water quality friendly lawn care practices and alternative designs and native planting options	M	Conservation District	DS1,DS2, DS4, DG1, G2, DG3	1. 10 hrs. staff time	1. Number of units provided, increased implementation of practices
Recreation	Sediment, Nutrients, Bacteria/Pathogens, Pesticides	Benefits of soil and fertilizer management on golf courses	1. Develop and distribute informational resources about golf course management that benefits water quality	M	Conservation District, Bronson Golf Course, Island Hills Golf Course, Sauganash Golf Course	DS1,DS2, , DS4, DG1, DG2, DG3	1. 10 hrs. staff time	1. Increase implementation of water quality related practices
		Water Quality friendly designs for boat launches and public parks	1. Develop and distribute informational resources designed to highlight alternative design methods that promote healthy water quality 2. Provide in-person presentations to governmental units to promote practices for public parks or access sites	M	Local Liveries, Townships / Villages / Cities, Parks and Recreation Dept.	DS1,DS2, DS4, DG1, G2,	1. 15 hrs. staff time 2. 26 hrs. staff time	1. Increased interest, inquiries, implementation of practices 2. Number of units presented to or number of attendees
		Clean Boats, Clean Waters	1. Promote the implementation of the Clean Boats, Clean Waters Program 2. Provide information about invasive species	L	Clean Boats, Clean Waters Program, Local Lake Associations,	DS1, DS4, DG1, DG2	1. 8 hrs. staff time 2. 8-10 hrs. staff time	1. Number of Lake Associations participating 2. Increased signage

Audience	Targeted Pollutant(s)	I/E Message	Task	Priority H-High M-Medium L-Low	Lead Partners	Goal Addressed	Cost	Evaluation
					Conservation District			
Recreation	Sediment, Nutrients, Bacteria/Pathogens, Pesticides	Clean Camping Practices	1. Develop campground information on proper waste and sewage disposal	L	Conservation District, Parks and Recreation Dept., Townships / Villages / Cities	DS1,DS2, DS4, DG1, G2, DG3	1. 8 hrs. staff time	1. Increased Signage
		Maintain and Enhance Accessibility for recreational small boat use	1. Maintain and enhance the PRW's 32 navigable miles for canoe/kayak and fishing vessels 2. Promote responsible use of navigable water	L	Conservation District, Parks and Recreation Dept., Townships / Villages / Cities	DG1, DS1, DS4	40 – 80 hrs. staff time/plus volunteers/year	1. Amount of debris removed/year 2. Number of people using the waterways.
Students/Educators	Prevention of All	Impacts of NPS pollution on water quality	1. Present watershed related topics to local school groups 2. Provide fun activities related to learning about NPS pollution	M	Conservation District, Local Schools	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 15 hrs. staff time/school 2. 20 hrs. staff time	1. Number of school groups, outdoor events 2. Number of schools receiving activities and implementing 3. Outcome responses from educators concerning improved student knowledge base.
		Watershed concepts in the classroom	1. Participate in local schools outdoor committee 2. Coordinate site visits within watershed for school groups 3. Develop hands-on activities for learning watershed concepts in the classroom 4. Provide educators with curriculum to bring watershed concepts to the classroom	M	Conservation District, Local Schools	DS1,DS2, DS3, DS4, DG1,DG2, DG3	1. 24 hrs. staff time/year 2. 30 hrs. staff time/school 3. 20 hrs. staff time/school 4. 20 hrs. staff time/school	1. Increase in school participation 2. Number of schools participating 3. Number of classrooms receiving activities 4. Number of educators receiving curriculum 5. Outcome responses from educators concerning improved student knowledge base.

11. EVALUATION

Project evaluation is a necessary part of evaluating the success of implementation. By implementing this plan, a variety of water quality benefits can occur and those measures should be monitored. For the evaluation process of the Prairie River Watershed, Branch County Conservation District should be the responsible party for managing any review needed or tasks completed in this section.

Evaluation of on-site improvements is recommended during implementation and can include photo documentation and visual inventories of “before and after” products. This will be especially relevant to on-the-ground BMP’s implemented from the action plans in Section 10.1 and require before and after monitoring to determine BMP benefit. The I&E strategy can be evaluated through knowledge surveys, follow-up surveys to determine changes in practices or mindset, distribution of I&E materials and tracking attendance at training sessions and workshops.

Additional evaluation and monitoring of PRW water quality related to E. coli in particular as well as other pollutants is also merited. Since as noted, locations of livestock crossings and possible septic issue identified throughout this planning project and the survey was not extensive enough to fully examine all possible sites which are suspected to exist, further evaluation would be prudent.

The most important measure of evaluation would be pollutant load reductions. Collecting actual pollutant load reductions and comparing those to the plan pollutant load predictions can show a rough measure of success. By evaluating pollutant load reductions during implementation, we can better determine how successful the project and tasks are throughout the watershed. However, not all pollutant loads are easy to determine, such as changes in land use. This would have an impact on the water quality if, for example, land previously documented as agricultural becomes forested. It will have a long term impact on water quality but be difficult to measure. Additionally, items in this plan such as wetland protection would not necessarily reduce pollutants, but instead prevent watershed degradation.

In addition, a significant method of evaluation would be a periodic review of this document. Watersheds are influenced by a number of factors making it necessary to evaluate and revise this WMP as needed to best reflect current watershed conditions. This would include the evaluation of the following information:

- Land Cover Data
- Demographic Data
- Local Water Quality Policies
- Water Quality Information (MDEQ Integrated Reports, Monitoring results, scheduled TMDL’s, etc.)
- Prioritization of areas, pollutants and pollutant sources
- Goals and Objectives (to ensure it reflects current watershed conditions)
- Action Plan Items (to ensure it meets any changes to goals/objectives and to reflect achievements)

If no revisions or amendments are prompted by the acquisition of new data or information, it is recommended that a mandatory plan review be completed every five years.

In general, the success of implementation for this plan will be known when the following criteria are achieved:

1. Predicted pollutant load reductions are achieved (as determined from resulting BMP’s implemented, monitoring, modeling, etc.)
2. Continued maintaining of all Water Quality Standards for surface water bodies in the watershed
3. All designated uses are maintained, improved and supported by surface water bodies in the watershed
4. Public awareness, knowledge and participation is increased

Rachel Smith, primary author of this watershed management plan, served as the Prairie River Watershed Coordinator under the guidance of the Branch Conservation District in Coldwater, Michigan from June 2011 through May 2014.

She holds a Bachelor of Science in Environment Analysis and Resource Management - Earth Science from Western Michigan University, with additional coursework from Northern Michigan University, and is certified as a Citizen Planner through Michigan State University.

Rachel previously worked as a Water Stewardship Technician for Eaton County, the Rocky River Watershed Coordinator, Irrigation Technician and Community Garden Coordinator for Saint Joseph County. She also served as an EarthTeam volunteer with the Natural Resource Conservation Service in Barry County, a board member for the Friends of the Saint Joseph River Association and is an active member of the Soil and Water Conservation Society.

Rachel is currently employed by the Cumberland County Soil and Water Conservation District as a Watershed Specialist in Portland Maine.

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For additional information contact:

Branch County Conservation District

378 N. Willowbrook Rd.

Suite F

Coldwater, Michigan 49036

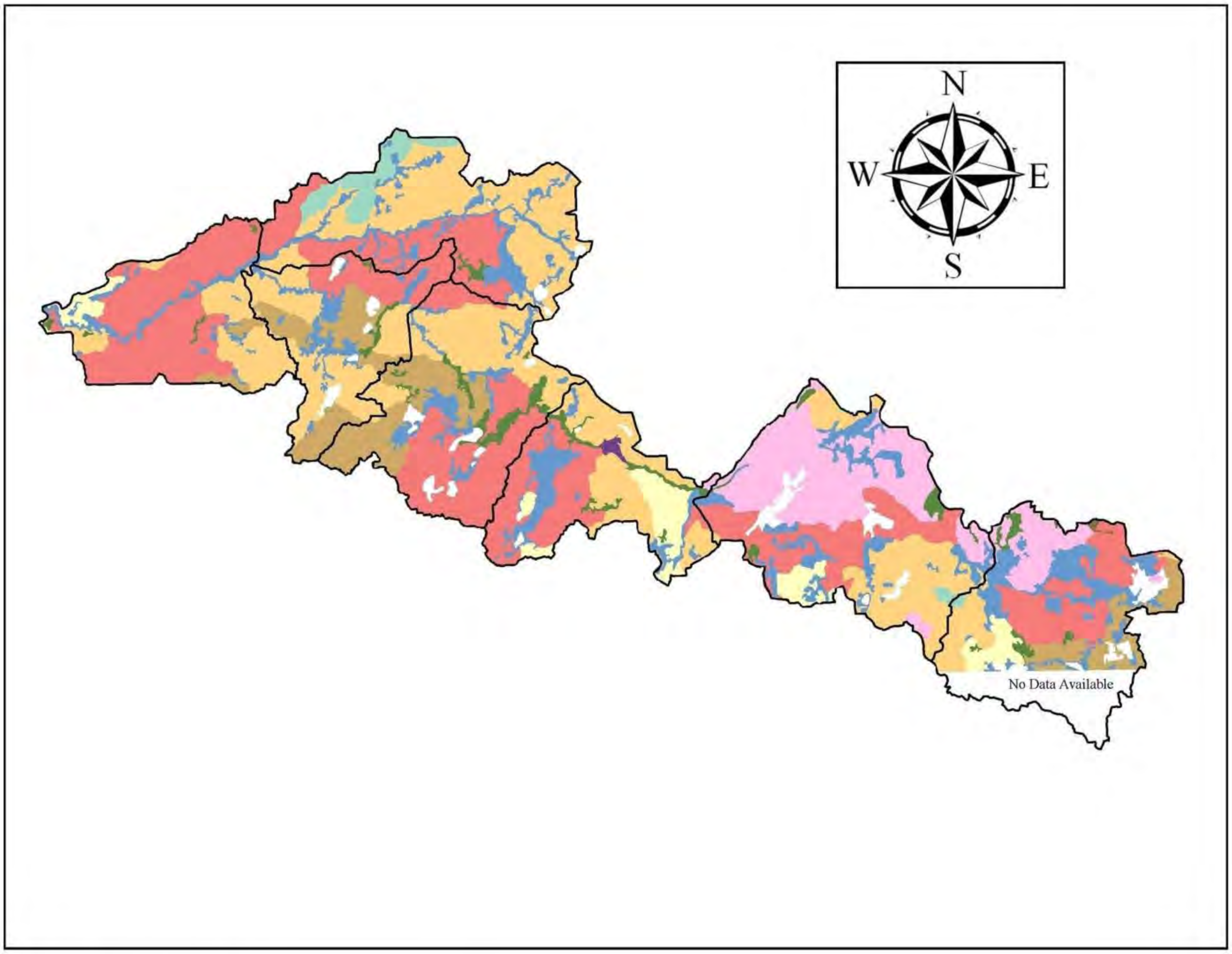
Phone: (517) 278-2725 Ext. 5

APPENDICES

Appendix 1

Prairie River Watershed

Maps



LEGEND

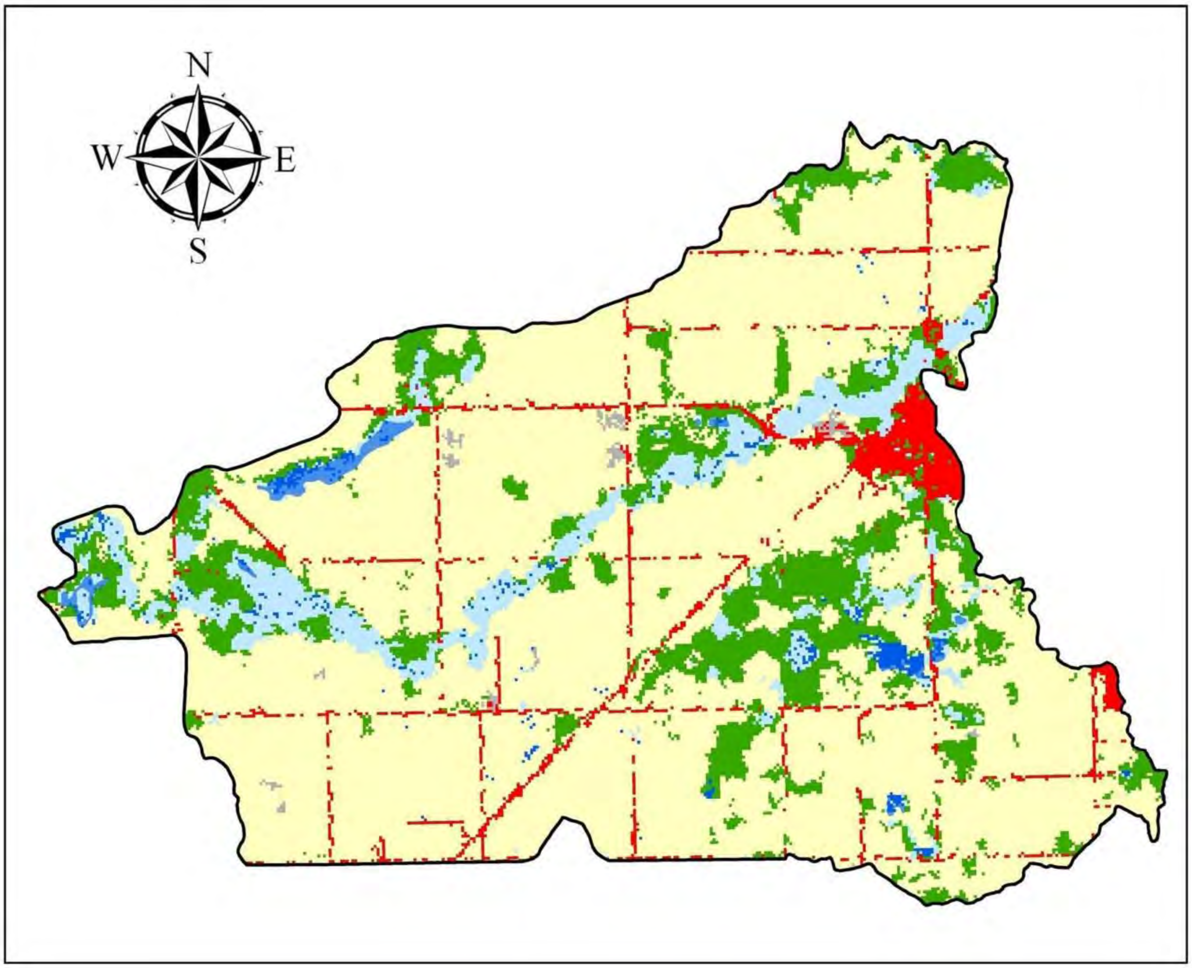
- Grassland
- Black Oak Barren
- Mixed Oak Savanna
- Mixed Hardwood Swamp
- Beech-Sugar Maple
- Oak-Hickory Forest
- Mixed Oak Forest
- Black Ash Swamp
- Mixed Conifer Swamp
- Shrub Swamp Emergent
- Wet Prairie
- Lake/River

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Pre-settlement Land Cover

Appendix 1
Map A
1-1

Data Source: Michigan Natural Resources Conservation Service



LEGEND

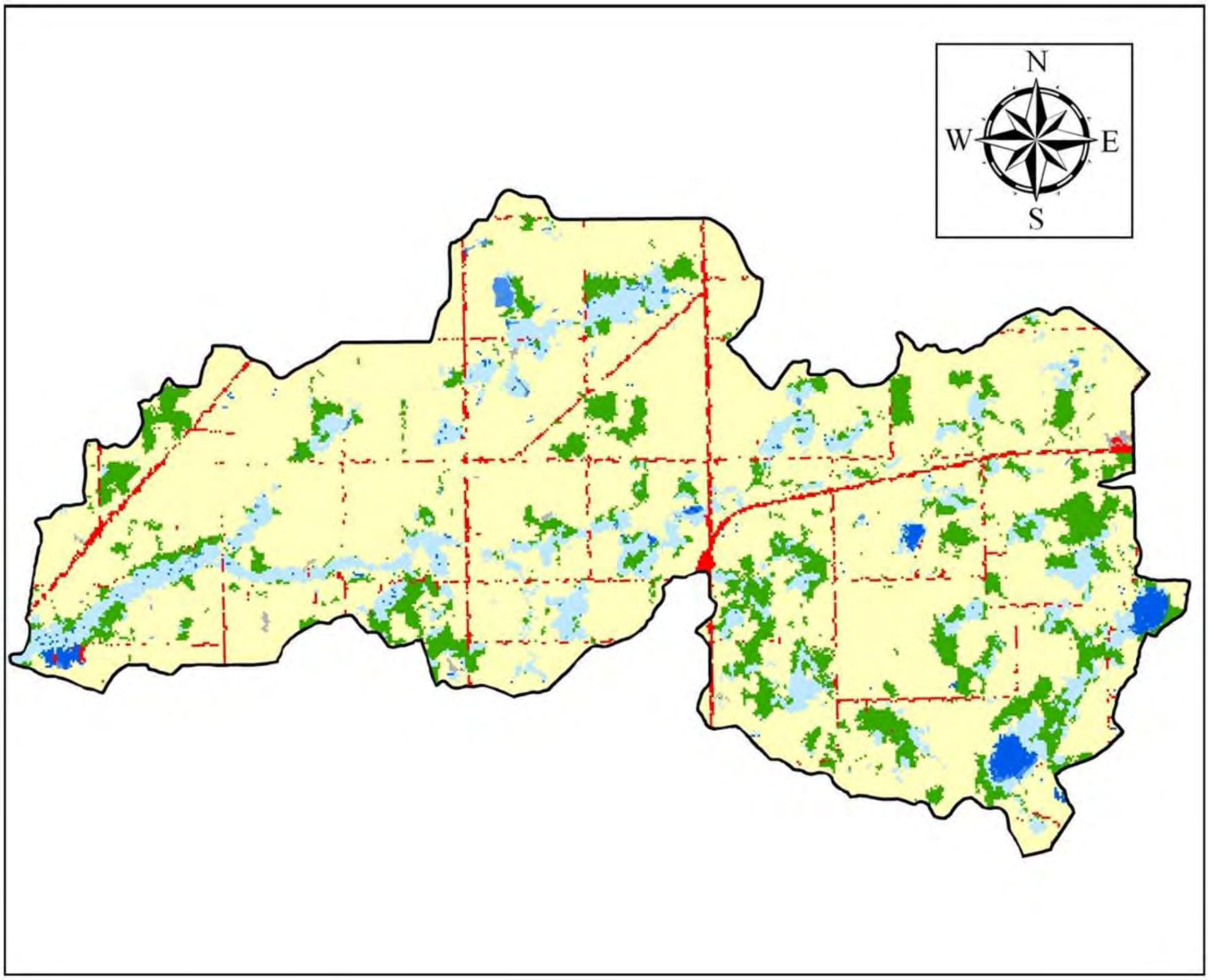
- Agriculture *(10,039 acres)* ~ 72%
- Developed *(678.85 acres)* ~ 4.9%
- Forest *(1,918.1 acres)* ~ 13.8%
- Water *(142.5 acres)* ~ 1%
- Wetlands *(1,076 acres)* ~ 7.7%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Bullhead Lake Sub-watershed
Land Cover (2006)

Appendix 1
Map B

Data Source: Coastal Change Analysis Program (CCAP) 2006



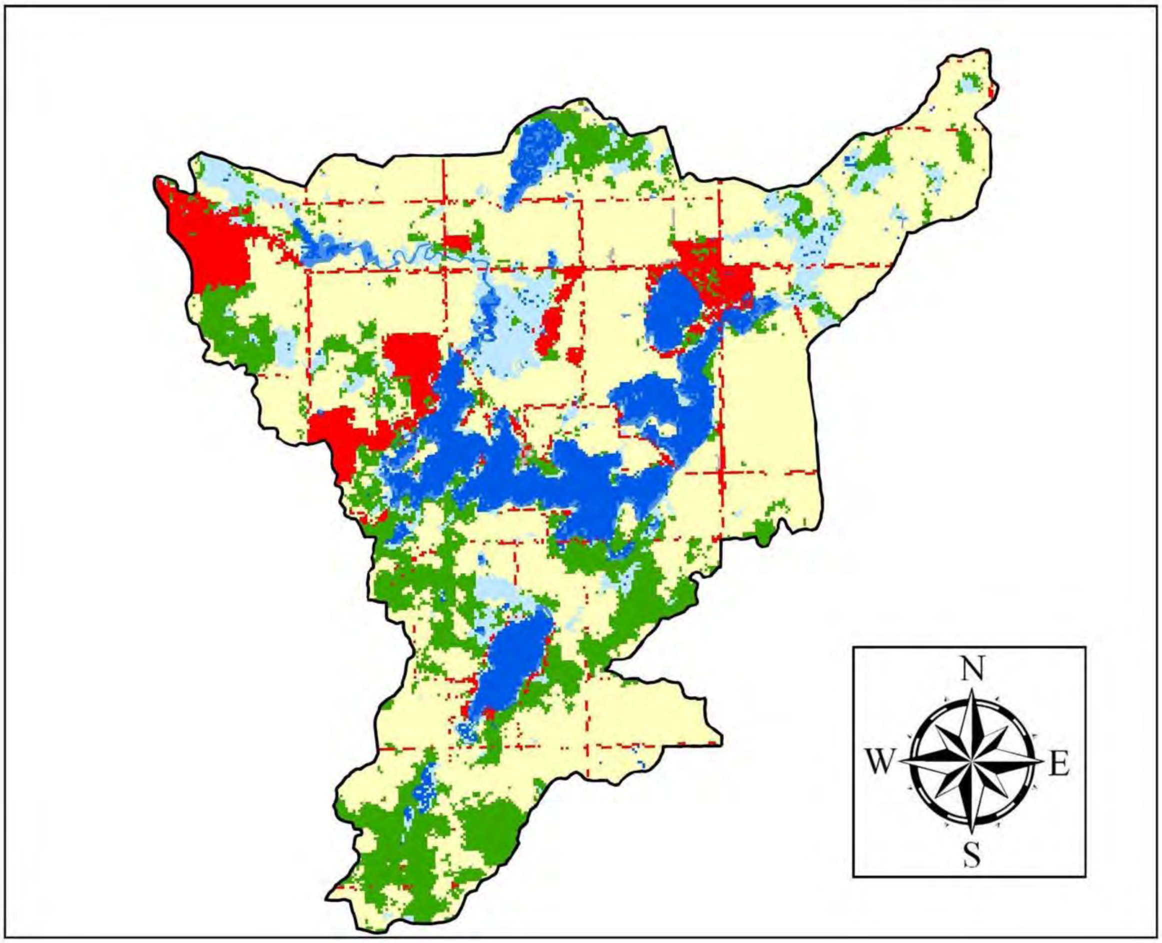
LEGEND

- Agriculture *(13,785.9 acres)* ~ 75%
- Developed *(517 acres)* ~ 2.8%
- Forest *(1,992 acres)* ~ 10.9%
- Water *(201.7 acres)* ~ 1.1%
- Wetlands *(1,787.6 acres)* ~ 9.8%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Spring Creek Sub-Watershed
Land Cover (2006)

Data Source: Coastal Change Analysis Program (CCAP) 2006



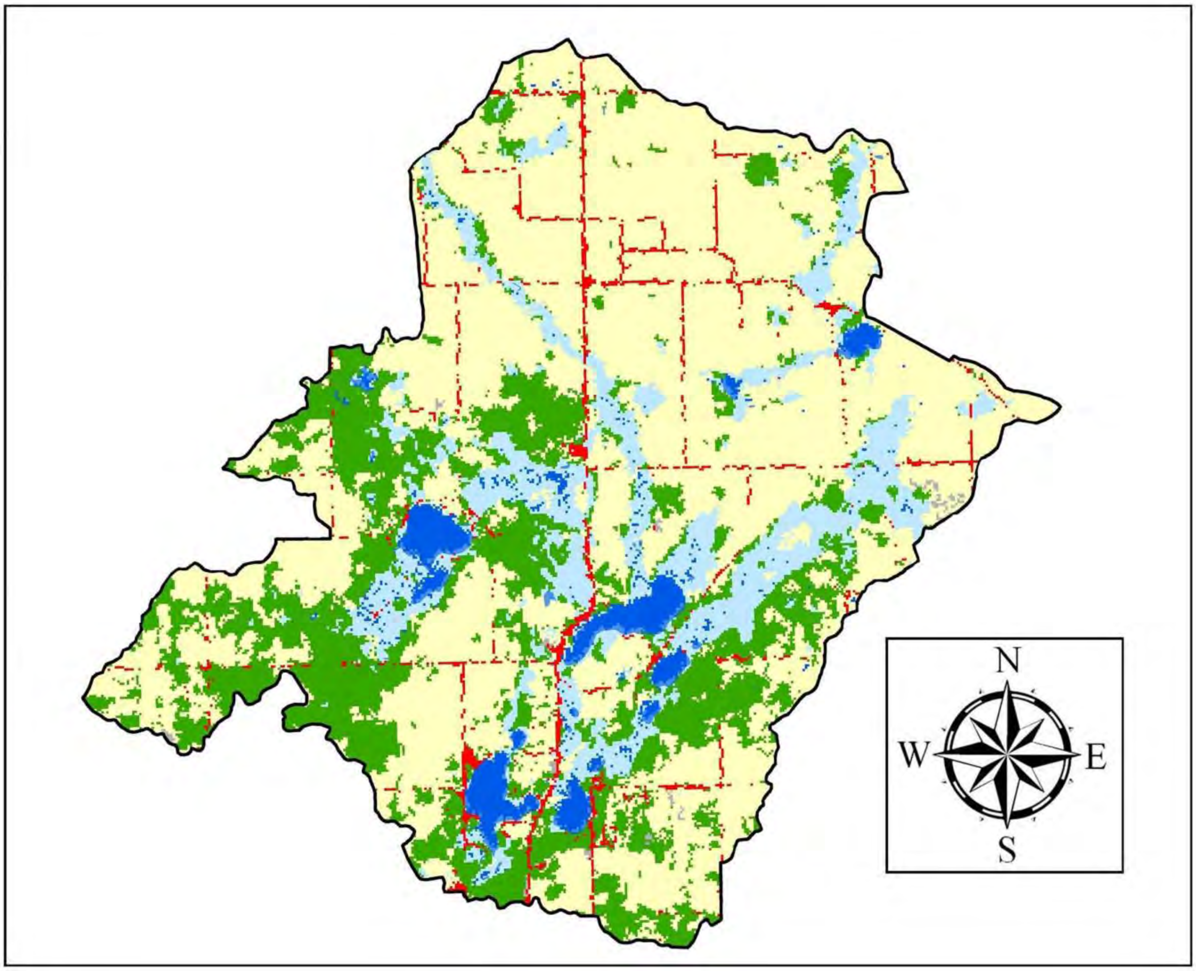
LEGEND

- Agriculture *(6,391 acres)* ~ 54.7%
- Developed *(984 acres)* ~ 8.4%
- Forest *(1,947 acres)* ~ 16.7%
- Water *(1,193 acres)* ~ 10%
- Wetlands *(1,160.9 acres)* ~ 9.9%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Lake Templene Sub-Watershed
Land Cover (2006)

Data Source: Coastal Change Analysis Program (CCAP) 2006



LEGEND

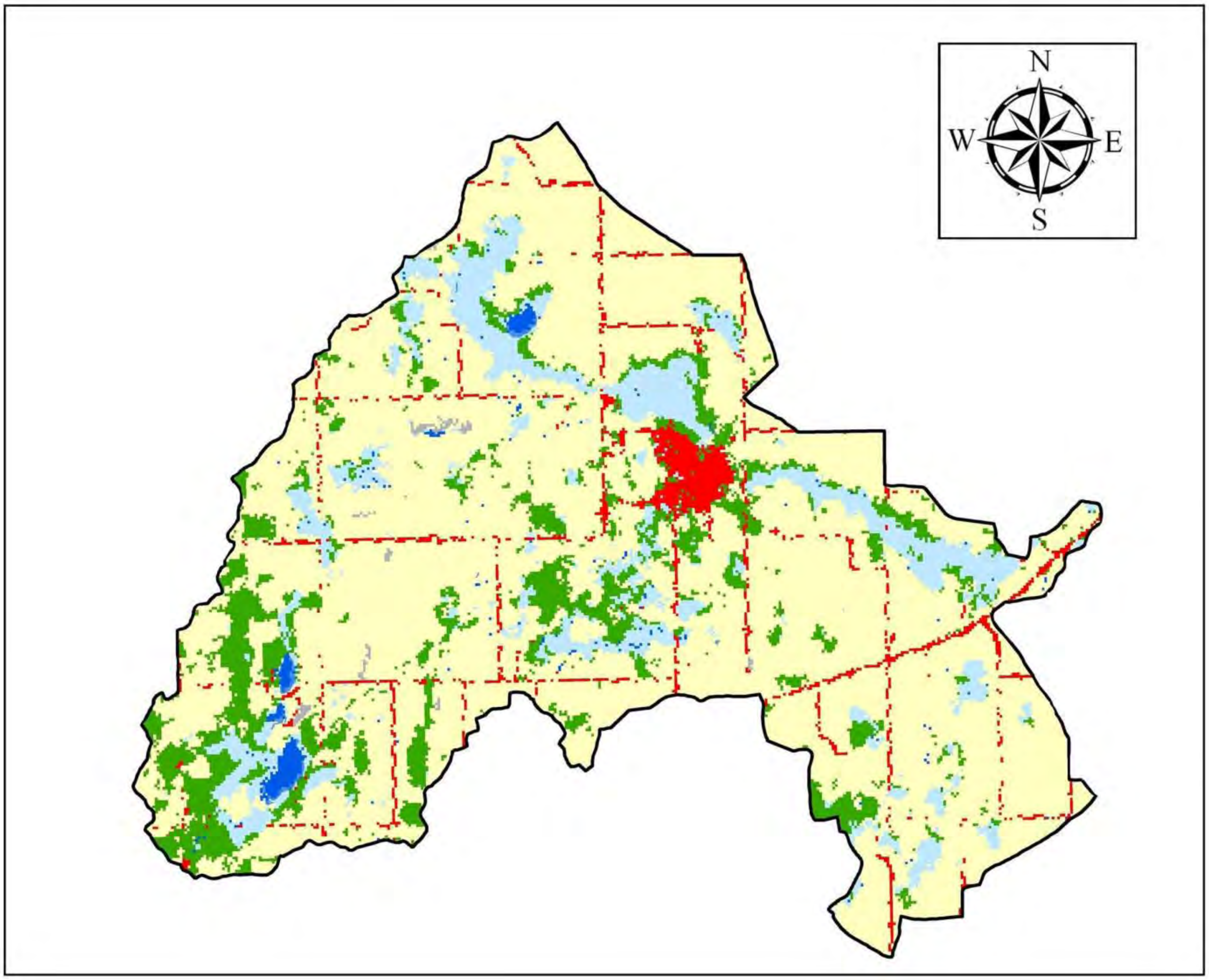
- Agriculture *(10,153 acres)* ~ 57%
- Developed *(533.5 acres)* ~ 3%
- Forest *(3,991.3 acres)* ~ 22.5%
- Water *(625.7 acres)* ~ 3.5%
- Wetlands *(2,365.8 acres)* ~ 13.3%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Prairie River Lake Sub-Watershed
Land Cover (2006)

Appendix 1
Map E
1-5

Data Source: Coastal Change Analysis Program (CCAP) 2006



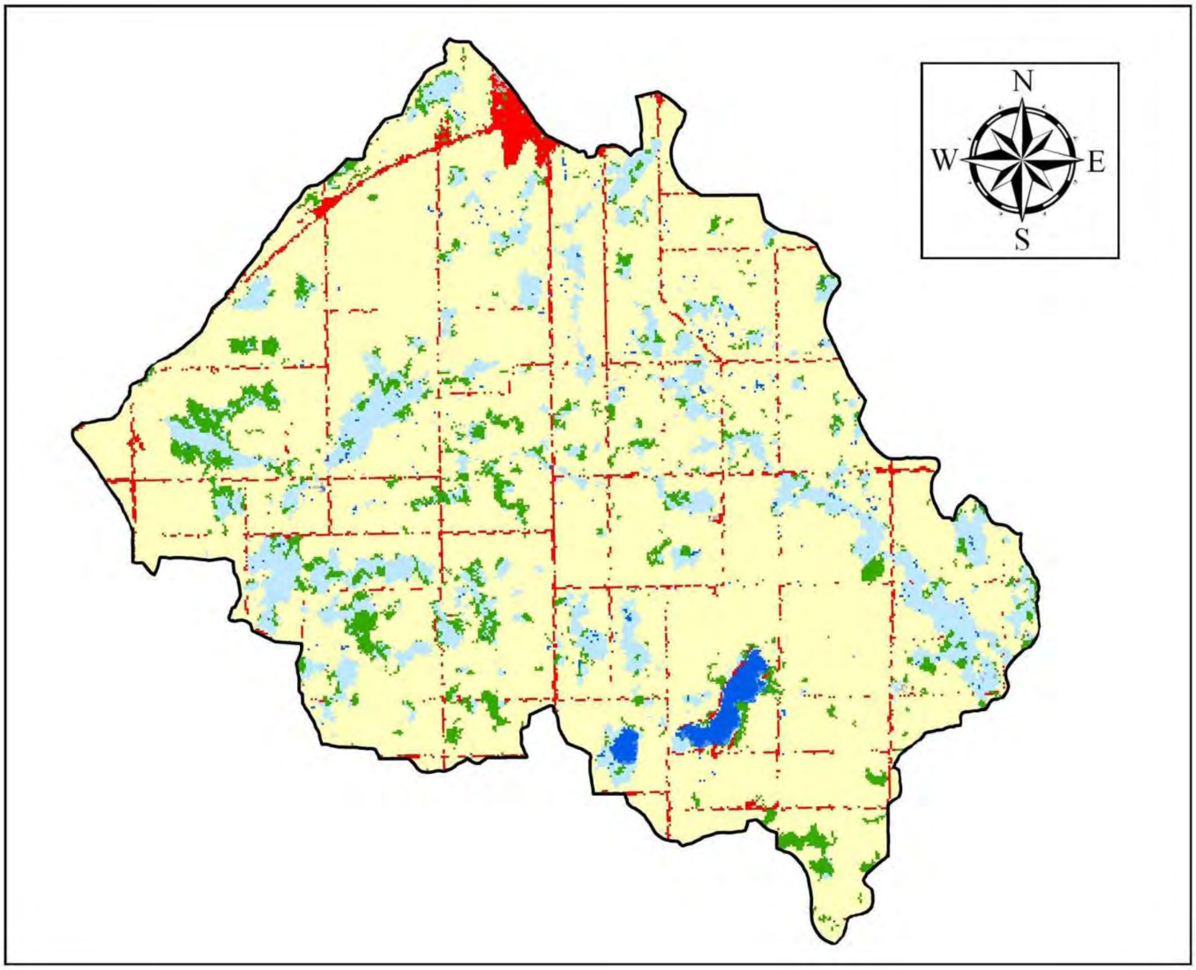
LEGEND

- Agriculture *(9274 acres)* ~ 72%
- Developed *(558.8 acres)* ~ 4.3%
- Forest *(1511.8 acres)* ~ 11.7%
- Water *(107.2 acres)* ~ 0.8%
- Wetlands *(1384.7 acres)* ~ 10.8%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Stewart Lake Drain Sub-Watershed
Land Cover (2006)

Data Source: Coastal Change Analysis Program (CCAP) 2006



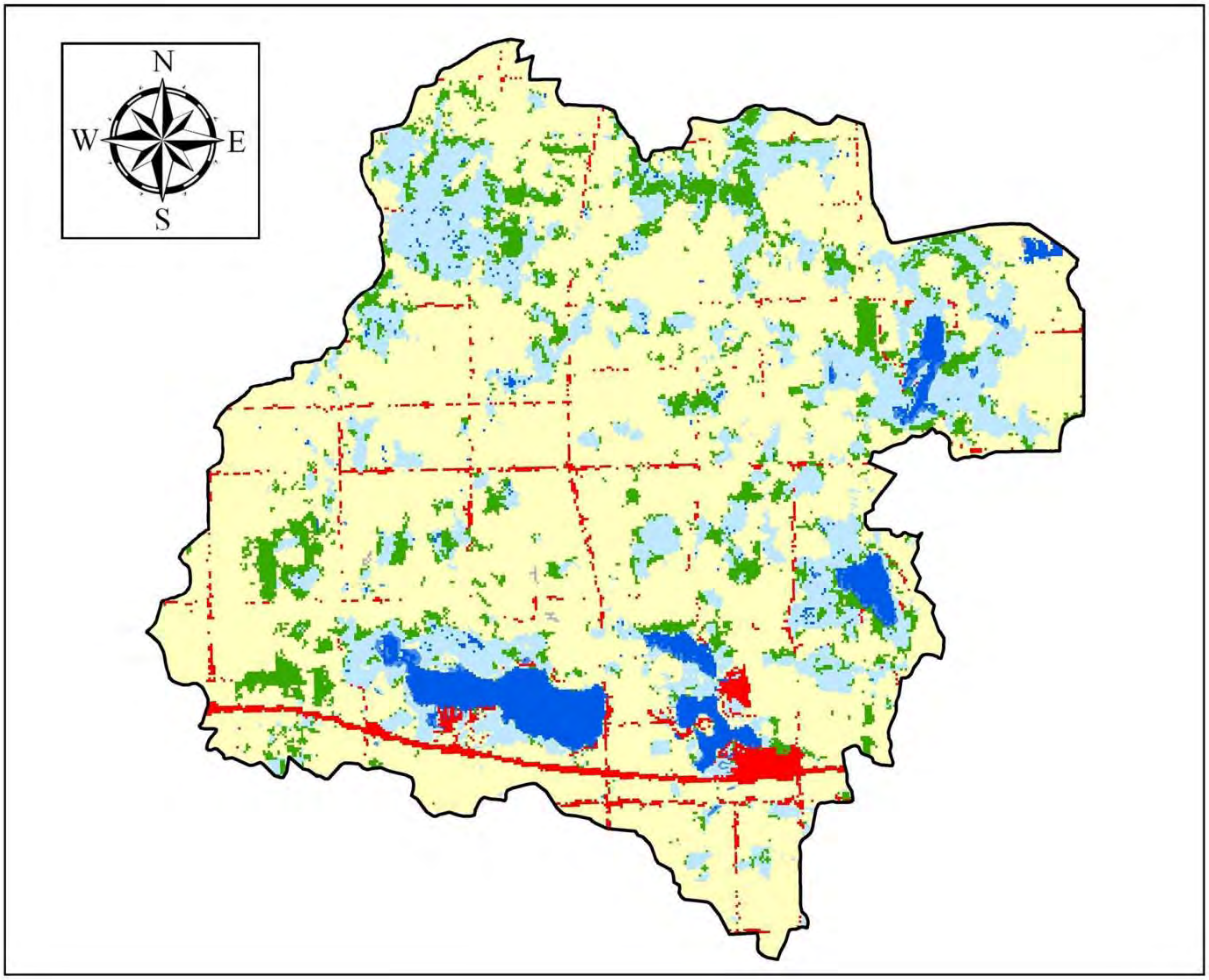
LEGEND

- Agriculture *(18,406.8 acres)* ~ 78.7%
- Developed *(889.3 acres)* ~ 3.8%
- Forest *(1,283.8 acres)* ~ 5.5%
- Water *(260.5acres)* ~ 1.1%
- Wetlands *(2524.3 acres)* ~ 10.8%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Gilead Lake Sub-Watershed
Land Cover (2006)

Data Source: Coastal Change Analysis Program (CCAP) 2006



LEGEND

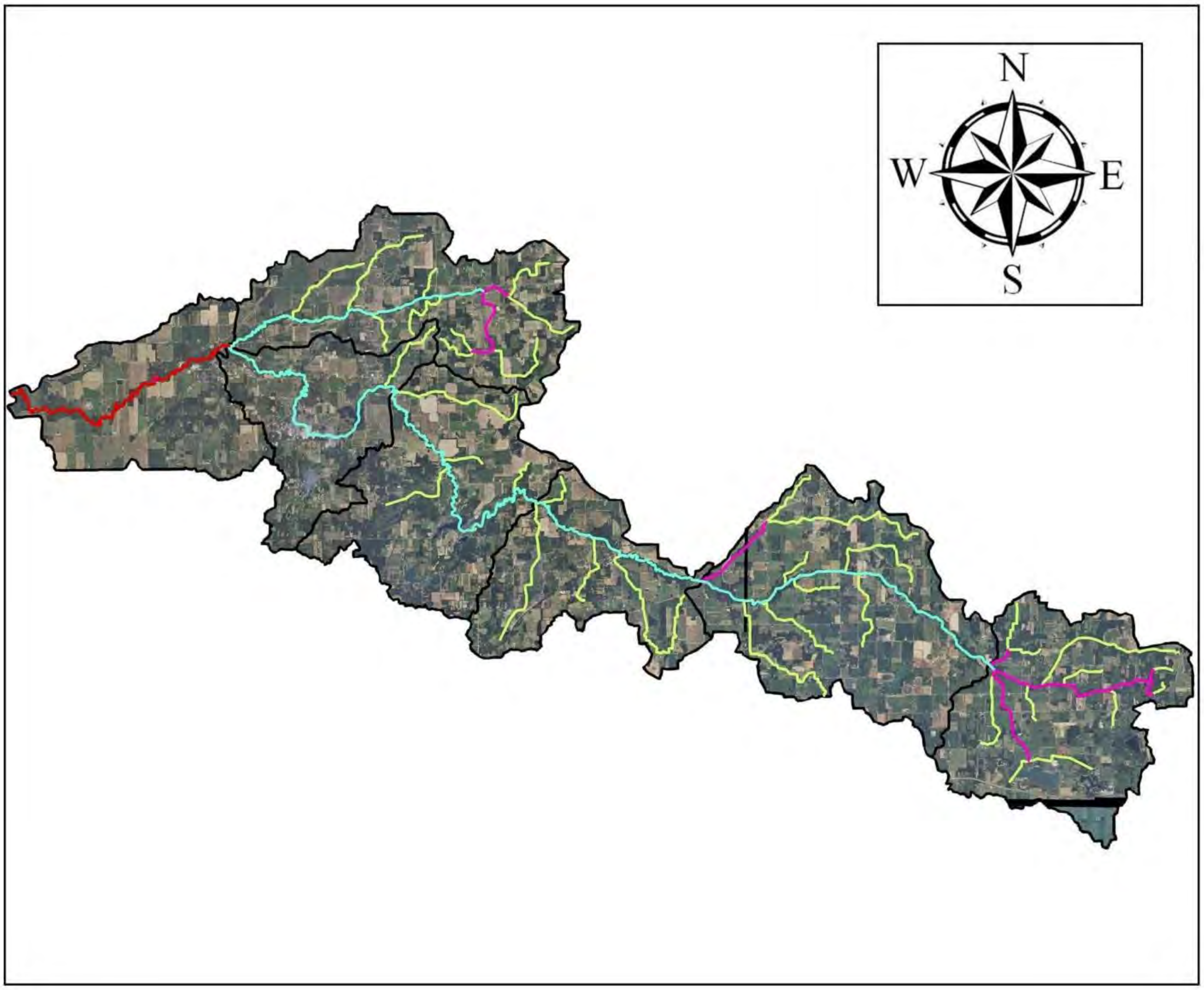
- Agriculture *(12,459 acres)* ~ 66%
- Developed *(651 acres)* ~ 3.5%
- Forest *(153.8 acres)* ~ 8.8%
- Water *(781 acres)* ~ 4.2%
- Wetlands *(3236 acres)* ~ 17%

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Headwaters Sub-Watershed
Land Cover (2006)

Data Source: Coastal Change Analysis Program (CCAP) 2006

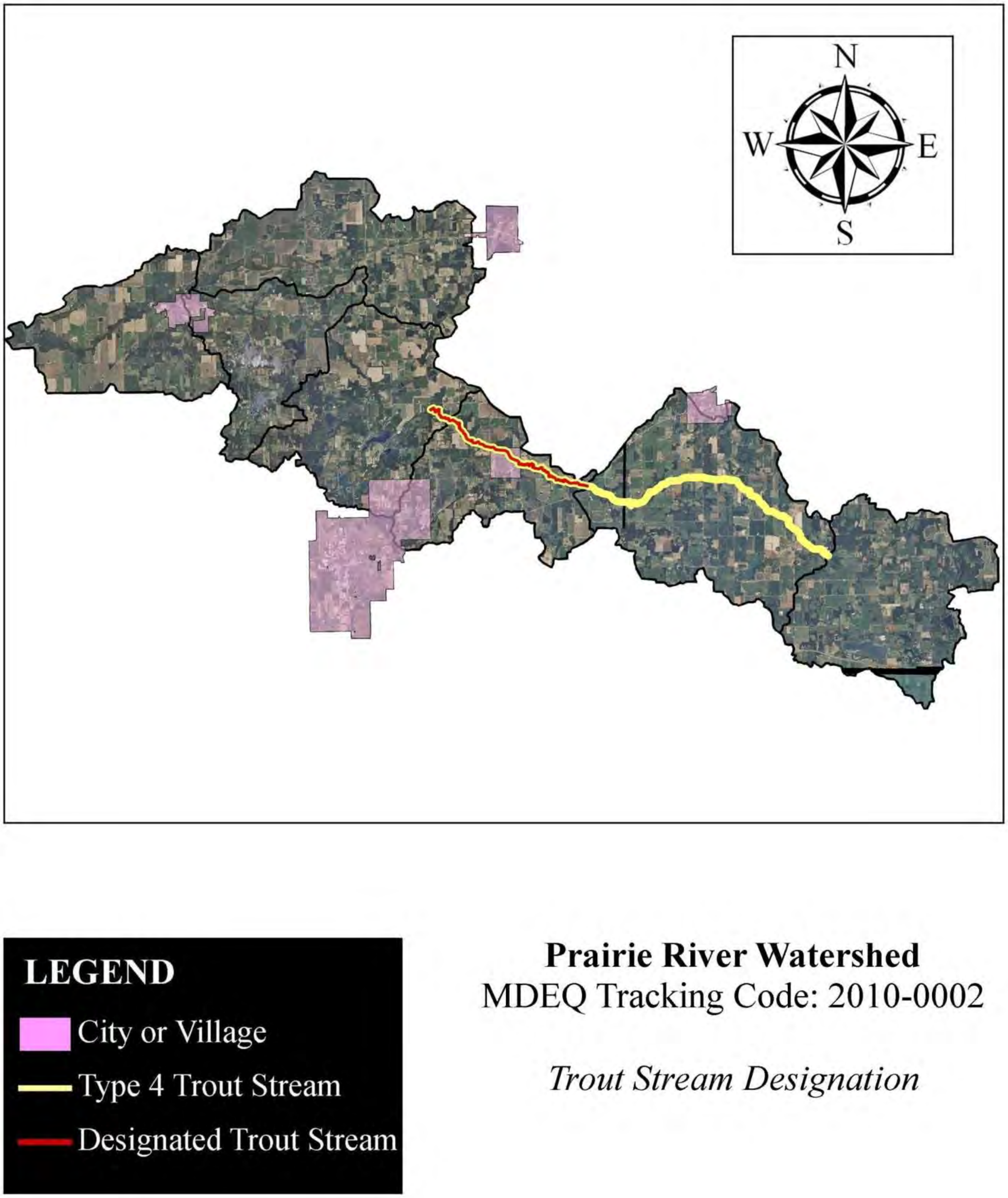
Appendix 1
Map H



Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Stream Order

Appendix 1
Map I
1-10

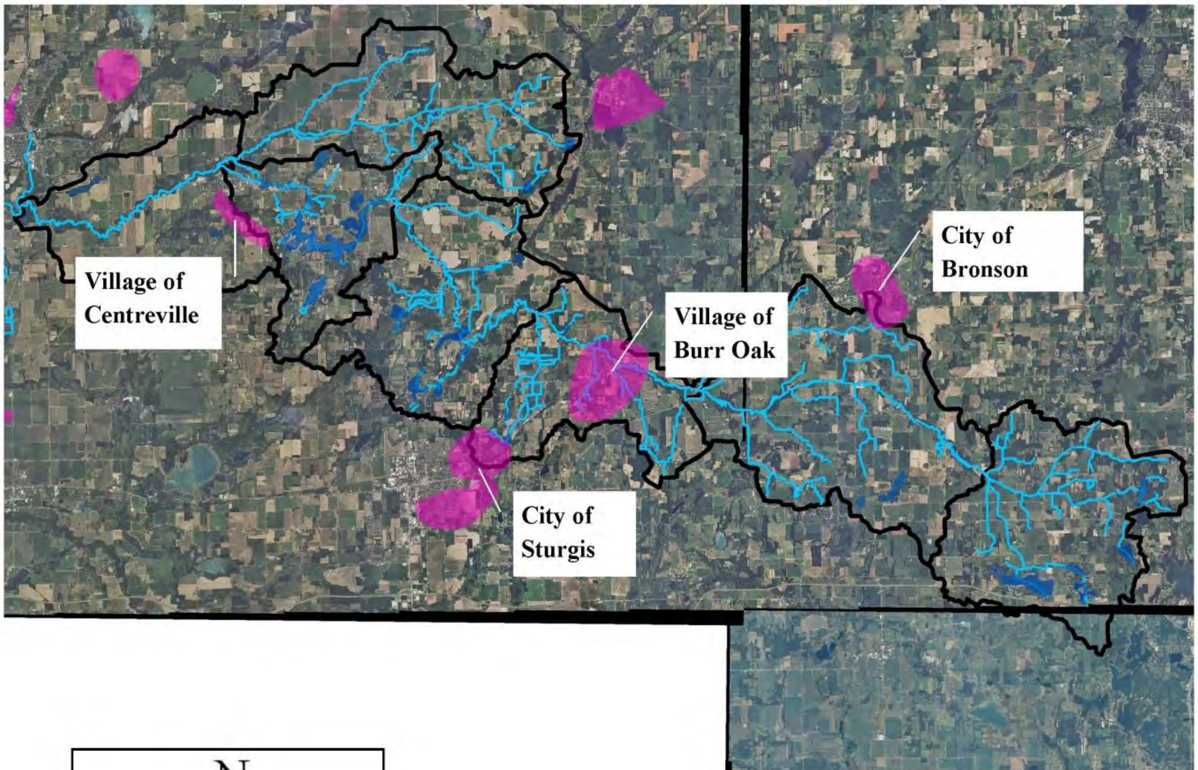


Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Trout Stream Designation

Appendix 1
Map J
1-11

Data Source: Michigan Department of Natural Resources



Prairie River Watershed

MDEQ Tracking Code 2010-0002

LEGEND

Prairie River Watershed

Rivers and Streams

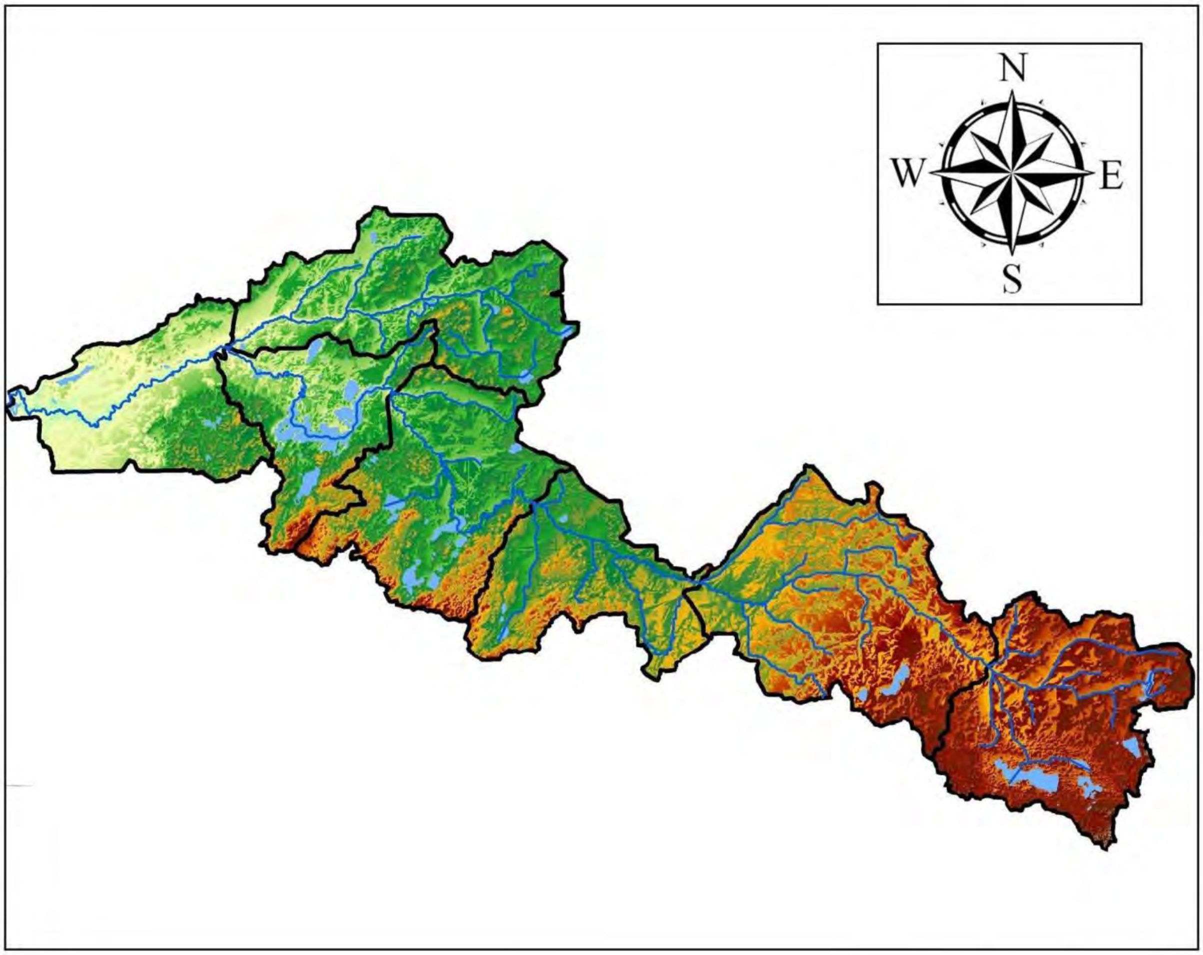
Lakes

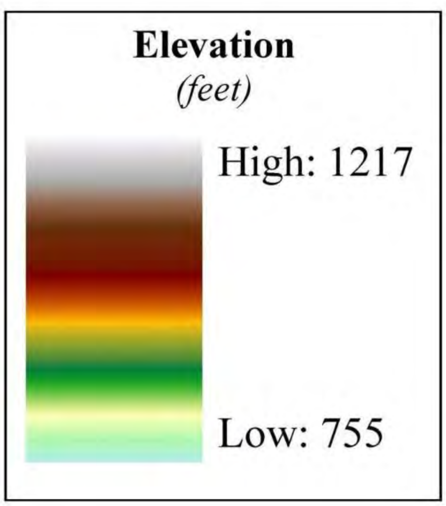
Wellhead Protection Areas

Wellhead Protection Areas

Appendix 1
Map K
1-11

Data Source: Michigan Natural Resources Conservation Service

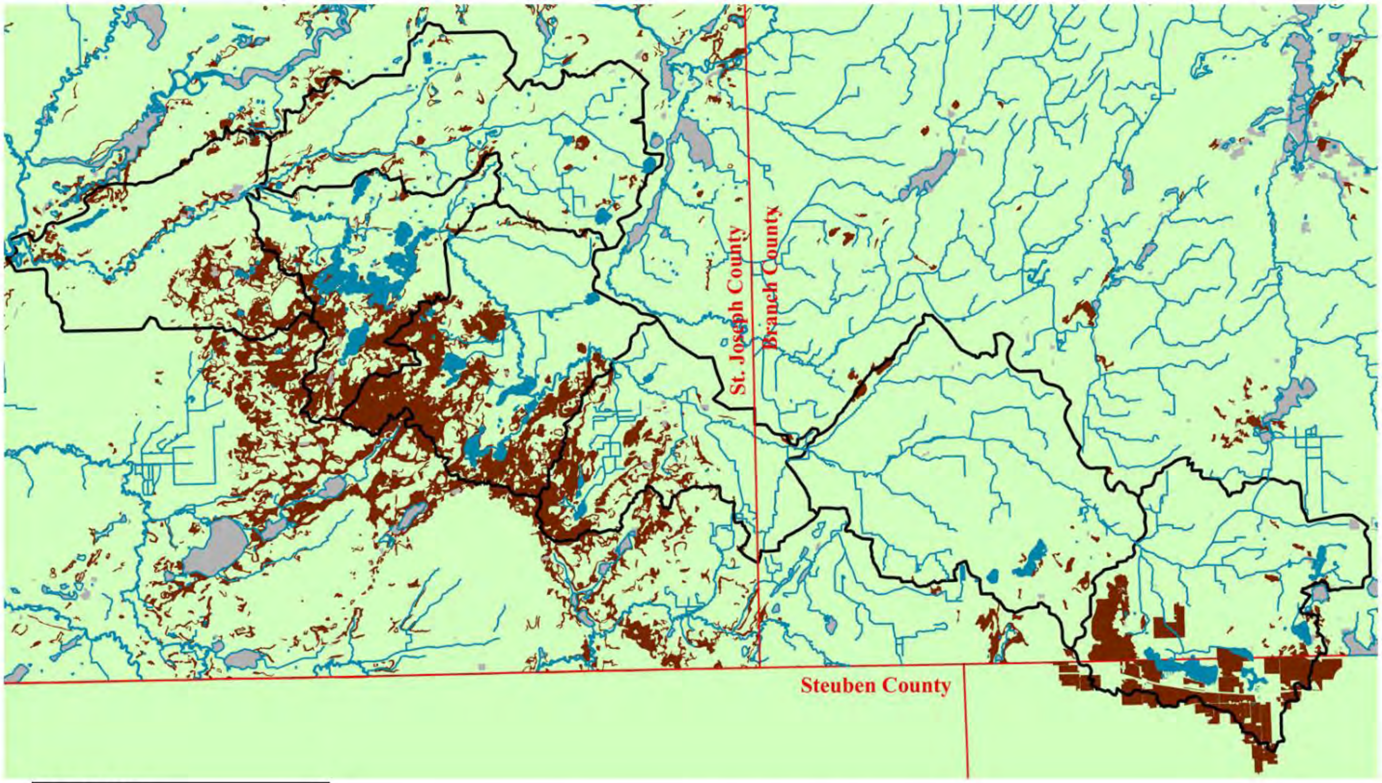




Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Elevation

Appendix 1
Map L
1-13



LEGEND

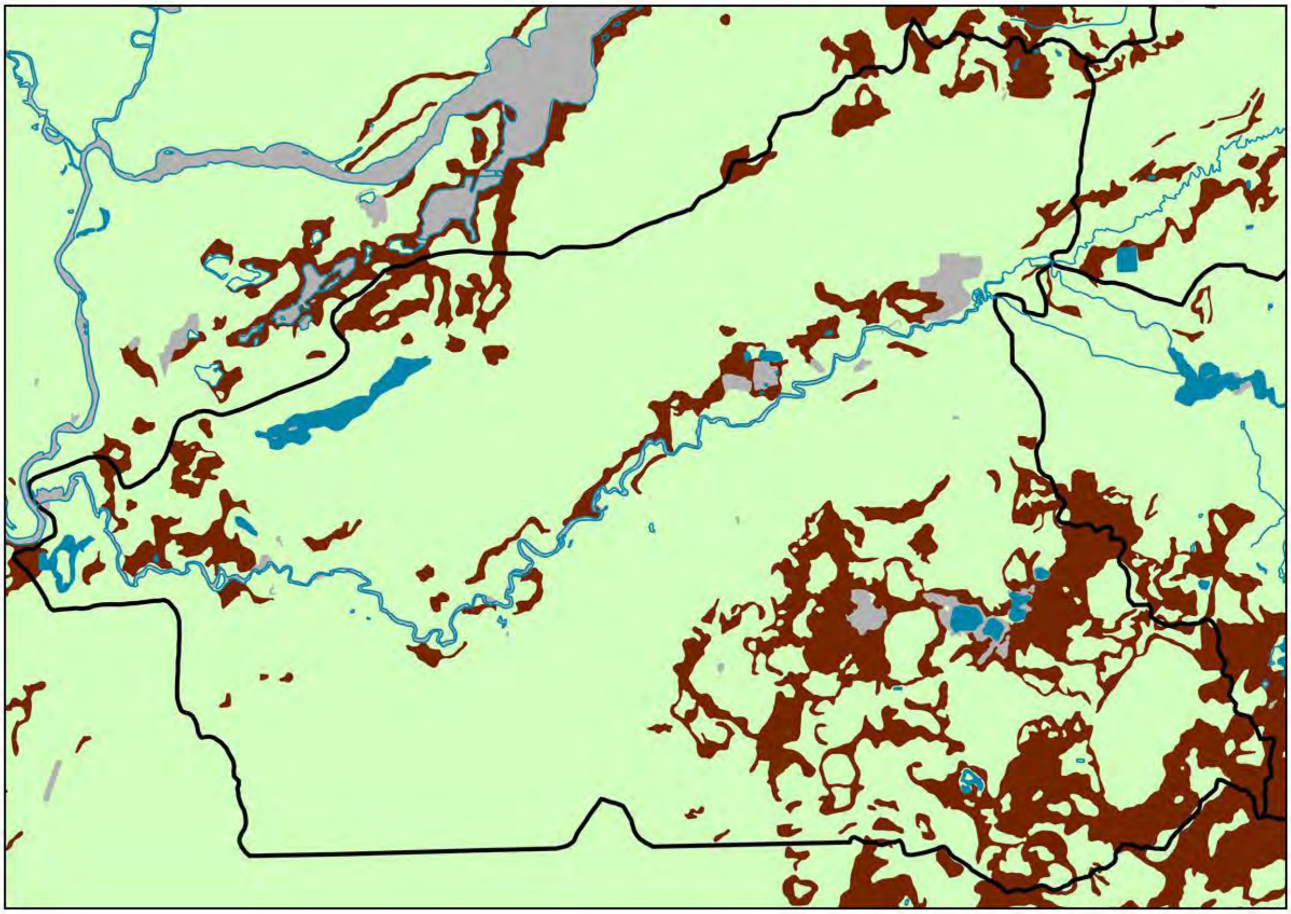
- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Prairie River Watershed
- Counties

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Highly Erodible Land

N
W E
S

Appendix 1
Map M
1-14



LEGEND

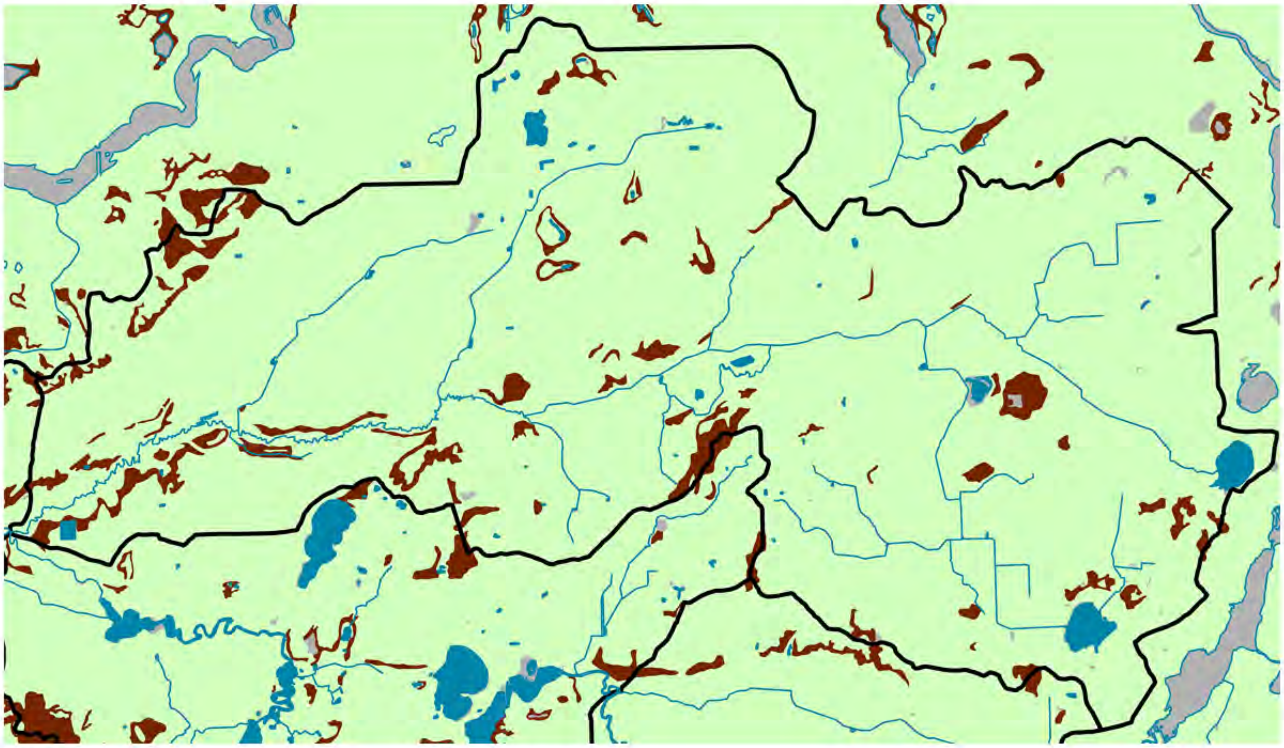
- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub-Watershed Boundary

Prairie River Watershed

MDEQ Tracking Code: 2010-0002

Bullhead Lake Sub-Watershed

Highly Erodible Land

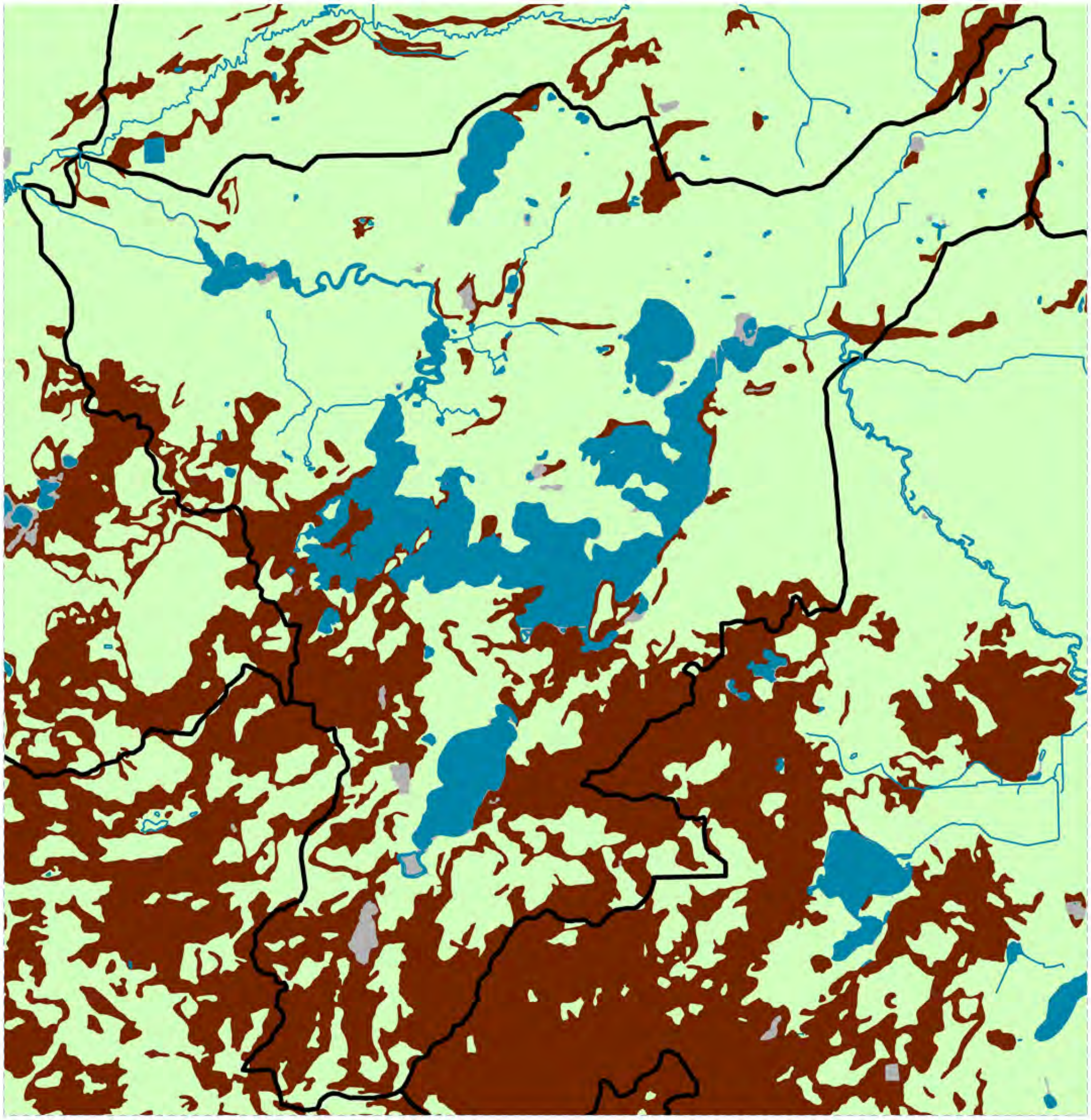


LEGEND

- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub-Watershed Boundary

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Spring Creek Sub-Watershed
Highly Erodible Land



LEGEND

- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub-Watershed Boundary

Prairie River Watershed

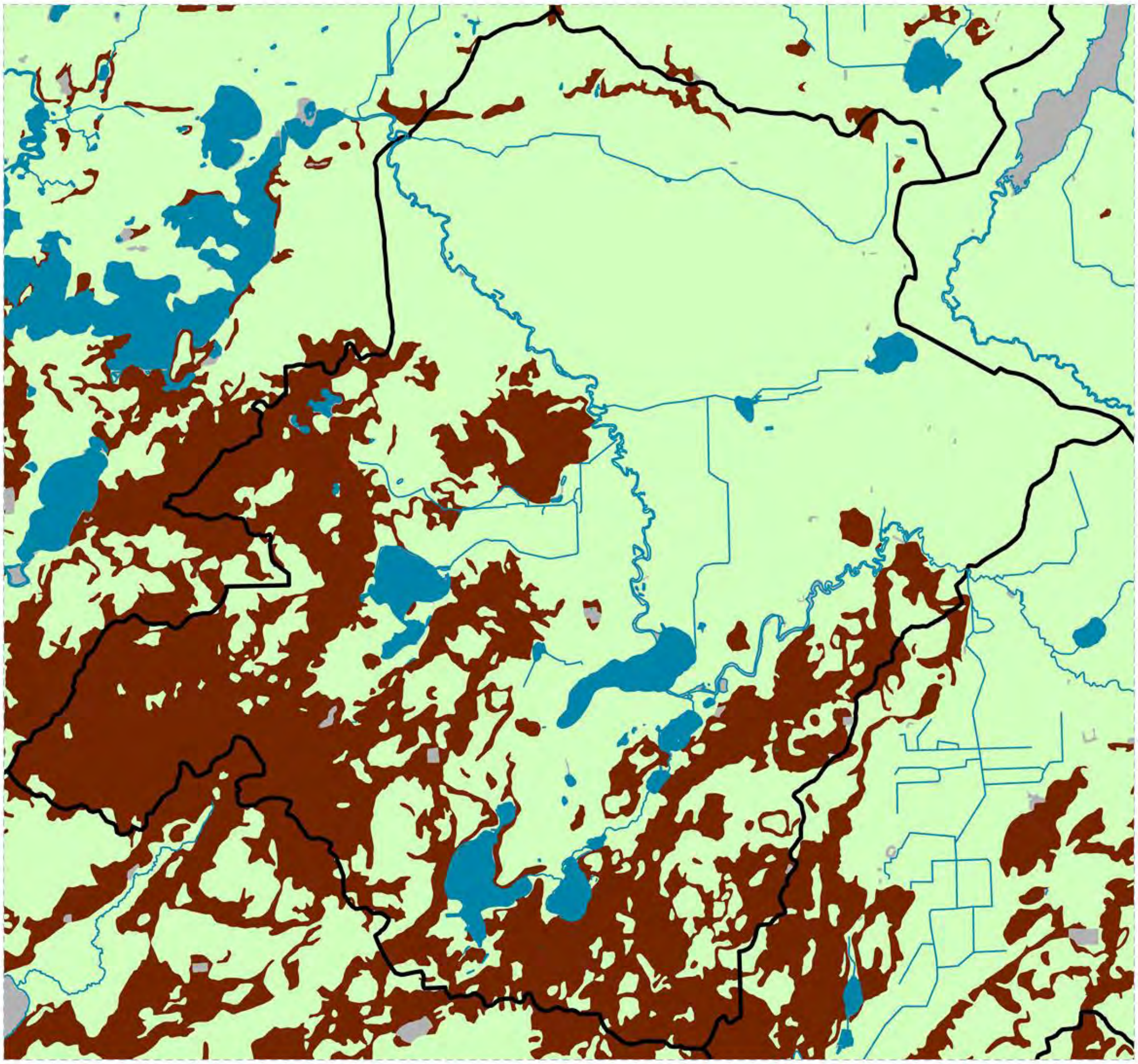
MDEQ Tracking Code: 2010-0002

Lake Templene Sub-Watershed

Highly Erodible Land

Appendix 1

Map P



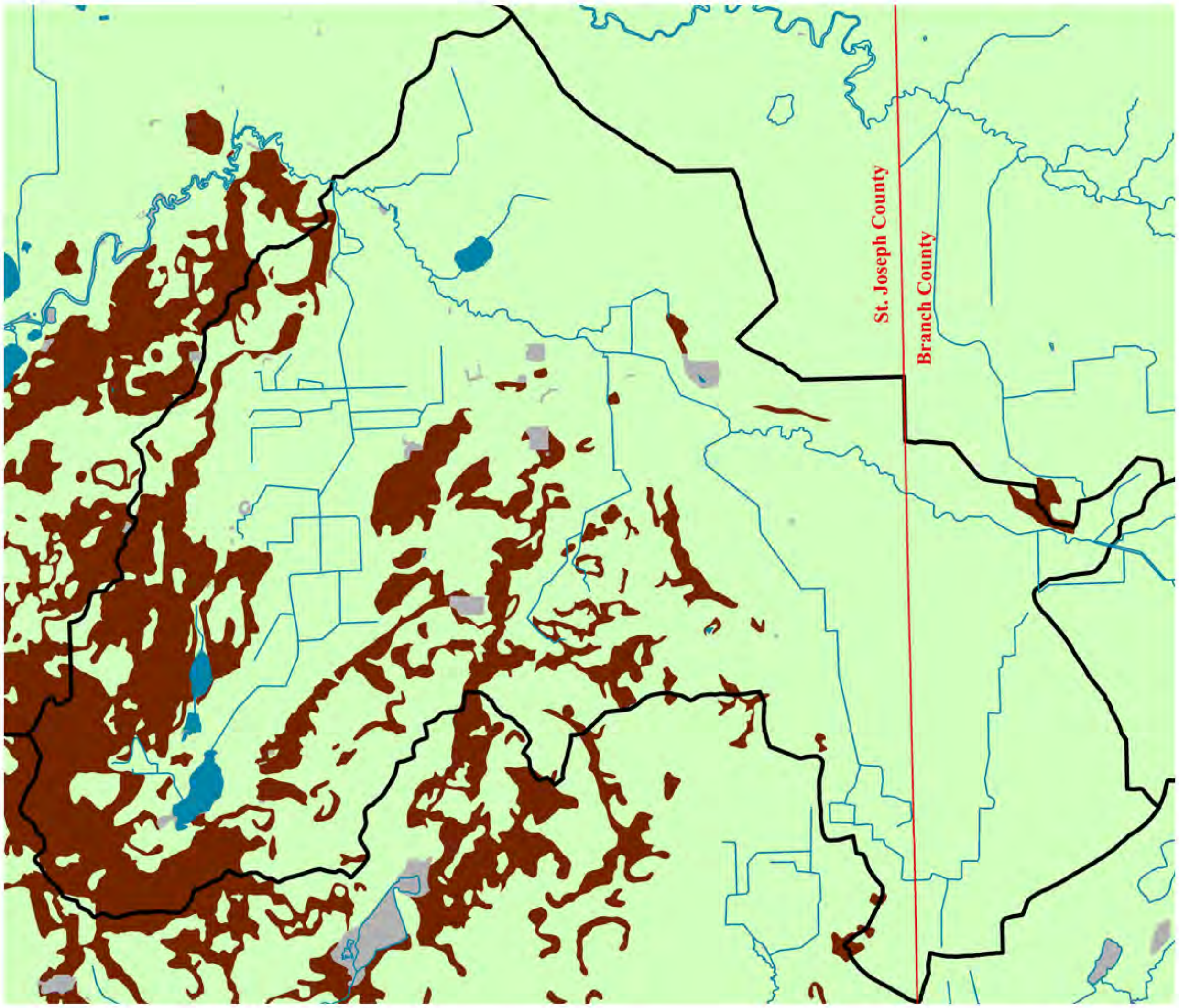
LEGEND

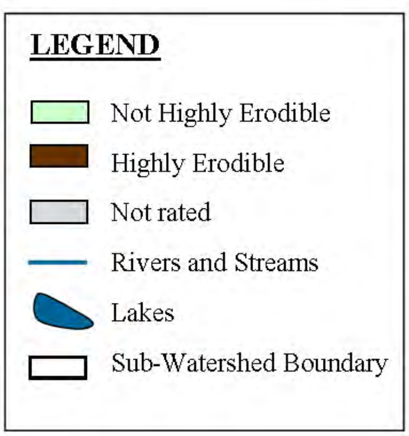
- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub-Watershed Boundary

Prairie River Watershed
MDEQ Tracking Code: 2010-0002

Prairie River Lake Sub-Watershed
Highly Erodible Land

Appendix 1
Map Q





Prairie River Watershed

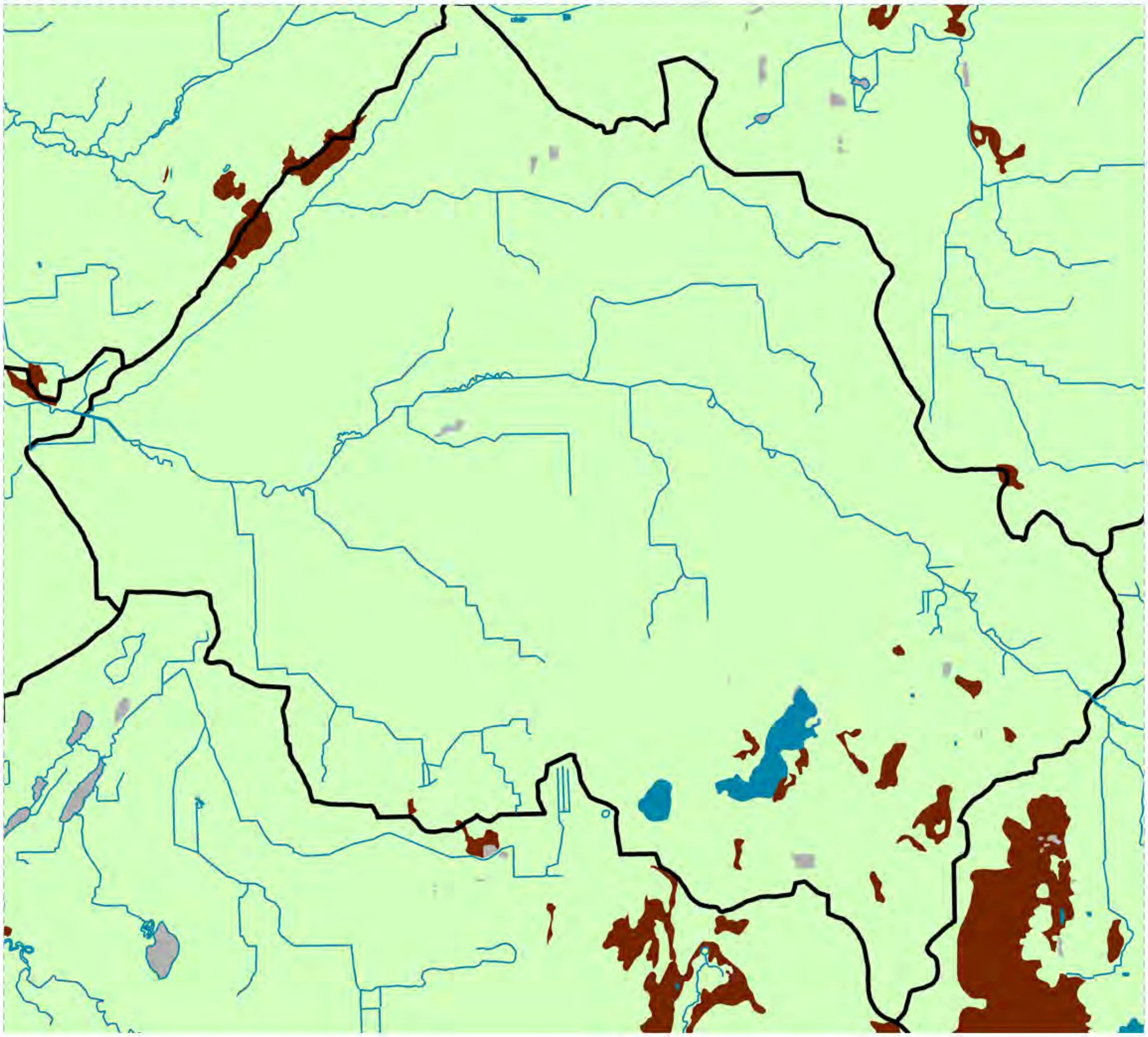
MDEQ Tracking Code: 2010-0002

Stewart Lake Drain Sub-Watershed

Highly Erodible Land

Appendix 1

Map R



LEGEND

- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub- Watershed Boundary

Prairie River Watershed

MDEQ Tracking Code: 2010-0002

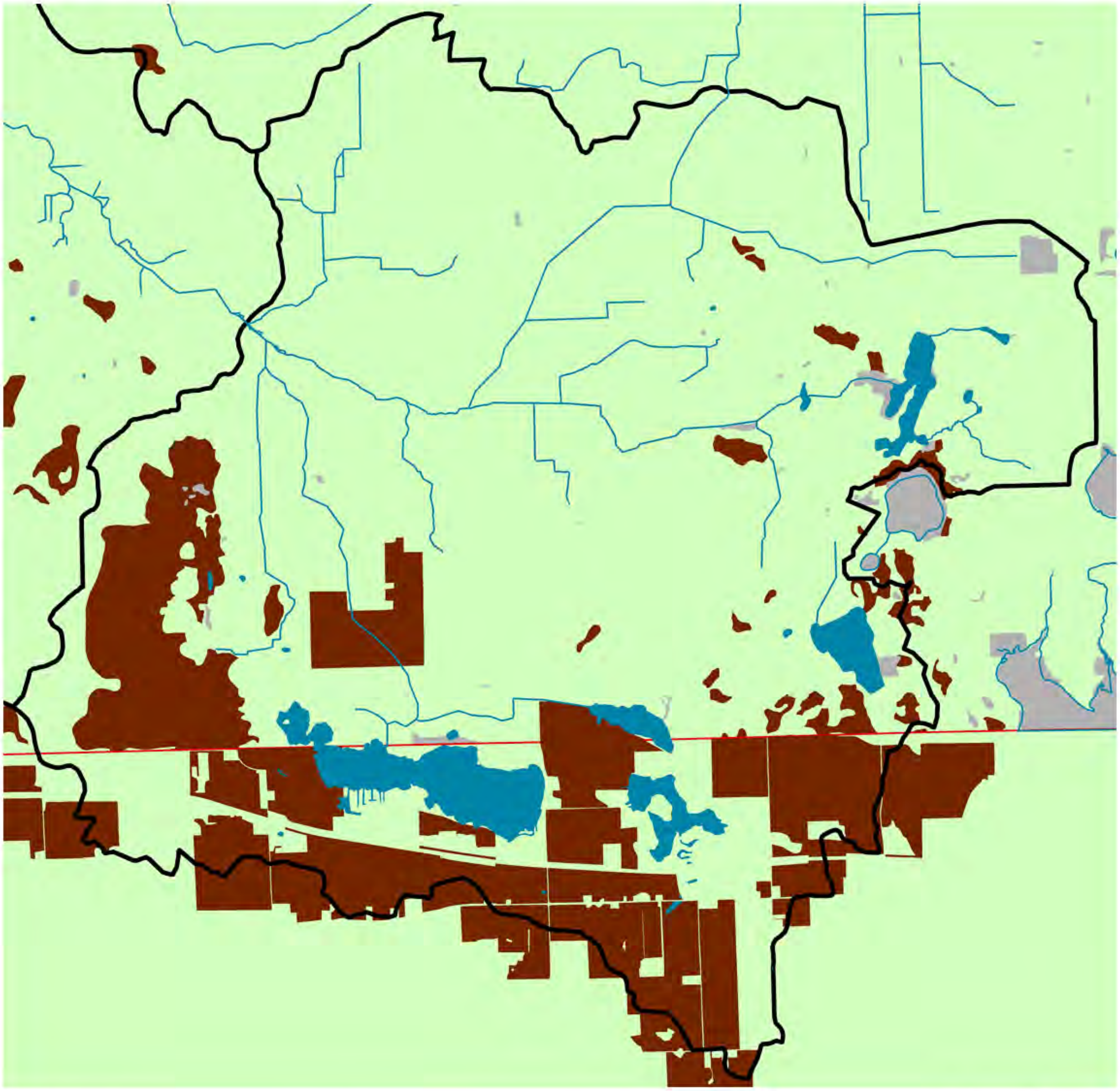
Gilead Lake Sub-Watershed

Highly Erodible Land

Appendix 1

Map S

1-20



LEGEND

- Not Highly Erodible
- Highly Erodible
- Not rated
- Rivers and Streams
- Lakes
- Sub-Watershed Boundary

Prairie River Watershed

MDEQ Tracking Code: 2010-0002

Headwaters Sub-Watershed

Highly Erodible Land

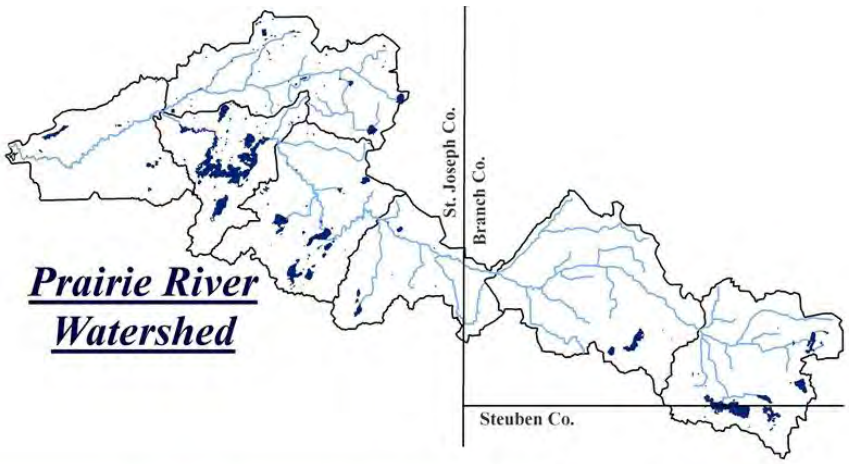
Appendix 1

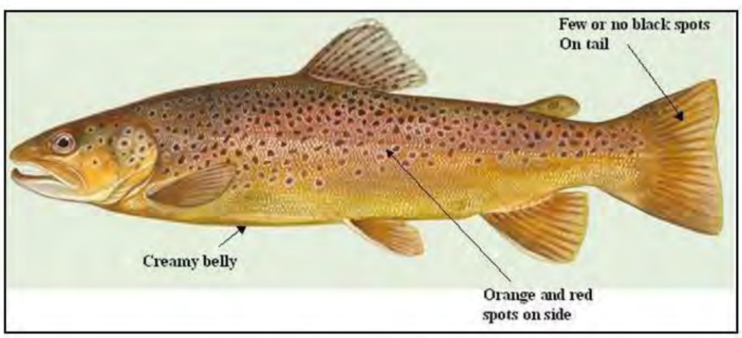
Map T

Appendix 2

Prairie River Watershed

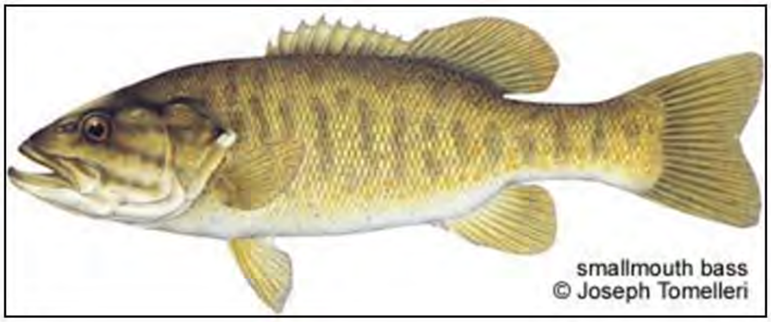
Michigan Department of Natural Resources
Prairie River 2011 – 2012 Fish Survey Report
and 2013 Mussel Survev Results





Oklahoma Dept. of Wildlife Conservation

Ohio Dept of Natural Resources



Prairie River 2011-2012 Survey Report

Prepared by Brian Gunderman

The Prairie River arises near Kinderhook and flows 54 miles northwesterly to its confluence with the St. Joseph River south of the city of Three Rivers. The Prairie River watershed encompasses 201 square miles and includes portions of Branch and St. Joseph counties in Michigan and Steuben County, Indiana. Agriculture is the predominant land use in the watershed. There are two registered dams (Centreville Dam and Lake Templene Dam) on the mainstem. An unknown number of small unregistered dams have been constructed on tributaries to the Prairie River. The portion of the Prairie River from Bowers Road to McKale Road currently is classified as a Type 4 trout stream.

The topography within the watershed is flat to gently rolling. Stream gradient averages 6 ft/mile in Branch County and 3 ft/mile from St. Joseph Road to McKale Road. The surficial geology of this area consists primarily of glacial outwash sand and gravel and postglacial alluvium with scattered end moraines of coarse-textured till. The river flows through a mosaic of soil types, but most of the watershed is covered by sandy loams and loamy sands. In Branch County, the Prairie River is a designated county drain. Many of the tributaries to the mainstem also are designated drains and large portions of the river system have been affected by dredging and channelization. During 1997-2003, temperature loggers were placed at various locations on the Prairie River (Table 1). Mean July water temperatures ranged from 65.7 °F at Orland Road in 1997 to 69.5 °F at Burr Oak Road in 2002.

The first fisheries survey on the Prairie River was completed in 1969. Electrofishing near the St. Joseph Road and McKale Road crossings yielded a total of 13 fish species. The only game fish collected during the survey were one adult largemouth bass and a few small yellow perch. In 1971, an annual brown trout stocking program was initiated. For the first decade of this stocking program, yearling brown trout generally were released at the Middle Colon Road and McKale Road crossings. Electrofishing surveys were completed at multiple locations from St. Joseph Road to McKale Road during 1972-1976. The cumulative brown trout catch for this period was 13 fish. Total lengths for captured brown trout varied from 6 inches to 9 inches.

The first electrofishing surveys on the Branch County portion of the Prairie River were conducted in 1977. Twenty-one fish species were collected during this effort, including the creek chubsucker which is listed as endangered in Michigan. Ten brown trout (total length = 7-14 inches) were captured. These fish had moved upstream from their stocking locations in St. Joseph County.

Beginning in spring 1983, yearling brown trout were stocked annually at several sites in Branch and St. Joseph counties (Table 2). During the summer of 1983, electrofishing surveys were conducted at 6 sites on the Prairie River from Bowers Road to US-12. The cumulative catch from Bowers Road to Bawden Road (4 sites) was 104 brown trout. Three brown trout were captured near the Prairie River Road crossing, and zero brown trout were collected near the US-12 crossing. Most of the brown trout were yearlings that presumably were stocked in 1983. Two young-of-year fish and five age 2 fish also were captured, indicating that some natural reproduction was occurring in this system.

Electrofishing was completed near the Cranson Road and Orland Road crossings in 1988. Two yearling brown trout were collected at Cranson Road and zero were captured at Orland Road. Water levels were low, and biologists speculated that trout had moved downstream to find deeper pools.

As part of county drain maintenance, the Prairie River was dredged and large woody structure was removed from Orland Road to approximately 0.5 miles downstream of St. Joseph Road during the early 1990s. These activities reduced the abundance of fish cover in the stream, altered flow regimes, and reduced shading resulting in increased summer water temperatures. In 1992, electrofishing was conducted at five sites from St. Joseph Road to McKale Road. Eight brown trout were collected, including four wild young-of-year fish. Due to the habitat alterations and poor trout catch during the survey, brown trout stocking was discontinued after 1992.

No brown trout were captured during electrofishing surveys conducted near the Block Road, Bowers Road, and St. Joseph Road crossings in 1993 (Kosek 1994). However, sampling completed in 2000 yielded very different results. Brown trout population estimates were obtained for a 725 ft station at Orland Road and an 800 ft station at Bowers Road using the two-pass depletion method. The brown trout population estimates were 175 fish (1,272 fish/mile) at the Orland Road station and 247 fish (1,633 fish/mile) at the Bowers Road station. Young-of-year fish composed 72% of the catch at Orland Road and 92% of the catch at Bowers Road. Only one fish larger than 10 inches was captured at Bowers Road, whereas 11 fish ≥ 10 inches were collected at Orland Road. No fish older than age 2 were captured, indicating poor survival or emigration of larger fish. The Michigan Department of Environmental Quality (MDEQ) conducted additional sampling at two sites on the Prairie River in 2005. Seven brown trout were captured at the Bowers Road station and zero trout were collected at the McKale Road station (Walterhouse 2007).

Irrigation commonly is used to enhance agricultural production within the Prairie River watershed. In analyses of past surveys, fisheries managers expressed concerns about the effects of surface water withdrawals on discharge patterns and brown trout production in the river. Since July 9, 2009, Part 327 of Public Act 451 requires all large-quantity withdrawals (defined as 70 gallons per minute [100,000 gallons per day] or greater) to be registered with MDEQ. A water withdrawal assessment tool (WWAT) was created to facilitate estimation of the ecological effects of proposed withdrawals (Hamilton and Seelbach 2011). If a proposed withdrawal is predicted to have adverse effects on the fish community, the applicant is directed to pursue alternative options (e.g., digging a deeper well, finding a different location for a well, or acquiring water from other farmers within the sub-watershed that are not using all of their permitted withdrawal capacity). The Prairie River watershed provides an excellent location to test the logistics of implementing the registration process and assess performance of the WWAT in protecting fish communities under a variety of environmental conditions.

Materials and Methods

A stream shocker (250 V DC, 6A, two probes) was used to capture fish in the Prairie River on July 20, 2011 as part of MDNR's Status and Trends Program. This program involves standardized sampling on randomly selected stream segments to provide information on spatial and temporal trends in Michigan fish communities. The sampling station began 300 ft downstream of the Orland Road crossing and extended upstream for a distance of 800 ft (Figure 1). A single electrofishing run was completed while moving in an upstream direction. Total length was recorded for all brown trout captured. Scale samples were collected from 10 brown trout per inch group for age determination. For non-game fish species, all fish were counted and total lengths were recorded for the first 30 individuals. Weights for all fish species were calculated using the length-weight regression coefficients compiled by Schneider et al. (2000b). Fish habitat and riparian bank conditions within the sampling station were assessed using the methods outlined by Wills et al. (2005). An Onset® Hobo® Temp Pro v2 temperature logger was deployed 30 ft downstream of the Orland Road crossing on January 12, 2011. The logger was programmed to record water temperatures every hour and was retrieved on December 7, 2011.

A severe drought occurred in 2012 and Fisheries Division received reports of extremely low water levels in the Prairie River. To evaluate the effects of the drought on the brown trout population, electrofishing was conducted at the same 800 ft sampling station on July 30, 2012. Brown trout were captured during a single electrofishing run with a stream shocker (250 V DC, 6A, two probes) while moving in an upstream direction. Total length was recorded for all brown trout captured. No data were collected for non-game fish species.

Additional sampling was completed near the Bowers Road crossing on September 12, 2012. The station began 900 ft downstream of the Bowers Road culvert and extended upstream to the culvert. Brown trout were collected during a single electrofishing run with a stream shocker (250 V DC, 5A, two probes) while moving in an upstream direction. Total length was recorded for all brown trout captured. All non-game fish were counted, but total lengths were not recorded for these species.

Onset® Hobo® Temp Pro v2 temperature loggers were deployed at 19 locations within the Prairie River watershed on March 14, 2012 (Table 3; Figure 1). The loggers were programmed to record water temperatures every hour. The loggers were retrieved during December 18-19, 2012.

Results

In 2011, 228 brown trout were captured at the Orland Road sampling station. The total length range for these fish was 2-22 inches. Seven percent of the brown trout collected were of legal size (≥ 10 inches; Figure 2). Analyses of scale samples revealed the presence of four year classes (ages 0-3). No scales suitable for age determination were obtained from the 22 inch brown trout, but this fish clearly was older than age 3. Young-of-year (YOY) fish composed 60% of the brown trout catch (Figure 3). Mean lengths-at-age were above statewide averages (Figure 4).

Eleven additional fish species were captured during the 2011 fish community survey at Orland Road (Table 4). Hornyhead chubs, blacknose dace, and rainbow darters were the most abundant non-game species in the catch. Coldwater and transitional fish species made up 66% of the catch by number and 91% of the catch by weight.

Gravel and small cobble covered 65% of the Orland Road sampling station in 2011. Deep pools and large woody structure were scarce. Large cobble (11%) and boulders (2%) were present and provided cover for small brown trout. The channel was incised due to past dredging activity, and bank stability was rated as "poor" (50-75% of streambank = bare soil) at 54% of the measurement locations. The estimated discharge at the time of the 2011 survey was 10.4 cfs. During July 2011, the mean water temperature was 67.9 °F and the mean daily maximum temperature was 70.8 °F. The mean temperature during the hottest week (July 18-24) was 71.4 °F.

Only three brown trout were captured at the Orland Road sampling station in 2012. The total length range for these fish was 3-10 inches. Scale samples were not collected for age determination. Based on the total lengths of the fish and the length-at-age data from 2011, the 2012 catch consisted of one YOY fish, one yearling, and one age 2 fish. Data were not collected for non-game species, but abundance of these fish appeared to be substantially lower than in 2011. The estimated discharge at the time of the 2012 survey was 4.3 cfs.

Thirty-seven brown trout were captured at the Bowers Road sampling station in 2012. The total length range for captured brown trout was 3-15 inches (Figure 5). Only three YOY fish were collected. Twelve other fish species were observed during the survey (Table 5). Creek chubs and rainbow darters were the most abundant species in the sampling station. Coldwater and transitional fish species made up 68% of the catch by number.

In 2012, mean July water temperatures in the Prairie River varied from 66.8 °F at Bowers Road to 74.4 °F at McKale Road (Tables 6-7). Mean daily maximum water temperatures during July 2012 were lowest at Walker Road (72.6 °F) and highest at Prairie River Road (84.2 °F). During the hottest week (July 1-7), mean water temperatures varied from 68.3 °F at Bowers Road to 77.6 °F at McKale Road. In general, water temperatures were substantially cooler at the headwaters (Walker Road to Parham Road) than in the downstream reaches (Prairie River Road to McKale Road).

Mean July water temperatures in tributaries to the Prairie River ranged from 57.9 °F in the Sutter & Pinney Drain to 75.5 °F in the Blosser Drain. Mean daily maximum water temperatures and mean water temperatures during the hottest week followed a similar trend, being lowest in the Sutter & Pinney Drain and highest in the Blosser Drain. Four tributaries had mean July water temperatures < 68 °F.

Analysis and Discussion

A variety of factors influence brown trout population dynamics in the Prairie River. Some of these factors involve physical modifications that have long-term effects on the aquatic ecosystem, whereas other factors are continually changing (e.g., discharge and water temperature). Dredging, channelization, and large woody structure removal create physical changes that affect fish habitat in the Prairie River watershed for years or even decades after the projects are completed. On most stream reaches, fish cover (e.g., logjams or undercut banks) is scarce. Stream banks in the dredged channels are steep and often are poorly vegetated. The sediment that erodes from the raw stream banks covers spawning gravel and reduces habitat heterogeneity in the stream bottom and thus production of macroinvertebrates. Sedimentation also increases turbidity, which can reduce brown trout foraging efficiency (Stuart-Smith et al. 2004). The physical changes caused by drain construction and maintenance activities affect fish indirectly by influencing water temperatures and discharge patterns within the river. The removal of trees along the stream bank reduces shading which, in turn, increases summer water temperatures. Dredging, channelization, and draining of wetlands alter the hydrology of the system, resulting in a flow regime characterized by rapid increases in discharge followed by equally rapid decreases in flow.

Discharge patterns strongly influence brown trout abundance in this system. Discharge has been measured at the United States Geological Survey gauge site on the Prairie River near M-66 since October 1962. Brown trout catch rates in the Prairie River were high in 2000 and 2011. Mean monthly flows for June and July were average (within 25% of mean monthly flows for the period of record) in 2000 and above average in 2011. On the other hand, brown trout catch rates were low in 2012 when monthly mean flows for June and July were substantially below the long-term averages. During June 2012, the monthly mean flow was only 13.5 cfs, whereas the long-term average for June was 65 cfs. Daily mean discharge dropped below 5 cfs during July 11-18, 2012 before rain events caused flows to rebound somewhat in late July.

Droughts, such as the one experienced in 2012, affect fish populations in multiple ways. As water levels decline, the quantity of available habitat decreases. Lobón-Cerviá (2007) found that mean stream depth was an important determinant of the carrying capacity for riverine fish populations, and Stoneman and Jones (2000) demonstrated that the quantity of pool habitat influences trout biomass in southern Ontario streams.

Summer water temperatures also tend to be higher under drought conditions (Elliott 2000), which has important consequences for the brown trout fishery in the Prairie River. Brown trout growth occurs when water temperatures are between 39 °F and 67 °F (Elliott 1993), and McMichael and Kaya (1991) observed that brown trout catch per angler hour decreased when water temperatures exceeded 66 °F. Similarly, brown trout in Jocassee Reservoir exhibited a preference for water ≤ 68 °F (Barwick et al. 2004) and data collected during the Michigan Rivers Inventory indicated that streams with mean July temperatures (MJTs) > 68 °F rarely supported sizeable trout populations (Andy Nuhfer, MDNR – Fisheries Division, personal communication). Unusually hot weather, coupled with the drought conditions, resulted in abnormally high water temperatures in the Prairie River in 2012. Every site on the mainstem except the Bowers Road site had MJTs > 68 °F. The MJT at the Prairie River Road crossing was 8 °F higher in 2012 than in 1997 (when the mean monthly flow for July was close to the long-term average).

The ultimate lethal temperature for brown trout is 85.8 °F (Elliott 1981). At this temperature, brown trout will perish in approximately 10 minutes. In 2012, this threshold was exceeded on multiple occasions in the Prairie River at Prairie River Road and in four tributary streams (sites 3, 10, 13, and 18; Table 6). The incipient lethal temperature for brown trout is 76.5 °F (Elliott 1981; Elliott 2000). This is the maximum temperature brown trout can tolerate for a 7 day period. During July 1-7, 2012, mean water temperatures exceeded this threshold in the Blosser and County No. 59 drains and in the Prairie River at the Prairie River Road and McKale Road crossings (Table 6). Mean water temperatures for this period were slightly below the incipient lethal temperature in the Prairie River at St. Joseph Road and in the Stewart Lake Drain.

Some of the tributaries to the Prairie River receive substantial groundwater inputs. These tributaries reduce water temperatures in the mainstem and provide coldwater refugia for brown trout. The Sutter & Pinney, Lanes, County No. 25, and Weaver drains had mean July temperatures < 68 °F and maintained suitable temperatures for trout through the hottest week of the summer.

In summary, 2012 was a difficult year for brown trout in the Prairie River as evidenced by the drastic decline in brown trout abundance at Orland Road from 2011 to 2012. The low water levels and elevated water temperatures in 2012 were the result of scant precipitation, above average air temperatures, and surface water withdrawals for irrigation. Low water levels in 2012 also exacerbated conflicts between irrigators, anglers, and riparian landowners.

Some of the thermal classifications in the WWAT appear to be incorrect. Mean July water temperature and the species composition of the fish community are used to assign stream segments to a particular thermal class. Because 2012 was an abnormally hot, dry year the MJTs measured in 2012 were higher than would be expected in a "normal" year. Thus, it would not be appropriate to move a stream segment from its current thermal class to a warmer thermal class based on the 2012 data. Conversely, it would be appropriate to move a stream from its current thermal class to a colder thermal class based on the 2012 data. For example, the Sutter & Pinney Drain currently is classified as a warm stream, but its MJT in 2012 indicates that it should be classified as a cold stream. Fish community data are lacking for the Sutter & Pinney Drain and most tributaries to the Prairie River. Due to their small size and lack of public access, fishing pressure on these streams is minimal. From a fisheries standpoint, the primary functions of these streams are to provide cold water for the mainstem and to serve as short-term coldwater refuges for trout and other fish that spend most of their lives in the Prairie River. Thus, thermal classifications for these streams should be based primarily on MJTs.

The Branch County portion of the Prairie River currently is classified as a warm stream. The 2012 temperature logger data for sites from Parham Road to St. Joseph Road supports this classification. However, warm streams do not support naturally reproducing brown trout populations. The 2011 electrofishing survey at Orland Road and the 2012 electrofishing survey at Bowers Road revealed fish communities dominated by coldwater and transitional fish species (Tables 4-5), which is indicative of a cold-transitional stream (Lyons et al. 2009). Furthermore, the MJT recorded at Bowers Road in 2012 and the MJT recorded at Orland Road in 1997 were within the expected range for a cold transitional stream (Table 1). In 2011, the MJT at Orland Road (67.9 ° F) was slightly above the range for cold transitional streams; however, the mean air temperature for July also was above average (Jeruzal 2011). Based on all of the available evidence, the portion of the Prairie River upstream of the Bronson No. 12 Drain confluence should be classified as a cold transitional stream and the stream segment between the Bronson No. 12 Drain confluence and St. Joseph Road should be reclassified as a warm transitional stream.

This study has focused on the brown trout because it is the species that is most sensitive to elevated water temperatures in the Prairie River. However, all fish species are negatively affected by reductions in pool habitat and removal of large woody structure. Another group of organisms that could be particularly affected by low flow conditions is freshwater mussels. Recent data on mussel abundance and distribution in the Prairie River are not available. According to the Michigan Natural Features Inventory Database (http://mnfi.anr.msu.edu/), three special concern species (elktoe, ellipse, and rainbow) were found in the lower reaches of the river in 1930. As mussels have limited mobility, they are subject to desiccation when water levels drop rapidly. Golladay et al. (2002) documented an 80% decline in mussel abundance in several Georgia rivers under drought conditions. Like the Prairie River, these streams were connected to aquifers that were heavily utilized for irrigation.

A creek chubsucker was captured in the Prairie River in 1977, but no creek chubsuckers were observed during the 2011 and 2012 electrofishing surveys. This species typically is found in clear headwater streams and is highly sensitive to siltation and pollution (Carman 2001). Additional work is needed to determine the status of this state-endangered species in the Prairie River watershed.

Management Recommendations

The Prairie River has supported a self-sustaining brown trout fishery since 1992. As the only trout stream in Branch County, it is a unique resource that should be protected. Habitat degradation is the main factor limiting trout production in this system. Eight management goals have been developed for the Prairie River. Goal 1: Support MDEQ's and Michigan Department of Agriculture and Rural Development's (MDARD) efforts to identify unregistered water withdrawals. Goal 2: Change the thermal classifications for some stream segments within the Prairie River watershed based on mean July water temperatures and fish community data. Goal 3: Reduce rapid fluctuations in stream discharge. Goal 4: Reduce erosion and sedimentation. Goal 5: Increase fish cover within the Prairie River and tributary streams. Goal 6: Monitor the brown trout population to ascertain if it can recover from the drought of 2012. Goal 7: Collect additional information on the status and distribution of creek chubsuckers in the Prairie River watershed. Goal 8: Collect additional information on the abundance and distribution of mussels in the Prairie River.

To accomplish Goal 1, Fisheries Division will work with MDEQ, MDARD, and other partners to identify unregistered water withdrawals within the watershed. MDEQ has scheduled an "on-the-ground" assessment of water withdrawals in 2013. Fisheries Division will continue to work with various partners to inform irrigators and other interested stakeholders of the ecological consequences of excessive water withdrawals.

The 2012 temperature logger and 2011-2012 fish community data revealed major discrepancies between the existing thermal classifications in the WWAT and the actual conditions in several stream segments within the Prairie River watershed. Reclassifications are recommended for the following stream segments (proposed thermal classifications listed): Prairie River upstream of the Bronson No. 12 Drain confluence = cold transitional, Prairie River between the Bronson No. 12 Drain confluence and St. Joseph Road = warm transitional, Lanes Drain = cold, Weaver Drain = cold transitional, County No. 25 Drain = cold transitional, and Sutter & Pinney Drain = cold. In 2013, temperature loggers will be deployed in roughly the same locations as in 2012. This data will be used to further evaluate and refine the thermal classifications for stream segments within the watershed.

A variety of methods will be used to accomplish Goal 3. One approach for reducing stream flashiness is to slow the movement of runoff into the river through restoration of wetlands. The Friends of the St. Joe River (Friends) received funding from the United States Environmental Protection Agency to conduct a functional assessment of all historic and existing wetlands within the St. Joseph River watershed. That assessment is nearly completed. The Friends and partner organizations have used this tool to identify high quality wetlands for protection (e.g., conservation easements) and potential sites for wetland restoration. This information will be relayed to local units of government so that they can incorporate wetland conservation and restoration planning into their zoning and ordinances. The wetlands tool also has been used to identify and invite landowners to wetland protection and restoration workshops, and some wetland restoration projects already are underway as a result of these efforts. Another method to reduce stream flashiness is to restore connectivity between the river and its floodplain. This could be accomplished by cutting berms or creating a floodplain within the banks (i.e., a two-stage ditch). As much of the Prairie River system consists of designated drains, such projects would require extensive collaboration with the Branch County and St. Joseph County drain commissioners. The measures outlined for Goals 1 and 2 also will facilitate attainment of Goal 3.

Throughout much of the watershed, stream banks are steep and sparsely vegetated. Thus, sediment is a major pollutant in this system. The Branch County Conservation District (BCCD) has received a Section 319 (Nonpoint Source Management Program) grant to write a watershed management plan for the Prairie River. One component of the planning process is to identify sources of sedimentation and develop strategies to reduce sediment inputs to the river. Fisheries Division will work with BCCD, MDEQ, riparian landowners, and the drain commissioners to implement soil erosion and sediment control practices throughout the watershed. Goals 3-4 are inter-related, and the measures discussed for Goal 3 also will facilitate progress toward accomplishing Goal 4.

Large woody structure has been cleared from many stream reaches to facilitate rapid downstream movement of water. The removal of large woody structure directly affects trout by reducing habitat complexity and abundance of holding cover and affects trout indirectly by reducing abundance of macroinvertebrates. Fisheries Division will work with the county drain commissioners to develop options for retaining fish cover (i.e., Goal 5) while meeting the needs of the adjacent landowners.

To accomplish Goals 6 and 7, electrofishing surveys will be conducted at the Orland Road and Bowers Road sampling stations during the summer of 2013. These surveys will follow the same sampling protocols as the 2011 Status and Trends survey at Orland Road. Brown trout stocking is not recommended at this time, but may be prescribed if catch rates do not improve in 2013.

Nineteen mussel species are listed as threatened or endangered in Michigan, and several of these species have been found in Branch and St. Joseph counties. To accomplish Goal 8, Fisheries Division will request assistance from mussel experts from universities, private consulting firms, or other organizations. Mussel surveys will be conducted at various locations along the mainstem Prairie River, and Fisheries Division personnel will assist with these surveys as necessary.

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Table 1.–Mean July water temperatures and mean daily maximum water temperatures in July at various locations on the Prairie River, 1997-2003. Water temperatures were recorded with Onset StowAway® loggers. Water temperatures were recorded every hour in 2003 and once every 2 hours during 1997-2002.

Site	Year	Mean July temperature (°F)	Mean daily maximum temperature (°F)
Orland Road	1997	65.7	69.2
Prairie River Road	1997	66.4	71.0
Burr Oak Road	1998	68.9	71.7
Burr Oak Road	2002	69.5	72.4
St. Joseph Road	2003	69.3	72.6

Table 2.–Brown trout stocking in the Prairie River, 1979-1992. Unless otherwise indicated, all fish were stocked as yearlings.

Year	County	Site	Number	Average length (inches)
1979	St. Joseph	Middle Colon Road	2,100	6.24
1980	St. Joseph	McKale Road*	12,000	2.84
1982	St. Joseph	Middle Colon Road	1,800	4.68
		Needham Road	1,300	4.68
		McKale Road	2,200	4.68
1983	Branch	Bowers Road	800	6.36
		Snow Prairie Road	1,000	6.36
		Cranson Road	1,200	6.36
		Rierson Road	1,200	6.36
		Orland Road	1,000	6.40
		Bawden Road	1,200	6.40
	St. Joseph	Middle Colon Road	1,350	6.40
		Needham Road	1,000	6.40
		McKale Road	2,910	6.40
1984	Branch	Bowers Road	800	5.92
		Snow Prairie Road	1,000	5.84
		Cranson Road	1,200	5.84
		Rierson Road	1,200	5.92
		Orland Road	1,000	5.84
		Prairie River Road	1,000	5.84
	St. Joseph	Middle Colon Road	2,000	5.84
		Needham Road	1,500	5.84
		McKale Road	2,500	6.84
1985	Branch	Bowers Road	520	6.40
		Snow Prairie Road	680	6.28
		Cranson Road	1,010	7.44
		Rierson Road	1,010	6.40
		Orland Road	680	6.28
		Bawden Road	1,010	6.36
		Prairie River Road	810	6.36
	St. Joseph	Middle Colon Road	1,530	6.36
		Needham Road	1,030	6.36
		McKale Road	1,530	6.36
1986	Branch	Bowers Road	580	6.48
		Snow Prairie Road	850	6.96
		Cranson Road	1,050	6.96
		Rierson Road	1,050	6.48
		Orland Road	850	6.96

Table 2.–Continued.

Year	County	Site	Number	Average length (inches)
1986	Branch	Bawden Road	1,050	6.96
		Prairie River Road	850	6.96
	St. Joseph	Middle Colon Road	1,500	5.68
		Needham Road	1,000	5.68
		McKale Road	1,500	5.68
1987	Branch	Bowers Road	620	5.92
		Snow Prairie Road	880	5.72
		Cranson Road	1,080	5.72
		Rierson Road	1,080	5.92
		Orland Road	880	5.72
		Bawden Road	1,080	5.72
		Prairie River Road	880	5.72
	St. Joseph	Middle Colon Road	1,700	6.44
		Needham Road	1,200	6.44
		McKale Road	1,700	6.44
1988	Branch	Bowers Road	800	5.56
		Snow Prairie Road	1,000	5.56
		Cranson Road	1,200	5.56
		Rierson Road	1,200	5.56
		Orland Road	1,000	5.56
		Bawden Road	1,200	5.56
		Prairie River Road	1,000	5.56
	St. Joseph	Middle Colon Road	2,030	5.36
		Needham Road	1,530	5.36
		McKale Road	2,030	5.36
1989	Branch	Bowers Road	800	5.92
		Snow Prairie Road	1,000	5.92
		Cranson Road	1,200	5.92
		Rierson Road	1,200	5.92
		Orland Road	1,000	5.92
		Bawden Road	1,200	5.92
		Prairie River Road	1,000	5.92
	St. Joseph	Middle Colon Road	2,000	6.36
		Needham Road	1,500	6.36
		McKale Road	2,000	6.36
1990	Branch	Bowers Road	800	5.08
		Snow Prairie Road	1,000	5.32
		Cranson Road	1,200	5.32
		Rierson Road	1,200	5.08

Table 2.–Continued.

Year	County	Site	Number	Average length (inches)
1990	Branch	Orland Road	1,000	5.32
		Bawden Road	1,200	5.32
		Prairie River Road	1,000	5.32
	St. Joseph	Middle Colon Road	2,000	5.32
		Needham Road	1,500	5.32
		McKale Road	2,000	5.32
1991	Branch	Bowers Road	783	5.92
		Snow Prairie Road	981	5.92
		Cranson Road	1,179	5.92
		Rierson Road	1,179	5.92
		Orland Road	990	5.92
		Bawden Road	1,190	5.92
		Prairie River Road	990	5.92
	St. Joseph	Middle Colon Road	2,075	5.84
		Needham Road	1,554	5.84
		McKale Road	2,076	5.84
1992	Branch	Cranson Road	1,189	6.08
		Rierson Road	1,190	6.08
		Orland Road	989	6.08
		Prairie River Road	989	6.08
	St. Joseph	Middle Colon Road	1,960	6.08
		Needham Road	1,460	6.08
		McKale Road	1,960	6.08

* Fish stocked as spring fingerlings

Table 3.–Temperature logger deployment sites in the Prairie River watershed, March-December 2012.

Site #	Stream	Nearest road crossing	Latitude	Longitude
1	Kinderhook No. 2 Drain	Southern Road	41.78185	-85.04713
2	Prairie River	Walker Road	41.78982	-85.05432
3	County No. 59 Drain	Block Road	41.79531	-85.08363
4	Lanes Drain	Booth Road	41.78934	-85.10760
5	Weaver Drain	Rubley Road	41.80086	-85.11448
6	Prairie River	Bowers Road	41.80065	-85.11459
7	Prairie River	Parham Road	41.83259	-85.16540
8	County No. 25 Drain	Cemetery Road (adjacent)	41.83767	-85.18483
9	Bethel & Bronson No. 4 & 1 Drain	Kosmerick Road	41.84014	-85.19125
10	Bronson No. 12 Drain	Bawden Road	41.84206	-85.21640
11	Prairie River	Prairie River Road	41.82777	-85.23374
12	Sutter & Pinney Drain	Prairie River Road	41.82412	-85.23357
13	Blosser Drain	Douglas Road	41.82559	-85.24585
14	County No. 10 Drain	Carpenter Road	41.83995	-85.25733
15	Prairie River	St. Joseph Road	41.84124	-85.29345
16	Burr Oak County Line Drain	Burr Oak Road	41.84111	-85.31136
17	Prairie River	Middle Colon Road	41.85466	-85.33116
18	Stewart Lake Drain	Cowles Road	41.86555	-85.35725
19	Prairie River	McKale Road	41.87097	-85.36916

Table 4.–Numbers, calculated weights, total lengths, and thermal classifications for fish species collected at the Orland Road electrofishing station on the Prairie River on July 20, 2011. Thermal classifications from Lyons et al. (2009).

Species	Number	Percent by number	Weight (lb)	Percent by weight	Total length range (inches)	Thermal classification
Brown trout	228	46.2	23.5	74.2	2-22	Coldwater
Hornyhead chub	108	21.9	2.2	7.0	1-7	Warmwater
Blacknose dace	58	11.8	0.3	0.9	1-2	Transitional
Rainbow darter	49	9.9	0.2	0.5	1-2	Warmwater
Johnny darter	12	2.4	0.1	0.2	2-3	Transitional
Northern hog sucker	10	2.0	4.2	13.1	7-12	Transitional
Grass pickerel	9	1.8	0.3	0.9	2-9	Warmwater
White sucker	7	1.4	0.7	2.1	1-11	Transitional
Creek chub	4	0.8	0.2	0.6	2-7	Transitional
Central mudminnow	4	0.8	0.0	0.1	2-3	Transitional
American brook lamprey	3	0.6	0.0	0.1	5-5	Transitional
Green sunfish	1	0.2	0.0	0.1	3	Warmwater
Total	493		31.7			

Table 5.–Numbers and thermal classifications for fish species collected at the Bowers Road electrofishing station on the Prairie River on September 12, 2012. Thermal classifications from Lyons et al. (2009).

Species	Number	Percent by number	Thermal classification
Creek chub	496	43.3	Transitional
Rainbow darter	346	30.2	Warmwater
Johnny darter	123	10.7	Transitional
White sucker	90	7.9	Transitional
Brown trout	37	3.2	Coldwater
Blacknose dace	28	2.4	Transitional
Grass pickerel	10	0.9	Warmwater
Bluegill	5	0.4	Warmwater
Green sunfish	5	0.4	Warmwater
Yellow bullhead	2	0.2	Warmwater
Northern hog sucker	1	0.1	Transitional
Pirate perch	1	0.1	Warmwater
Central mudminnow	1	0.1	Transitional
Total	1,145		

Table 7.–Mean July water temperatures (MJTs), current thermal classifications in Michigan's Water Withdrawal Assessment Tool, and thermal classifications based on water temperature data collected within the Prairie River watershed in 2012. All temperatures are in degrees Fahrenheit. For 2012, streams were classified as cold if MJT was < 63.5 °F, cold transitional if MJT was between 63.5 °F and 67.1 °F, cool if MJT was between 67.1 °F and 69.8 °F, and warm if MJT was > 69.8 °F.

Site #	Stream	Nearest road crossing	Mean July water temperature	Current thermal classification	Thermal classification based on 2012 data
1	Kinderhook No. 2 Drain	Southern Road	69.8	Warm	Cool
2	Prairie River	Walker Road	68.8	Warm	Cool
3	County No. 59 Drain	Block Road	73.9	Warm	Warm
4	Lanes Drain	Booth Road	63.3	Warm	Cold
5	Weaver Drain	Rubley Road	66.2	Warm	Cold transitional
6	Prairie River	Bowers Road	66.8	Warm	Cold transitional
7	Prairie River	Parham Road	70.2	Warm	Warm
8	County No. 25 Drain	Cemetery Road (adjacent)	64.3	Warm	Cold transitional
9	Bethel & Bronson No. 4 & 1 Drain	Kosmerick Road	68.5	Warm	Cool
10	Bronson No. 12 Drain	Bawden Road	72.2	Warm	Warm
11	Prairie River	Prairie River Road	74.3	Warm	Warm
12	Sutter & Pinney Drain	Prairie River Road	57.9	Warm	Cold
13	Blosser Drain	Douglas Road	75.5	Warm	Warm
14	County No. 10 Drain	Carpenter Road	72.3	Warm	Warm
15	Prairie River	St. Joseph Road	74.1	Cool	Warm
16	Burr Oak County Line Drain*	Burr Oak Road	---	Cool	---
17	Prairie River*	Middle Colon Road	---	Cool	---
18	Stewart Lake Drain	Cowles Road	72.6	Cool	Warm
19	Prairie River	McKale Road	74.4	Cool	Warm

* Temperature loggers were stolen or washed downstream

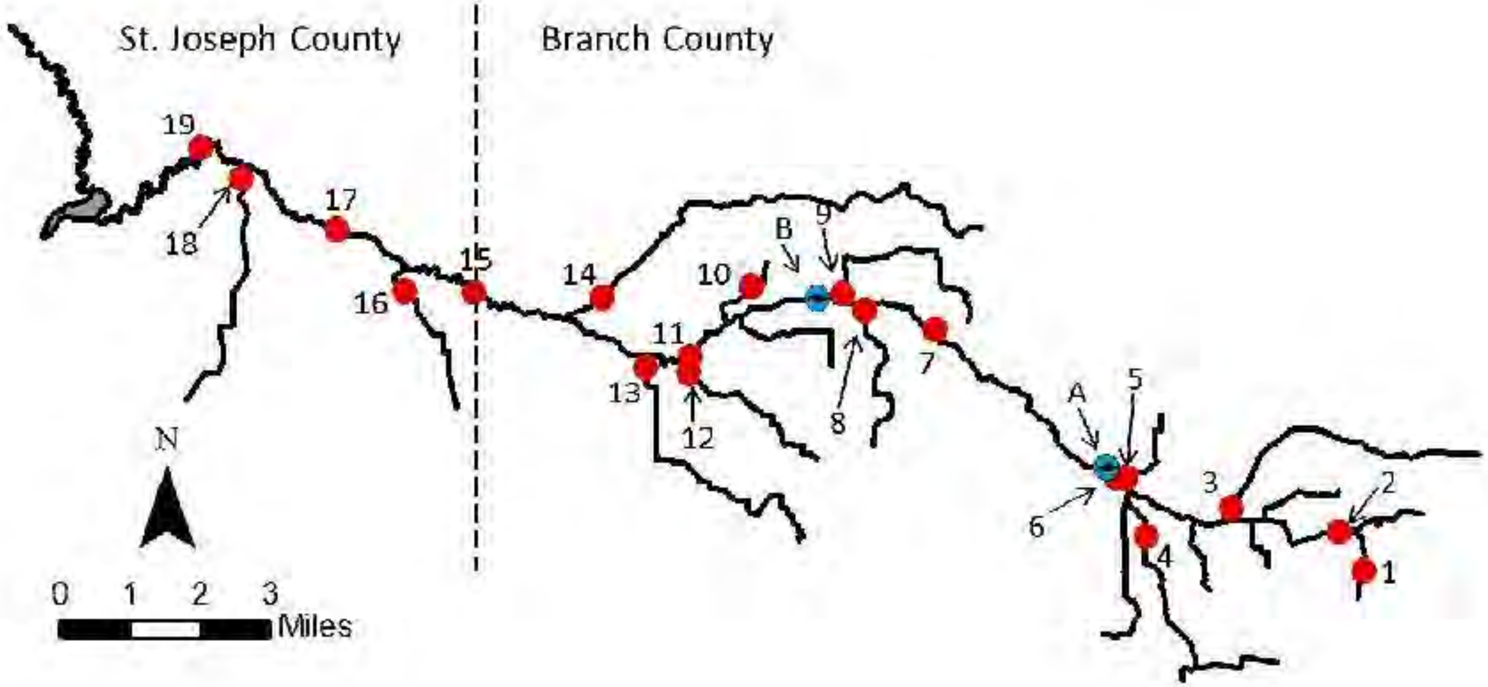


Figure 1.–Sampling locations in the Prairie River watershed. Red dots indicate sites where temperature loggers were deployed during March-December, 2012. The blue dots (A = Orland Road and B = Bowers Road) indicate locations where electrofishing was conducted during 2012. (See Table 3 for descriptions of temperature logger deployment sites.)

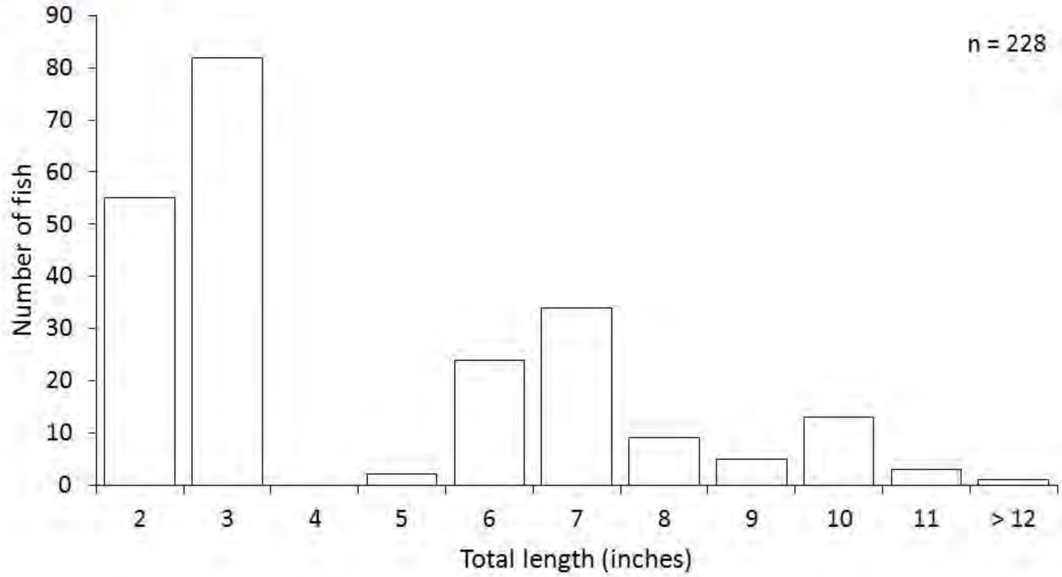


Figure 2.–Length frequency distribution for brown trout captured at the Orland Road sampling station on the Prairie River on July 20, 2011.

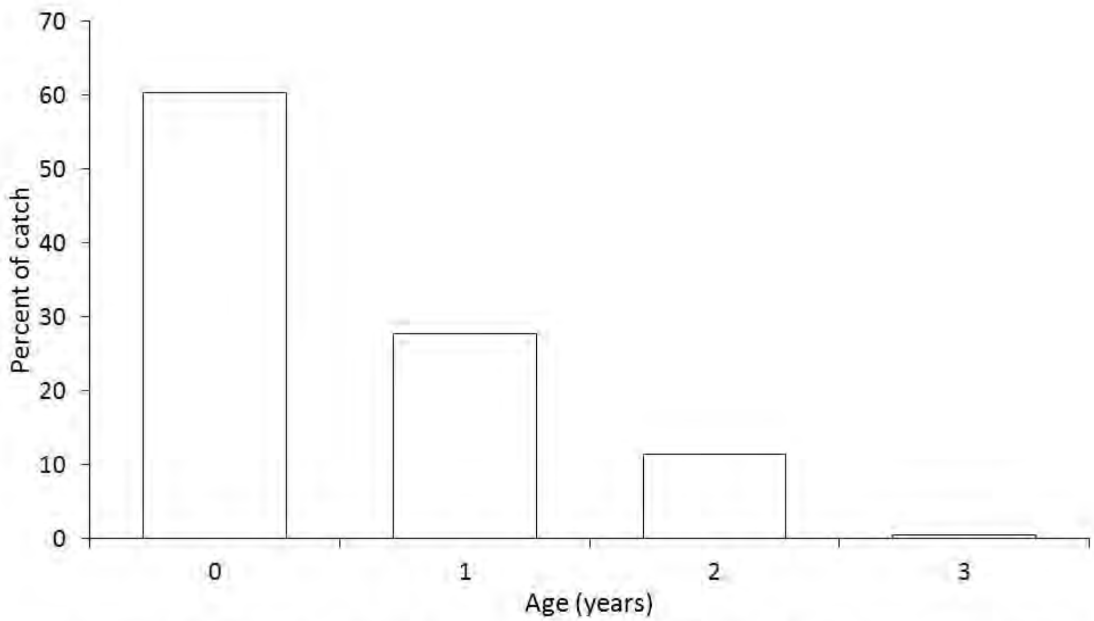


Figure 3.–Age frequency distribution for brown trout captured at the Orland Road sampling station on the Prairie River on July 20, 2011.

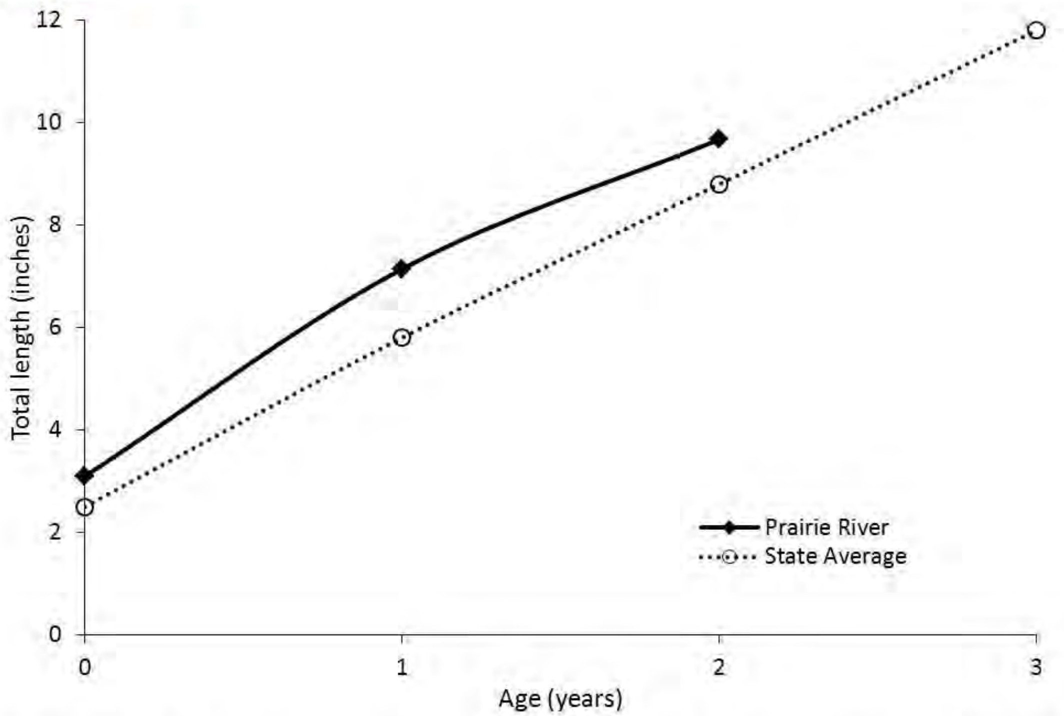


Figure 4.–Growth of brown trout in the Prairie River, as determined from scale samples collected at the Orland Road sampling station on July 20, 2011. State average lengths for June-July are from Schneider et al. (2000a).

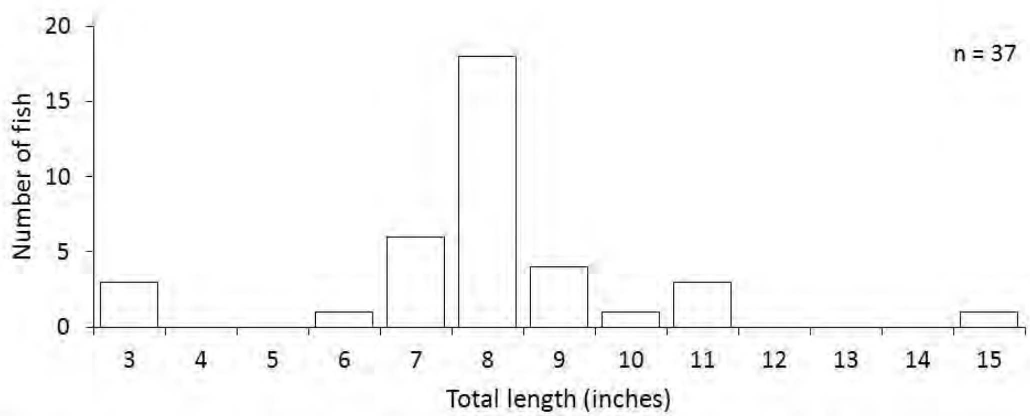


Figure 5.–Length frequency distribution for brown trout captured at the Bowers Road sampling station on the Prairie River on September 12, 2012.

2013 Mussel Survey Results

Freshwater mussels are among the most endangered groups of animals in the world. Little is known about the Prairie River mussel fauna; Michigan Natural Features Inventory staff has surveyed only one location (Neaman Road, in 2005), and prior to that the river hadn't been surveyed for mussels since approximately 1930. Assessing current mussel abundance and distribution is a goal in the DNR's *Prairie River 2011-2012 Survey Report* (Gunderman, 2013), and is pertinent to this watershed management plan because the Prairie River is subject to water withdrawals for row crop irrigation, which could adversely affect mussels and/or their host fish (mussel larvae are temporarily parasitic on certain species of fish). Dams in Centreville and on Lake Templene may also impact mussel populations by interfering with host fish migration.

In July 2013 staff from DEQ Water Resources Division, DNR Fish Division, DNR Wildlife Division, and the University of Michigan surveyed the mussel populations at four locations in the Prairie River in St. Joseph County (Figure X). The river was not surveyed upstream of State Route 66 because of very low flows in that reach in some years (Brian Gunderman, DNR, personal communication).

A total of 8 mussel species were found alive, including low numbers of the round pigtoe (*Pleurobema sintoxia*) and the ellipse (*Venustaconcha ellipsiformis*). Both are Michigan Species of Special Concern, and neither has been found in the river since the 1930s. Dead shells of a third Species of Special Concern, the elktoe (*Alasmidonta marginata*), were also found at the Findley Road site. Density and diversity of the mussel communities at the four sites surveyed in 2013 and MNFI's Neaman Road site were rather low (≤ 0.2 mussels/square meter, and 3 to 5 species; Table X). However, several year classes were found for the most numerous species, Wabash pigtoe (*Fusconaia flava*), indicating this species is reproducing.

<u>Reference cited</u>

Gunderman, B. 2013. *Prairie River 2011-2012 Survey Report*. Michigan Department of Natural Resources. 20 pp.

(Strange floater, *Strophitus undulatus*)

(Wabash pigtoe, *Fusconaia flava*)

(Pocketbook, *Lampsilis ventricosa*; top = female, bottom = male)

Figure X. Pictures from the 2013 mussel surveys.

Table X. Mussels found in recent Prairie River surveys; 2005 and 2013. Stations arranged from upstream to downstream.

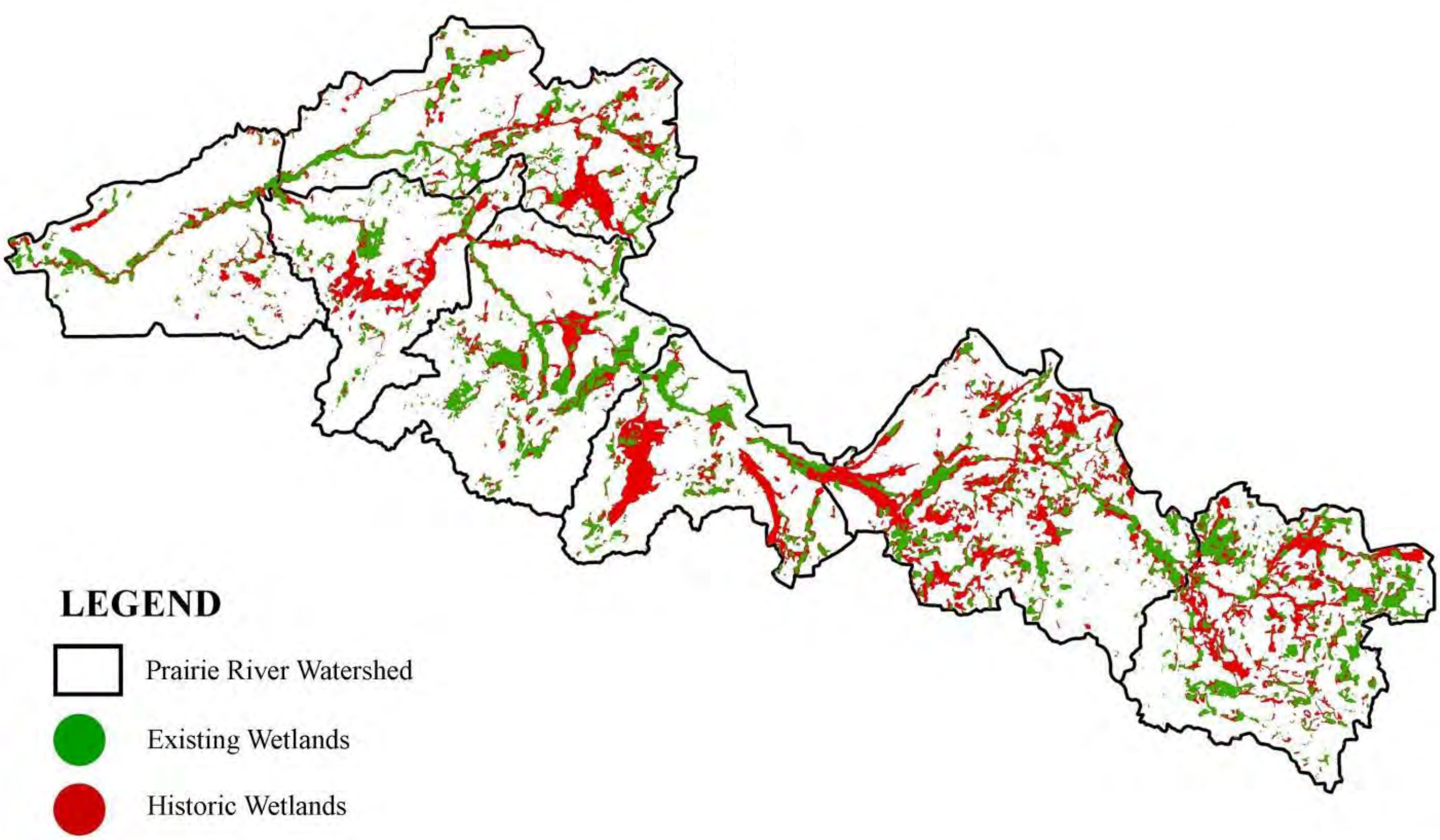
Species	Findley Road (2013) Downstream ~ 250 ft.	Truckenmiller Road (2013) Downstream ~ 200 ft.	Covered Bridge Road (2013) Downstream ~ 3,900 ft.	Strobel Road (2013) Upstream ~ 2,000 ft.	Neaman Road (2005)
Mucket (*Actinonaias ligamentina*)	3				16
Spike (*Elliptio dilatata*)				2	1
Wabash pigtoe (*Fusconaia flava*)		10	18	1	10
Pocketbook (*Lampsilis ventricosa*)		4	1		3
Fluted-shell (*Lasmigona costata*)		1			1
Round pigtoe (*Pleurobema sintoxia*)*	1				
Strange floater (*Strophitus undulatus*)		2	1	1	
Ellipse (*Venustaconcha ellipsiformis*)*	1		1		
Total species	3	4	5	3	5
Total individuals	5	17	21	4	31

(* Michigan Species of Special Concern)

Appendix 3

Prairie River Watershed

Wetland Status & Trends and other Landscape Level Wetland Functional Assessment Data



Prairie River Watershed

Status and Trends
Pre-settlement to
2005

Department of Environmental Quality
July, 2011
By: Jeremy Jones

DATA LIMITATIONS AND DISCLAIMER

National Wetlands Inventory (NWI)

- Wetland boundaries determined from Aerial Imagery
- Last updated in 2005
- Obvious limitations to Aerial Photo Interpretation:
  - Errors of Omission (forested and drier-end wetlands)
  - Errors of Comission (misinterpretation of aerials)

The 2005 NWI data was used in this analysis to report status and trends, as this is currently the best data source available. However, this data may not accurately reflect current conditions on the ground.

PRAIRIE RIVER WATERSHED
WETLAND RESOURCES STATUS AND TRENDS

- <u>PRESETTLEMENT WETLAND CONDITION</u>
- 23,548 total acres of wetland
- 1,168 Polygons
- Average Size – 20 Acres

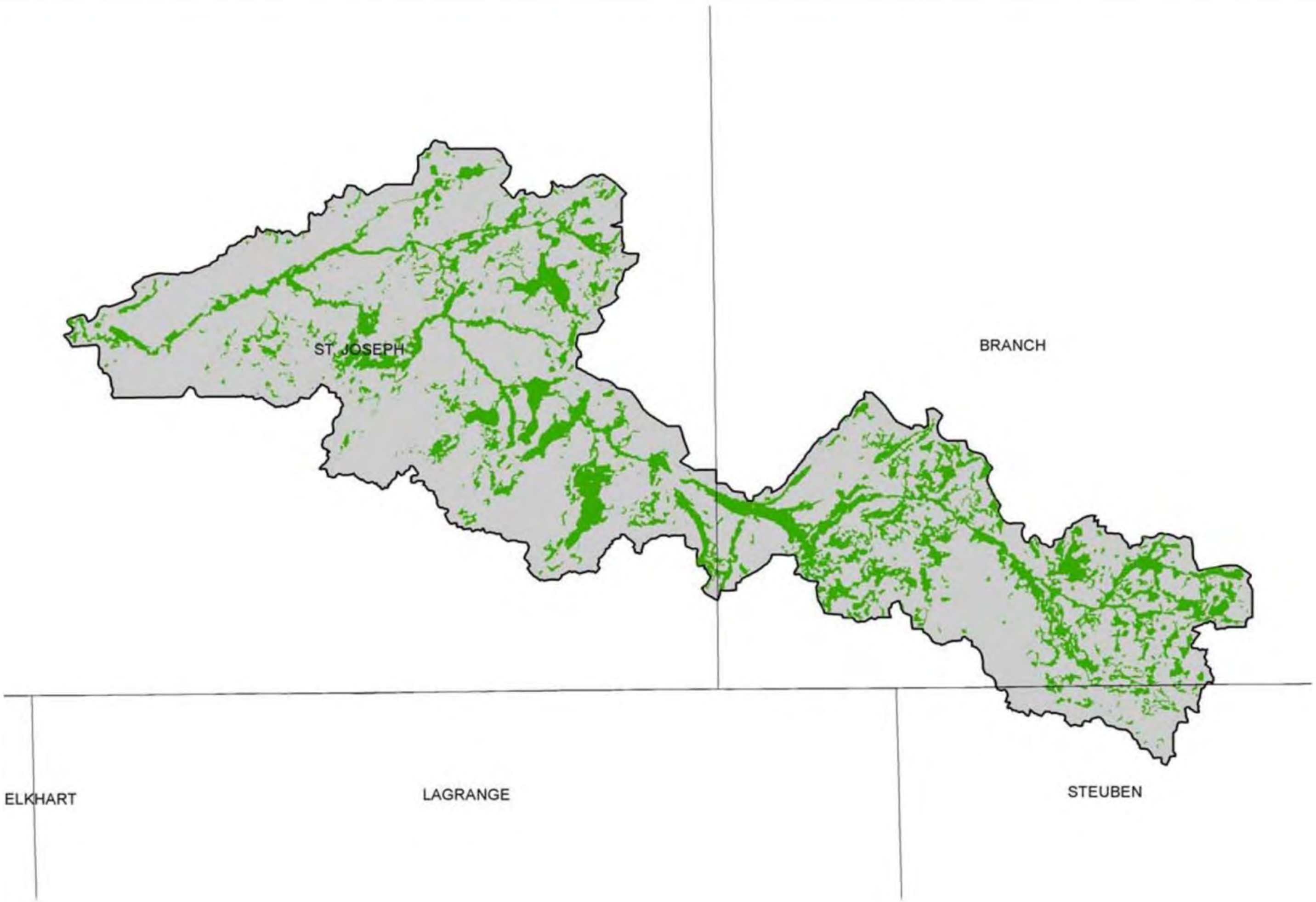
- <u>2005 WETLAND CONDITION</u>
- 12,347 total acres of wetland
- 2,312 Polygons
- Average Size – 5 Acres

52% OF ORIGINAL WETLAND ACREAGE REMAINS
48 % LOSS OF TOTAL WETLAND RESOURCE

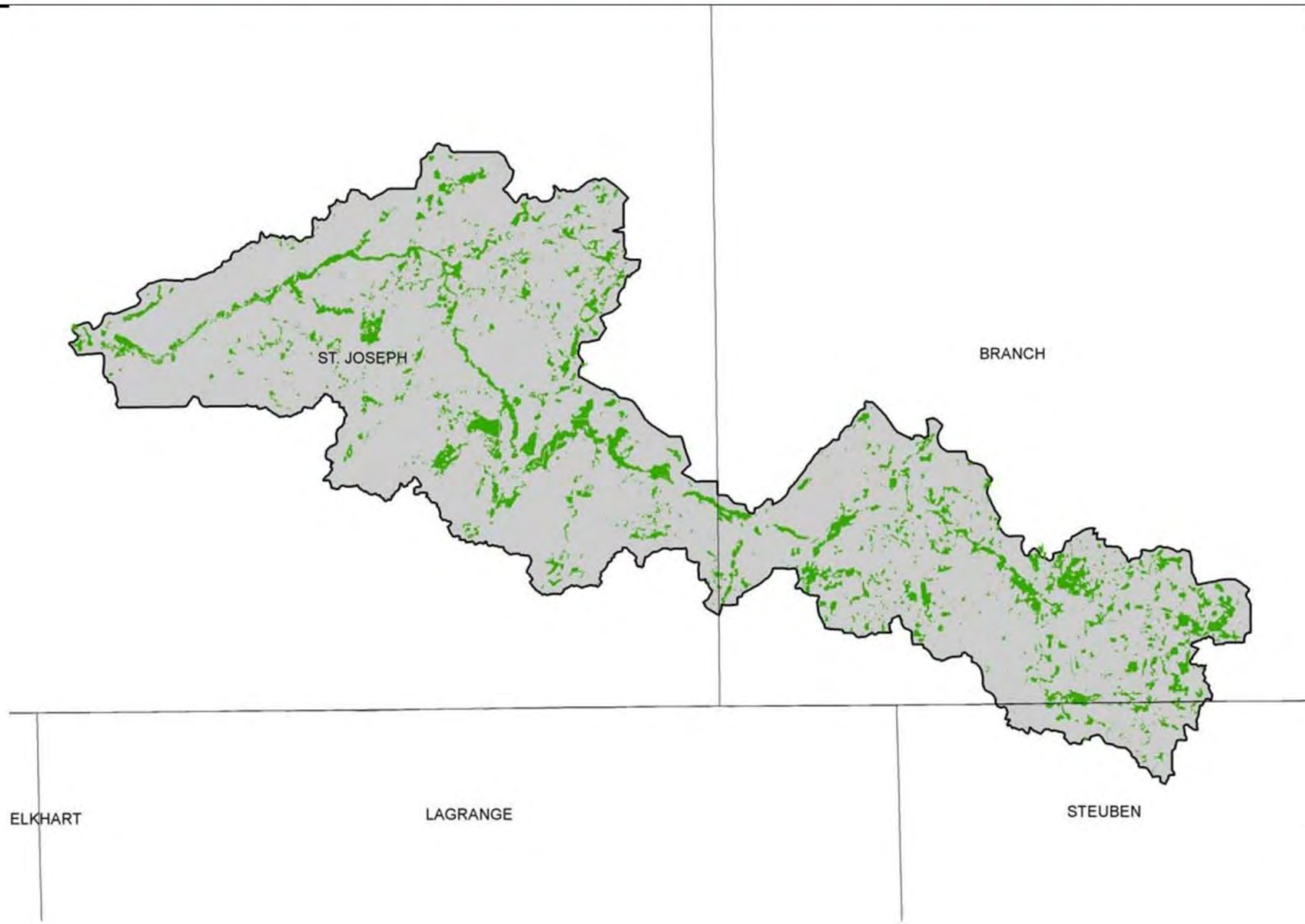
TOTAL ACREAGE LOSS OF:
11,201 ACRES

* These statistics exclude open water type wetlands.

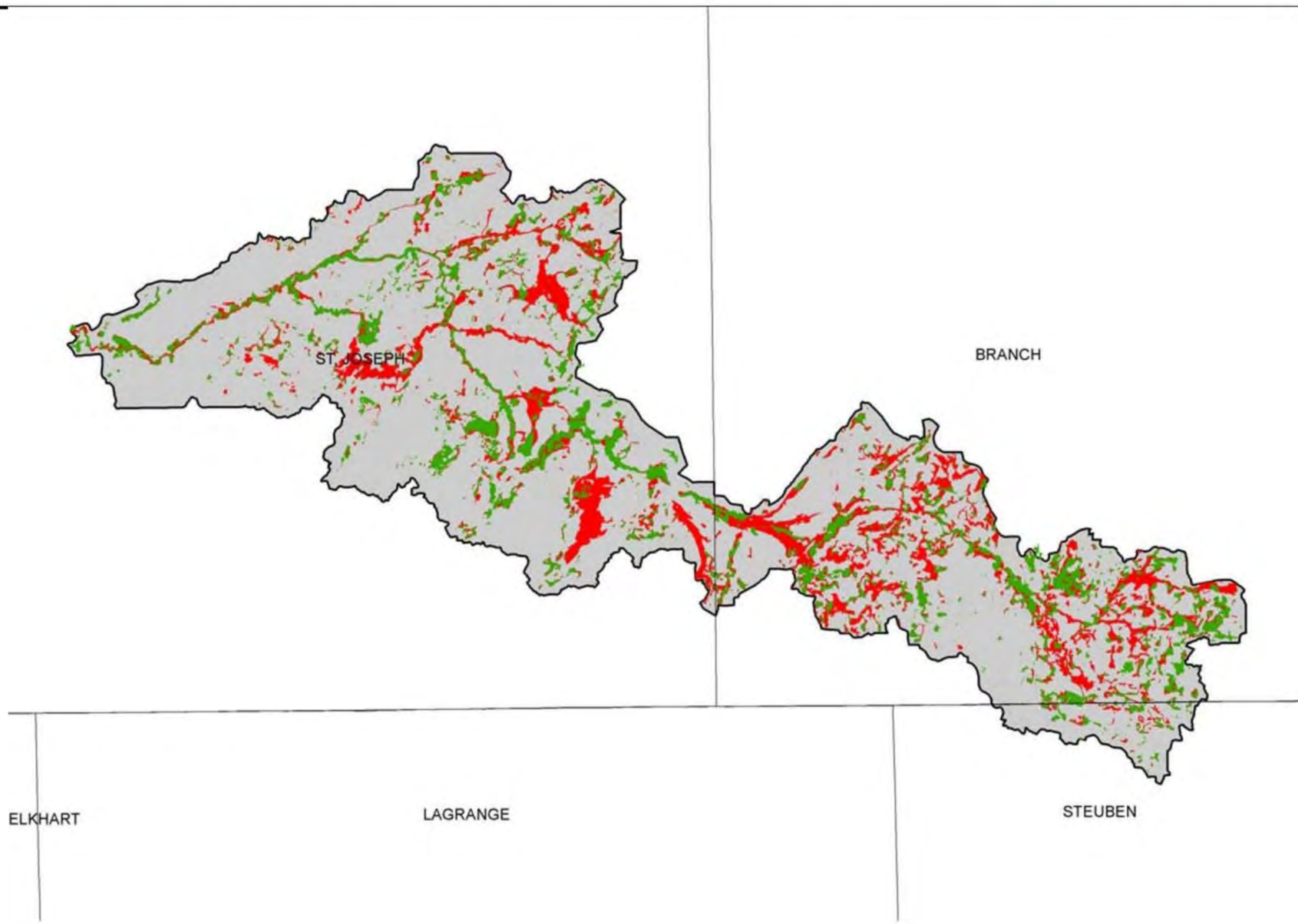
PRAIRIE RIVER WATERSHED: PRE-SETTLEMENT WETLANDS



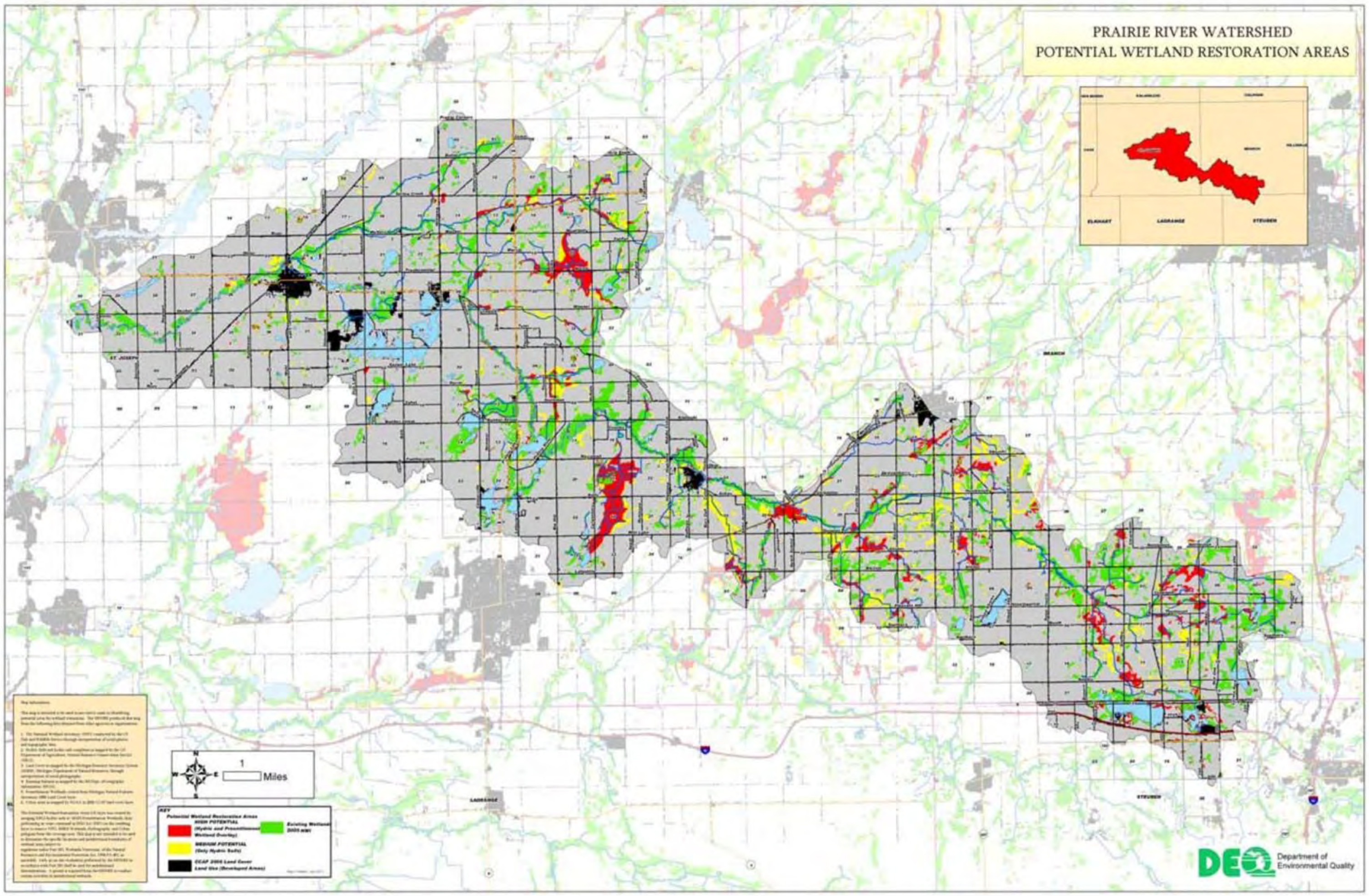
PRAIRIE RIVER WATERSHED: 2005 NWI WETLANDS



PRAIRIE RIVER WATERSHED: APPROXIMATE AREAS OF WETLAND LOSS



PRAIRIE RIVER WATERSHED



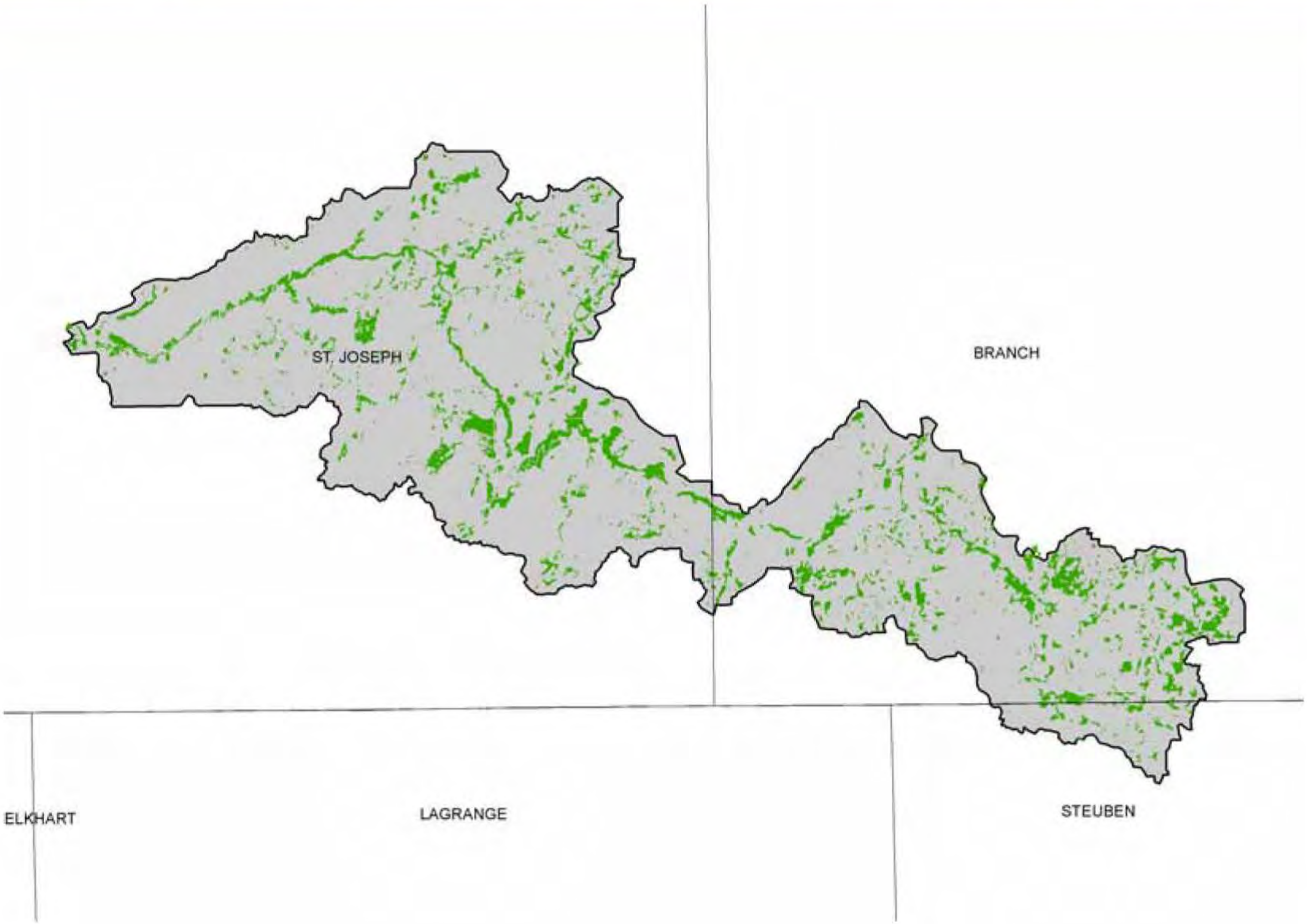
PRAIRIE RIVER WATERSHED

Landscape Level Wetland Functional Assessment

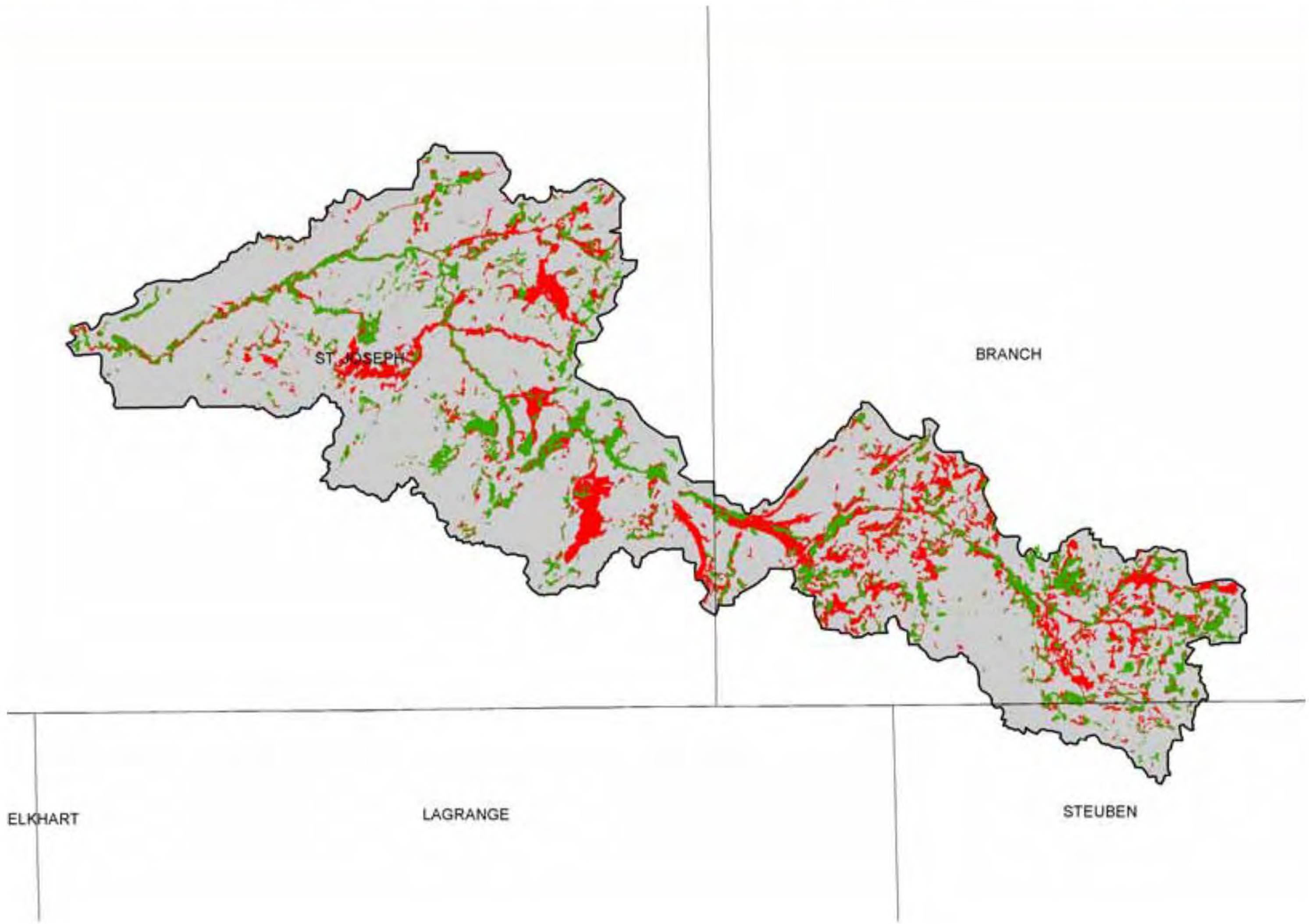
(Enhanced NWI)

Department of Environmental Quality

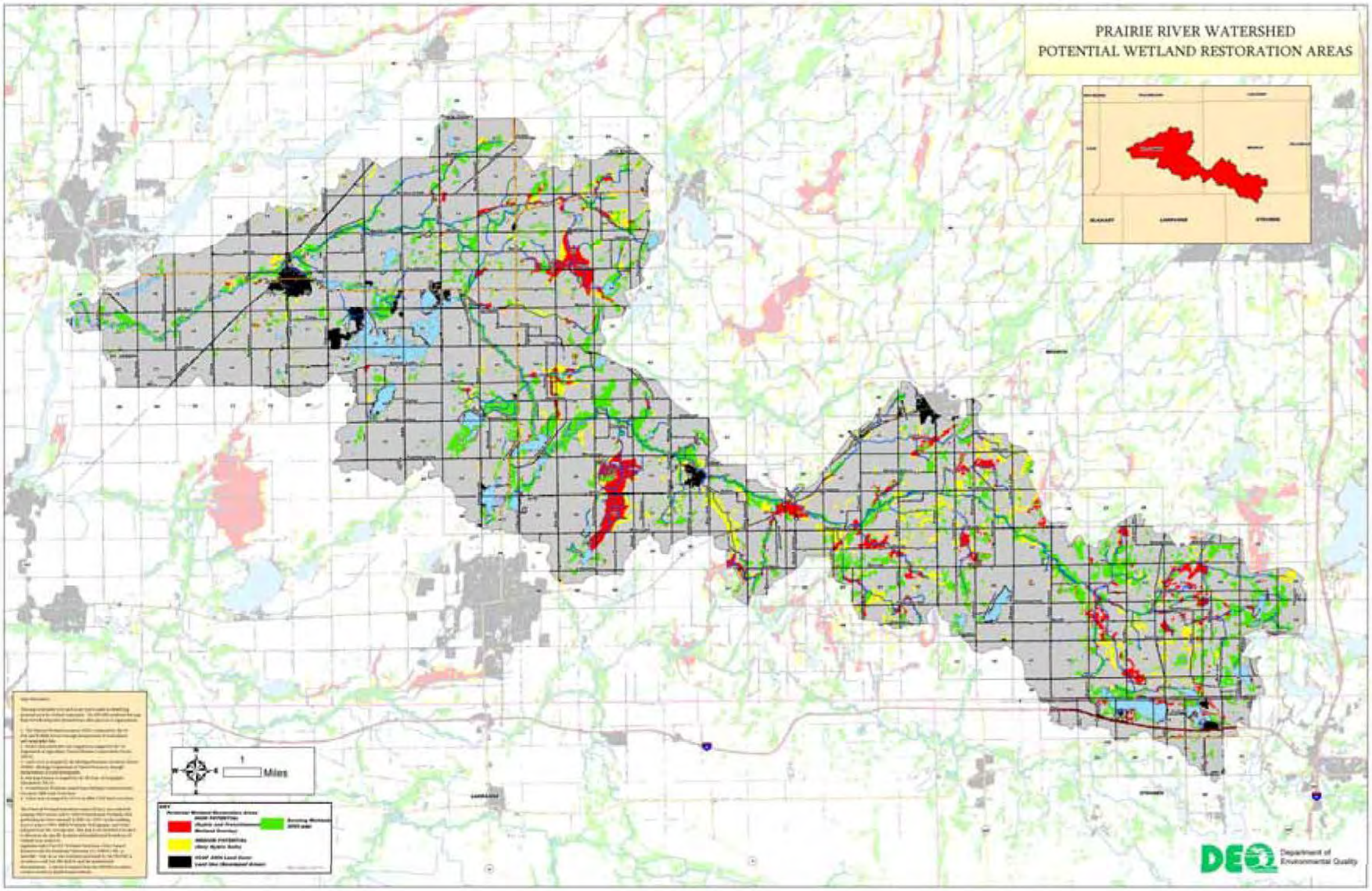
2005 WETLAND COVERAGE



APPROXIMATE WETLAND LOSS PRE-EUROPEAN SETTLEMENT TO 2005



PRAIRIE RIVER WATERSHED



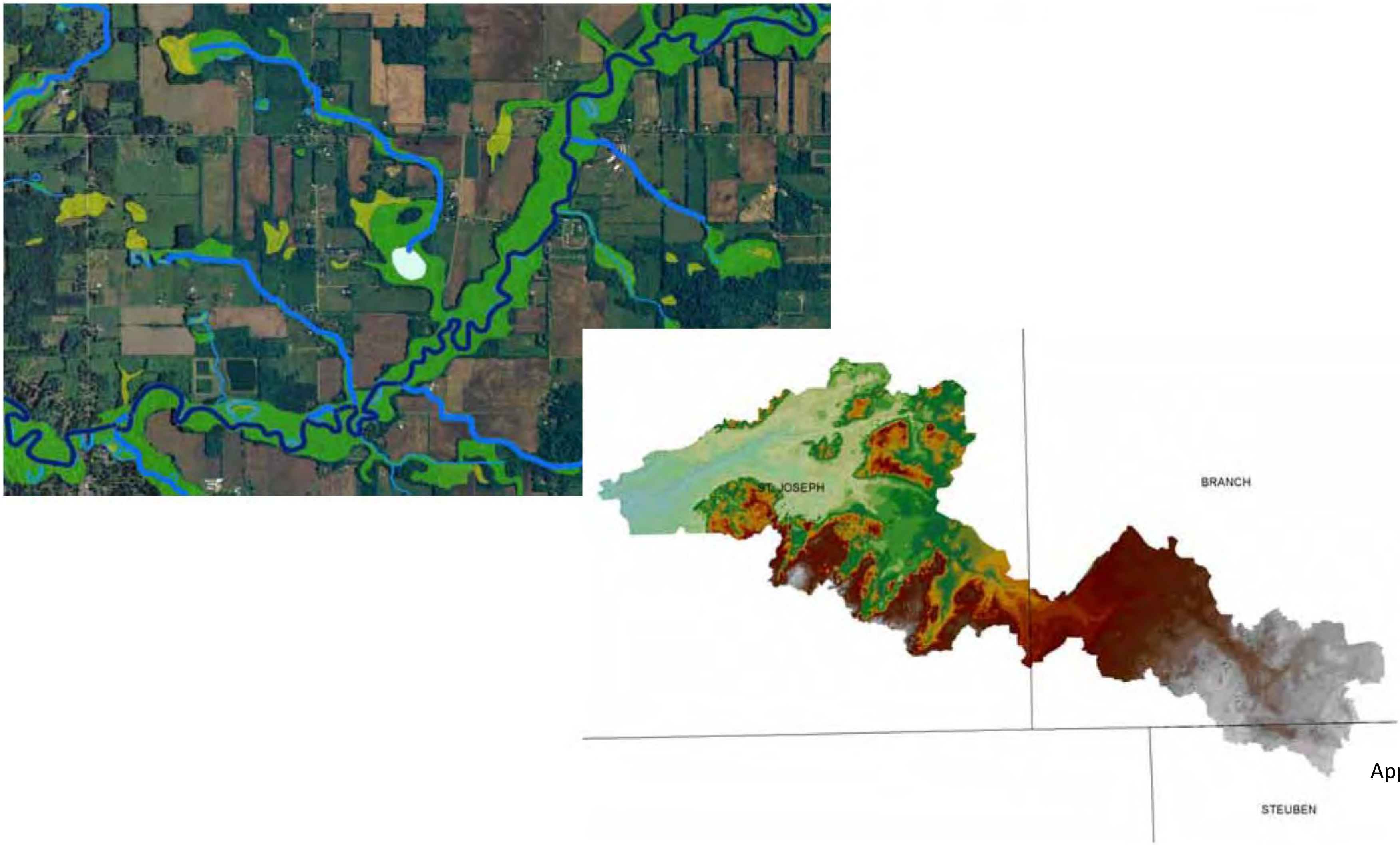
NWI TYPE COMPARISON

Table 1: Generalized NWI type comparison

Wetland Type	Pre-European Settlement Acres	2005 Acres of Wetlands	Net Acres Remaining
Palustrine Emergent	381	3,522*	100%
Palustrine Forested	11,411	6,791**	59%
Palustrine Shrub-Scrub	11,770***	1,624****	13%
Other Palustrine			
Ponds	0*****	357	100%
Total	23,562	12,294	52%

*Includes mixed emergent wetland classes and mixed communities where subclasses include Forested and Shrub-Scrub Areas
**Includes mixed forested wetland classes and mixed communities where subclasses include Emergent and Shrub-Scrub Areas
*** Includes mixed Shrub-Scrub/Emergent communities
****Includes mixed shrub-scrub wetland classes and mixed communities where subclasses include Emergent, Forested and Shrub-Scrub
***** Little acreage in ponds due to mapping differences between Pre-Settlement and Current wetland coverage's.

ENHANCING NWI FOR LANDSCAPE-LEVEL WETLAND FUNCTIONAL ASSESSMENT IN THE PRAIRIE RIVER WATERSHED



Using NWI for Functional Assessment

- Lack of hydro-geomorphic (HGM) information
  - No landscape position
  - No landform
  - No water flow direction
  - General pond classification
  - Features important for assessing many functions are lacking
- *Most of these features can be interpreted from the maps*

What information can we extract from NWI?

How many wetlands are there?

What is the size range of wetlands?

What is the average size of a given wetland type?

How many wetlands are in various size classes?

…With HGM information added?

How much and how many

- occur along rivers?
- along streams?
- in lake basins?
- are isolated?
- are sources of streams?
- have inflow but no outflow?
- are connected to other wetlands?
- What types of ponds are there and what is their extent?

Wetland Landscape Positions

- Landscape Position
  - Terrene
  - Lentic
  - Lotic River
  - Lotic Stream

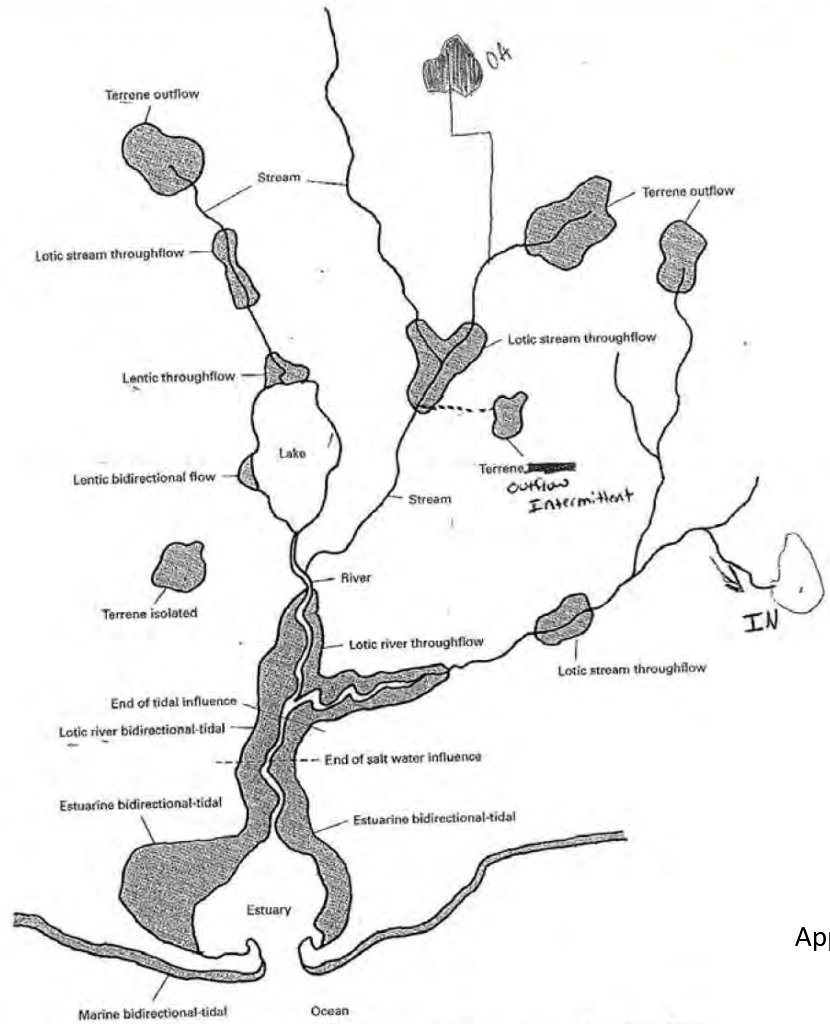


Figure 14.4. Typical wetland landscape positions and water flow paths in the eastern United States.

TERRENE

LENTIC

LOTIC

RIVER

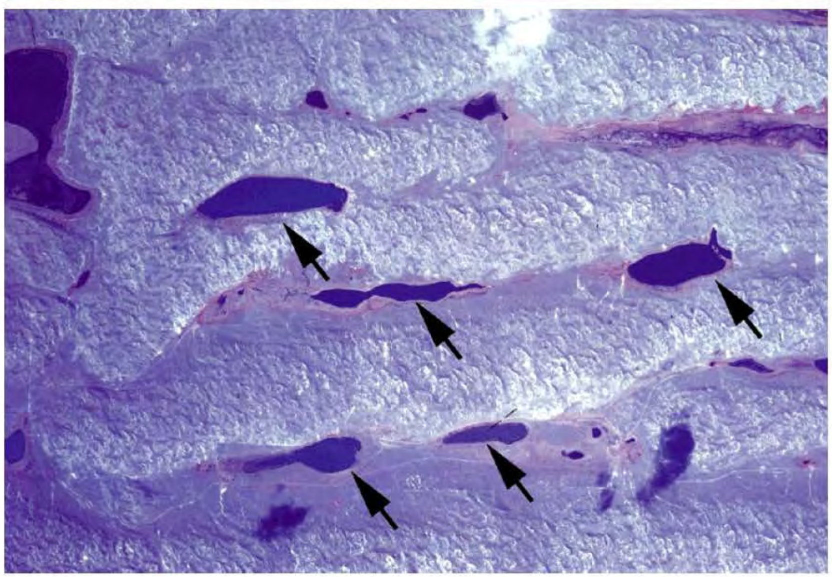
STREAM

Wetland Landform Types

- Fringe
- Basin
- Flat
- Floodplain
- Slope

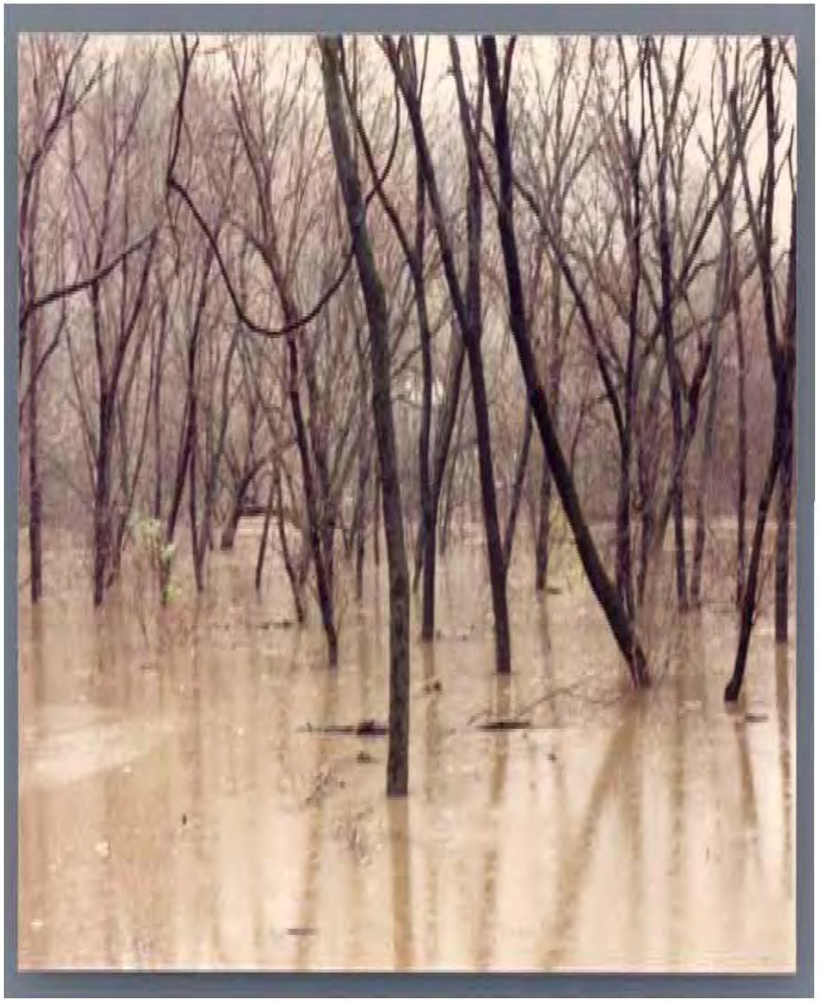
FRINGE

BASIN



FLAT

FLOODPLAIN

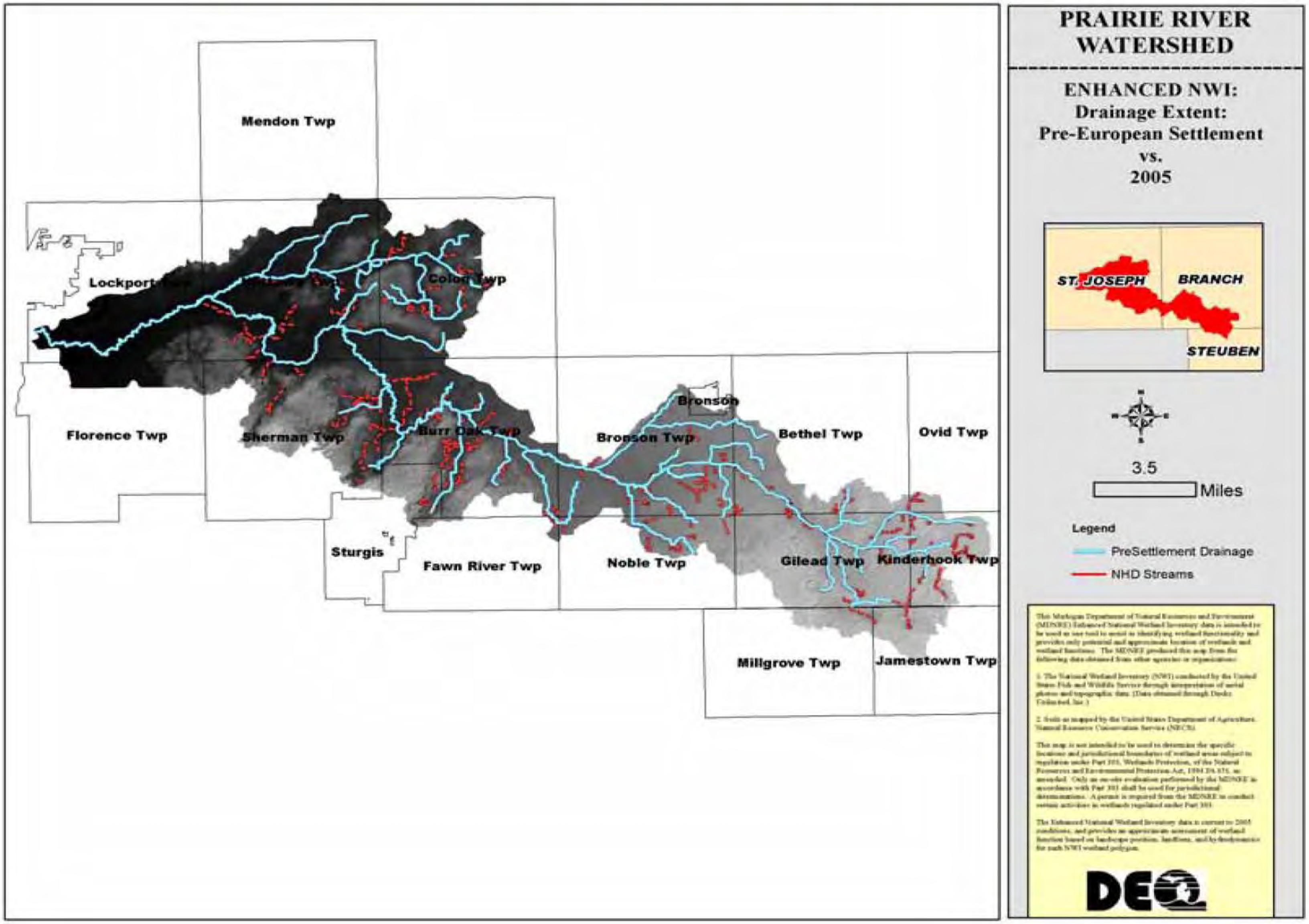


SLOPE

Evaluated Wetland Functions

- Flood Water Storage
- Streamflow Maintenance
- Nutrient Transformation
- Sediment and Other Particulate Retention
- Shoreline Stabilization
- Stream Shading
- Conservation of Rare and Imperiled Wetlands
- Ground Water Influence
- Fish Habitat
- Waterfowl/Waterbird Habitat
- Shorebird Habitat
- Interior Forest Bird Habitat
- Amphibian Habitat
- Carbon Sequestration
- Pathogen Retention

DRAINAGE EXTENT



DETAILED FUNCTIONAL COMPARISONS

Table 2: Detailed Functional Comparisons

Function	Potential Significance	Pre-European Settlement Acreage	2005 Acreage	% Change in Acreage
Flood Water Storage	High	13,371.30	6,851.91	-49
	Moderate	8,880.83	1,809.95	-80
	Total	22,252.13	8,661.86	-61
Streamflow Maintenance	High	14,223.33	6,764.73	-52
	Moderate	7,625.50	4,921.53	-35
	Total	21,848.83	11,686.26	-47
Nutrient Transformation	High	15,039.63	10,109.77	-33
	Moderate	8,523.53	1,962.03	-77
	Total	23,563.16	12,071.80	-49
Sediment and Retention of Other Particulates	High	14,504.00	6,234.10	-57
	Moderate	3,787.04	3,616.30	-5
	Total	18,291.04	9,850.40	-46
Shoreline Stabilization	High	13,107.73	5,076.46	-61
	Moderate	5,926.34	3,632.87	-39
	Total	19,034.07	8,709.33	-54
Fish Habitat	High	21,314.05	7,872.20	-63
	Moderate	1,047.23	3,856.90	268 *
	Total	22,361.28	11,729.10	-48
Stream Shading	High	6,178.30	1,036.60	-83
	Moderate	2,190.50	697.61	-68
	Total	8,368.80	1,734.21	-79

* Increases in the moderate & high category in the functions above can be attributed to the mapping differences in the two wetland layers and may not represent the current conditions on the ground.

DETAILED FUNCTIONAL COMPARISONS CONT…

Function	Potential Significance	Pre-European Settlement Acreage	2005 Acreage	% Change in Acreage
Waterfowl/Waterbird Habitat	High	8,900.93	4,683.80	-47
	Moderate	6,138.70	5,334.00	-13
	Total	15,039.63	10,017.80	-33
Shorebird Habitat	High	0.00	312.40	100 *
	Moderate	21,704.95	11,707.82	-46
	Total	21,704.95	12,020.22	-45
Interior Forest Bird Habitat	High	13,345.43	2,869.56	-78
	Moderate	9,836.50	5,546.00	-44
	Total	23,181.93	8,415.56	-64
Amphibian Habitat	High	7,839.12	4,096.90	-48
	Moderate	1,273.80	2,314.50	82 *
	Total	9,112.92	6,411.40	-30
Carbon Sequestration	High	1,024.68	2,183.50	113 *
	Moderate	11,901.86	3,982.10	-67
	Total	12,926.54	6,165.60	-52
Ground Water Influence	High	65.53	51.70	-21
	Moderate	21,749.34	13,026.40	-40
	Total	21,814.87	13,078.10	-40
Conservation of Rare and Imperiled Wetlands	High	Null	1,293.71	Null
	Moderate	Null	12,664.32	Null
	Total	Null	13,958.03	Null

* Increases in the moderate & high categories in the functions above can be attributed to the mapping differences in the two wetland layers and may not represent the current conditions on the ground.

FUNCTIONAL ACRES COMPARISON

Table 3: Functional Acers comparison

Function	Pre-European Settlement Functional Acres	2005 Functional Acres	Predicted % of Original Capacity Left	Predicted % Change in Functional Capacity
Flood Water Storage	35,623.43	15,513.77	44	-56
Streamflow Maintenance	36,072.16	18,450.99	51	-49
Nutrient Transformation	38,602.79	22,181.57	57	-43
Sediment and Other Particulate Retention	32,795.04	16,084.50	49	-51
Shoreline Stabilization	32,141.80	13,785.79	43	-57
Fish Habitat	43,675.33	19,601.30	45	-55
Stream Shading	14,547.10	2,770.81	19	-81
Waterfowl and Waterbird Habitat	23,940.56	14,701.60	61	-39
Shorebird Habitat	21,704.95	12,332.62	57	-43
Interior Forest Bird Habitat	36,527.36	11,285.12	31	-69
Amphibian Habitat	16,952.04	10,508.30	62	-38
Carbon Sequestration				
Ground Water Influence	21,880.40	13,129.80	60	-40
Conservation of Rare and Imperiled Wetlands	0	15,251.74	NA	NA

- Increases in the predicted percent change functional capacity in the functions above can be attributed to the mapping differences in the two wetland layers and may not represent the current conditions on the ground.

Frequency of Functions

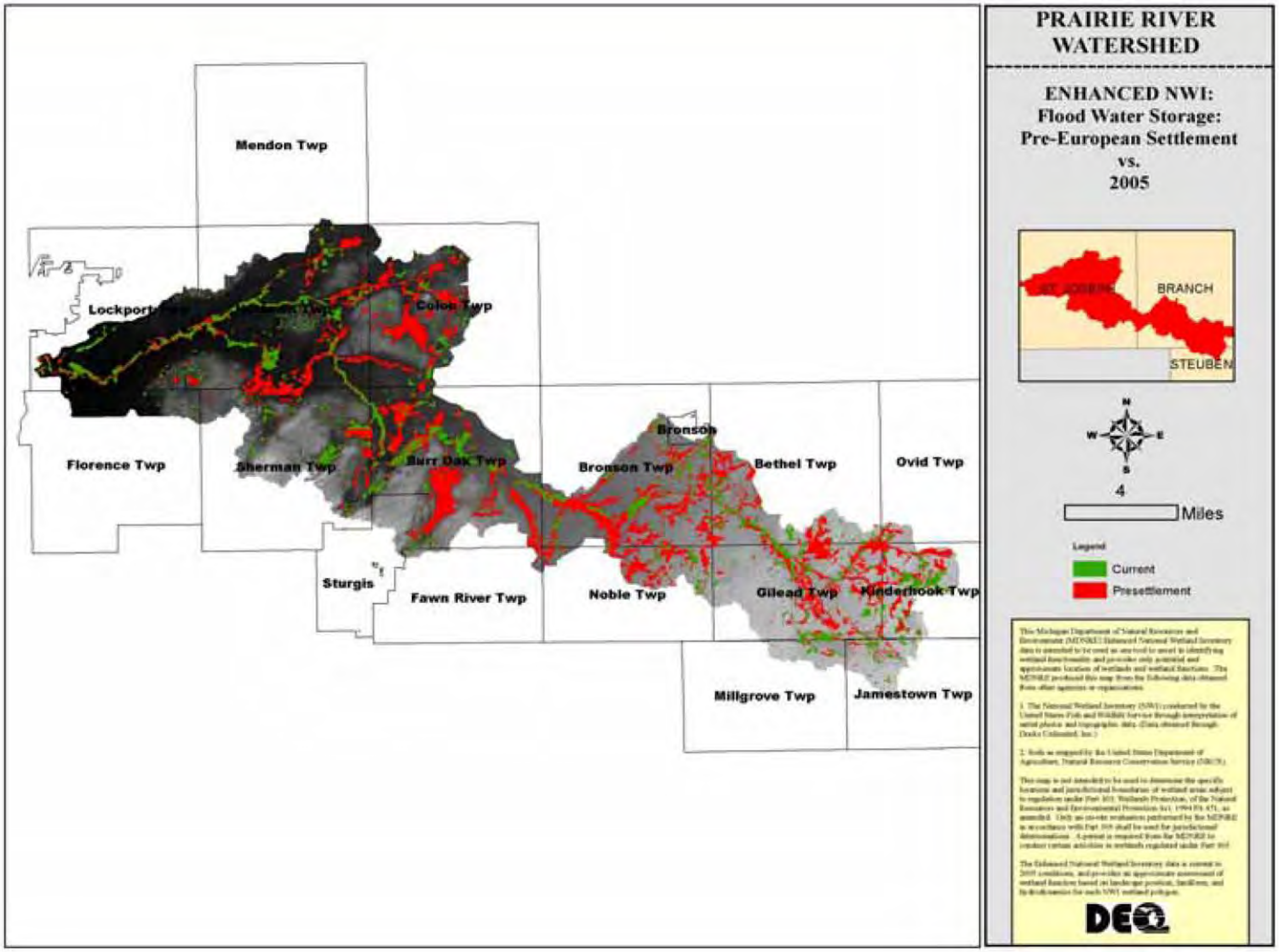
# of Wetlands	# of Functions	ACRES
37	1	13.99
205	2	189.93
221	3	1196.41
111	4	2347.63
112	5	289.70
169	6	381.64
140	7	577.45
332	8	1420.64
581	9	2380.79
526	10	2827.22
194	11	834.60
133	12	846.15
119	13	2525.00
4	14	9.39

# of Wetlands	# of Functions	ACRES
1	1	34.73
14	2	751.85
49	3	1812.13
107	4	854.17
65	5	143.39
64	6	1026.74
161	7	1080.58
122	8	1677.94
197	9	2660.40
151	10	5163.40
115	11	1987.71
162	12	8650.09

FLOOD WATER STORAGE

- This function is important for reducing the downstream flooding and lowering flood heights, both of which aid in minimizing property damage and personal injury from such events.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

FLOOD WATER STORAGE



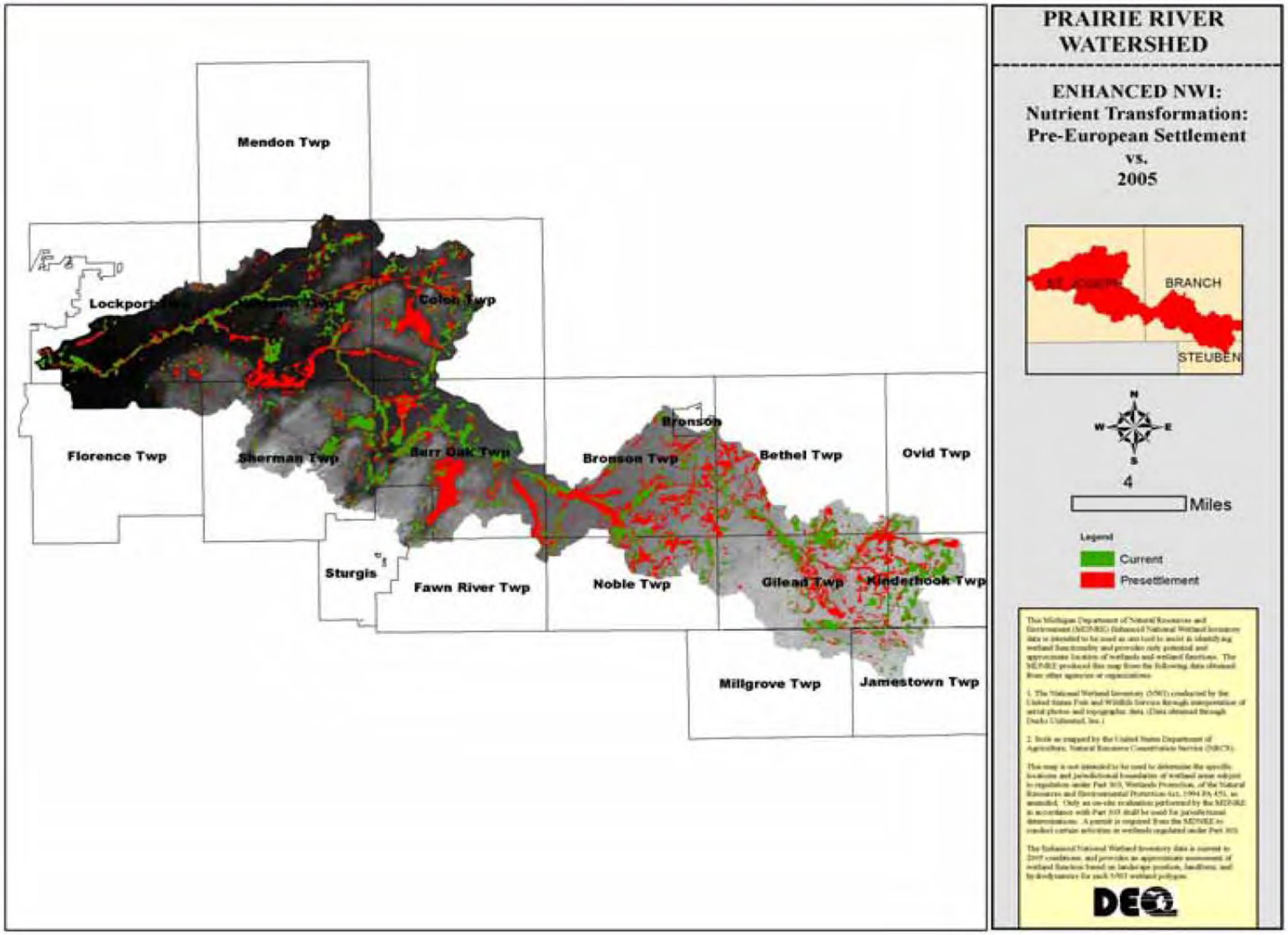
STREAMFLOW MAINTENANCE

- Wetlands that are sources of groundwater discharge that sustain streamflow in the watershed. Such wetlands are critically important for supporting aquatic life in streams. All wetlands classified as headwater wetlands are important for streamflow.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

NUTRIENT TRANSFORMATION

- Wetlands that have a fluctuating water table are best able to recycle nutrients. Natural wetlands performing this function help improve local water quality of streams and other watercourses.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

NUTRIENT TRANSFORMATION



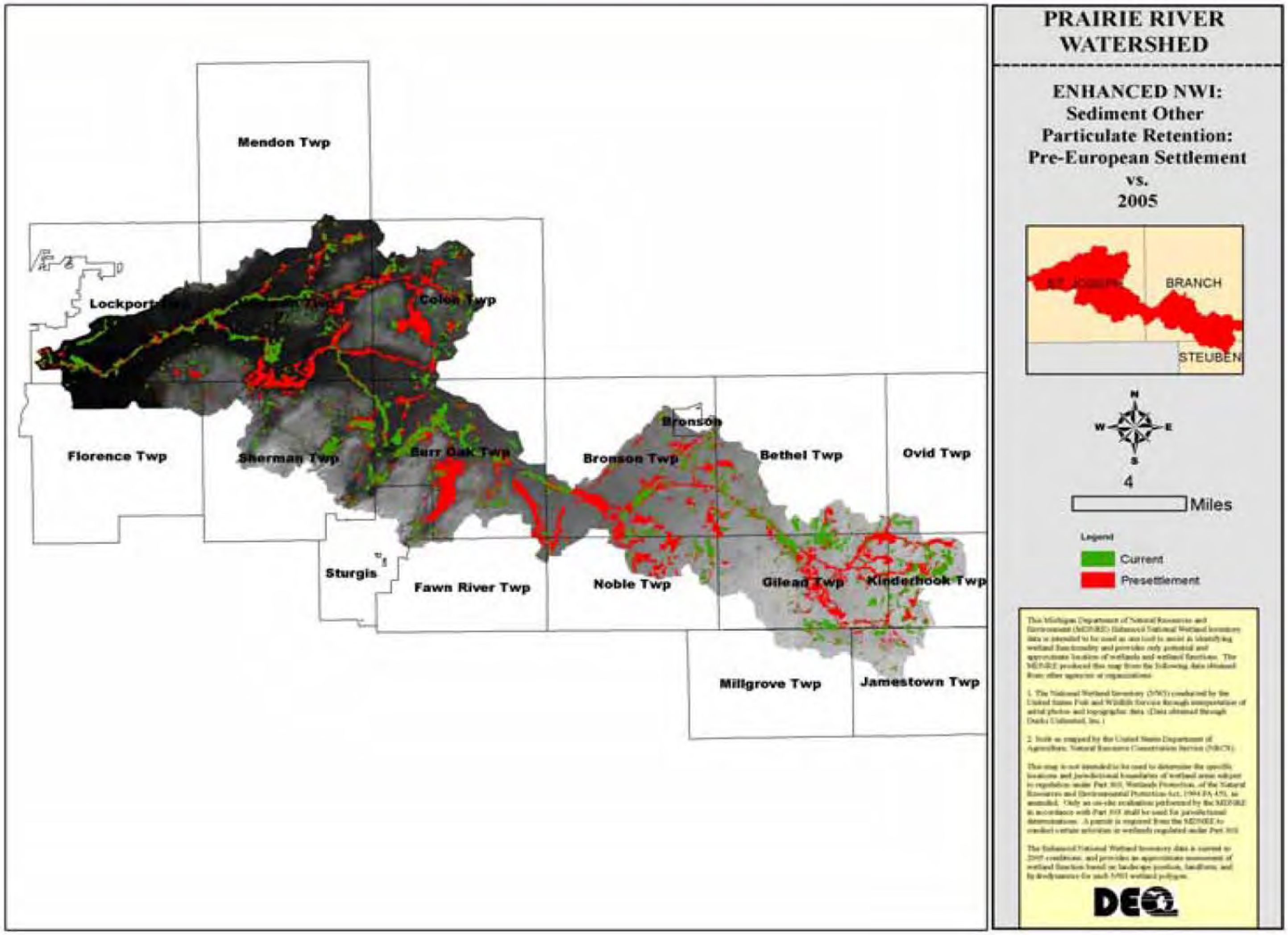
SHORELINE STABILIZATION

- Vegetated wetland along all waterbodies (e.g. estuaries, lakes, rivers, and streams) provide this function. Vegetation stabilizes the soil or substrate and diminished wave action, thereby reducing shoreline erosion potential.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

SEDIMENT AND OTHER PARTICULATE RETENTION

- This function supports water quality maintenance by capturing sediments with bonded nutrients or heavy metals. Vegetated wetlands will perform this function at higher levels than those of non-vegetated wetlands.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

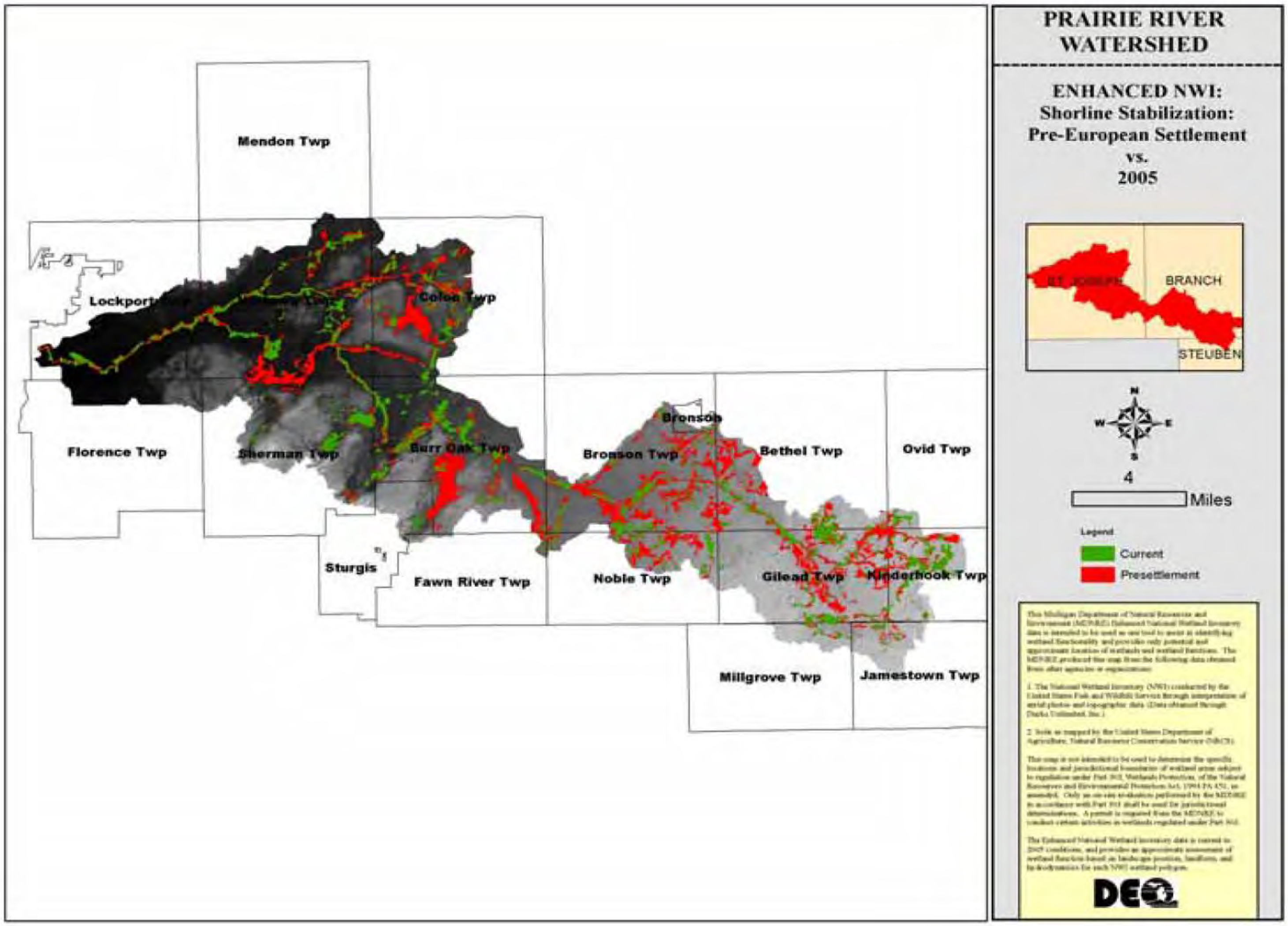
SEDIMENT AND OTHER PARTICULATE RETENTION



SHORELINE STABILIZATION

- Vegetated wetland along all waterbodies (e.g. estuaries, lakes, rivers, and streams) provide this function. Vegetation stabilizes the soil or substrate and diminished wave action, thereby reducing shoreline erosion potential.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

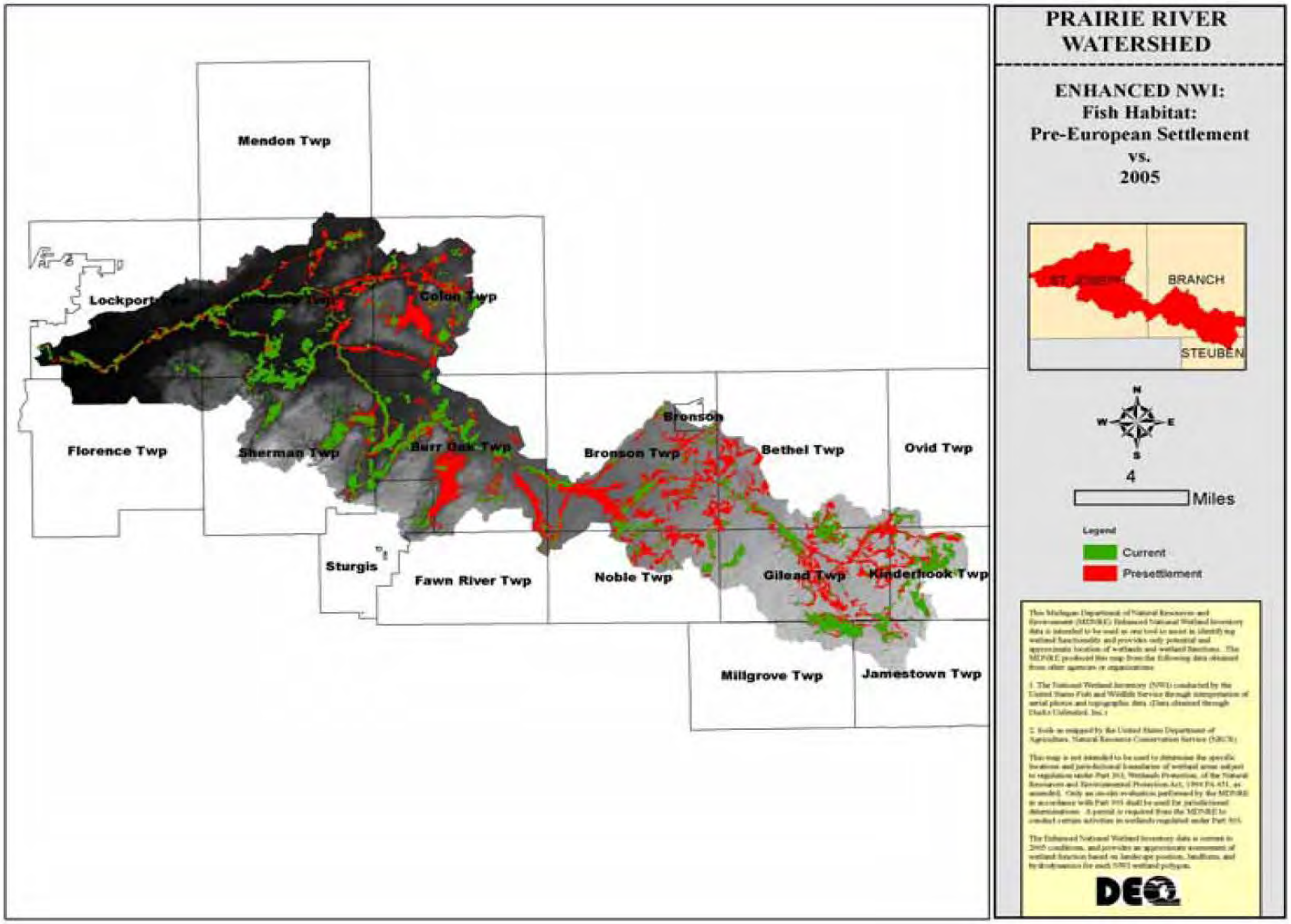
SHORELINE STABILIZATION



FISH HABITAT

- Wetlands that are considered essential to one or more parts of fish life cycles. Wetlands designated as important for fish are generally those used for reproduction, or feeding.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

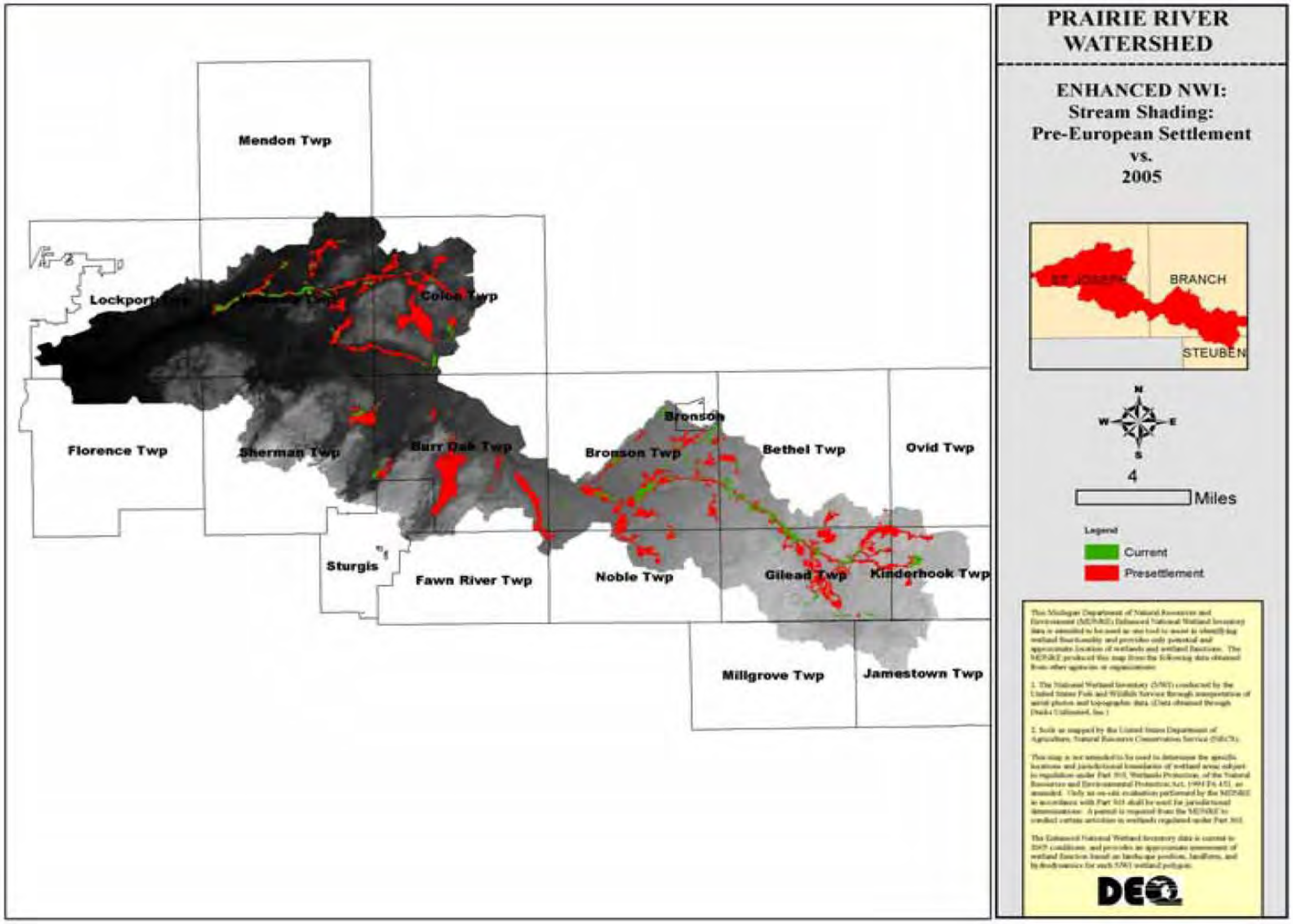
FISH HABITAT



STREAM SHADING

- Wetlands that perform water temperature control due to the proximity to streams and waterways. These wetlands generally are Palustrine Forested or Scrub-Shrub.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

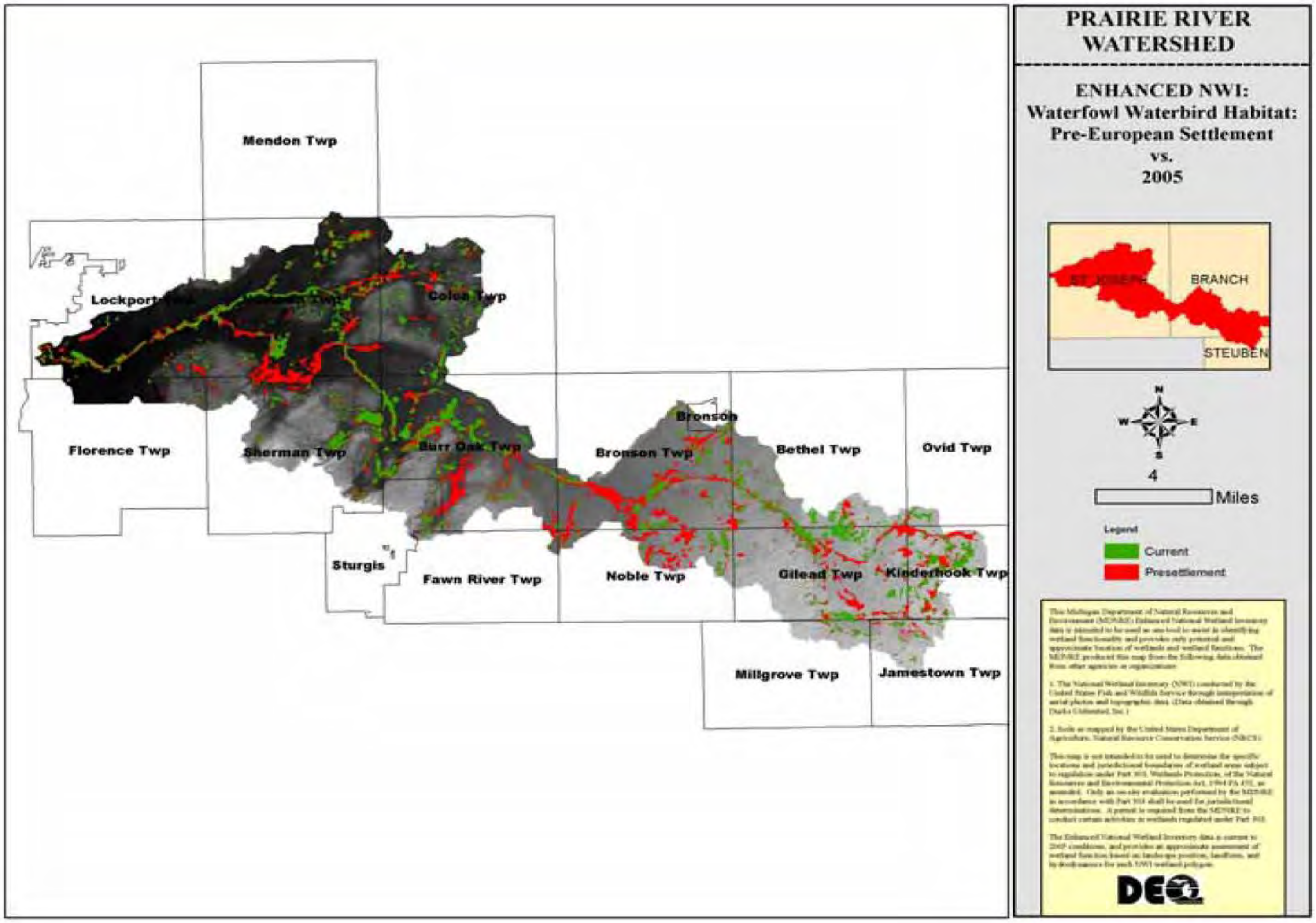
STREAM SHADING



WATERFOWL AND WATERBIRD HABITAT

- Wetlands designated as important for waterfowl and waterbirds are generally those used for nesting, reproduction, or feeding. The emphasis is on the wetter wetlands and ones that are frequently flooded for long periods.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

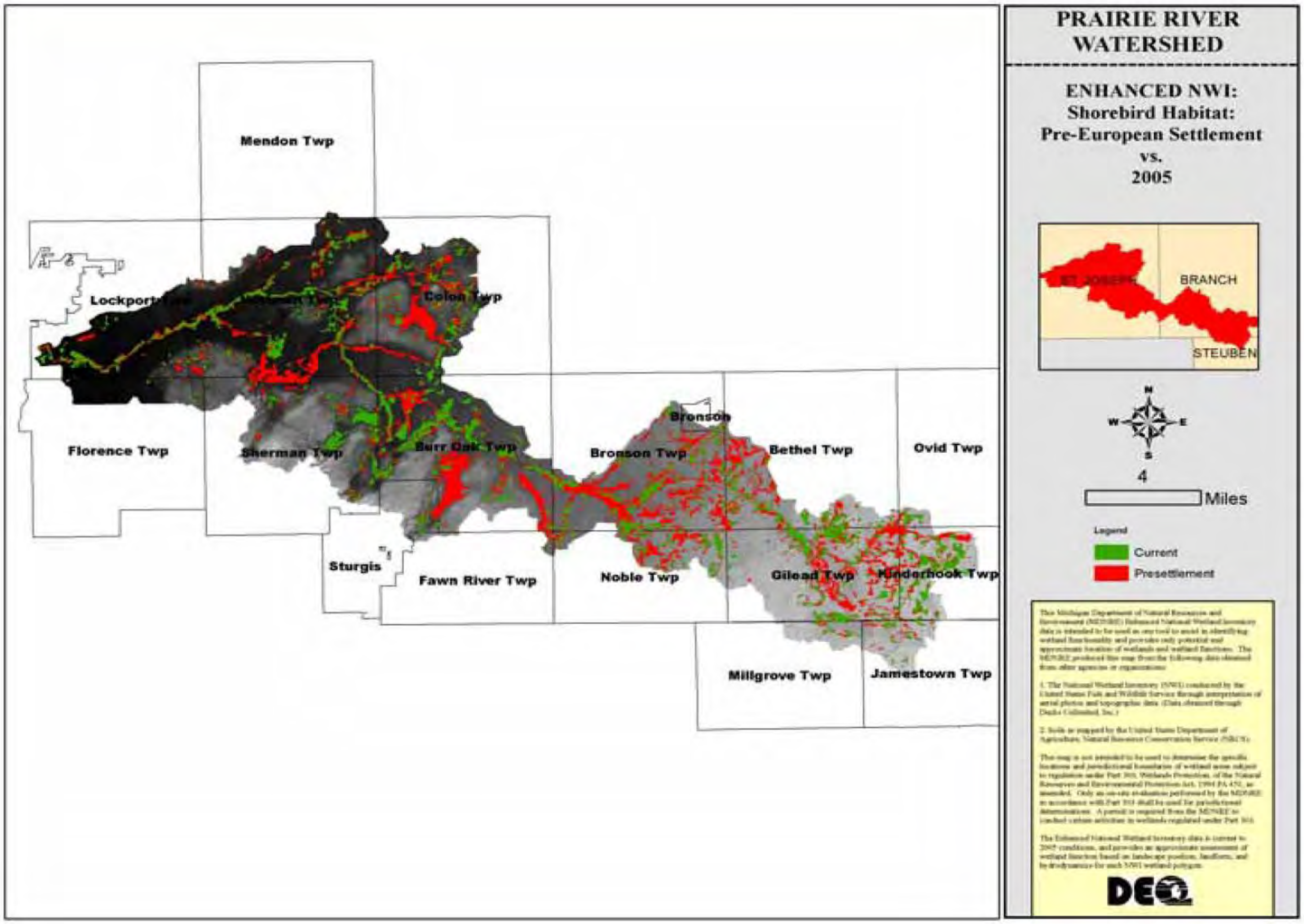
WATERFOWL & WATERBIRD HABITAT



SHOREBIRD HABITAT

- Shorebirds generally inhabit open areas of beaches, grasslands, wetlands, and tundra and undertake some of the longest migrations known. Along their migration pathway, many shorebirds feed in coastal and inland wetlands where they accumulate fat reserves needed to continue their flight. Common species include; plovers, oystercatchers, avocets, stilts, and sandpipers. This function attempts to capture wetland types most likely to provide habitat for these species.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

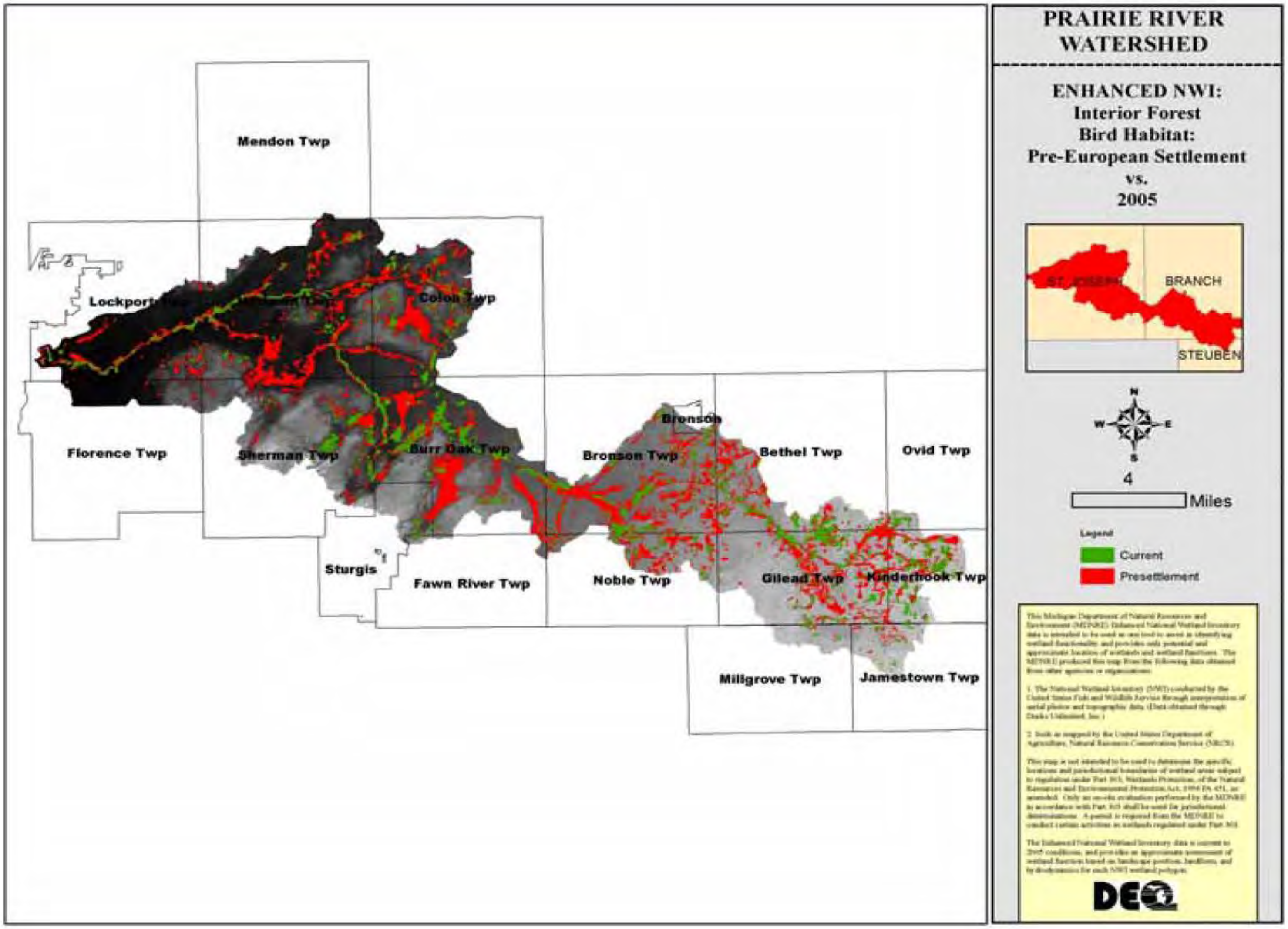
SHORE BIRD HABAITAT



INTERIOR FOREST BIRDS

- Interior Forest Birds require large forested areas to breed successfully and maintain viable populations. This diverse group includes colorful songbirds such as; tanagers, warblers, vireos that breed in North America and winter in the Caribbean, Central and South America, as well as residents and short-distance migrants such as; woodpeckers, hawks, and owls. They depend on large forested tracts, including streamside and floodplain forests. It is important to note that adjacent upland forest to these riparian areas are critical habitat for these species as well. This function attempts to capture wetland types most likely to provide habitat for these species.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

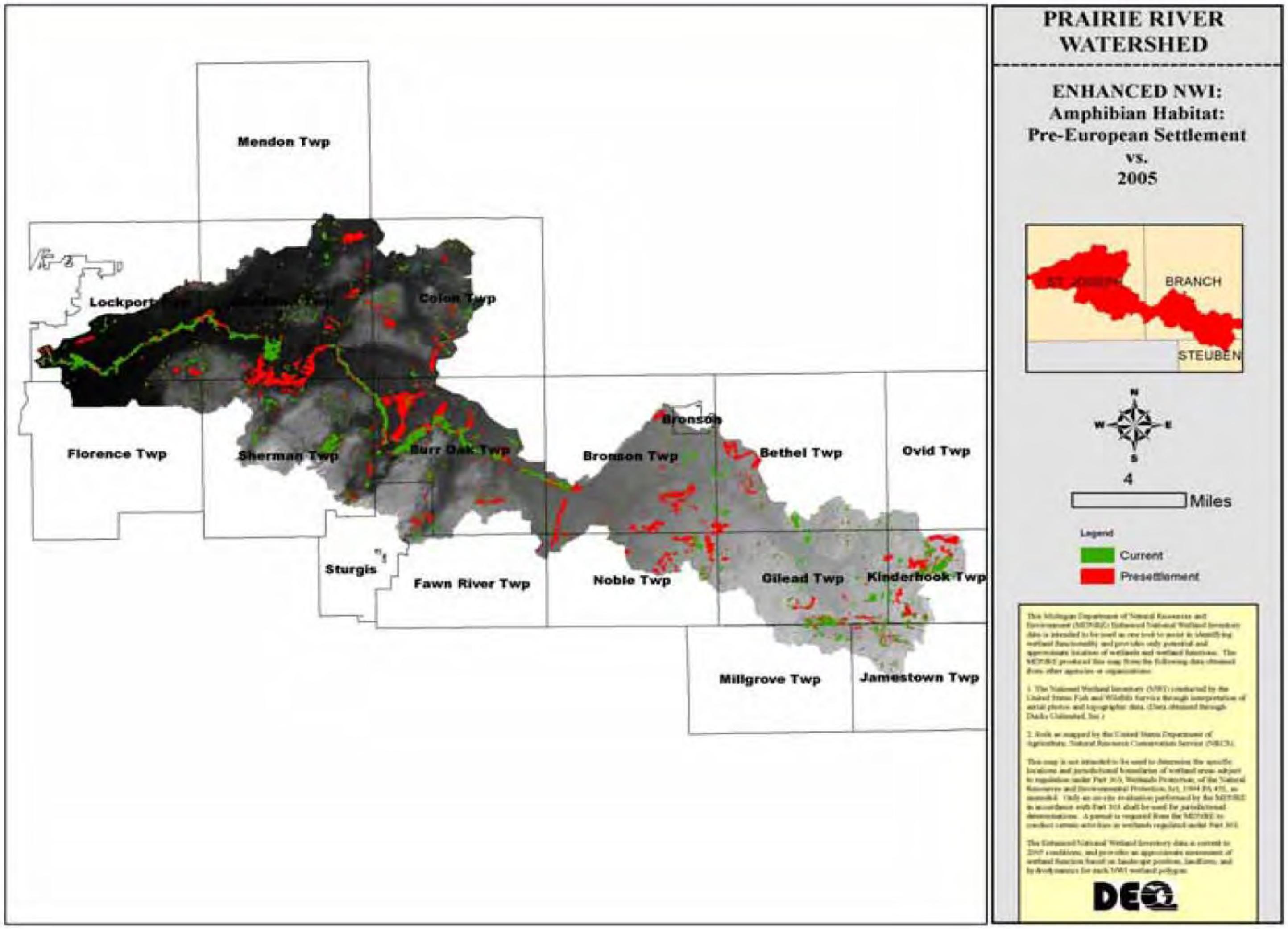
INTERIOR FOREST BIRD HABITAT



AMPHIBIAN HABITAT

- Amphibians share several characteristics in common including wet skin that functions in respiration and gelatinous eggs that require water or moist soil for development. Most amphibians have an aquatic stage and a terrestrial stage and thus live in both aquatic and terrestrial habitats. Aquatic stages of these organisms are often eaten by fish and so for certain species, successful reproduction may occur only in fish-free ponds. Common sub-groups of amphibians are salamanders, frogs, and toads. This function attempts to capture wetland types most likely to provide habitat for these species.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

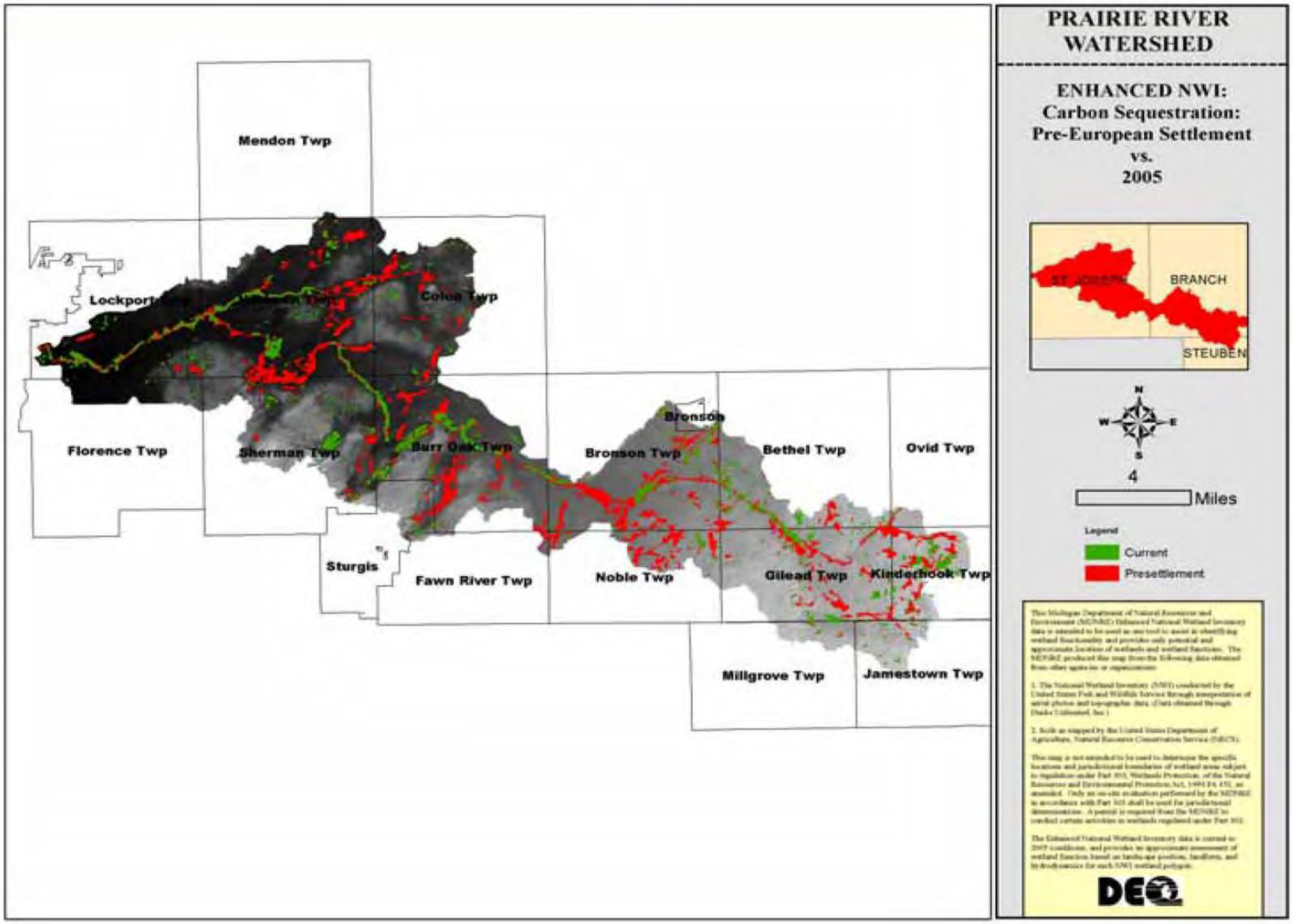
AMPHIBIAN HABITAT



CARBON SEQUESTRATION

- Wetlands are different from other biomes in their ability to sequester large amounts of carbon, as a consequence of high primary production and then deposition of decaying matter in the anaerobic areas of their inundated soils.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

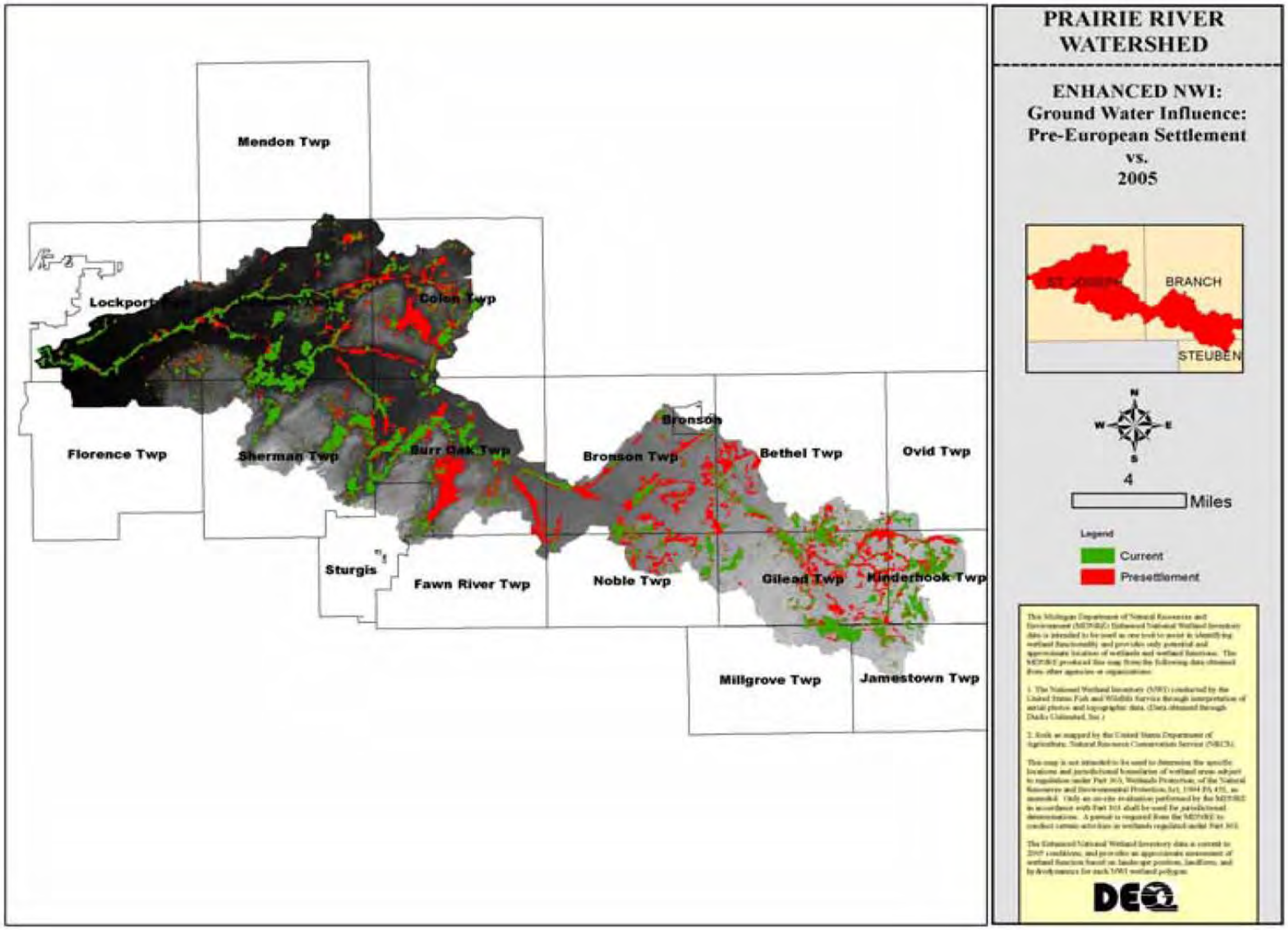
CARBON SEQUESTRATION



GROUND WATER INFLUENCE

- Wetlands categorized as High or Moderate for Groundwater Influence are areas that receive some or all of their hydrologic input from groundwater reflected at the surface. The DARCY (definition of acronym) model was the data source utilized to determine this wetland/groundwater connection, which is based upon soil transmissivity and topography. Wetlands rated for this function are important for maintaining streamflows and temperature control in waterbodies.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in two distinct time periods; Pre-European settlement (red), and wetlands circa 2005 (green).

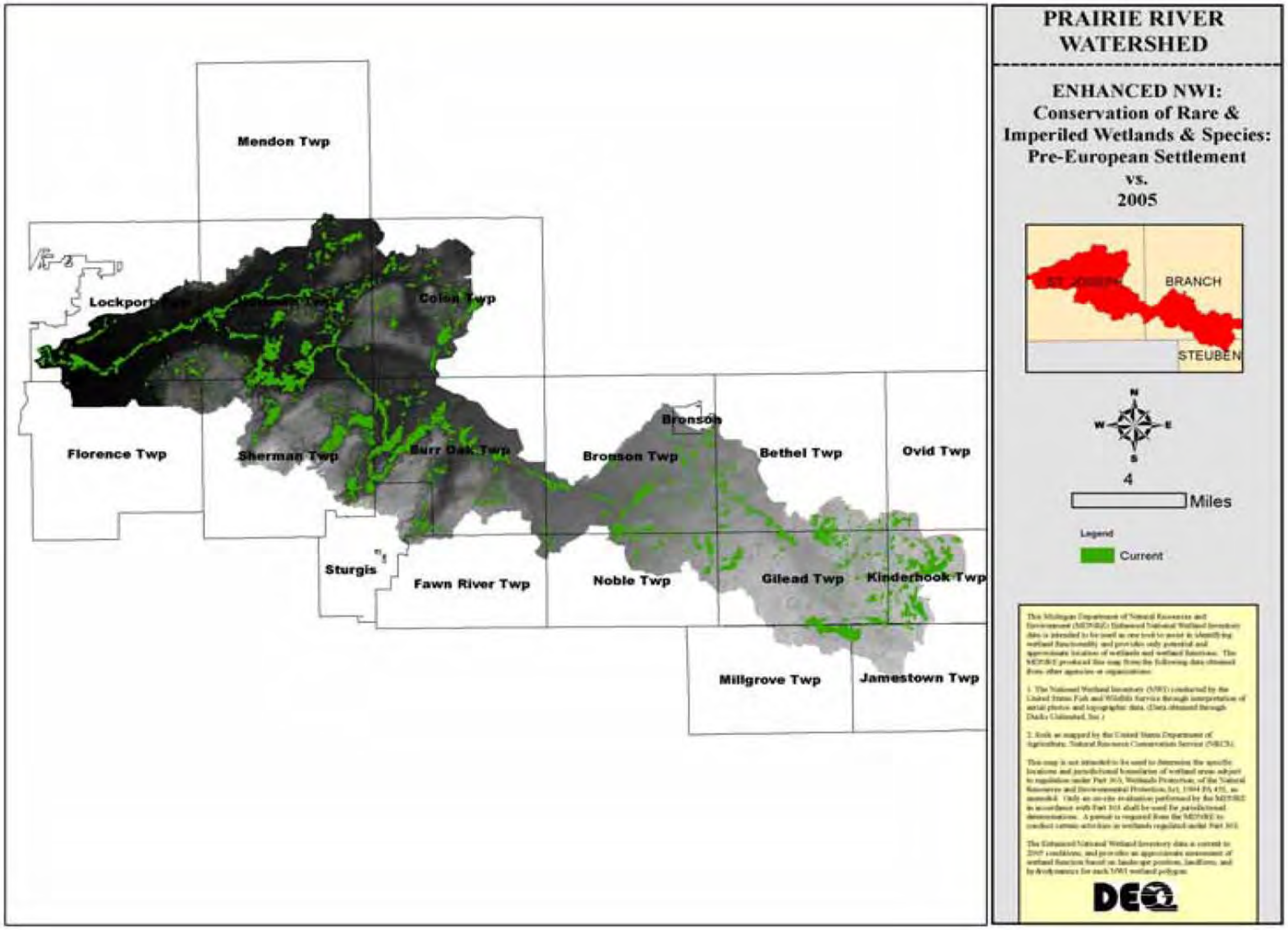
GROUND WATER INFLUENCE



CONSERVATION OF RARE AND IMPERILED WETLANDS & SPECIES

- Wetlands that are considered rare either globally or at the state level. They are likely to contain a wide variety of flora and fauna, or contain threatened or endangered species.
- This function is derived from the Michigan Natural Features Dataset (MNFI) of known sightings of threatened, endangered, or special concern species and high quality natural communities. The model values are reported on a 40 acre polygon grid for the state of Michigan, or a subset of MI. Due to this the dataset should not be used as a comprehensive inventory of Rare and Imperiled wetlands.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function are mapped in (green) circa 2005.

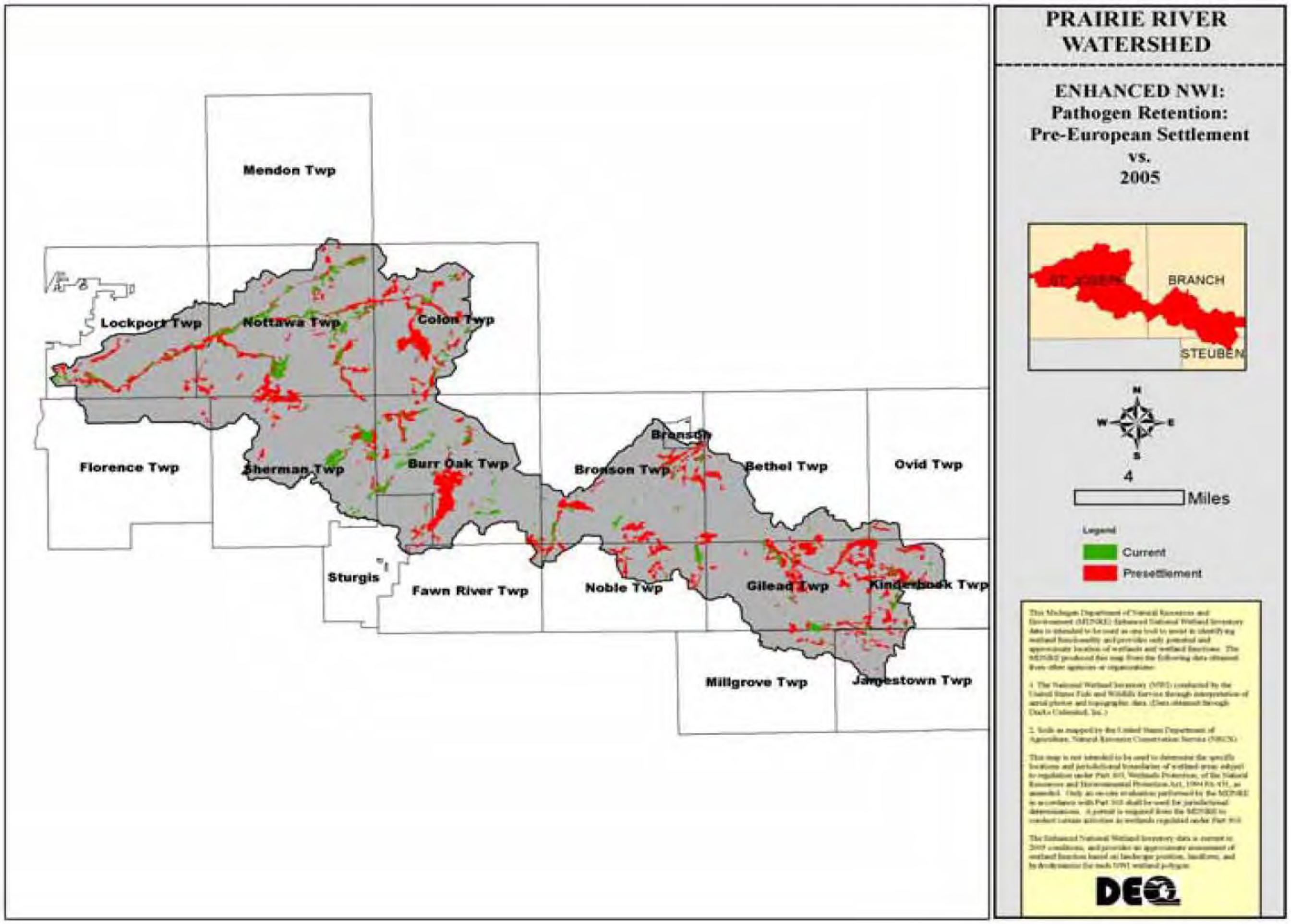
CONSERVATION OF RARE IMPERILED WETLANDS, & SPECIES



PATHOGEN RETENTION

- Wetlands can improve water quality through natural processes of filtration for sedimentation, nutrients and Escherichia coli (E. coli). E. coli is a sub-set of fecal coli forms whose presence in water indicates fecal contamination from warm blooded animals. The presence of E. coli indicates that contamination has occurred, and other harmful pathogens may also be present.
- The following map illustrates wetlands that perform the above ecological service at a level of significance above that of wetlands not designated. Wetlands deemed to be performing this function at a high level are mapped in (green) circa 2005. Wetlands deemed valuable for restoration for this function are mapped in (red).

PATHOGEN RETENTION



Data Limitations and Disclaimer

National Wetlands Inventory Plus (NWI)

- Wetland boundaries determined from Aerial Imagery
- Last updated in 2005
- Obvious limitations to Aerial Photo Interpretation:
  - Errors of Omission (forested and drier-end wetlands)
  - Errors of Comission (misinterpretation of aerials)

The 2005 NWI data was used in this analysis to report status and trends, as this is currently the best data source available. However, this data may not accurately reflect current conditions on the ground.

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Landscape Level Wetland Functional Assessment (LLWFA)

- Source data are a primary limiting factor.
- Wetland mapping limitations due to scale, photo quality, and date and time of year of the photos.

- Functional assessment is a preliminary one based on:
  - Wetland Characteristics interpreted through remote sensing
  - Professional Judgment of various specialists to develop correlations between those wetlands and their functions.
- Watershed-based Preliminary Assessment of wetland functions:
  - Applies general knowledge about wetlands and their functions
  - Develops a watershed overview that highlights possible wetlands of significance
  - Does not consider the condition of the adjacent upland
  - Does not obviate the need for more detailed assessment of various functions
- This analysis is a "Landscape Level" assessment and used to identify wetlands that are likely to perform a given function at a level above that of other wetlands not designated

Appendix 4

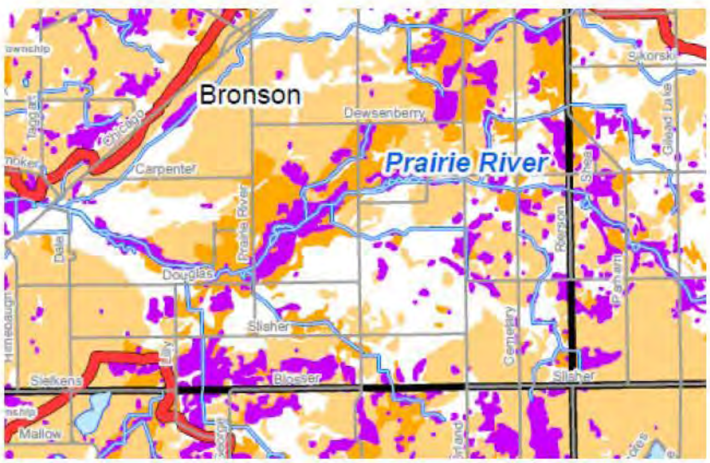
Prairie River Watershed
Townships and County Master Plan and Zoning Ordinance Recommendations

BRANCH COUNTY

OVID TOWNSHIP

BURR OAK TOWNSHIP

Prairie River Watershed
Policy Review Document for Branch County, Michigan



February 2013
MDEQ Tracking Code #2010-0002

Fishbeck, Thompson, Carr & Huber
engineers • scientists • architects • constructors

Appendix 4

PRAIRIE RIVER WATERSHED PLANNING PROJECT

BRANCH COUNTY

POLICY REVIEW DOCUMENT
MDEQ TRACKING CODE #2010-0002

FEBRUARY 2013
PROJECT NO. G120246

Michigan's Nonpoint Source Program

This nonpoint source pollution control project has been funded in part through the Michigan Nonpoint Source Program by the United States Environmental Protection Agency under assistance agreement C9975474-10 to the Branch Conservation District, for the Prairie River Watershed Planning project. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Fishbeck, Thompson, Carr & Huber, Inc. Engineers • Scientists • Architects • Constructors
1515 Arboretum Drive, SE, Grand Rapids, MI 49546 Telephone: 616-575-3824

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LIST OF ABBREVIATIONS/ACRONYMS

BCD	Branch Conservation District
BCRC	Branch County Road Commission
BMP	Best Management Practice
CIP	County Improvement Program
County	Branch County
FEMA	Federal Emergency Management Agency
FTC&H	Fishbeck, Thompson, Carr & Huber, Inc.
GIS	Geographical Information System
I&E	Information and Education

Appendix 4

4-4

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LID	Low Impact Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MS4	Municipal Separate Storm Sewer System
ND	Neighborhood Development
NPS	Nonpoint Source
NREPA	Natural Resources and Environmental Protection Act
O&M	Operation and Maintenance
PRD	Policy Review Document
PUD	Planned Unit Development
SCMPC	Southcentral Michigan Planning Council
SESC	Soil Erosion and Sedimentation Control
State	State of Michigan
Watershed	Prairie River Watershed
WMP	Watershed Management Plan

EXECUTIVE SUMMARY

The Prairie River flows west from its headwaters in the southwest corner of Branch County (County), Michigan, into St. Joseph County, where it empties into the St. Joseph River, just south of Three Rivers, Michigan. The Prairie River Watershed (Watershed) is experiencing very low development, similar to other areas around the State of Michigan (State) during this downturn in the economy. However, citizens are concerned when growth does happen, it will be in an uncontrolled manner and could jeopardize the quality of the Watershed's valued resources.

The Prairie River Watershed Management Plan (WMP) stresses the importance of water resources as a vital component of land use decisions at the local level. Communities in the Watershed are interested in achieving sustainable development defined as economic growth protecting the environment.

This Policy Review Document (PRD) provides an assessment of the Master Plan and other development rules and regulations of Branch County impacting water quality. An examination of existing policies is crucial to provide for well crafted and complimentary municipal codes reflecting the desires of the diverse communities within the Watershed. The current path of development in communities can be evaluated through this process and redirected if necessary. Communities often find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, combining economic growth with the protection of natural resources.

Existing policies and regulations in Branch County were compared to accepted development principles as presented in various water resource protection guidebooks. A policy review spreadsheet was used to document the comparisons and identify compliance and discrepancies with the principles. A review of LEED for Neighborhood Development (ND) prerequisites applicable to the County was conducted.

The assessment reviewed the status of land use planning in the County and how well the rules and regulations addressed the concerns of the Watershed: sediment in rivers, streams, and lakes; excess nutrients; streambank erosion; *E. coli*; and increased peak flow due to loss of wetlands. The results of the policy review are summarized in Appendix 1. The result of the LEED ND assessment is illustrated in Figure 1.

The results of this policy review reveal areas of the existing development rules that are generally good in their efforts of watershed protection and other areas that need improvement. Specific recommendations related to the County's Master Plan are listed below:

1. Complete and approve the update of the Master Plan and Land Use Map.

2. Develop Model Zoning including water resource protection, clustering and open space development incentives, and criteria for site plan review.
3. Develop a Capital Improvement Program.
4. Gain Michigan Department of Natural Resources (MDNR) approval of the Recreation Plan every five years identifying priority lands for acquisition or protection for future recreational use.
5. Use proper siting and design of development to increase efficiency and conservation to mitigate the impact of development.
6. Work with Michigan Department of Environmental Quality (MDEQ) to establish a wetland mitigation banking program.
7. Create a solid waste management plan to reduce the amount of waste going into landfills.
8. Develop a transportation program providing access to transportation for people to conduct their daily activities and reduce the number of automobile trips generated by new development.
9. Investigate funding options for conducting additional studies and projects assisting the County in implementing the recommendations in this report.

The use of the development principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources and revising the Master Plan, if necessary. Model ordinances selected from communities in Michigan supporting the development principles are provided at the end of the report for reference.

INTRODUCTION

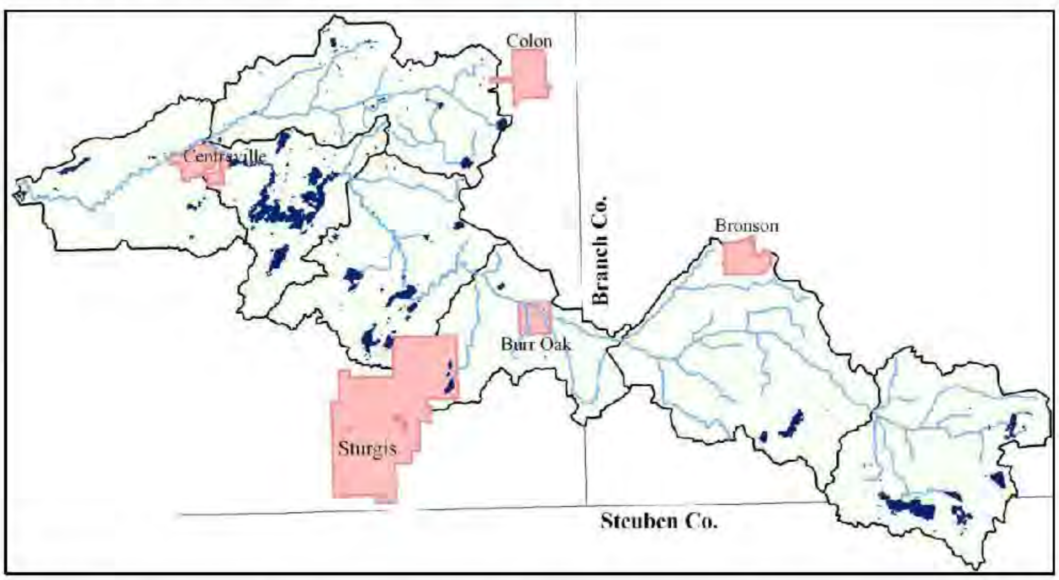
PURPOSE

The purpose of this PRD is to assist the County with implementation of generally accepted development standards and to identify impediments to innovative site design for the purpose of water resource protection. This policy assessment will provide a baseline to measure changes in the planning and management of growth in the County. The current path of development can be evaluated through this process and redirected if necessary. A similar assessment could be conducted in five years to determine if changes have been made to the rules and regulations increasing the level of watershed protection.

PRAIRIE RIVER WMP

The Branch Conservation District (BCD) is currently developing a WMP for the Watershed. The Watershed encompasses 128,644 acres in Branch and St. Joseph Counties, Michigan, and a small portion of Steuben County, Indiana (Exhibit 1).

Exhibit 1 - Prairie River Watershed



The WMP will include a complete evaluation of nonpoint source (NPS) pollutants and create an implementation plan to address resource concerns, problems, and needs, and outline solutions for known or suspected pollutants of the river. The public will be encouraged to participate, as well as other Stakeholders in the Watershed, to develop information and education (I&E) programs necessary for long-term sustainable land use planning. An examination of existing policies is crucial to provide for well-crafted and complimentary municipal codes reflecting the desires of the communities within the Watershed.

The Prairie River WMP has identified priority NPS pollution impairments as follows:

- Sediment in rivers, streams, and lakes
- Excess nutrients
- Streambank erosion
- *E. coli*
- Increased peak flow due to loss of wetlands

The goals described in the WMP will work toward all waterbodies meeting designated uses of:

- Other indigenous aquatic life and wildlife use
- Partial body contact recreational use
- Total body contact recreational use
- Coldwater fishery use
- Warmwater fishery use
- Agricultural use
- Navigational use
- Industrial water supply
- Public water supply

The Stakeholders in the Watershed have also indentified the following desired uses for the Watershed:

- Fish Habitat
  - Maintain healthy water temperatures to continue healthy coldwater fisheries
  - Elongate designated trout stream further upstream

- Protect and Enhance Indigenous Wildlife Habitat
  - Invasive remediation
  - Particularly where threatened, endangered, and special concerns depend on healthy habitats
  - Educate on identifying and procreation of invasive species
  - Educational signage at high-traffic boat launches (Nottawa, Gilead, etc.)

- Develop Coordination
  - Invasive management guide for lake communities
  - Implement "clean boats, clean waters" program at lakes in the Watershed
  - Promote Stakeholder involvement

- Maintain news articles and media presence

- Recreation
  - Maintain and enhance 32 navigable miles
  - Create volunteer group to help keep pathways open
  - Educate on improving navigability without impacting habitat especially aquatic habitats
  - Create a heritage water trail

- Agricultural
  - Maintain agricultural economy
  - Maintain rural character
  - Promote sustainable soil and water practices
  - Promote balanced irrigation practices
  - Promote practices addressing unrestricted livestock access and fuel tanks in riparian corridors

- Coordinated Land Use Planning
  - Low impact development (LID) in urban areas
  - Stormwater guidelines/ordinances where appropriate and desired
  - Develop or update resource tools pertaining to water quality for planning officials

- Maintain, Protect, Enhance, Create Wetland Areas
  - Create a priority list for wetland areas by function and use to promote to landowners on options for wetland enhancement

- Groundwater Protection
  - Promote healthy soil practices (particularly in areas where soil types are leaching soils)
  - LID practices in urban areas
  - Promote farm bill for spill protection (fuel pads - especially for irrigation in riparian zones)
  - Urban stormwater management
  - Determine current and future surface withdrawals and potential impacts

- *E. coli* Testing
  - Because of many unrestricted livestock areas, identify additional *E. coli* sites within the Watershed

- Bank Stabilization
  - Incorporate bank stabilization near boat launch areas where erosion is present
  - Incorporate native plantings at sites identified in the Watershed

- Natural Shoreline Program
  - Utilize program in identified sites

The objective of this policy review is to develop specific land-use recommendations using a watershed-based approach to achieve the WMP goals and desired uses. This effort will bring together County departments responsible for growth and development in the County to protect water quality and reduce NPS pollution through the revision and adoption of the Master Plan and the establishment of ordinances and policies supporting the vision of the Master Plan for natural resource protection.

BACKGROUND

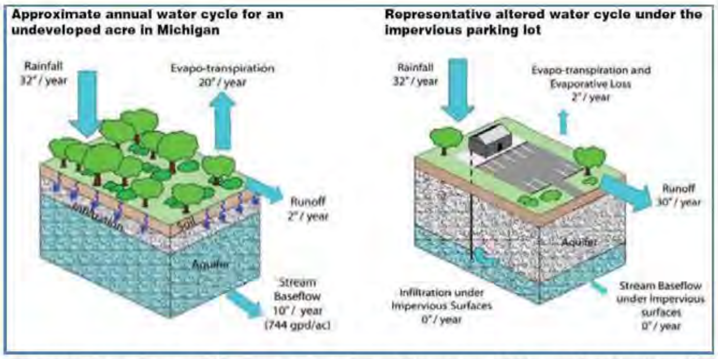
A grant was awarded to the BCD to develop a WMP for the Watershed. As part of the grant, a task was defined to assist communities in assessing their policies and guidelines shaping how development occurs in their communities. State and local agencies recognize the time to plan for growth is now, when activity is low and time is available for a thorough review of policies and standards working together to improve quality of life.

LAND USE AND WATER RESOURCE PROTECTION

Local Land Use Decisions Have Regional Impacts. Residents, business owners, and local planners are not always aware of the impacts their individual actions might have on their natural surroundings. Cumulative effects of these actions are not considered in most development and land use decisions. A watershed planning perspective will encourage local planners and developers to look at the entire area contributing to a water body and determine its needs for management and protection. Often, communities find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. The Watershed is taking the first step in realizing the regional consequences of the local land use decisions, by evaluating current policies and implementing appropriate measures to enhance and protect water quality while experiencing growth and development. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, which combines economic growth with the protection of natural resources.

Development Impacts to Watercourses. One of the basic concepts accepted in watershed planning is the amount of impervious cover in a watershed directly relates to its water quality. Increased urbanization results in natural vegetation being replaced with hard surfaces, such as rooftops, roadways, and parking lots. The additional impervious area increases the rate and volume of surface water runoff and decreases water infiltration into the ground, as illustrated in Exhibit 2. Development reduces base flow, since water is not infiltrating, which causes perennial streams to become intermittent streams. When more of the water enters the streams as surface runoff, the bankfull channel flows create highly erosive conditions.

Exhibit 2 - Impacts of Development



(Source: A Design Guide for Implementers and Reviewers: Low Impact Development Manual for Michigan, SEMCOG, 2008)

Other concerns of impervious surfaces include higher concentrations of nutrients in higher volumes of runoff and increased occurrences of heavy metals. Another impact occurs when municipal services are required to expand to provide water and sewer for developments currently outside of service areas. Locating developments close to existing towns and city centers reduces the effects of sprawl and minimizes the expansion of infrastructure increasing harmful stormwater runoff.

REGULATIONS IMPACTING LAND USE AT THE STATE LEVEL

The Michigan Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended is the State's primary environmental legislation. The MDEQ regulates wetlands, sand dunes, soil erosion and sedimentation (SESC) from earth change activities, inland lakes and streams, shorelines, and other land use decisions impacting water resources, including management of floodplain development, public health standards, subdivision rules, and stormwater discharges from municipal separate storm sewer systems (MS4). The State, however, does not oversee land use planning at the local level. The over 1,850 units of government in Michigan are responsible for protecting water resources through local regulations (Ardizone, 2010).

LAND USE PLANNING AT THE LOCAL LEVEL

A County Master Plan should identify goals and a vision for future development in the County. Townships, cities and villages are responsible for developing land use plans and zoning ordinances, as well as ensuring their implementation. Land use plans and zoning ordinances are the regulatory tools that can be used to protect surface water and groundwater. The planning and zoning process typically starts with a Master Plan, which outlines the vision of how the residents and leaders want the communities to look in future years. The Master Plan is the foundation upon which the Code of Ordinances and zoning ordinances are developed. Formulation of a Master Plan is therefore of highest importance to the County and its communities. A community's Code of Ordinances is intended to provide the rules and regulations preserving the health, safety, and welfare of the residents of the community. Design manuals and construction specifications for development guide the alterations of land and water necessary for growth in the community. All of these policies must be integrated to ensure their goals and objectives are compatible. The policy review requires the examination of all of these documents to be able to assess the capacity of the community to continue to grow and prosper while protecting the natural resources.

METHODOLOGY

POLICY REVIEW

FTC&H worked with the BCD to develop a worksheet listing water quality issues and outlines accepted development principles. BCD and Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) met with the County to review the worksheet and obtain the County's Master Plan and collect other policies, standards, ordinances, and guidance that the County has for growth and infrastructure management. These one-on-one meetings with the County helped ensure all documents were current and the intent of the development standards was understood. The following documents were reviewed:

- Master Plan (April 2011 - Updated "DRAFT" Master Plan)
- Branch County Recreation Plan 2012 to 2017
- Farmland Open Space Preservation Ordinance (Ordinance No.17)
- Branch County Road Commission (BCRC) Minimum Specifications for Construction of Roads and Streets
- SESC Ordinance

FTC&H reviewed the goals of the Master Plan and how other regulations succeed in upholding those goals. Additional documents were reviewed using the worksheet to evaluate their conformity to development principles for water resource protection.

Recommendations and suggestions for the County to consider in their future updates and planning and zoning decisions are included in the Recommendations section of this report.

The detailed results of the policy review are in table format in Appendix 1.

LEED FOR NEIGHBORHOOD DEVELOPMENT EVALUATION

FTC&H also evaluated the County's characteristics against LEED ND rating system's prerequisites to map areas where development would have the least impact on natural resources. The rating system encourages smart growth and new urbanist best practices, promoting the location and design of neighborhoods reducing vehicle miles traveled, and communities where jobs and services are accessible. It promotes more efficient energy and water use, especially important in urban areas where infrastructure is often overtaxed. The prerequisites of the LEED ND rating system are listed below:

Smart Location and Linkages

Smart Location

Imperiled Species and Ecological Communities Conservation

Wetland and Water Body Conservation

Agricultural Land Conservation
Floodplain Avoidance

Neighborhood Pattern and Design

Walkable Streets
Compact Development
Connected and Open Community

Green Infrastructure and Buildings

Certified Green Building
Minimum Building Energy Efficiency
Minimum Building Water Efficiency

For this report, the following layers were created in the Geographical Information System (GIS) to map the prerequisites applicable for mapping at the County level. Figure 1 - LEED for Neighborhood Development Suitability Analysis illustrates the results of the evaluation.

- Roads
- Natural Features Inventory - High probability of occurrence
- Wetlands and 50 foot buffer
- Water courses and 100 foot buffer
- Lakes
- Watershed boundary
- Prime Farmland and locally important soils
- Federal Emergency Management Agency (FEMA) 100-year floodplain
- Water and sewer system service areas

RECOMMENDATIONS

After completing the document review for the County, a list of recommendations based on the worksheet was developed and shared with the Planning Commission to incorporate into their Master Plan goals and objectives.

Watershed Issues

- Recognize subwatershed boundaries within the County (Figure 2).
- State the importance of watershed resources protection in order to protect the health, safety, and welfare of residents.

Stream Corridors and Floodplains

- State the importance of riparian buffers for streambank erosion protection, reducing pollutants in stormwater runoff, providing food and habitat for wildlife, preventing sedimentation in waterways, providing tree canopy to shade streams, and promoting scenic value and recreational opportunities (Figure 1, Layer: Water courses and 100 foot buffer).
- Connect the importance of protection of stream corridors to promoting health safety of residents (flood control, stream corridor protection, and water quality).

Impervious Surface Reduction

- State the importance of minimizing surfaces in new construction and redevelopment projects to reduce runoff and improve infiltration.
- Connect the reduction of impervious surfaces to the protection of water quality, natural features, and open space.

Land Conservation and Development Techniques

- Recognize the importance of open space preservation as a way to protect the health, safety, and welfare of residents; protect air, land, and water resource quality; buffer air and noise pollution; preserve wildlife habitat; and preserve aesthetic values and the community's beauty (Figure 3).
- Identify and map prime and unique agricultural lands (Figure 1, Layer: Prime Farmland and locally important soils).
- Encourage the use of conservation easements to conserve open space.

Wetland Protection

- Create a wetlands map (Figure 4).
- Recognize the importance of wetlands, and the functions they play in protecting residents' health, safety, and welfare from problems such as flooding and poor water quality (Figure 5).

- State the importance of wetlands protection within an ecosystem context (protecting adjacent uplands, waterways, and vegetated buffers as well).
- Support and encourage the establishment of a wetland mitigation banking program.

Lake Management

- Create a map of lakes in the County (Figure 1, Layer: Lakes).
- State the importance of the value of lakes for recreation, economic development, habitat, and fisheries.

Habitat Preservation

- State the importance of preservation of natural areas for wildlife habitat protection.
- Link habitat preservation to protection of the health, safety, and welfare of the resident.
- Identify and map high-priority natural areas (Figure 1, Layer: Natural Features Inventory - High probability of occurrence).
- State the importance of native vegetation to protect air, land and water quality; buffer noise and air pollution; preserve wildlife habitat; and preserve aesthetic value and community beauty.

Woodlands

- Conduct woodlands inventory and create existing woodlands map (Figure 3).
- State the importance of woodlands to protect water, air and soil quality; buffer air and noise pollution; moderate local climate and storm hazards; preserve wildlife habitat; and to preserve aesthetic values and community beauty.
- Recognize the importance of woodlands for stormwater infiltration, thus reducing flooding and minimizing water pollution.

Greenways and Green Infrastructure

- Create a greenways plan or encourage greenways and green infrastructure as important natural transportation corridors for wildlife, and for the protection of other natural features.

Groundwater

- Identify and map groundwater recharge areas.
- State the importance of groundwater to health, safety, and welfare of residents.
- State the importance of protecting groundwater as an important natural resource.
- Identify and map wellhead protection areas and state the importance of limiting high-risk land use activities in these areas.

Stormwater Management

- State the importance of preservation of natural features as parkland in open space development to help alleviate problems associated with stormwater runoff.
- State stormwater management as an important goal.
- Recognize that quality and quantity of stormwater are important issues to address in stormwater management policies.
- Relate stormwater management to the protection of health, safety, and welfare of community residents.
- Include policies encouraging the use of best management practices (BMPs) to minimize, collect, and treat stormwater.
- State the importance of preservation of natural features to preserve existing infiltration of stormwater.

Erosion and Sedimentation Control

- Identify erosion and sedimentation control as a mechanism to protect health, safety, and welfare of residents through protection of water and soil resources.

Sanitary Sewer Planning and Infrastructure

- Identify areas suitable and unsuitable for septic systems.
- State that community involvement in placement and maintenance of septic systems is critical to the health, safety, and welfare of residents (Figure 6).
- Identified and/or map designated county drainage systems, including all points of discharge to natural systems.
- Encourage a program for identifying and eliminating illicit discharges.
- Encourage a program labeling outfall structures discharging runoff to natural systems.

Renewable Energy

- Identify and map potential areas for wind energy to be generated.

The April 2011 Updated “DRAFT” Master Plan includes a section of “Branch County Goals and Objectives” based on the land uses identified in the County. Numerous objectives are listed in the Master Plan for each of the goals. Additional objectives, based on the recommendations above, could be added for each goal addressing resource protection and follow the Master Plan criteria for conformance with accepted development principles.

IMPLEMENTATION

The WMP outlines recommendations to meet the goals and objectives identified by the Watershed Steering Committee. Land use planning was determined to be an important part of the sustainability of the Watershed. This policy review is one component of the complex issue of land use planning, but will assist the County in identifying opportunities to protect natural resources.

Several recommendations contained in this policy review could involve changes not fully within the control of the County. Some might require State approval or legislative action. The County's elected officials should consider these issues when reviewing the recommendations of this report.

COMMUNITY RESPONSIBILITIES

The April 2011 draft Updated Master Plan lists "Recommendations for Implementation" prioritizing actions for the County to pursue. Additional guidance is provided to assist the County in implementing these recommendations below:

ACTION A - COMMUNITY LAND USE PLANNING
All land in Branch County is also in a township, village, or city. Consequently, the goals and objectives of this plan as related to land use are also subject to community planning policy and zoning regulations. Branch County government should encourage township, village, and city planning and zoning as a means of implementing the Master Plan.

Additional Guidance: The County should also update its own Master Plan and Land Use Map. The draft Master Plan states that "based on an evaluation of this information a proposed future land use map was developed to reflect this evaluation and serve as a basis of future zoning recommendations to the municipalities of Branch County," however, a map has not yet been produced. When communities in the Watershed are in the process of creating or updating their Master Plans, they must be aware of how the coordination of plans should occur. The health of a community and the natural resources are affected by development decisions. The County's Updated Master Plan does identify a role of the County's Planning Commission to consult with representatives of adjacent counties in respect to their planning so conflicts in overall county plans may be avoided. This concept should also be explicit in encouraging townships, cities, and villages consulting with each other, in respect to their planning, to have a coordinated effort in implementing the Master Plan.

The most effective (and cost-effective) approach to preventing or minimizing impacts to resources is by understanding the existing natural resource conditions of a site and by locating development in a non-sensitive area. Protection of critical natural resources should always be emphasized. Natural resource-base planning can be used to minimize runoff, pollutants, and impacts on natural resources.

Some Master Plans encourage cluster development to preserve open space, but few have implemented such tools. The use of the development principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources and revising the Master Plan, if necessary.

ACTION B - MODEL ZONING

In 1974 Branch County Government authorized the production of a model zoning ordinance to serve as a guide to township zoning. Through a contract between the Branch County Planning Commission and the Southcentral Michigan Planning Council (SCMPC) twelve townships have used the model to develop township zoning regulations. However, due to significant changes over the three decades, a new model ordinance should be developed to more properly guide the development and updates to township zoning ordinances.

Additional Guidance:

Development Principles Criteria for Zoning Ordinance: Water Resource Protection

- Develop County stormwater design criteria and development standards to regulate the volume and rate of stormwater runoff from development.
- Coordinate regulations with County Drain Commissioner's SESC program.
- Require naturally vegetated buffers along streams, lakes, and wetlands (50 to 100 feet).
- Require building and no-disturbance setback from wetlands (20 to 30 feet).
- Create overlay zone or other language protecting floodplains from undesirable development and a vegetated buffer encompassing the 100-year floodplain.
- Include details of requirements for establishing a wetland mitigation banking program.

Development Principles Criteria for Zoning Ordinance: Clustering and Open Space Development

- Require open space in planned unit developments (PUDs) of at least 40%.
- Utilize incentives to encourage use of open space development options (such as bonus densities, expedited plan review).
- Require open spaces to be consolidated into larger units when feasible.
- Require open spaces to be managed in a natural condition.
- List types of uses allowed in dedicated open space, restrict to low impact uses.

Development Principles Criteria for Site Plan Review (SWMPC, 2009)

- Require to show all natural features on site plans (wetlands, woodlands, streams, rivers, etc.).
- Require developers to preserve natural features and natural drainage patterns to the fullest extent possible (minimize site clearing).
- Coordinate with receipt of applicable county (drain, soil erosion) and state permits.
- Encourage use of BMPs improving a site's infiltration and have BMPs labeled and shown on the site plan.

- Require use of native or site suitable plants for landscaping plans and for runoff/stormwater controls (prohibit invasive and exotic species).
- Require use of BMPs and encourage use of above ground BMP instead of underground stormwater conveyance systems.
- Prohibit direct discharge of stormwater into wetlands, streams, or other surface waters without pre-treatment.
- Require periodic monitoring of BMPs to ensure they are working properly and require maintenance of all stormwater BMPs.
- Require BMP long-term operation and maintenance (O&M) plans be signed before plans are approved.
- Require developers to consult with MDEQ or other professionals about threatened/endangered species on site.

The ways in which neighborhoods and commercial areas are designed and the use of LID can reduce the amount of runoff and pollutants resulting from development. Building residential areas near community services and schools reduce impacts of traffic and the need for additional infrastructure. Increasing the amount of pervious surfaces and naturalized areas where water can slowly infiltrate are examples of effective ways to reduce the impact of new development.

ACTION C - CAPITAL IMPROVEMENTS PROGRAM

A multi-year capital improvements program should be developed as a guide to future county government capital improvements. Such a program can aid in maximizing return on capital investments through proper planning and timing of such improvements.

Additional Guidance: The development of a Capital Improvement Program (CIP) should be an iterative process responding to the County's needs and priorities. As limited resources continue to be a challenge, County officials face difficult decisions involving the allocation of those resources between operational and capital costs. Having a structure in place for prioritizing those needs allows the County to make informed decisions and those that are in the best interest of its residents. The coordination of the Master Plan with the CIP will integrate resource protection into those projects and ensure the County valued resources will be available for future generations. The following are suggestions that can be taken into consideration when a CIP is developed by the County:

- Link the CIP with the protection of the health, safety, and welfare of residents in the Master Plan.
- Include policies related to natural resource protection.
- Include standards as the basis for design of stormwater and sanitary systems.
- Include capital improvement for installation, maintenance, and replacement of sanitary and stormwater utilities.

- Call for the use, maintenance, and replacement of stormwater BMPs.

ACTION D - RECREATIONAL PLANNING

Branch County's Five Year Recreation Plan should be maintained to assure appropriate planning and to maintain eligibility for state/federal grant funding.

Additional Guidance:

- Gain MDNR approval of Recreation Plan every 5 years.
- Identify priority lands for acquisition or protection for future recreational use in Recreation Plan.

ACTION E - HOUSING PLANNING

Planning for and assessment of housing needs should continue to address the shelter needs of county residents and to maintain eligibility for state/federal grant funding.

Additional Guidance: Remediation measures to increase efficiency and conservation can mitigate the impact of development when proper siting and design of development are not sufficient to control runoff and pollutants resulting from development. Practices such as restored wetlands and retention basins are examples of infrastructure practices mitigating the impacts of development on water resources. Maintenance activities on buildings and building sites can include water reuse, and street and parking lot sweeping.

ACTION F - SOLID WASTE MANAGEMENT

Planning should continue under the Solid Waste Management Act (Act 641) to properly plan for future solid waste recycling, reuse and disposal.

Additional Guidance: The goal of solid waste management should be to reduce the amount of waste going into landfills. Providing easy access to recycling and hazardous waste collection services will encourage recycling during construction and occupancy of buildings and housing developments.

ACTION G - TRANSPORTATION NEEDS PRIORITIES

Cooperative efforts among the county and municipalities should continue to develop and maintain a transportation (capital) improvements program to assure maximum efficiency and effectiveness of county transportation investments.

Additional Guidance: Programs should be implemented with the goal of providing access to transportation for people to conduct their daily activities. Another goal is to reduce the number of automobile trips generated by new development, which leads to saving gas and cleaner air. Alternative transportation options provide safe, convenient, and comfortable transit facilities and positive experiences while waiting for a bus.

ACTION H - SPECIAL STUDIES

As needed, the county government should support special studies to assure that relevant information is brought to bear on decision-making related to the county residents and resources. Collaborative efforts should be encouraged to maximize participation among potentially impacted parties.

Additional Guidance: Funding options should be investigated for conducting additional studies and projects assisting the County in implementing the recommendations in this report. Several partners in the area are involved in resource protection and would welcome the County as an active participant in these efforts.

CONCLUSIONS

The recommendations listed in this report would improve plans and policies in the County to better protect water quality and natural resources. To work toward that, the County approved a motion in December 2012 to encourage this policy review document is referenced, reviewed, and/or adopted as part of future Master Planning revisions.

Introducing new concepts to local officials requires substantial time and effort spent on presenting information to gain a level of comfort with the new techniques. The document review sheet (Appendix 1) can continue to guide future work for both an updated Master Plan and a model zoning ordinance. Further, some municipalities which applied for assistance did not receive it because of limited resources. This document and the policy review spreadsheet should be used as a review tool and the language developed for the County could be applicable to other communities within the County.

If development were focused in the identified areas illustrated in Figure 1, a score would be achieved to earn LEED ND certification. The benefit of earning LEED ND certification for a development is recognition of protecting and enhancing the overall health, natural environment, and quality of life of our communities, which contributes to the overall character and appeal of a community. Communities that are walkable, energy efficient, and have accessible natural resources are increasing in demand as the population ages, and energy costs rise. LEED ND certified projects could contribute to the County's sustainability through improving efficiency, contributing to economic development, protecting the natural environment, strengthening energy independence, supporting climate protection, building healthier communities, and enhancing the quality of live (USGBC, 2008).

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of watershed protection and other areas that could be enhanced for greater resource protection. Assessing the current development rules and the identification of the impediments to innovative site design will assist the community to create and implement better development designs.

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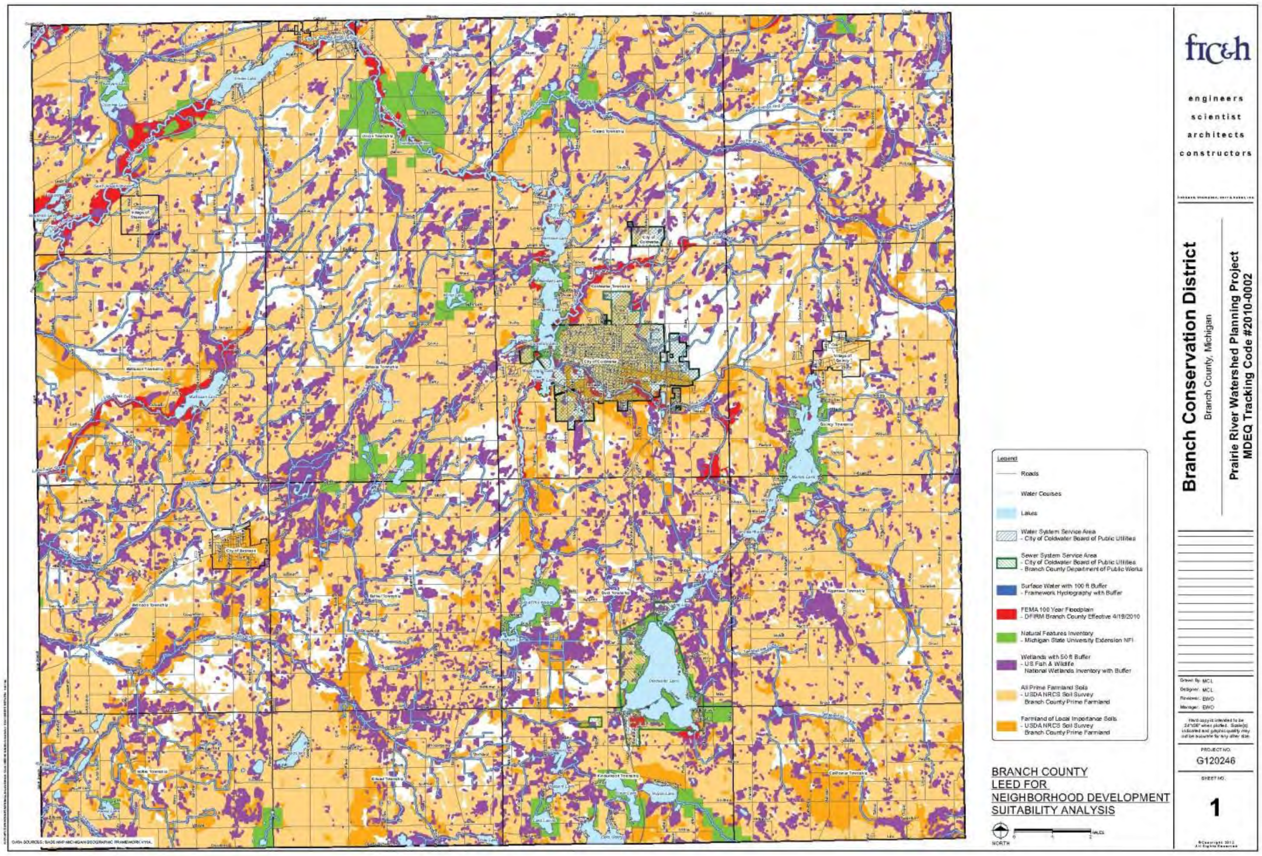
Figures


fTC&h
engineers
scientist
architects
constructors
Branch Conservation District
Branch County, Michigan
Prairie River Watershed Planning Project
MDEQ Tracking Code #2010-0002
Legend
Roads
Water Courses
Lakes
Water System Service Area
- City of Coldwater Board of Public Utilities
Sewer System Service Area
- City of Coldwater Board of Public Utilities
- Branch County Department of Public Works
Surface Water with 100 ft Buffer
- Framework Hydrography with Buffer
FEMA 100 Year Floodplain
- DFIRM Branch County Effective 4/19/2010
Natural Features Inventory
- Michigan State University Extension NFI
Wetlands with 50 ft Buffer
- US Fish & Wildlife
National Wetlands Inventory with Buffer
All Prime Farmland Soils
- USDA NRCS Soil Survey
Branch County Prime Farmland
Farmland of Local Importance Soils
- USDA NRCS Soil Survey
Branch County Prime Farmland
BRANCH COUNTY
LEED FOR
NEIGHBORHOOD DEVELOPMENT
SUITABILITY ANALYSIS
NORTH
Drawn By: MCL
Designer: MCL
Reviewer: EWO
Manager: EWO
PROJECT NO.
G120246
SHEET NO.
1

Appendices

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Watershed Issues		
I. Watershed Activities		
A. Plans and Policies:		
1. Does the Master Plan identify the watershed(s) in which the community is located?	No	Section III B 4 a. Surface Water (Page 9) describes all surface waters but not in a watershed context.
2. Does the Master Plan call for protection of watershed resources in order to protect the health, safety and welfare of residents?	No	Section I C 7 Develop Generalized Land Use Plan (Page 4) states "...national standards have been developed for land development to ensure adequate community health and safety", but is not directly related to watershed resources.
Stream Corridors and Flood Plains		
I. Stream Corridors		
A. Plans and Policies:		
1. Does the Master Plan indicate the importance of any of the following: riparian buffers to assist in flood control, protect the streambank from erosion, remove pollutants from storm water runoff, provide food and habitat for wildlife, prevent sediment from settling in the water course, provides tree canopy to shade streams, and promote desirable aquatic organisms, scenic value and recreational opportunities?	No	Part Two. Section 3 E. Recreational and Open Space Development (Page 28) identifies goal to enhance the County's natural features, but does not list specifics or the importance of doing so.
2. Does the Master Plan state that protection of stream corridors is important in promoting the health, safety and welfare of residents through flood control, and water quality and riparian corridor preservation?	No	Does not relate protection to public health, safety and welfare.
B. Development / Redevelopment Regulations:		
1. Are regulations coordinated with regulations protecting County drains?	No	Branch County Drain Commissioner reviews all site plan that impact a County Drain
2. Does the community require naturally-vegetated buffers along drainage way corridors?	No	Consideration in BCDC site plan review.
a. What is the width of the corridor?	n/a	
3. Does the community restrict development adjacent to stream corridors to those which do any of the following: offer no danger of topographical disturbance to the corridor, degradation to water quality, increased runoff, sedimentation, stream channel alterations, or degradation of dependent, non-hydrologic resources (i.e. flora and fauna)?	No	Consideration in BCDC site plan review.
4. Are waterbody setbacks in place of at least 30-50 feet?	No	
II. Flood Control		
A. Plans and Policies:		
1. Does the Master Plan identify floodplain protection as important for any of the following to promote the health, safety and welfare of residents: flood control, stream bank protection, pollutant filter, wildlife habitat, reduce sedimentation, shade watercourse and provide scenic value and recreational opportunities?	Yes	Part Two: Section 3 A. Residential Development (Page 26) states as Objective d: Prohibit residential development in flood prone areas and regulate residential development in natural areas which would be severely damaged by uncontrolled development. Section 3 E. Recreational and Open Space Development (Page 28) states as Objective d. Prohibit floodplain development except for recreational purposes.
2. Does the community call for coordination of their efforts to protect the floodplain with adjoining communities and the County?	Yes	Section 1. Introduction. It shall be the duty of the county planning commission to ...(4)consult with representatives of adjacent counties in respect to their planning so that conflicts in overall county plans may be avoided.
B. Development / Redevelopment Regulations:		
1. Does the community participate in the National Flood Insurance Program?	Yes	Branch County has a revised FIS and revised FIRM now in effect (or will be become effective soon). The effective date of the revised study and maps is 4/19/10. The County GIS maintains all floodplain maps for communities.
2. If yes, does the community have an overlay zone or other ordinance language that protects floodplains from undesirable development?	No	
3. Do the community's floodplain regulations address the following:		
a. Provide for assessing the impacts of flood management projects on water quality?	No	Consideration in BCDC site plan review.
b. Provide for adding BMP's to existing projects?	No	Consideration in BCDC site plan review.
4. Is there a variable width, naturally vegetated buffer that encompasses the 100 year floodplain area?	No	Consideration in BCDC site plan review.
Impervious Surface Reduction		

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
I. Reducing Impervious Surfaces		
A. Plans and Policies:		
1. Does the Master Plan call for minimizing impervious surfaces in new construction and redevelopment projects to reduce the amount of runoff and improve infiltration?	No	
2. Is the Master Plan goal of reducing impervious surface tied to protecting the health, safety and welfare of residents through protection of water quality, natural features and open space?	No	
II. Parking Lots/Driveways/Sidewalks		
A. Development / Redevelopment Regulations:		
1. Does the community have flexibility in the parking ordinance to reduce the number of spaces constructed if warranted by the proposed development?	No	
2. Is some portion of a parking lot required to be planted with trees/vegetation within the parking lot paving?	No	
3. Does the community require stormwater treatment for parking lot runoff in landscaping areas?	No	Consideration in BCDC site plan review
B. Design Standards:		
1. Are shared parking facilities encouraged?	No	
2. Is 30% of the parking area required to have spaces with smaller dimensions for compact cars? (9ft-width and 18ft - length or less)?	No	
3. Is there a maximum on parking spaces size (9ft-width and 18ft - length or less)?	No	
4. Are developers encouraged to use parking lot islands as stormwater infiltration areas?	Yes	Consideration in BCDC site plan review
5.Are driveways or overflow parking areas allowed to be pervious or porous pavements?	Yes	Consideration in BCDC site plan review
6. Are maximum spaces given instead of minimum (for office bldgs - 3spaces/1000ft2; shopping - 4.5 spaces/1000ft2; residential - 2 spaces/single family home)?	No	
7. Are sidewalks only allowed to be on one side of the road?	No	
8. Are sidewalks eliminated if an alternative path is provided?	No	
III. Street and Access		
A. Development / Redevelopment Regulations:		
1. Does the community have jurisdiction over roads or allow private roads?	Yes	BCRC Minimum Specifications for Construction of Roads and Streets, Section 2 C Private Road Specification on new Private Roads (Page 4). Any private drive platted must meet all design requirements of a public road with the exception of those private drives that may be a continuance to an existing drive if there exists no chance for the original drive to be improved to public road specifications.
2. If yes, do regulations pertaining to roads include the following standards:		
a. Are streets to be designed with the minimum required pavement width needed to support travel lanes, emergency, maintenance and service vehicles (18-22 ft for low traffic roads)?	Yes	BCRC Minimum Specifications for Construction of Roads and Streets. Section 7.E Surface (Page 9). Current paving standards are as follows (1) 20' wide;330#/sq. yd. MDOT Spec 13A with binder P.G. 64-22 on gravel in Section 7C & D above placed in two equal courses or (2) 20' wide, 7" non-reinforced concrete on gravel as in Section 7C & D above.
b. Are right-of-way widths minimized to avoid mass clearing and grading (less than 45 feet)?	No	BCRC Minimum Specifications for Construction of Roads and Streets pg 4 - "All roads and streets shall have a minimum right-of-way width of 66'. A minimum of 33' from the centerline is required dedicated to the use of public on all existing public roads."
c. Are there required landscaped areas in cul-de-sacs?	No	
d. Are the minimum radii of cul-de-sacs no more than 35 feet?	No	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5). ". . . a cul-de-sac or turn-around shall be constructed with a minimum right-of-way radius of 50'. The surfaced area of such cul-de-sac shall have a minimum of 40' radius."
e. Are hammerheads allowed instead of cul-de-sacs?	No	
f. Are the use of open swales allowed instead of curb and gutter?	Sometimes	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5). If the proposed roadway intersects on existing primary road curbing is required.
g. If curb and gutter is used, are perforated curbs (allows water to flow into swales) or invisible curbs (flush with road surface) required?	No	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5).The curbs shall meet the Michigan Department of Transportation (MDOT) B2 Curb Specification and follow MDOT 2003 Standard Specification for construction Section 802.02 and 802.3 except 802.03 G.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
IV. Lot Setbacks / Lot Width / Lot Coverage		
A. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance allow for the relaxation of side yard setbacks and narrower frontages to reduce the total road length (and overall site imperviousness)?	n/a	No County Zoning Ordinance
2. Does the Zoning Ordinance allow for the relaxation of front yard setbacks to reduce driveway lengths (and overall site imperviousness)?	n/a	No County Zoning Ordinance
3. Does the Zoning Ordinance allow the location of bioretention, rain gardens, filter strips and swales in required setback areas and common areas?	n/a	No County Zoning Ordinance
4. In rural, low density areas are there limits on impervious lot coverage (15% maximum includes all impervious surfaces not just the house)?	n/a	No County Zoning Ordinance
5. Are there limits on the extent of lawn area on residential lots in rural areas?	n/a	No County Zoning Ordinance
The Development Review Process		
I. Site Plan Review		
A. Development / Redevelopment Regulations:		
1. Is the review process coordinated with the receipt of applicable County and State permits?	Yes	Review process coordinated with Soil Erosion permits and impacts to County Drains.
2. Does the Zoning Ordinance require that developers preserve natural features, such as lakes, ponds, streams, floodplains and floodways, wetlands, woodlands, steep slopes, and natural drainage patterns to the fullest extent possible?	No	Consideration in BCDC site plan review.
3. Are BMP's required to be labeled and shown, in detail, on the site plan so that they can be reviewed for effectiveness during the site plan review process?	Yes	Consideration in BCDC site plan review.
4. Is a Soil Erosion and Sedimentation Control Plan required as part of the site plan review process?	Yes	Required by BCDC
5. Are developers required to show all natural features on site plans, such as lakes, ponds, streams, rivers, floodplains and floodways, wetlands, woodlands, steep slopes, and natural drainage patterns?	Yes	Consideration in BCDC site plan review.
II. Pre-Construction Meetings		
A. Development / Redevelopment Regulations:		
1. Is the construction sequence required to start with a pre-construction meeting?	No	
III. Construction		
A. Plans and Policies:		
1. Does the community chart the progress of all construction projects to ensure that they are in compliance with the approved site plan?	No	
B. Development / Redevelopment Regulations:		
1. Is a Pre-winter meeting required to assess whether the existing soil cover will provide adequate soil erosion and sedimentation control during winter months?	No	
Land Conservation and Development Techniques		
I. Open Space / Park Acquisition		
A. Plans and Policies:		
1. Does the Master Plan and/or Recreation Master Plan call for community acquisition of open space?	Yes	Branch County Recreation Plan 2012-2017. Goal 3 - Retain public land for future generations. Objective: Retain existing parkland and acquire new public lands to meet the recreational needs of the community.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
2. Does the Master Plan and/or Recreation Master Plan recognize the importance of open space preservation as a way to protect the health, safety and welfare of residents, protect vital air, land and water resource quality, to buffer air and noise pollution, preserve wildlife habitat, and preserve aesthetic values and the community's beauty?	No	Part Two. Section 3.A. Residential Development (Page 26) states a Goal to: Provide adequate year-around recreation facilities to meet the needs of the County and preserve and enhance the County's natural features, but does not recognize the importance.
II. Conservation Easement and Similar Tools		
A. Plans and Policies:		
1. Does the Master Plan call for the use of conservation easements or other tools to conserve open space in the community?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28) has several objectives that call for conservation of open space and natural areas.
III. Clustering and Open Space Developments		
A. Plans and Policies:		
1. Does the Master Plan include goals to preserve natural features and protect the quality of vital air, land, and water resources while accommodating development?	Yes	Part Two. Section 3.A. Residential Development (Page 26) states several objectives that promote growth and development in a controlled and orderly manner and does not damage natural areas.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
B. Development / Redevelopment Regulations:		
1. Does the community have a Clustering and/or Open Space Ordinance?	Yes	Branch County Farmland and Open Space Preservation Ordinance, Ordinance Number 17, Adopted: September 12, 2007, Effective: September 12, 2007
2. Are flexible site design criteria available for developers that use open space or cluster design options? (Ex. Relaxed setback widths and lessened sidewalk requirements.)	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
3. Are open spaces required to be consolidated into larger units (contiguous), or required to be a minimum size or width?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
4. Does the open space have to be managed in a natural condition?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
5. Are the types of uses allowed in the open space restricted to low impact uses?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
6. Is open space required to be protected through a conservation easement or other similar mechanism?	No	Not required, but encouraged. Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f. Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.
7. Are incentives put into place to encourage open space development?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
a. Are bonus densities utilized as an incentive?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
8. Do all Planned Unit Developments require open space?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
IV. Urbanized Communities		
A. Plans and Policies:		
1. Are infill developments encouraged in areas that already have significant development?	Yes	Part Two. Section 3.C. Commercial Development (Page 27). Objective e. Encourage major commercial and service facilities to locate in downtown areas or in cluster developments (shopping centers) where essential public services can be economically provided and traffic can be accommodated without increasing traffic congestion.
B. Design Standards:		
1. Are infill and redevelopment projects encouraged to promote conservation and natural resource preservation?	Yes	Part Two. Section 3.A. Residential Development (Page 26) Objective d. Prohibit residential development in flood prone areas and regulate residential development in natural areas which would be severely damaged by uncontrolled development.
2. Are re-development projects required to coordinate improvements with existing facilities and infrastructure?	No	emailed Michael Hard
V. Rural Communities		
A. Plans and Policies:		
1. Is agriculture described in the Master Plan as an economically viable profession in the community?	Yes	Part Two. A. Agriculture. 2 Advantages. c. agriculture provides a financially strong economic aspect to the county.
2. Have prime and unique agricultural lands been identified and mapped in the Master Plan?	No	Part Two. Section 3.B. Agricultural Development (Page 26) Objective a. Develop definite criteria for the designation of the most productive farmlands in the County and take steps to encourage long-term commitments to agricultural activities in the identified areas.
B. Development / Redevelopment Regulations:		
1. Has the community designated an Agricultural Zoning District?	No	No County Zoning Ordinance
2. Does the Agricultural Zoning District utilize a method such as sliding scale to limit fragmentation of farmland and to less conflicts between farming and residential uses?	No	No County Zoning Ordinance
3. Does the Agricultural Zoning District utilize setbacks or buffers for any new residential development?	No	No County Zoning Ordinance
4. Does the Agricultural Zoning District also consider the preservation and protection of natural features, such as wetlands or groundwater?	No	No County Zoning Ordinance
Recreation Plan		
A. Plans and Policies		
1. Has a Recreation Plan been approved by MDNR within the last 5 years that identifies priority lands for acquisition or protection for future recreational use?	No	Approved by MDNR? Branch County Recreation Plan 2012-2017. Goal 3 - Retain public land for future generations. Objective: Retain existing parkland and acquire new public lands to meet the recreational needs of the community. No identification of future acquisition.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Wetland Preservation		
I. Inventory		
A. Plans and Policies:		
1. Does the Master Plan include a map of wetlands?	No	Branch County Recreation Plan 2012-2017 does includes Figure 6 - Map of waterways, woodlands and wetlands
II. Wetlands Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of wetlands, and the functions they play in protecting residents' health, safety and welfare from problems such as flooding and poor water quality?	No	No reference to importance of wetlands in Master Plan although the Recreation Plan states: Woodlands and wetlands are also important natural resources to be considered when planning for parks and resource protection. They are unique ecosystems that provide important wildlife habitat and natural scenic beauty.
2. Does the Master Plan call for the protection of wetlands within an ecosystem context (protecting adjacent uplands, waterways, and vegetated buffers as well)?	No	Encourages protection but not in ecosystem context. Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f: Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.
B. Development / Redevelopment Regulations:		
1. Has the community adopted a local wetlands ordinance that protects wetlands less than five acres in size?	No	No County Zoning Ordinance
2. Is this ordinance coordinated with the State's wetlands regulations?	No	No County Zoning Ordinance
3. Are there building and a no-disturbance setback requirements from wetland areas (at least 20-30 feet)?	No	No County Zoning Ordinance
Lake Management		
A. Plans and Policies:		
1. Does the Master Plan have a map of lakes?	No	Branch County Recreation Plan 2012-2017 does includes Figure 6 - Map of waterways, woodlands and wetlands
2. Does the Master Plan discuss the values of lakes such as recreation, economic development, habitat, fisheries?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
B. Development / Redevelopment Regulations		
1. Does the zoning ordinance include an anti-funneling provision for waterbodies?	No	No County Zoning Ordinance
Habitat Preservation		
I. Natural Area Preservation / Restoration		
A. Plans and Policies:		
1. Does the Master Plan call for preservation of natural areas for wildlife habitat protection?	No	
2. Does the Master Plan link habitat preservation to protection of the health, safety and welfare of residents through natural resource preservation?	No	
3. Has the community identified high quality natural areas to be preserved?	No	No Land Use Map available
4. Does the community have a plan to protect the high priority areas?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f: Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
II. Native Plant Species		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of native vegetation in the protection of vital air, land and water resource quality, to buffer air and noise pollution, preserve wildlife habitat, and preserve aesthetic values and the community's beauty?	No	
B. Design Standards:		
1. Do the Design Standards specify the use of native plant species in the storm water system to help reduce storm water velocities, filter runoff and provide additional opportunities for wildlife habitat?	No	Consideration in BCDC site plan review.
2. Are invasive and exotic plants prohibited from being used?	No	Consideration in BCDC site plan review.
3. Does the site plan review process require developers to consult with the Michigan Department of Environmental Quality about Threatened/Endangered Species on site?	No	Consideration in BCDC site plan review.
Woodlands Preservation		
I. Inventory		
A. Plans and Policies:		
1. Has the community conducted a woodlands inventory and mapped this information?	No	Branch County Recreation Plan 2012-2017 includes Figure 6 - Map of waterways, woodlands and wetlands from Natural Resource Inventory, but County has not conducted an on-the-ground inventory.
II. Woodlands Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of woodlands to protect any of the following: water, air and soil quality, to buffer air and noise pollution, to moderate local climate and storm hazards, to preserve wildlife habitat, and to preserve aesthetic values and community beauty?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
2. Does the Master Plan recognize the importance of woodlands for storm water infiltration, thus reducing flooding and minimizing water pollution?	No	
3. Does the Master Plan identify woodlands as an important landscape feature that protects the health, safety and welfare of residents?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
B. Development / Redevelopment Regulations:		
1. Has the community adopted a local woodlands or tree protection ordinance?	No	
2. Are woodlands defined in a broad manner so that existing trees and remnant woodlands are also protected?	No	
3. Does the ordinance require replacement of trees that are removed?	No	
4. Does the ordinance minimize the clearing of a site?	No	
5. Are permits required to clear a site?	Yes	A Soil Erosion and Sedimentation Control permit is required if the clearing disturbs one or more acres of land; or is located with 500 feet of the Waters of the State regardless of the amount of land disturbed; or is located within 500 feet of a storm drain inlet regardless of the amount of land disturbed.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Greenways/Green Infrastructure		
I. Greenway/Green Infrastructure Plan		
A. Plans and Policies:		
1. Does the community have a greenway plan or support greenways/green infrastructure through its Master Plan or Recreation Master Plan?	No	
2. If yes, does this plan do the following:	n/a	
a. Identify greenways/green infrastructure as important natural transportation corridors for wildlife, and for the protection of other natural features?	n/a	
b. Connect many natural areas within the community?	n/a	
c. Connect the community's greenway/green infrastructure plan with adjacent communities', County's or regional greenway plans?	n/a	
Groundwater		
I. Mapping		
A. Plans and Policies:		
1. Do Master Plan goals call for the identification and mapping of groundwater recharge areas?	No	
2. Is a map of groundwater resources or groundwater recharge areas included in the Master Plan?	No	
II. Groundwater Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of the groundwater to the health, safety and welfare of its residents?	No	
2. Does the Master Plan identify groundwater as an important natural resource, and call for its protection?	No	
B. Development / Redevelopment Regulations:		
1. Is ground water considered in the zoning designations of parcels?	No	
2. Are there additional requirements for site plan submittals in groundwater recharge areas?	No	
III. Wellhead Protection		
A. Plans and Policies:		
1. Does this community have municipal well fields?	Yes	The cities of Bronson and Coldwater, and the villages of Quincy and Union City provide municipal water to their residents.
2. If yes, has the community done the following:		
a. Developed a wellhead protection program?	Yes	Bronson, Union City, Coldwater, Colon, Quincy have wellhead protection areas mapped.
b. Restricts high risk land use activities in wellhead protection areas?	Unknown	Do not know if these communities have Wellhead Protection Plans approved and in place.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Storm Water Management		
I. Storm Water Management Standards		
A. Plans and Policies:		
1. Does the Master Plan call for the preservation of natural features as parkland and/or in open space developments to help alleviate problems associated with storm water runoff?	No	
2. Does the Master Plan identify storm water management as an important community goal or policy?	No	
3. Does the Master Plan state both the quality and quantity of storm water are important issues to address in storm water management policies?	No	
4. Does the Master Plan relate storm water management to the protection of health, safety and welfare of the community's residents? (For example, storm water management can reduce flooding, improve water quality, etc.)	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance require that developers preserve natural drainage patterns to the fullest extent possible?	No	Consideration in BCDC site plan review.
2. Do you regulate storm water in your community?	No	BCDC oversees storm water management
3. If yes, are your regulations coordinated with the County's storm water regulations so that your rules do not contradict the County's?	n/a	
4. If your community regulates storm water, do your regulations address the following:		
a. Are there storm water guidelines that fully detail specific storm water design criteria?	No	
b. Maintain or establish buffer strips (between 30 and 100 feet wide) from the top of bank of any watercourse or surface water?	No	
5. Does the Zoning Ordinance include flood control and water resource protection performance standards?	No	
6. If yes, do they address the following to reduce the quantity of runoff and improve runoff quality:		
a. Limit land disturbance and grading?	No	
b. Maintain vegetated buffer strips and other existing vegetation to improve infiltration of storm water?	No	Consideration in BCDC site plan review.
c. Minimize impervious surfaces?	No	
d. Encourage the use of infiltration devices (such as filter strips, vegetated swales, sand filters, rain gardens, etc and allow for 72 hour ponding prior to infiltration?	No	Consideration in BCDC site plan review.
7. Are all development/redevelopment plans required to go to the County Drain Commissioner for review?	Yes	
II. Engineered Best Management Practices (BMP's)		
A. Plan and Policies		
1. Does the Master Plan include goals / policies that encourage the use of Best Management Practices (BMP's) to minimize, collect, and treat storm water?	No	

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance require the use of BMP's when possible?	No	
2. Does the Zoning Ordinance require the use of above ground BMP's instead of belowground storm water conveyance systems?	No	Consideration in BCDC site plan review.
3. Does the Zoning Ordinance prohibit direct discharge of storm water into wetlands, streams or other surface waters without pre-treatment?	No	Consideration in BCDC site plan review.
4. Does the Zoning Ordinance call for periodic monitoring of BMP's to ensure they are working properly?	No	
5. Does the Zoning Ordinance require that all storm water management systems and / or BMP's be maintained?	No	Consideration in BCDC site plan review.
C. Design Standards:		
1. Do the Design Standards provide minimum guidelines for BMP's that pre-treat and filter storm water, and retain storm water in a bio-retention facility?	No	Consideration in BCDC site plan review.
III. Infiltration		
A. Plans and Policies		
1. Does the Master Plan call for the preservation of natural features for the purpose of preserving the existing infiltration of storm water?	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance call for the use of BMP's that improve a site's infiltration potential?	No	Consideration in BCDC site plan review.
Erosion and Sedimentation Control		
I. Erosion and Sedimentation Control (ESC):		Drain Commissioner (Michael Hard) = CEA; BCRC = APA; Coldwater = APA & MEA
A. Plans and Policies:		
1. Is erosion and sedimentation control identified in the Master Plan as an important mechanism to protect the health, safety and welfare of residents through protection of water and soil resources?	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance address erosion and sedimentation controls?	No	No County Zoning Ordinance
2. If yes, is the program coordinated with the County's program?	Yes	The BCDC is the County Enforcing Agency and the BCRC is an Authorized Public Agency for administering Part 91 on their own projects.
3. If yes, does the community's program include the following standards?		
a. Require that soil erosion control measures be in place before granting a building permit?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 4. Building Permits.
b. Protect waterways and stabilize drainage ways by requiring mechanisms, such as silt fencing, at the edge of the waterway buffer and special crossing and diversion techniques at waterway crossings?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
c. Require that all erosion and sedimentation controls be maintained?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
d. Require that all erosion and sedimentation controls be monitored on a periodic basis?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
e. Methods to respond to public complaints regarding construction site erosion control?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
4. If no, does the community staff report erosion problems to the County enforcing agency?		
5. Are there any references in the Zoning Ordinance about compliance with the County Soil Erosion and Sediment Control Standards?	No	No County Zoning Ordinance
Sanitary Sewer Planning and Infrastructure		
I. Sanitary Sewer Planning and Infrastructure		
A. Plans and Policies:		

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
1. Does the Master Plan address sanitary sewer planning?	Yes	Part Two. 1. Land Use Trends. 4. Industrial Land Use. Development by many types of industries has avoided areas not served by sanitary treatment plants.
2. If yes, does the Master Plan tie sanitary sewer planning to protection of the health, safety and welfare of residents?	Yes	Part Two. 1. Land Use Trends. 4. Industrial Land Use. Increased concern over the liabilities associated with both past environmental pollution and the potential for future liability has caused industrial developers to focus efforts on new industrial park facilities. Development by many types of industries has avoided areas not served by sanitary treatment plants.
3. If yes, does the Master Plan address the following:		
a. Has the community delineated a Sewer Service Area?	No	Not a County Service. Section III.F.2.g. Utilities (Page 16). The cities of Bronson and Coldwater, and the villages of Quincy and Union City provide sanitary sewer to their residents. There is also a sanitary sewer district around Coldwater, Long and Lake George lakes. All other areas of the county are on septic tanks.
b. Has the Sewer Service Area been mapped, including all the facilities in the system (such as manholes, pipes, etc.)?	No	
c. Is the map to be used in zoning decisions?	No	No County Zoning Ordinance
II. Septic Systems		
A. Plans and Policies:		
1. Does the Master Plan identify areas that are suitable and unsuitable for septic systems?	No	Part Two. Section 3.5. d. Permit single-family residential development in areas not serviced by sanitary sewer provided lot sizes are consistent with public health requirements for septic systems and county residential and environmental policies.
2. Does the Master Plan state that community involvement in placement and maintenance of septic systems is critical to the health, safety and welfare of residents?	No	
B. Development / Redevelopment Regulations:		
1. Are regulations that pertain to septic systems coordinated with the County's regulations?	Yes	Part Two. Section 3.5. d. Permit single-family residential development in areas not serviced by sanitary sewer provided lot sizes are consistent with public health requirements for septic systems and county residential and environmental policies.
2. Does the Zoning Ordinance require that a septic system location be at least 100 feet from a lake, wetland, stream, or other water feature?	No	
3. Does the Zoning Ordinance specify a minimum isolation distance from residential and community wells?	No	
4. Does the Zoning Ordinance create septic maintenance districts?	No	
III. Minimizing Inflow		
A. Development / Redevelopment Regulations:		
1. Does the community prohibit connecting downspouts to the storm water system?	No	
2. Does the community have a program to identify and disconnect footing drains from sanitary sewer lines?	No	
3. Does the community promote rain barrels and rain gardens?	No	

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
IV. Illicit Discharge Elimination		
A. Plans and Policies:		
1. Has the community identified and/or mapped the community's drainage system, including all points of discharge and locations of illicit discharges to the drainage system?	No	
2. Does the community have a program for identifying illicit discharges, and eliminating them?	No	
3. Does the community have a program to identify sanitary sewer or septic systems that are seeping into the storm water system, surface waters or groundwater?	No	
Public Education		
I. Public Education Efforts		
A. Plans and Policies:		
1. Does the community have a system in place to distribute environmental education information?	Yes	Branch County website has Video TourBook and section for Links. http://www.countyofbranch.com/
2. Has the community encouraged residents to report illicit discharges or improper disposal of materials into storm drains or natural water bodies?	No	
3. Has the community educated commercial, industrial and institutional owners and tenants on how to reduce significant storm water pollutants?	No	
Pollution Prevention and Housekeeping Practices		
I. Storm Water System Maintenance		
A. Plans and Policies:		
1. Does the community have a program in place to regularly clean out, maintain and/or inspect structural controls (such as catch basins, vegetated swales, infiltration basins, sedimentation basins, etc.)?	Yes	DPW's responsibility
2. Does the community have a program that labels outfall structures that discharge runoff to natural systems?	No	
II. Roadways		
A. Plans and Policies:		
1. Does the community have jurisdiction over streets?	No	BCRC responsibility
2. If yes,		
a. Does the community sweep the streets monthly or more often in high construction areas?	No	
b. Does the community evaluate the amount of salt and/or sand that is applied to its roads in the winter?	No	
c. Does the community provide leaf collection in the fall?	No	

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

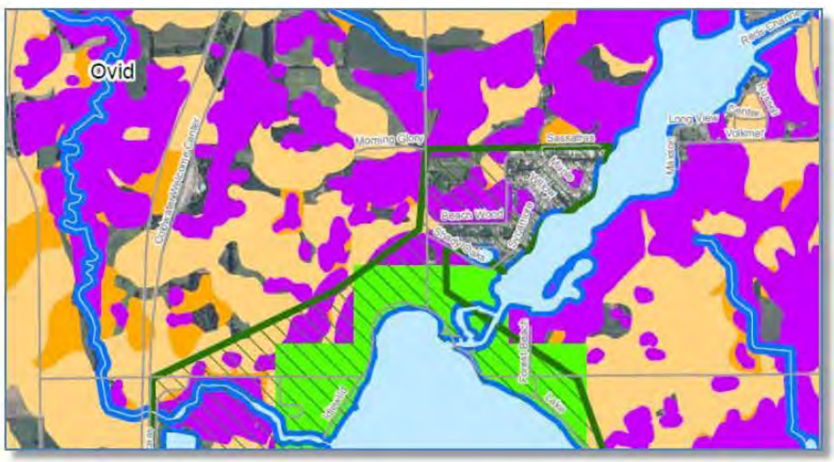
Criteria	Yes/No	Comments
III. Public Facilities Maintenance		
A. Plans and Policies:		
1. Does your community have a maintenance building?	Yes	DPW's responsibility
2. If yes, does the following occur:		DPW's responsibility
a. Confirm that floor drains are connected to a sanitary sewer, or sealed?	Yes	DPW's responsibility
3. Does the community maintain its own vehicles?	Yes	DPW's responsibility
4. If yes, is a regular schedule of maintenance followed?	Yes	DPW's responsibility
5. Are vehicles or other equipment maintained and cleaned where fluids and/or cleaning water will not flow into the street, gutter, storm drain or water body?	Yes	DPW's responsibility
IV. Landscaping Practices		
A. Plans and Policies:		
1. Does the community have a schedule of landscape maintenance practices for municipal property?	Yes	DPW's responsibility
2. Are employees trained on the proper application of chemical pesticides, herbicides and fertilizers?	Yes	DPW's responsibility
3. Are soils tested on municipal property before fertilizers are applied?	No	
4. Does the community use native vegetation in landscaping their properties?	No	
5. Does the community encourage landscaping with native plant species throughout the community?	No	
B. Development / Redevelopment Regulations		
1. Is a fertilizer ordinance in place that only permits zero-phosphorus fertilizer to be used?		
Animal Waste (Pets & Kennels)		
A. Plans and Policies		
1. Are residents educated about the availability, location, and requirements of properly disposing of pet waste?	No	
Capital Improvement Plan		
I. Capital Improvement Plan		
A. Plans and Policies:		
1. Does the community have a Capital Improvement Plan?	No	
2. If yes, does the Master Plan link the Capital Improvement Plan with the protection of the health, safety and welfare of residents?	n/a	
3. If a Capital Improvement Plan is in place, does the plan:	n/a	
a. Include policies related to natural resource protection?	n/a	
b. Include standards as the basis for design of storm water and sanitary systems?	n/a	
c. Include capital improvement for installation, maintenance and replacement of storm water utilities?	n/a	
d. Include capital improvement for installation, maintenance and replacement of sanitary sewer utilities?	n/a	
e. Call for the use, maintenance and replacement of storm water BMP's?	n/a	
Agricultural Manure Management		
A. Plans and Policies		
1. Are agricultural operators educated about the requirements of properly storing and applying manure?	No	
Wind Ordinance		
A. Plans and Policies		

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
1. Does a zoning district allow and promote the effective and efficient use of wind energy conversion systems?	No	

Prairie River Watershed
Policy Review Document for
Ovid Township
Branch County, Michigan



February 2013
MDEQ Tracking Code #2010-0002

Fishbeck, Thompson, Carr & Huber
engineers • scientists • architects • constructors

ftc&h

PRAIRIE RIVER WATERSHED PLANNING PROJECT

OVID TOWNSHIP

POLICY REVIEW DOCUMENT
MDEQ TRACKING CODE #2010-0002

FEBRUARY 2013
PROJECT NO. G120246

Michigan's Nonpoint Source Program

This nonpoint source pollution control project has been funded in part through the Michigan Nonpoint Source Program by the United States Environmental Protection Agency under assistance agreement C9975474-10 to the Branch Conservation District, for the Prairie River Watershed Planning project. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Fishbeck, Thompson, Carr & Huber, Inc. Engineers • Scientists • Architects • Constructors
1515 Arboretum Drive, SE, Grand Rapids, MI 49546 Telephone: 616-575-3824

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BCD	Branch Conservation District
BMP	Best Management Practice

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PRW	Prairie River Watershed
FTC&H	Fishbeck, Thompson, Carr & Huber, Inc.
LEED ND	LEED for Neighborhood Development
LID	Low Impact Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MS4	Municipal Separate Storm Sewer System
NPS	Nonpoint Source
NRCS	USDA Natural Resources Conservation Service
NREPA	Natural Resources and Environmental Protection Act
PRD	Policy Review Document
PUD	Planned Unit Development
SEMCOG	Southeast Michigan Council of Governments
SWMPC	Southwest Michigan Planning Commission
USEPA	U.S. Environmental Protection Agency
WMP	Watershed Management Plan

EXECUTIVE SUMMARY

The Prairie River flows west from its headwaters in the southwest corner of Branch County, Michigan, into St. Joseph County, where it empties into the St. Joseph River just south of Three Rivers, Michigan. The Prairie River Watershed (PRW) is experiencing very low development, similar to other areas around the state during this downturn in the economy. However, citizens are concerned that when growth does happen it will be in an uncontrolled manner and could jeopardize the quality of the watershed's valued resources.

The Prairie River Watershed Management Plan (WMP) stresses the importance of water resources as a vital component of land use decisions at the local level. Communities in the PRW are interested in achieving sustainable development, defined as economic growth that also protects the environment.

This Policy Review Document (PRD) provides an assessment of the Master Plan, Zoning Ordinances, and other development standards of Ovid Township that impact water quality. An examination of existing policies is crucial to provide for well crafted and complimentary municipal codes that reflect the desires of the diverse communities within the PRW. The current path of development in these communities can be evaluated through this process and redirected if necessary. Often, communities find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, which combines economic growth with the protection of natural resources.

Existing policies and regulations in Ovid Township were compared to accepted development principles as presented in various water resource protection guidebooks. A policy review spreadsheet was used to document the comparisons and identify compliance and discrepancies with the principles.

The assessment reviewed the status of land use planning and zoning in Ovid Township, and how well the rules and regulations address the concerns of the watershed. The results are summarized in Appendix 1.

Master Plan Revisions

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of watershed protection and other areas benefiting from modifications. Priority actions the township could take to improve resource protection include:

1. Update the Master Plan to reflect the success of implementation efforts.
2. Create Resource Protection Overlay District and update Future Land Use Map with identification of all natural resources and Resource Protection Overlay District delineation.
3. State the importance of a stormwater management plan with a goal of increasing infiltration and decreasing imperviousness in new construction and redevelopment to reduce the amount of stormwater runoff.
4. Incorporate the importance of stream corridor, floodplain, wetland, and woodlands protection.

Zoning Ordinance Revisions

A review of the Ovid Zoning Ordinances resulted in additional recommendations for the planning commission to consider incorporating into the existing Zoning Ordinances to improve measures for resource protection. The priority zoning concepts providing the most benefit and protection of water resources include:

- Requiring building setbacks from water bodies (streams, rivers, lakes, wetlands) with a native vegetative buffer.
- Modifying parking lot standards to reduce impervious surfaces (shared parking, parking space size, minimum parking requirements).
- Preserving open spaces by encouraging compact development in areas with existing infrastructure.
- Encourage low impact development techniques to reduce runoff and increase infiltration.
- Improve private road standards to reduce impervious surfaces.

Specific language that can be used to modify the sections within the Zoning Ordinance is included in the Recommendations Section of this report.

The Township's Master Plan outlines numerous tools and techniques that can be used to implement the Future Land Use Plan. Additional guidance was provided for each tool. The importance of developing an approvable Recreation Plan and a community-wide Capital Improvement Program is also described.

The use of the development principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources and preserving the rural character of the township.

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INTRODUCTION

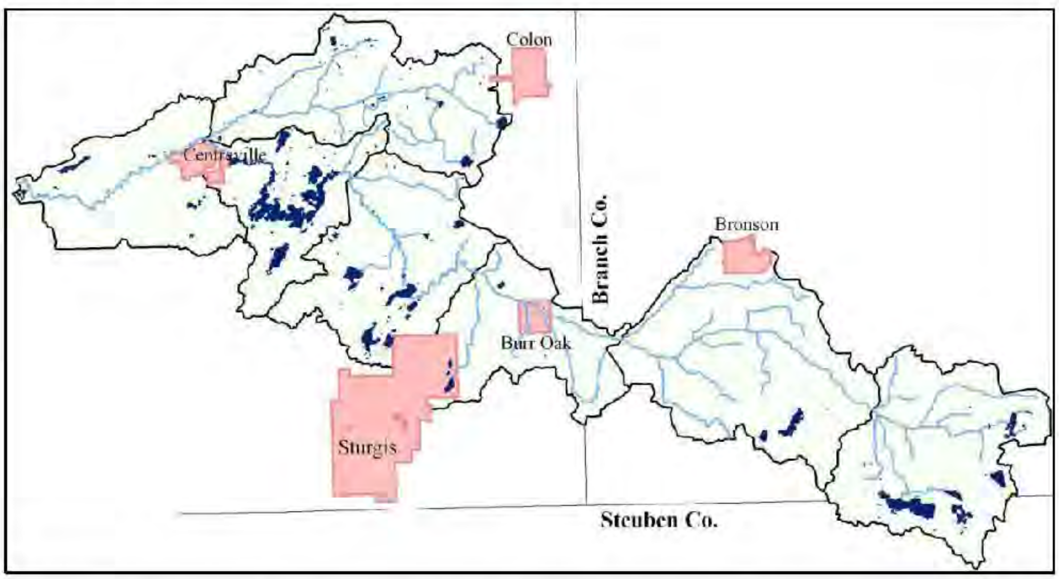
PURPOSE

The purpose of this PRD is to assist the County with implementation of generally accepted development standards and to identify impediments to innovative site design for the purpose of water resource protection. This policy assessment will provide a baseline to measure changes in the planning and management of growth in the County. The current path of development can be evaluated through this process and redirected if necessary. A similar assessment could be conducted in five years to determine if changes have been made to the rules and regulations increasing the level of watershed protection.

PRAIRIE RIVER WMP

The Branch Conservation District (BCD) is currently developing a WMP for the Watershed. The Watershed encompasses 128,644 acres in Branch and St. Joseph Counties, Michigan, and a small portion of Steuben County, Indiana (Exhibit 1).

Exhibit 1 - Prairie River Watershed



The WMP will include a complete evaluation of nonpoint source (NPS) pollutants and create an implementation plan to address resource concerns, problems, and needs, and outline solutions for known or suspected pollutants of the river. The public will be encouraged to participate, as well as other Stakeholders in the Watershed, to develop information and education (I&E) programs necessary for long-term sustainable land use planning. An examination of existing policies is crucial to provide for well-crafted and complimentary municipal codes reflecting the desires of the communities within the Watershed.

The Prairie River WMP has identified priority NPS pollution impairments as follows:

- Sediment in rivers, streams, and lakes
- Excess nutrients
- Streambank erosion
- *E. coli*
- Increased peak flow due to loss of wetlands

The goals described in the WMP will work toward all waterbodies meeting designated uses of:

- Other indigenous aquatic life and wildlife use
- Partial body contact recreational use
- Total body contact recreational use
- Coldwater fishery use
- Warmwater fishery use
- Agricultural use
- Navigational use
- Industrial water supply
- Public water supply

The Stakeholders in the Watershed have also indentified the following desired uses for the Watershed:

- Fish Habitat
  - Maintain healthy water temperatures to continue healthy coldwater fisheries
  - Elongate designated trout stream further upstream

- Protect and Enhance Indigenous Wildlife Habitat
  - Invasive remediation
  - Particularly where threatened, endangered, and special concerns depend on healthy habitats
  - Educate on identifying and procreation of invasive species
  - Educational signage at high-traffic boat launches (Nottawa, Gilead, etc.)

- Develop Coordination
  - Invasive management guide for lake communities
  - Implement “clean boats, clean waters” program at lakes in the Watershed
  - Promote Stakeholder involvement

- Maintain news articles and media presence

- Recreation
  - Maintain and enhance 32 navigable miles
  - Create volunteer group to help keep pathways open
  - Educate on improving navigability without impacting habitat especially aquatic habitats
  - Create a heritage water trail

- Agricultural
  - Maintain agricultural economy
  - Maintain rural character
  - Promote sustainable soil and water practices
  - Promote balanced irrigation practices
  - Promote practices addressing unrestricted livestock access and fuel tanks in riparian corridors

- Coordinated Land Use Planning
  - Low impact development (LID) in urban areas
  - Stormwater guidelines/ordinances where appropriate and desired
  - Develop or update resource tools pertaining to water quality for planning officials

- Maintain, Protect, Enhance, Create Wetland Areas
  - Create a priority list for wetland areas by function and use to promote to landowners on options for wetland enhancement

- Groundwater Protection
  - Promote healthy soil practices (particularly in areas where soil types are leaching soils)
  - LID practices in urban areas
  - Promote farm bill for spill protection (fuel pads - especially for irrigation in riparian zones)
  - Urban stormwater management
  - Determine current and future surface withdrawals and potential impacts

- *E. coli* Testing
  - Because of many unrestricted livestock areas, identify additional *E. coli* sites within the Watershed

- Bank Stabilization
  - Incorporate bank stabilization near boat launch areas where erosion is present
  - Incorporate native plantings at sites identified in the Watershed

- Natural Shoreline Program
    - Utilize program in identified sites

The objective of this policy review is to develop specific land-use recommendations using a watershed-based approach to achieve the WMP goals and desired uses. This effort will bring together County departments responsible for growth and development in the County to protect water quality and reduce NPS pollution through the revision and adoption of the Master Plan and the establishment of ordinances and policies supporting the vision of the Master Plan for natural resource protection.

BACKGROUND

A grant was awarded to the BCD to develop a WMP for the Watershed. As part of the grant, a task was defined to assist communities in assessing their policies and guidelines shaping how development occurs in their communities. State and local agencies recognize the time to plan for growth is now, when activity is low and time is available for a thorough review of policies and standards working together to improve quality of life.

LAND USE AND WATER RESOURCE PROTECTION

Local Land Use Decisions Have Regional Impacts. Residents, business owners, and local planners are not always aware of the impacts their individual actions might have on their natural surroundings. Cumulative effects of these actions are not considered in most development and land use decisions. A watershed planning perspective will encourage local planners and developers to look at the entire area contributing to a water body and determine its needs for management and protection. Often, communities find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. The Watershed is taking the first step in realizing the regional consequences of the local land use decisions, by evaluating current policies and implementing appropriate measures to enhance and protect water quality while experiencing growth and development. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, which combines economic growth with the protection of natural resources.

Development Impacts to Watercourses. One of the basic concepts accepted in watershed planning is the amount of impervious cover in a watershed directly relates to its water quality. Increased urbanization results in natural vegetation being replaced with hard surfaces, such as rooftops, roadways, and parking lots. The additional impervious area increases the rate and volume of surface water runoff and decreases water infiltration into the ground, as illustrated in Exhibit 2. Development reduces base flow, since water is not infiltrating, which causes perennial streams to become intermittent streams. When more of the water enters the streams as surface runoff, the bankfull channel flows create highly erosive conditions.

METHODOLOGY

POLICY REVIEW

FTC&H worked with the BCD to develop a worksheet listing water quality issues and outlines accepted development principles. BCD and Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) met with the County to review the worksheet and obtain the County's Master Plan and collect other policies, standards, ordinances, and guidance that the County has for growth and infrastructure management. These one-on-one meetings with the County helped ensure all documents were current and the intent of the development standards was understood. The following documents were reviewed:

- Master Plan (April 2011 - Updated "DRAFT" Master Plan)
- Branch County Recreation Plan 2012 to 2017
- Farmland Open Space Preservation Ordinance (Ordinance No.17)
- Branch County Road Commission (BCRC) Minimum Specifications for Construction of Roads and Streets
- SESC Ordinance

FTC&H reviewed the goals of the Master Plan and how other regulations succeed in upholding those goals. Additional documents were reviewed using the worksheet to evaluate their conformity to development principles for water resource protection.

Recommendations and suggestions for the County to consider in their future updates and planning and zoning decisions are included in the Recommendations section of this report.

The detailed results of the policy review are in table format in Appendix 1.

LEED FOR NEIGHBORHOOD DEVELOPMENT EVALUATION

FTC&H also evaluated the County's characteristics against LEED ND rating system's prerequisites to map areas where development would have the least impact on natural resources. The rating system encourages smart growth and new urbanist best practices, promoting the location and design of neighborhoods reducing vehicle miles traveled, and communities where jobs and services are accessible. It promotes more efficient energy and water use, especially important in urban areas where infrastructure is often overtaxed. The prerequisites of the LEED ND rating system are listed below:

Smart Location and Linkages

Smart Location

Imperiled Species and Ecological Communities Conservation

Wetland and Water Body Conservation

Agricultural Land Conservation

Floodplain Avoidance

Neighborhood Pattern and Design

Walkable Streets

Compact Development

Connected and Open Community

Green Infrastructure and Buildings

Certified Green Building

Minimum Building Energy Efficiency

Minimum Building Water Efficiency

For this report, the following layers were created in the Geographical Information System (GIS) to map the prerequisites applicable for mapping at the County level. Figure 1 - LEED for Neighborhood Development Suitability Analysis illustrates the results of the evaluation.

- Roads
- Natural Features Inventory - High probability of occurrence
- Wetlands and 50 foot buffer
- Water courses and 100 foot buffer
- Lakes
- Watershed boundary
- Prime Farmland and locally important soils
- Federal Emergency Management Agency (FEMA) 100-year floodplain
- Water and sewer system service areas

RECOMMENDATIONS

After completing the document review for the County, a list of recommendations based on the worksheet was developed and shared with the Planning Commission to incorporate into their Master Plan goals and objectives.

Watershed Issues

- Recognize subwatershed boundaries within the County (Figure 2).
- State the importance of watershed resources protection in order to protect the health, safety, and welfare of residents.

Stream Corridors and Floodplains

- State the importance of riparian buffers for streambank erosion protection, reducing pollutants in stormwater runoff, providing food and habitat for wildlife, preventing sedimentation in waterways, providing tree canopy to shade streams, and promoting scenic value and recreational opportunities (Figure 1, Layer: Water courses and 100 foot buffer).
- Connect the importance of protection of stream corridors to promoting health safety of residents (flood control, stream corridor protection, and water quality).

Impervious Surface Reduction

- State the importance of minimizing surfaces in new construction and redevelopment projects to reduce runoff and improve infiltration.
- Connect the reduction of impervious surfaces to the protection of water quality, natural features, and open space.

Land Conservation and Development Techniques

- Recognize the importance of open space preservation as a way to protect the health, safety, and welfare of residents; protect air, land, and water resource quality; buffer air and noise pollution; preserve wildlife habitat; and preserve aesthetic values and the community's beauty (Figure 3).
- Identify and map prime and unique agricultural lands (Figure 1, Layer: Prime Farmland and locally important soils).
- Encourage the use of conservation easements to conserve open space.

Wetland Protection

- Create a wetlands map (Figure 4).
- Recognize the importance of wetlands, and the functions they play in protecting residents' health, safety, and welfare from problems such as flooding and poor water quality (Figure 5).

- State the importance of wetlands protection within an ecosystem context (protecting adjacent uplands, waterways, and vegetated buffers as well).
- Support and encourage the establishment of a wetland mitigation banking program.

Lake Management

- Create a map of lakes in the County (Figure 1, Layer: Lakes).
- State the importance of the value of lakes for recreation, economic development, habitat, and fisheries.

Habitat Preservation

- State the importance of preservation of natural areas for wildlife habitat protection.
- Link habitat preservation to protection of the health, safety, and welfare of the resident.
- Identify and map high-priority natural areas (Figure 1, Layer: Natural Features Inventory - High probability of occurrence).
- State the importance of native vegetation to protect air, land and water quality; buffer noise and air pollution; preserve wildlife habitat; and preserve aesthetic value and community beauty.

Woodlands

- Conduct woodlands inventory and create existing woodlands map (Figure 3).
- State the importance of woodlands to protect water, air and soil quality; buffer air and noise pollution; moderate local climate and storm hazards; preserve wildlife habitat; and to preserve aesthetic values and community beauty.
- Recognize the importance of woodlands for stormwater infiltration, thus reducing flooding and minimizing water pollution.

Greenways and Green Infrastructure

- Create a greenways plan or encourage greenways and green infrastructure as important natural transportation corridors for wildlife, and for the protection of other natural features.

Groundwater

- Identify and map groundwater recharge areas.
- State the importance of groundwater to health, safety, and welfare of residents.
- State the importance of protecting groundwater as an important natural resource.
- Identify and map wellhead protection areas and state the importance of limiting high-risk land use activities in these areas.

Stormwater Management

- State the importance of preservation of natural features as parkland in open space development to help alleviate problems associated with stormwater runoff.
- State stormwater management as an important goal.
- Recognize that quality and quantity of stormwater are important issues to address in stormwater management policies.
- Relate stormwater management to the protection of health, safety, and welfare of community residents.
- Include policies encouraging the use of best management practices (BMPs) to minimize, collect, and treat stormwater.
- State the importance of preservation of natural features to preserve existing infiltration of stormwater.

Erosion and Sedimentation Control

- Identify erosion and sedimentation control as a mechanism to protect health, safety, and welfare of residents through protection of water and soil resources.

Sanitary Sewer Planning and Infrastructure

- Identify areas suitable and unsuitable for septic systems.
- State that community involvement in placement and maintenance of septic systems is critical to the health, safety, and welfare of residents (Figure 6).
- Identified and/or map designated county drainage systems, including all points of discharge to natural systems.
- Encourage a program for identifying and eliminating illicit discharges.
- Encourage a program labeling outfall structures discharging runoff to natural systems.

Renewable Energy

- Identify and map potential areas for wind energy to be generated.

The April 2011 Updated "DRAFT" Master Plan includes a section of "Branch County Goals and Objectives" based on the land uses identified in the County. Numerous objectives are listed in the Master Plan for each of the goals. Additional objectives, based on the recommendations above, could be added for each goal addressing resource protection and follow the Master Plan criteria for conformance with accepted development principles.

IMPLEMENTATION

The WMP outlines recommendations to meet the goals and objectives identified by the Watershed Steering Committee. Land use planning was determined to be an important part of the sustainability of the Watershed. This policy review is one component of the complex issue of land use planning, but will assist the County in identifying opportunities to protect natural resources.

Several recommendations contained in this policy review could involve changes not fully within the control of the County. Some might require State approval or legislative action. The County's elected officials should consider these issues when reviewing the recommendations of this report.

COMMUNITY RESPONSIBILITIES

The April 2011 draft Updated Master Plan lists "Recommendations for Implementation" prioritizing actions for the County to pursue. Additional guidance is provided to assist the County in implementing these recommendations below:

ACTION A - COMMUNITY LAND USE PLANNING

All land in Branch County is also in a township, village, or city. Consequently, the goals and objectives of this plan as related to land use are also subject to community planning policy and zoning regulations. Branch County government should encourage township, village, and city planning and zoning as a means of implementing the Master Plan.

Additional Guidance: The County should also update its own Master Plan and Land Use Map. The draft Master Plan states that "based on an evaluation of this information a proposed future land use map was developed to reflect this evaluation and serve as a basis of future zoning recommendations to the municipalities of Branch County," however, a map has not yet been produced. When communities in the Watershed are in the process of creating or updating their Master Plans, they must be aware of how the coordination of plans should occur. The health of a community and the natural resources are affected by development decisions. The County's Updated Master Plan does identify a role of the County's Planning Commission to consult with representatives of adjacent counties in respect to their planning so conflicts in overall county plans may be avoided. This concept should also be explicit in encouraging townships, cities, and villages consulting with each other, in respect to their planning, to have a coordinated effort in implementing the Master Plan.

The most effective (and cost-effective) approach to preventing or minimizing impacts to resources is by understanding the existing natural resource conditions of a site and by locating development in a non-sensitive area. Protection of critical natural resources should always be emphasized. Natural resource-base planning can be used to minimize runoff, pollutants, and impacts on natural resources.

Some Master Plans encourage cluster development to preserve open space, but few have implemented such tools. The use of the development principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources and revising the Master Plan, if necessary.

ACTION B - MODEL ZONING

In 1974 Branch County Government authorized the production of a model zoning ordinance to serve as a guide to township zoning. Through a contract between the Branch County Planning Commission and the Southcentral Michigan Planning Council (SCMPC) twelve townships have used the model to develop township zoning regulations. However, due to significant changes over the three decades, a new model ordinance should be developed to more properly guide the development and updates to township zoning ordinances.

Additional Guidance:

Development Principles Criteria for Zoning Ordinance: Water Resource Protection

- Develop County stormwater design criteria and development standards to regulate the volume and rate of stormwater runoff from development.
- Coordinate regulations with County Drain Commissioner's SESC program.
- Require naturally vegetated buffers along streams, lakes, and wetlands (50 to 100 feet).
- Require building and no-disturbance setback from wetlands (20 to 30 feet).
- Create overlay zone or other language protecting floodplains from undesirable development and a vegetated buffer encompassing the 100-year floodplain.
- Include details of requirements for establishing a wetland mitigation banking program.

Development Principles Criteria for Zoning Ordinance: Clustering and Open Space Development

- Require open space in planned unit developments (PUDs) of at least 40%.
- Utilize incentives to encourage use of open space development options (such as bonus densities, expedited plan review).
- Require open spaces to be consolidated into larger units when feasible.
- Require open spaces to be managed in a natural condition.
- List types of uses allowed in dedicated open space, restrict to low impact uses.

Development Principles Criteria for Site Plan Review (SWMPC, 2009)

- Require to show all natural features on site plans (wetlands, woodlands, streams, rivers, etc.).
- Require developers to preserve natural features and natural drainage patterns to the fullest extent possible (minimize site clearing).
- Coordinate with receipt of applicable county (drain, soil erosion) and state permits.
- Encourage use of BMPs improving a site's infiltration and have BMPs labeled and shown on the site plan.

- Require use of native or site suitable plants for landscaping plans and for runoff/stormwater controls (prohibit invasive and exotic species).
- Require use of BMPs and encourage use of above ground BMP instead of underground stormwater conveyance systems.
- Prohibit direct discharge of stormwater into wetlands, streams, or other surface waters without pre-treatment.
- Require periodic monitoring of BMPs to ensure they are working properly and require maintenance of all stormwater BMPs.
- Require BMP long-term operation and maintenance (O&M) plans be signed before plans are approved.
- Require developers to consult with MDEQ or other professionals about threatened/endangered species on site.

The ways in which neighborhoods and commercial areas are designed and the use of LID can reduce the amount of runoff and pollutants resulting from development. Building residential areas near community services and schools reduce impacts of traffic and the need for additional infrastructure. Increasing the amount of pervious surfaces and naturalized areas where water can slowly infiltrate are examples of effective ways to reduce the impact of new development.

ACTION C - CAPITAL IMPROVEMENTS PROGRAM

A multi-year capital improvements program should be developed as a guide to future county government capital improvements. Such a program can aid in maximizing return on capital investments through proper planning and timing of such improvements.

Additional Guidance: The development of a Capital Improvement Program (CIP) should be an iterative process responding to the County's needs and priorities. As limited resources continue to be a challenge, County officials face difficult decisions involving the allocation of those resources between operational and capital costs. Having a structure in place for prioritizing those needs allows the County to make informed decisions and those that are in the best interest of its residents. The coordination of the Master Plan with the CIP will integrate resource protection into those projects and ensure the County valued resources will be available for future generations. The following are suggestions that can be taken into consideration when a CIP is developed by the County:

- Link the CIP with the protection of the health, safety, and welfare of residents in the Master Plan.
- Include policies related to natural resource protection.
- Include standards as the basis for design of stormwater and sanitary systems.
- Include capital improvement for installation, maintenance, and replacement of sanitary and stormwater utilities.

- Call for the use, maintenance, and replacement of stormwater BMPs.

ACTION D - RECREATIONAL PLANNING

Branch County's Five Year Recreation Plan should be maintained to assure appropriate planning and to maintain eligibility for state/federal grant funding.

Additional Guidance:

- Gain MDNR approval of Recreation Plan every 5 years.
- Identify priority lands for acquisition or protection for future recreational use in Recreation Plan.

ACTION E - HOUSING PLANNING

Planning for and assessment of housing needs should continue to address the shelter needs of county residents and to maintain eligibility for state/federal grant funding.

Additional Guidance: Remediation measures to increase efficiency and conservation can mitigate the impact of development when proper siting and design of development are not sufficient to control runoff and pollutants resulting from development. Practices such as restored wetlands and retention basins are examples of infrastructure practices mitigating the impacts of development on water resources. Maintenance activities on buildings and building sites can include water reuse, and street and parking lot sweeping.

ACTION F - SOLID WASTE MANAGEMENT

Planning should continue under the Solid Waste Management Act (Act 641) to properly plan for future solid waste recycling, reuse and disposal.

Additional Guidance: The goal of solid waste management should be to reduce the amount of waste going into landfills. Providing easy access to recycling and hazardous waste collection services will encourage recycling during construction and occupancy of buildings and housing developments.

ACTION G - TRANSPORTATION NEEDS PRIORITIES

Cooperative efforts among the county and municipalities should continue to develop and maintain a transportation (capital) improvements program to assure maximum efficiency and effectiveness of county transportation investments.

Additional Guidance: Programs should be implemented with the goal of providing access to transportation for people to conduct their daily activities. Another goal is to reduce the number of automobile trips generated by new development, which leads to saving gas and cleaner air. Alternative transportation options provide safe, convenient, and comfortable transit facilities and positive experiences while waiting for a bus.

ACTION H - SPECIAL STUDIES

As needed, the county government should support special studies to assure that relevant information is brought to bear on decision-making related to the county residents and resources. Collaborative efforts should be encouraged to maximize participation among potentially impacted parties.

Additional Guidance: Funding options should be investigated for conducting additional studies and projects assisting the County in implementing the recommendations in this report. Several partners in the area are involved in resource protection and would welcome the County as an active participant in these efforts.

CONCLUSIONS

The recommendations listed in this report would improve plans and policies in the County to better protect water quality and natural resources. To work toward that, the County approved a motion in December 2012 to encourage this policy review document is referenced, reviewed, and/or adopted as part of future Master Planning revisions.

Introducing new concepts to local officials requires substantial time and effort spent on presenting information to gain a level of comfort with the new techniques. The document review sheet (Appendix 1) can continue to guide future work for both an updated Master Plan and a model zoning ordinance. Further, some municipalities which applied for assistance did not receive it because of limited resources. This document and the policy review spreadsheet should be used as a review tool and the language developed for the County could be applicable to other communities within the County.

If development were focused in the identified areas illustrated in Figure 1, a score would be achieved to earn LEED ND certification. The benefit of earning LEED ND certification for a development is recognition of protecting and enhancing the overall health, natural environment, and quality of life of our communities, which contributes to the overall character and appeal of a community. Communities that are walkable, energy efficient, and have accessible natural resources are increasing in demand as the population ages, and energy costs rise. LEED ND certified projects could contribute to the County's sustainability through improving efficiency, contributing to economic development, protecting the natural environment, strengthening energy independence, supporting climate protection, building healthier communities, and enhancing the quality of live (USGBC, 2008).

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of watershed protection and other areas that could be enhanced for greater resource protection. Assessing the current development rules and the identification of the impediments to innovative site design will assist the community to create and implement better development designs.

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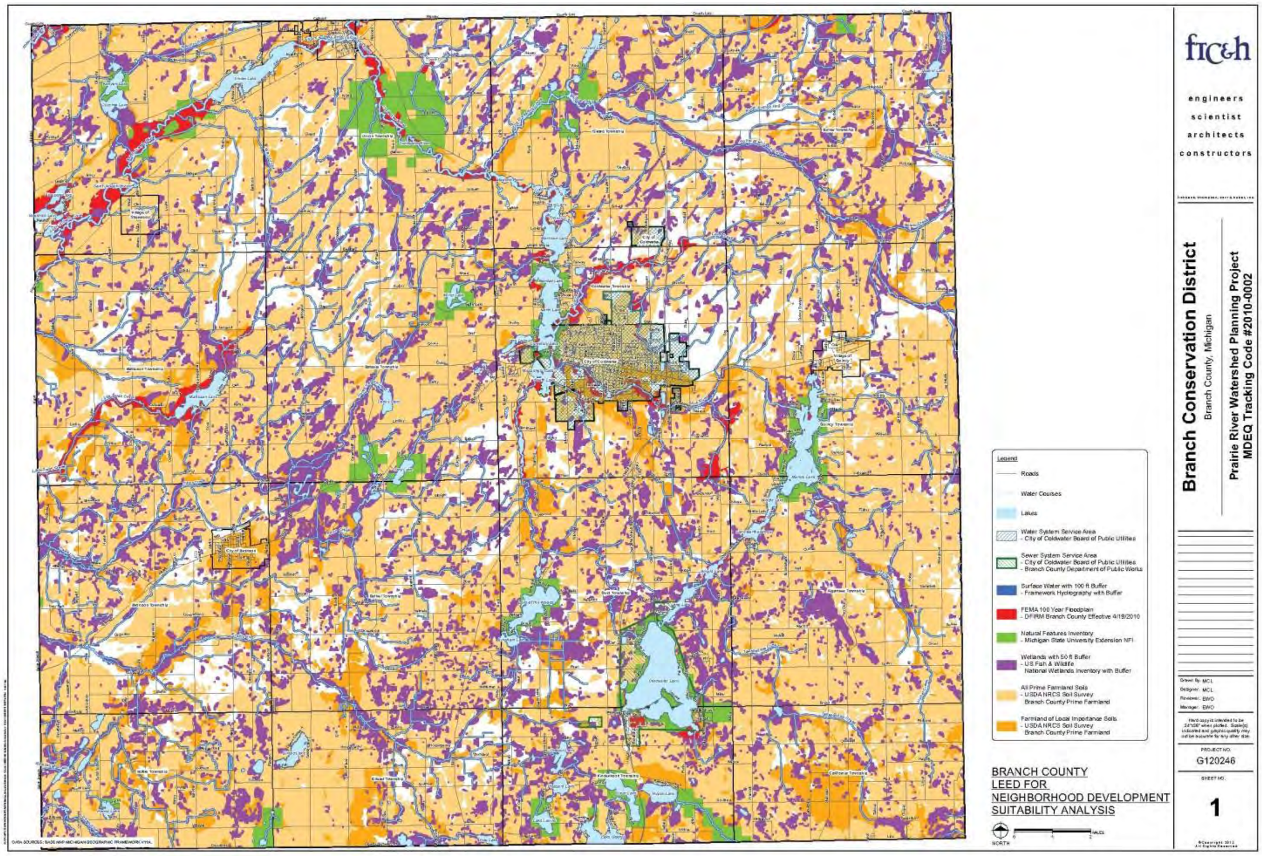
Figures


ftc&h
engineers
scientist
architects
constructors
Branch Conservation District
Branch County, Michigan
Prairie River Watershed Planning Project
MDEQ Tracking Code #2010-0002
Legend
Roads
Water Courses
Lakes
Water System Service Area
- City of Coldwater Board of Public Utilities
Sewer System Service Area
- City of Coldwater Board of Public Utilities
- Branch County Department of Public Works
Surface Water with 100 ft Buffer
- Framework Hydrography with Buffer
FEMA 100 Year Floodplain
- DFIRM Branch County Effective 4/19/2010
Natural Features Inventory
- Michigan State University Extension NFI
Wetlands with 50 ft Buffer
- US Fish & Wildlife
National Wetlands Inventory with Buffer
All Prime Farmland Soils
- USDA NRCS Soil Survey
Branch County Prime Farmland
Farmland of Local Importance Soils
- USDA NRCS Soil Survey
Branch County Prime Farmland
BRANCH COUNTY
LEED FOR
NEIGHBORHOOD DEVELOPMENT
SUITABILITY ANALYSIS
NORTH
PROJECT NO.
G120246
SHEET NO.
1

Appendices

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Watershed Issues		
I. Watershed Activities		
A. Plans and Policies:		
1. Does the Master Plan identify the watershed(s) in which the community is located?	No	Section III B 4 a. Surface Water (Page 9) describes all surface waters but not in a watershed context.
2. Does the Master Plan call for protection of watershed resources in order to protect the health, safety and welfare of residents?	No	Section I C 7 Develop Generalized Land Use Plan (Page 4) states "...national standards have been developed for land development to ensure adequate community health and safety", but is not directly related to watershed resources.
Stream Corridors and Flood Plains		
I. Stream Corridors		
A. Plans and Policies:		
1. Does the Master Plan indicate the importance of any of the following: riparian buffers to assist in flood control, protect the streambank from erosion, remove pollutants from storm water runoff, provide food and habitat for wildlife, prevent sediment from settling in the water course, provides tree canopy to shade streams, and promote desirable aquatic organisms, scenic value and recreational opportunities?	No	Part Two. Section 3 E. Recreational and Open Space Development (Page 28) identifies goal to enhance the County's natural features, but does not list specifics or the importance of doing so.
2. Does the Master Plan state that protection of stream corridors is important in promoting the health, safety and welfare of residents through flood control, and water quality and riparian corridor preservation?	No	Does not relate protection to public health, safety and welfare.
B. Development / Redevelopment Regulations:		
1. Are regulations coordinated with regulations protecting County drains?	No	Branch County Drain Commissioner reviews all site plan that impact a County Drain
2. Does the community require naturally-vegetated buffers along drainage way corridors?	No	Consideration in BCDC site plan review.
a. What is the width of the corridor?	n/a	
3. Does the community restrict development adjacent to stream corridors to those which do any of the following: offer no danger of topographical disturbance to the corridor, degradation to water quality, increased runoff, sedimentation, stream channel alterations, or degradation of dependent, non-hydrologic resources (i.e. flora and fauna)?	No	Consideration in BCDC site plan review.
4. Are waterbody setbacks in place of at least 30-50 feet?	No	
II. Flood Control		
A. Plans and Policies:		
1. Does the Master Plan identify floodplain protection as important for any of the following to promote the health, safety and welfare of residents: flood control, stream bank protection, pollutant filter, wildlife habitat, reduce sedimentation, shade watercourse and provide scenic value and recreational opportunities?	Yes	Part Two. Section 3 A. Residential Development (Page 26) states as Objective d. Prohibit residential development in flood prone areas and regulate residential development in natural areas which would be severely damaged by uncontrolled development. Section 3 E. Recreational and Open Space Development (Page 28) states as Objective d. Prohibit floodplain development except for recreational purposes.
2. Does the community call for coordination of their efforts to protect the floodplain with adjoining communities and the County?	Yes	Section 1. Introduction. It shall be the duty of the county planning commission to ... (4) consult with representatives of adjacent counties in respect to their planning so that conflicts in overall county plans may be avoided.
B. Development / Redevelopment Regulations:		
1. Does the community participate in the National Flood Insurance Program?	Yes	Branch County has a revised FIS and revised FIRM now in effect (or will be become effective soon). The effective date of the revised study and maps is 4/19/10. The County GIS maintains all floodplain maps for communities.
2. If yes, does the community have an overlay zone or other ordinance language that protects floodplains from undesirable development?	No	
3. Do the community's floodplain regulations address the following:		
a. Provide for assessing the impacts of flood management projects on water quality?	No	Consideration in BCDC site plan review.
b. Provide for adding BMP's to existing projects?	No	Consideration in BCDC site plan review.
4. Is there a variable width, naturally vegetated buffer that encompasses the 100 year floodplain area?	No	Consideration in BCDC site plan review.
Impervious Surface Reduction		

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Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
I. Reducing Impervious Surfaces		
A. Plans and Policies:		
1. Does the Master Plan call for minimizing impervious surfaces in new construction and redevelopment projects to reduce the amount of runoff and improve infiltration?	No	
2. Is the Master Plan goal of reducing impervious surface tied to protecting the health, safety and welfare of residents through protection of water quality, natural features and open space?	No	
II. Parking Lots/Driveways/Sidewalks		
A. Development / Redevelopment Regulations:		
1. Does the community have flexibility in the parking ordinance to reduce the number of spaces constructed if warranted by the proposed development?	No	
2. Is some portion of a parking lot required to be planted with trees/vegetation within the parking lot paving?	No	
3. Does the community require stormwater treatment for parking lot runoff in landscaping areas?	No	Consideration in BCDC site plan review
B. Design Standards:		
1. Are shared parking facilities encouraged?	No	
2. Is 30% of the parking area required to have spaces with smaller dimensions for compact cars? (9ft-width and 18ft - length or less)?	No	
3. Is there a maximum on parking spaces size (9ft-width and 18ft - length or less)?	No	
4. Are developers encouraged to use parking lot islands as stormwater infiltration areas?	Yes	Consideration in BCDC site plan review
5.Are driveways or overflow parking areas allowed to be pervious or porous pavements?	Yes	Consideration in BCDC site plan review
6. Are maximum spaces given instead of minimum (for office bldgs - 3spaces/1000ft2; shopping - 4.5 spaces/1000ft2; residential - 2 spaces/single family home)?	No	
7. Are sidewalks only allowed to be on one side of the road?	No	
8. Are sidewalks eliminated if an alternative path is provided?	No	
III. Street and Access		
A. Development / Redevelopment Regulations:		
1. Does the community have jurisdiction over roads or allow private roads?	Yes	BCRC Minimum Specifications for Construction of Roads and Streets, Section 2.C Private Road Specification on new Private Roads (Page 4). Any private drive platted must meet all design requirements of a public road with the exception of those private drives that may be a continuance to an existing drive if there exists no chance for the original drive to be improved to public road specifications.
2. If yes, do regulations pertaining to roads include the following standards:		
a. Are streets to be designed with the minimum required pavement width needed to support travel lanes, emergency, maintenance and service vehicles (18-22 ft for low traffic roads)?	Yes	BCRC Minimum Specifications for Construction of Roads and Streets. Section 7.E Surface (Page 9) Current paving standards are as follows (1) 20' wide;330#/sq yd. MDOT Spec 13A with binder P.G. 64-22 on gravel in Section 7C & D above placed in two equal courses or (2) 20' wide, 7" non-reinforced concrete on gravel as in Section 7C & D above.
b. Are right-of-way widths minimized to avoid mass clearing and grading (less than 45 feet)?	No	BCRC Minimum Specifications for Construction of Roads and Streets pg 4 - "All roads and streets shall have a minimum right-of-way width of 66'. A minimum of 33' from the centerline is required dedicated to the use of public on all existing public roads."
c. Are there required landscaped areas in cul-de-sacs?	No	
d. Are the minimum radii of cul-de-sacs no more than 35 feet?	No	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5). ". . . a cul-de-sac or turn-around shall be constructed with a minimum right-of-way radius of 50'. The surfaced area of such cul-de-sac shall have a minimum of 40' radius."
e. Are hammerheads allowed instead of cul-de-sacs?	No	
f. Are the use of open swales allowed instead of curb and gutter?	Sometimes	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5). If the proposed roadway intersects on existing primary road curbing is required.
g. If curb and gutter is used, are perforated curbs (allows water to flow into swales) or invisible curbs (flush with road surface) required?	No	BCRC Minimum Specifications for Construction of Roads and Streets. Section 4 Alignment (Page 5) The curbs shall meet the Michigan Department of Transportation (MDOT) B2 Curb Specification and follow MDOT 2003 Standard Specification for construction Section 802.02 and 802.3 except 802.03 G.

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Criteria	Yes/No	Comments
IV. Lot Setbacks / Lot Width / Lot Coverage		
A. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance allow for the relaxation of side yard setbacks and narrower frontages to reduce the total road length (and overall site imperviousness)?	n/a	No County Zoning Ordinance
2. Does the Zoning Ordinance allow for the relaxation of front yard setbacks to reduce driveway lengths (and overall site imperviousness)?	n/a	No County Zoning Ordinance
3. Does the Zoning Ordinance allow the location of bioretention, rain gardens, filter strips and swales in required setback areas and common areas?	n/a	No County Zoning Ordinance
4. In rural, low density areas are there limits on impervious lot coverage (15% maximum includes all impervious surfaces not just the house)?	n/a	No County Zoning Ordinance
5. Are there limits on the extent of lawn area on residential lots in rural areas?	n/a	No County Zoning Ordinance
The Development Review Process		
I. Site Plan Review		
A. Development / Redevelopment Regulations:		
1. Is the review process coordinated with the receipt of applicable County and State permits?	Yes	Review process coordinated with Soil Erosion permits and impacts to County Drains.
2. Does the Zoning Ordinance require that developers preserve natural features, such as lakes, ponds, streams, floodplains and floodways, wetlands, woodlands, steep slopes, and natural drainage patterns to the fullest extent possible?	No	Consideration in BCDC site plan review.
3. Are BMP's required to be labeled and shown, in detail, on the site plan so that they can be reviewed for effectiveness during the site plan review process?	Yes	Consideration in BCDC site plan review.
4. Is a Soil Erosion and Sedimentation Control Plan required as part of the site plan review process?	Yes	Required by BCDC
5. Are developers required to show all natural features on site plans, such as lakes, ponds, streams, rivers, floodplains and floodways, wetlands, woodlands, steep slopes, and natural drainage patterns?	Yes	Consideration in BCDC site plan review.
II. Pre-Construction Meetings		
A. Development / Redevelopment Regulations:		
1. Is the construction sequence required to start with a pre-construction meeting?	No	
III. Construction		
A. Plans and Policies:		
1. Does the community chart the progress of all construction projects to ensure that they are in compliance with the approved site plan?	No	
B. Development / Redevelopment Regulations:		
1. Is a Pre-winter meeting required to assess whether the existing soil cover will provide adequate soil erosion and sedimentation control during winter months?	No	
Land Conservation and Development Techniques		
I. Open Space / Park Acquisition		
A. Plans and Policies:		
1. Does the Master Plan and/or Recreation Master Plan call for community acquisition of open space?	Yes	Branch County Recreation Plan 2012-2017. Goal 3 - Retain public land for future generations. Objective: Retain existing parkland and acquire new public lands to meet the recreational needs of the community.

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Criteria	Yes/No	Comments
2. Does the Master Plan and/or Recreation Master Plan recognize the importance of open space preservation as a way to protect the health, safety and welfare of residents, protect vital air, land and water resource quality, to buffer air and noise pollution, preserve wildlife habitat, and preserve aesthetic values and the community's beauty?	No	Part Two. Section 3.A. Residential Development (Page 26) states a Goal to: Provide adequate year-around recreation facilities to meet the needs of the County and preserve and enhance the County's natural features, but does not recognize the importance.
II. Conservation Easement and Similar Tools		
A. Plans and Policies:		
1. Does the Master Plan call for the use of conservation easements or other tools to conserve open space in the community?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28) has several objectives that call for conservation of open space and natural areas.
III. Clustering and Open Space Developments		
A. Plans and Policies:		
1. Does the Master Plan include goals to preserve natural features and protect the quality of vital air, land, and water resources while accommodating development?	Yes	Part Two. Section 3.A. Residential Development (Page 26) states several objectives that promote growth and development in a controlled and orderly manner and does not damage natural areas.

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Criteria	Yes/No	Comments
B. Development / Redevelopment Regulations:		
1. Does the community have a Clustering and/or Open Space Ordinance?	Yes	Branch County Farmland and Open Space Preservation Ordinance, Ordinance Number 17, Adopted: September 12, 2007, Effective: September 12, 2007
2. Are flexible site design criteria available for developers that use open space or cluster design options? (Ex. Relaxed setback widths and lessened sidewalk requirements.)	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
3. Are open spaces required to be consolidated into larger units (contiguous), or required to be a minimum size or width?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
4. Does the open space have to be managed in a natural condition?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
5. Are the types of uses allowed in the open space restricted to low impact uses?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
6. Is open space required to be protected through a conservation easement or other similar mechanism?	No	Not required, but encouraged. Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f. Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.
7. Are incentives put into place to encourage open space development?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
a. Are bonus densities utilized as an incentive?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
8. Do all Planned Unit Developments require open space?	No	Not covered in Farmland and Open Space Ordinance, no County Zoning Ordinance.
IV. Urbanized Communities		
A. Plans and Policies:		
1. Are infill developments encouraged in areas that already have significant development?	Yes	Part Two. Section 3.C. Commercial Development (Page 27). Objective e. Encourage major commercial and service facilities to locate in downtown areas or in cluster developments (shopping centers) where essential public services can be economically provided and traffic can be accommodated without increasing traffic congestion.
B. Design Standards:		
1. Are infill and redevelopment projects encouraged to promote conservation and natural resource preservation?	Yes	Part Two. Section 3.A. Residential Development (Page 26) Objective d. Prohibit residential development in flood prone areas and regulate residential development in natural areas which would be severely damaged by uncontrolled development.
2. Are re-development projects required to coordinate improvements with existing facilities and infrastructure?	No	emailed Michael Hard
V. Rural Communities		
A. Plans and Policies:		
1. Is agriculture described in the Master Plan as an economically viable profession in the community?	Yes	Part Two. A. Agriculture. 2 Advantages: c. agriculture provides a financially strong economic aspect to the county.
2. Have prime and unique agricultural lands been identified and mapped in the Master Plan?	No	Part Two. Section 3.B. Agricultural Development (Page 26) Objective a. Develop definite criteria for the designation of the most productive farmlands in the County and take steps to encourage long-term commitments to agricultural activities in the identified areas.
B. Development / Redevelopment Regulations:		
1. Has the community designated an Agricultural Zoning District?	No	No County Zoning Ordinance
2. Does the Agricultural Zoning District utilize a method such as sliding scale to limit fragmentation of farmland and to less conflicts between farming and residential uses?	No	No County Zoning Ordinance
3. Does the Agricultural Zoning District utilize setbacks or buffers for any new residential development?	No	No County Zoning Ordinance
4. Does the Agricultural Zoning District also consider the preservation and protection of natural features, such as wetlands or groundwater?	No	No County Zoning Ordinance
Recreation Plan		
A. Plans and Policies		
1. Has a Recreation Plan been approved by MDNR within the last 5 years that identifies priority lands for acquisition or protection for future recreational use?	No	Approved by MDNR? Branch County Recreation Plan 2012-2017. Goal 3 - Retain public land for future generations. Objective: Retain existing parkland and acquire new public lands to meet the recreational needs of the community. No identification of future acquisition.

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Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Wetland Preservation		
I. Inventory		
A. Plans and Policies:		
1. Does the Master Plan include a map of wetlands?	No	Branch County Recreation Plan 2012-2017 does includes Figure 6 - Map of waterways, woodlands and wetlands
II. Wetlands Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of wetlands, and the functions they play in protecting residents' health, safety and welfare from problems such as flooding and poor water quality?	No	No reference to importance of wetlands in Master Plan although the Recreation Plan states: Woodlands and wetlands are also important natural resources to be considered when planning for parks and resource protection. They are unique ecosystems that provide important wildlife habitat and natural scenic beauty.
2. Does the Master Plan call for the protection of wetlands within an ecosystem context (protecting adjacent uplands, waterways, and vegetated buffers as well)?	No	Encourages protection but not in ecosystem context. Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f: Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.
B. Development / Redevelopment Regulations:		
1. Has the community adopted a local wetlands ordinance that protects wetlands less than five acres in size?	No	No County Zoning Ordinance
2. Is this ordinance coordinated with the State's wetlands regulations?	No	No County Zoning Ordinance
3. Are there building and a no-disturbance setback requirements from wetland areas (at least 20-30 feet)?	No	No County Zoning Ordinance
Lake Management		
A. Plans and Policies:		
1. Does the Master Plan have a map of lakes?	No	Branch County Recreation Plan 2012-2017 does includes Figure 6 - Map of waterways, woodlands and wetlands
2. Does the Master Plan discuss the values of lakes such as recreation, economic development, habitat, fisheries?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
B. Development / Redevelopment Regulations		
1. Does the zoning ordinance include an anti-funneling provision for waterbodies?	No	No County Zoning Ordinance
Habitat Preservation		
I. Natural Area Preservation / Restoration		
A. Plans and Policies:		
1. Does the Master Plan call for preservation of natural areas for wildlife habitat protection?	No	
2. Does the Master Plan link habitat preservation to protection of the health, safety and welfare of residents through natural resource preservation?	No	
3. Has the community identified high quality natural areas to be preserved?	No	No Land Use Map available
4. Does the community have a plan to protect the high priority areas?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective f: Identify and protect appropriate open space and wetland areas of the County and incorporate these areas in the recreation plan.

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
II. Native Plant Species		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of native vegetation in the protection of vital air, land and water resource quality, to buffer air and noise pollution, preserve wildlife habitat, and preserve aesthetic values and the community's beauty?	No	
B. Design Standards:		
1. Do the Design Standards specify the use of native plant species in the storm water system to help reduce storm water velocities, filter runoff and provide additional opportunities for wildlife habitat?	No	Consideration in BCDC site plan review.
2. Are invasive and exotic plants prohibited from being used?	No	Consideration in BCDC site plan review.
3. Does the site plan review process require developers to consult with the Michigan Department of Environmental Quality about Threatened/Endangered Species on site?	No	Consideration in BCDC site plan review.
Woodlands Preservation		
I. Inventory		
A. Plans and Policies:		
1. Has the community conducted a woodlands inventory and mapped this information?	No	Branch County Recreation Plan 2012-2017 includes Figure 6 - Map of waterways, woodlands and wetlands from Natural Resource Inventory, but County has not conducted an on-the-ground inventory.
II. Woodlands Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of woodlands to protect any of the following: water, air and soil quality, to buffer air and noise pollution, to moderate local climate and storm hazards, to preserve wildlife habitat, and to preserve aesthetic values and community beauty?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
2. Does the Master Plan recognize the importance of woodlands for storm water infiltration, thus reducing flooding and minimizing water pollution?	No	
3. Does the Master Plan identify woodlands as an important landscape feature that protects the health, safety and welfare of residents?	Yes	Part Two. Section 3.E. Recreational and Open Space Development (Page 28). Objective b. Encourage conservation and protection of natural, scenic, lake and wooded areas for public enjoyment.
B. Development / Redevelopment Regulations:		
1. Has the community adopted a local woodlands or tree protection ordinance?	No	
2. Are woodlands defined in a broad manner so that existing trees and remnant woodlands are also protected?	No	
3. Does the ordinance require replacement of trees that are removed?	No	
4. Does the ordinance minimize the clearing of a site?	No	
5. Are permits required to clear a site?	Yes	A Soil Erosion and Sedimentation Control permit is required if the clearing disturbs one or more acres of land; or is located with 500 feet of the Waters of the State regardless of the amount of land disturbed; or is located within 500 feet of a storm drain inlet regardless of the amount of land disturbed.

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Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Greenways/Green Infrastructure		
I. Greenway/Green Infrastructure Plan		
A. Plans and Policies:		
1. Does the community have a greenway plan or support greenways/green infrastructure through its Master Plan or Recreation Master Plan?	No	
2. If yes, does this plan do the following:	n/a	
a. Identify greenways/green infrastructure as important natural transportation corridors for wildlife, and for the protection of other natural features?	n/a	
b. Connect many natural areas within the community?	n/a	
c. Connect the community's greenway/green infrastructure plan with adjacent communities', County's or regional greenway plans?	n/a	
Groundwater		
I. Mapping		
A. Plans and Policies:		
1. Do Master Plan goals call for the identification and mapping of groundwater recharge areas?	No	
2. Is a map of groundwater resources or groundwater recharge areas included in the Master Plan?	No	
II. Groundwater Protection		
A. Plans and Policies:		
1. Does the Master Plan recognize the importance of the groundwater to the health, safety and welfare of its residents?	No	
2. Does the Master Plan identify groundwater as an important natural resource, and call for its protection?	No	
B. Development / Redevelopment Regulations:		
1. Is ground water considered in the zoning designations of parcels?	No	
2. Are there additional requirements for site plan submittals in groundwater recharge areas?	No	
III. Wellhead Protection		
A. Plans and Policies:		
1. Does this community have municipal well fields?	Yes	The cities of Bronson and Coldwater, and the villages of Quincy and Union City provide municipal water to their residents.
2. If yes, has the community done the following:		
a. Developed a wellhead protection program?	Yes	Bronson, Union City, Coldwater, Colon, Quincy have wellhead protection areas mapped.
b. Restricts high risk land use activities in wellhead protection areas?	Unknown	Do not know if these communities have Wellhead Protection Plans approved and in place.

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Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
Storm Water Management		
I. Storm Water Management Standards		
A. Plans and Policies:		
1. Does the Master Plan call for the preservation of natural features as parkland and/or in open space developments to help alleviate problems associated with storm water runoff?	No	
2. Does the Master Plan identify storm water management as an important community goal or policy?	No	
3. Does the Master Plan state both the quality and quantity of storm water are important issues to address in storm water management policies?	No	
4. Does the Master Plan relate storm water management to the protection of health, safety and welfare of the community's residents? (For example, storm water management can reduce flooding, improve water quality, etc.)	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance require that developers preserve natural drainage patterns to the fullest extent possible?	No	Consideration in BCDC site plan review.
2. Do you regulate storm water in your community?	No	BCDC oversees storm water management
3. If yes, are your regulations coordinated with the County's storm water regulations so that your rules do not contradict the County's?	n/a	
4. If your community regulates storm water, do your regulations address the following:		
a. Are there storm water guidelines that fully detail specific storm water design criteria?	No	
b. Maintain or establish buffer strips (between 30 and 100 feet wide) from the top of bank of any watercourse or surface water?	No	
5. Does the Zoning Ordinance include flood control and water resource protection performance standards?	No	
6. If yes, do they address the following to reduce the quantity of runoff and improve runoff quality:		
a. Limit land disturbance and grading?	No	
b. Maintain vegetated buffer strips and other existing vegetation to improve infiltration of storm water?	No	Consideration in BCDC site plan review.
c. Minimize impervious surfaces?	No	
d. Encourage the use of infiltration devices (such as filter strips, vegetated swales, sand filters, rain gardens, etc and allow for 72 hour ponding prior to infiltration?	No	Consideration in BCDC site plan review.
7. Are all development/redevelopment plans required to go to the County Drain Commissioner for review?	Yes	
II. Engineered Best Management Practices (BMP's)		
A. Plan and Policies		
1. Does the Master Plan include goals / policies that encourage the use of Best Management Practices (BMP's) to minimize, collect, and treat storm water?	No	

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Criteria	Yes/No	Comments
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance require the use of BMP's when possible?	No	
2. Does the Zoning Ordinance require the use of above ground BMP's instead of belowground storm water conveyance systems?	No	Consideration in BCDC site plan review.
3. Does the Zoning Ordinance prohibit direct discharge of storm water into wetlands, streams or other surface waters without pre-treatment?	No	Consideration in BCDC site plan review.
4. Does the Zoning Ordinance call for periodic monitoring of BMP's to ensure they are working properly?	No	
5. Does the Zoning Ordinance require that all storm water management systems and / or BMP's be maintained?	No	Consideration in BCDC site plan review.
C. Design Standards:		
1. Do the Design Standards provide minimum guidelines for BMP's that pre-treat and filter storm water, and retain storm water in a bio-retention facility?	No	Consideration in BCDC site plan review.
III. Infiltration		
A. Plans and Policies		
1. Does the Master Plan call for the preservation of natural features for the purpose of preserving the existing infiltration of storm water?	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance call for the use of BMP's that improve a site's infiltration potential?	No	Consideration in BCDC site plan review.
Erosion and Sedimentation Control		
I. Erosion and Sedimentation Control (ESC):		Drain Commissioner (Michael Hard) = CEA; BCRC = APA; Coldwater = APA & MEA
A. Plans and Policies:		
1. Is erosion and sedimentation control identified in the Master Plan as an important mechanism to protect the health, safety and welfare of residents through protection of water and soil resources?	No	
B. Development / Redevelopment Regulations:		
1. Does the Zoning Ordinance address erosion and sedimentation controls?	No	No County Zoning Ordinance
2. If yes, is the program coordinated with the County's program?	Yes	The BCDC is the County Enforcing Agency and the BCRC is an Authorized Public Agency for administering Part 91 on their own projects.
3. If yes, does the community's program include the following standards?		
a. Require that soil erosion control measures be in place before granting a building permit?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 4. Building Permits.
b. Protect waterways and stabilize drainage ways by requiring mechanisms, such as silt fencing, at the edge of the waterway buffer and special crossing and diversion techniques at waterway crossings?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
c. Require that all erosion and sedimentation controls be maintained?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
d. Require that all erosion and sedimentation controls be monitored on a periodic basis?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
e. Methods to respond to public complaints regarding construction site erosion control?	Yes	Soil Erosion and Sedimentation Control Ordinance, Chapter 5. Earth Change Permit Requirements.
4. If no, does the community staff report erosion problems to the County enforcing agency?		
5. Are there any references in the Zoning Ordinance about compliance with the County Soil Erosion and Sediment Control Standards?	No	No County Zoning Ordinance
Sanitary Sewer Planning and Infrastructure		
I. Sanitary Sewer Planning and Infrastructure		
A. Plans and Policies:		

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Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
1. Does the Master Plan address sanitary sewer planning?	Yes	Part Two. 1. Land Use Trends. 4. Industrial Land Use. Development by many types of industries has avoided areas not served by sanitary treatment plants.
2. If yes, does the Master Plan tie sanitary sewer planning to protection of the health, safety and welfare of residents?	Yes	Part Two. 1. Land Use Trends. 4. Industrial Land Use. Increased concern over the liabilities associated with both past environmental pollution and the potential for future liability has caused industrial developers to focus efforts on new industrial park facilities. Development by many types of industries has avoided areas not served by sanitary treatment plants.
3. If yes, does the Master Plan address the following:		
a. Has the community delineated a Sewer Service Area?	No	Not a County Service. Section III.F.2.g. Utilities (Page 16). The cities of Bronson and Coldwater, and the villages of Quincy and Union City provide sanitary sewer to their residents. There is also a sanitary sewer district around Coldwater, Long and Lake George lakes. All other areas of the county are on septic tanks.
b. Has the Sewer Service Area been mapped, including all the facilities in the system (such as manholes, pipes, etc.)?	No	
c. Is the map to be used in zoning decisions?	No	No County Zoning Ordinance
II. Septic Systems		
A. Plans and Policies:		
1. Does the Master Plan identify areas that are suitable and unsuitable for septic systems?	No	Part Two, Section 3.5. d. Permit single-family residential development in areas not serviced by sanitary sewer provided lot sizes are consistent with public health requirements for septic systems and county residential and environmental policies.
2. Does the Master Plan state that community involvement in placement and maintenance of septic systems is critical to the health, safety and welfare of residents?	No	
B. Development / Redevelopment Regulations:		
1. Are regulations that pertain to septic systems coordinated with the County's regulations?	Yes	Part Two. Section 3.5. d. Permit single-family residential development in areas not serviced by sanitary sewer provided lot sizes are consistent with public health requirements for septic systems and county residential and environmental policies.
2. Does the Zoning Ordinance require that a septic system location be at least 100 feet from a lake, wetland, stream, or other water feature?	No	
3. Does the Zoning Ordinance specify a minimum isolation distance from residential and community wells?	No	
4. Does the Zoning Ordinance create septic maintenance districts?	No	
III. Minimizing Inflow		
A. Development / Redevelopment Regulations:		
1. Does the community prohibit connecting downspouts to the storm water system?	No	
2. Does the community have a program to identify and disconnect footing drains from sanitary sewer lines?	No	
3. Does the community promote rain barrels and rain gardens?	No	

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
IV. Illicit Discharge Elimination		
A. Plans and Policies:		
1. Has the community identified and/or mapped the community's drainage system, including all points of discharge and locations of illicit discharges to the drainage system?	No	
2. Does the community have a program for identifying illicit discharges, and eliminating them?	No	
3. Does the community have a program to identify sanitary sewer or septic systems that are seeping into the storm water system, surface waters or groundwater?	No	
Public Education		
I. Public Education Efforts		
A. Plans and Policies:		
1. Does the community have a system in place to distribute environmental education information?	Yes	Branch County website has Video TourBook and section for Links. http://www.countyofbranch.com/
2. Has the community encouraged residents to report illicit discharges or improper disposal of materials into storm drains or natural water bodies?	No	
3. Has the community educated commercial, industrial and institutional owners and tenants on how to reduce significant storm water pollutants?	No	
Pollution Prevention and Housekeeping Practices		
I. Storm Water System Maintenance		
A. Plans and Policies:		
1. Does the community have a program in place to regularly clean out, maintain and/or inspect structural controls (such as catch basins, vegetated swales, infiltration basins, sedimentation basins, etc.)?	Yes	DPW's responsibility
2. Does the community have a program that labels outfall structures that discharge runoff to natural systems?	No	
II. Roadways		
A. Plans and Policies:		
1. Does the community have jurisdiction over streets?	No	BCRC responsibility
2. If yes,		
a. Does the community sweep the streets monthly or more often in high construction areas?	No	
b. Does the community evaluate the amount of salt and/or sand that is applied to its roads in the winter?	No	
c. Does the community provide leaf collection in the fall?	No	

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
III. Public Facilities Maintenance		
A. Plans and Policies:		
1. Does your community have a maintenance building?	Yes	DPW's responsibility
2. If yes, does the following occur:		DPW's responsibility
a. Confirm that floor drains are connected to a sanitary sewer, or sealed?	Yes	DPW's responsibility
3. Does the community maintain its own vehicles?	Yes	DPW's responsibility
4. If yes, is a regular schedule of maintenance followed?	Yes	DPW's responsibility
5. Are vehicles or other equipment maintained and cleaned where fluids and/or cleaning water will not flow into the street, gutter, storm drain or water body?	Yes	DPW's responsibility
IV. Landscaping Practices		
A. Plans and Policies:		
1. Does the community have a schedule of landscape maintenance practices for municipal property?	Yes	DPW's responsibility
2. Are employees trained on the proper application of chemical pesticides, herbicides and fertilizers?	Yes	DPW's responsibility
3. Are soils tested on municipal property before fertilizers are applied?	No	
4. Does the community use native vegetation in landscaping their properties?	No	
5. Does the community encourage landscaping with native plant species throughout the community?	No	
B. Development / Redevelopment Regulations		
1. Is a fertilizer ordinance in place that only permits zero-phosphorus fertilizer to be used?		
Animal Waste (Pets & Kennels)		
A. Plans and Policies		
1. Are residents educated about the availability, location, and requirements of properly disposing of pet waste?	No	
Capital Improvement Plan		
I. Capital Improvement Plan		
A. Plans and Policies:		
1. Does the community have a Capital Improvement Plan?	No	
2. If yes, does the Master Plan link the Capital Improvement Plan with the protection of the health, safety and welfare of residents?	n/a	
3. If a Capital Improvement Plan is in place, does the plan:	n/a	
a. Include policies related to natural resource protection?	n/a	
b. Include standards as the basis for design of storm water and sanitary systems?	n/a	
c. Include capital improvement for installation, maintenance and replacement of storm water utilities?	n/a	
d. Include capital improvement for installation, maintenance and replacement of sanitary sewer utilities?	n/a	
e. Call for the use, maintenance and replacement of storm water BMP's?	n/a	
Agricultural Manure Management		
A. Plans and Policies		
1. Are agricultural operators educated about the requirements of properly storing and applying manure?	No	
Wind Ordinance		
A. Plans and Policies		

Document Review for Water Resource Protection

Name of Entity: **Branch County** *Date:* **August 2012**

Criteria	Yes/No	Comments
1. Does a zoning district allow and promote the effective and efficient use of wind energy conversion systems?	No	

Prairie River Watershed
Policy Review Document for Burr Oak Township St. Joseph County, Michigan

March 2013
MDEQ Tracking Code #2010-0002

ftc&h
Fishbeck, Thompson, Carr & Huber
engineers • scientists • architects • constructors

ftc&h

PRAIRIE RIVER WATERSHED PLANNING PROJECT

BURR OAK TOWNSHIP

POLICY REVIEW DOCUMENT
MDEQ TRACKING CODE #2010-0002

MARCH 2013
PROJECT NO. G120246

Michigan's
Nonpoint Source
Program

This nonpoint source pollution control project has been funded in part through the Michigan Nonpoint Source Program by the United States Environmental Protection Agency under assistance agreement C9975474-10 to the Branch Conservation District, for the Prairie River Watershed Planning project. The contents of the document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Fishbeck, Thompson, Carr & Huber, Inc. Engineers • Scientists • Architects • Constructors
1515 Arboretum Drive, SE, Grand Rapids, MI 49546 Telephone: 616-575-3824

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LIST OF ABBREVIATIONS/ACRONYMS

BCD	Branch Conservation District
BMP	Best Management Practice
FTC&H	Fishbeck, Thompson, Carr & Huber, Inc.
LID	Low Impact Development
MDEQ	Michigan Department of Environmental Quality
MDNRE	Michigan Department of Natural Resources and Environment
MS4	Municipal Separate Storm Sewer System
NPS	Nonpoint Source
NREPA	Natural Resources and Environmental Protection Act
PRD	Policy Review Document
PRW	Prairie River Watershed

TABLE OF CONTENTS

PUD	Planned Unit Development
RPO	Resource Protection Zone
SESC	Soil Erosion and Sedimentation Control
SWMPC	Southwest Michigan Planning Commission
Township	Burr Oak Township
WMP	Watershed Management Plan

EXECUTIVE SUMMARY

The Prairie River flows west from its headwaters in the southwest corner of Branch County, Michigan, into St. Joseph County, where it empties into the St. Joseph River just south of Three Rivers, Michigan. The Prairie River Watershed (PRW) is experiencing very low development, similar to other areas around the state during this downturn in the economy. However, citizens are concerned when growth does happen it will be in an uncontrolled manner and could jeopardize the quality of the watershed's valued resources.

The Prairie River Watershed Management Plan (WMP) stresses the importance of water resources as a vital component of land use decisions at the local level. Communities in the PRW are interested in achieving sustainable development, defined as economic growth protecting the environment.

This Policy Review Document (PRD) provides an assessment of the Land Use Plan, Zoning Ordinances, and other development standards of Burr Oak Township (Township) impacting water quality. An examination of existing policies is crucial to provide for well crafted and complimentary municipal codes reflecting the desires of the diverse communities within the PRW. The current path of development in these communities can be evaluated through this process and redirected if necessary. Often, communities find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, which combines economic growth with the protection of natural resources.

Existing policies and regulations in the Township were compared to accepted development principles as presented in various water resource protection guidebooks. A policy review spreadsheet was used to document the comparisons and identify compliance and discrepancies with the principles.

The assessment reviewed the status of land use planning and zoning in the Township, and how well the rules and regulations address concerns of the watershed. The results are summarized in Appendix 1.

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of watershed protection and other areas that could benefit from modifications. Priority actions that the Township could take to improve resource protection include:

Land Use Plan Revisions

1. Create Resource Protection Overlay Zone and update Future Land Use Map with identification of all natural resources and Resource Protection Overlay Zone delineation.
2. State the importance of a stormwater management plan with a goal of increasing infiltration and decreasing imperviousness in new construction and redevelopment to reduce the amount of stormwater runoff.

Zoning Ordinance Revisions

1. Support the County Drain Commissioner's effort in developing stormwater design criteria.
2. Revise Site Plan Review requirements to include illustrations of all natural resources and stormwater management plans on site plans.
3. Require setbacks from all water resources.
4. Improve parking lot standards to minimize impervious surfaces.
5. Develop a Planned Unit Development (PUD) ordinance.

6. Create specifications for Resource Protection Overlay Zone.

Other Recommendations

1. Update the Capital Improvement Program.
2. Update the Recreation Plan.
3. Support County's Farmland Preservation Ordinance.
4. Investigate funding options for conducting additional studies and projects assisting the Township in implementing the recommendations in this report.

The use of the development principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources.

fтс&h

INTRODUCTION

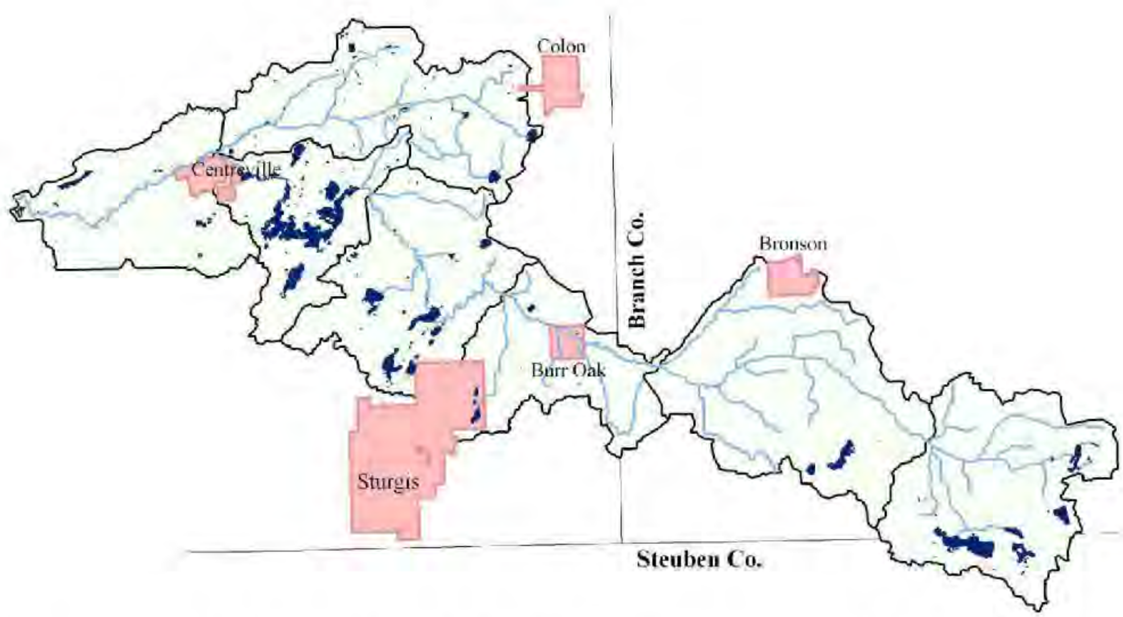
PURPOSE

The purpose of this PRD is to assist the Township with implementation of generally accepted development standards and to identify impediments to innovative site design for the purpose of water resource protection. An examination of existing policies is crucial to provide for well crafted and complimentary municipal codes reflecting the desires of the Township. This policy assessment will provide a baseline from which to measure changes in the planning and management of growth in the coming years. The current path of development in the Township can be evaluated through this process and redirected if necessary. A similar assessment could be conducted in five years to determine if changes have been made to the rules and regulations increasing the level of watershed protection.

PRAIRIE RIVER WMP

The Branch Conservation District (BCD) is currently developing a WMP for the PRW. The PRW encompasses 128,644 acres in Branch and St. Joseph Counties, Michigan, and a small portion of Steuben County, Indiana (Exhibit 1). The Township is located in the southeast corner of St. Joseph County, Michigan (Map 1).

Exhibit 1 - Prairie River Watershed



The WMP will include a complete evaluation of nonpoint source (NPS) pollutants and create an implementation plan to address resource concerns, problems, and needs, and outline solutions for known or suspected pollutants of the river. The public will be encouraged to participate, as well as other stakeholders in the watershed, to develop information and education programs necessary for long-term sustainable land use planning. An examination of existing policies is crucial to provide for well-crafted and complimentary municipal codes reflecting the desires of the communities within the PRW.

The Prairie River WMP has identified priority NPS pollution impairments as follows:

- Sediment in rivers, streams, and lakes
- Excess nutrients
- Streambank erosion
- *E. coli*
- Increased peak flow due to loss of wetlands

The goals described in the WMP will work towards all waterbodies meeting designated uses of:

- Other indigenous aquatic life and wildlife use
- Partial body contact recreational use
- Total body contact recreational use
- Cold water fishery use
- Warmwater fishery use
- Agricultural use
- Navigational use
- Industrial water supply
- Public water supply

The Stakeholders in the PRW have also indentified the following desired uses:

- Fish Habitat
  - Maintain healthy water temperatures to continue healthy coldwater fisheries
  - Elongate designated trout stream further downstream

- Protect And Enhance Indigenous Wildlife Habitat
  - Invasive remediation
  - Particularly where threatened, endangered, and special concerns depend on healthy habitats
  - Educate on identifying, and procreation of invasive species
  - Educational signage at high traffic boat launches (Nottawa, Gilead, etc.)

- Develop Coordination
  - Invasive management guide for lake communities
  - Implement "clean boats, clean waters" program at lakes in the PRW
  - Promote stakeholder involvement
  - Maintain news articles and media presence

- Recreation
  - Maintain and enhance 32 navigable miles
  - Create volunteer group to help keep pathways open
  - Educate on improving navigability without impacting habitat especially aquatic habitats
  - Create a heritage water trail

- Agricultural
  - Maintain agricultural economy
  - Maintain rural character
  - Promote sustainable soil and water practices
  - Promote balanced irrigation practices
  - Promote practices addressing unrestricted livestock access and fuel tanks in riparian corridors

- Coordinated Land Use Planning
    - Low impact development (LID) in urban areas
    - Stormwater guidelines/ordinances where appropriate and desired
    - Develop or update resource tools pertaining to water quality for planning officials

- Maintain, Protect, Enhance, Create Wetland Areas
    - Create a priority list for wetland areas by function and use to promote to landowners on options for wetland enhancement

- Groundwater Protection
    - Promote healthy soil practices (particularly in areas where soil types are leaching soils)
    - LID practices in urban areas
    - Promote farm bill for spill protection (fuel pads - especially for irrigation in riparian zones)
    - Urban stormwater management
    - Determine current and future surface withdrawals and potential impacts

- *E. coli* Testing
    - Because of many unrestricted livestock areas, identify additional *E. coli* sites within the PRW

- Bank Stabilization
    - Incorporate bank stabilization near boat launch areas where erosion present
    - Incorporate native plantings at sites identified in the PRW

- Natural Shoreline Program
    - Utilize program in identified sites

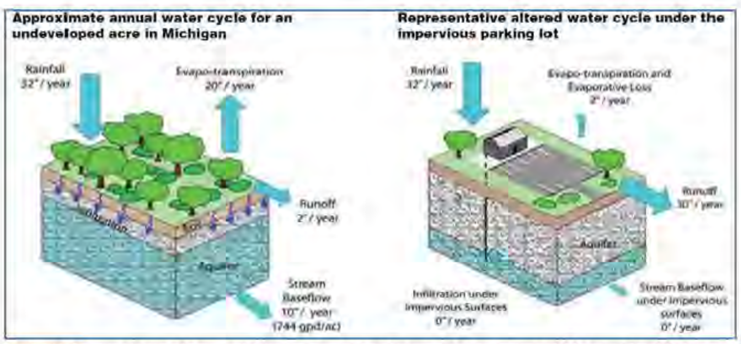
The objective of this policy review is to develop and implement specific land-use recommendations using a watershed-based approach to achieve the WMP goals and desired uses. This effort will bring together township boards, local officials, and planning commissions to protect water quality and reduce NPS pollution on a multi-township or county-wide basis through the revision of Master Plans, addition of ordinances for natural resource protection, and zoning to protect water quality supporting the vision of the Township's Master Plan.

BACKGROUND

A grant was awarded to the BCD to develop a WMP for the PRW. As part of the grant, a task was defined to assist communities in assessing their policies and guidelines shaping how development happens in their communities. The Township was one of the communities agreeing to participate in this assessment. The time to plan for growth is now, when activity is low and time is available for a thorough review of policies and standards working together to improve the quality of life.

LAND USE AND WATER RESOURCE PROTECTION

Local Land Use Decisions Have Regional Impacts. Residents, business owners, and local planners are not always aware of the impacts their individual actions might have on their natural surroundings. Cumulative effects of these actions are not considered in most development and land use decisions. A watershed planning perspective will encourage local planners and developers to look at the entire area contributing to a water body and determine its needs for management and protection. Often, communities find their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection. The PRW is taking the first step in realizing the regional consequences of the local land use decisions, by evaluating current policies and implementing appropriate measures to enhance and protect water quality while experiencing growth and development. Careful attention to appropriate water resource management can help communities reach a level of sustainable development, combining economic growth with the protection of natural resources.



(Source: A Design Guide for Implementers and Reviewers: Low Impact Development Manual for Michigan, SEMCOG, 2008)

Development Impacts to Watercourses. One of the basic concepts accepted in watershed planning is that the amount of impervious cover in a watershed directly relates to its water quality. Increased urbanization results in natural vegetation being replaced with hard surfaces, such as rooftops, roadways, and parking lots. The additional impervious area increases the rate and volume of surface water runoff and decreases water infiltration into the ground. Development often reduces base flow, since water is not infiltrating, which causes perennial streams to become intermittent streams. When more of the water enters the streams as surface runoff, the bankfull channel flows create highly erosive conditions. Other concerns of impervious surfaces include higher concentrations of nutrients in higher volumes of runoff and increased occurrences of heavy metals. Another impact occurs when municipal services are required to expand to provide water and sewer for developments currently outside of service areas. Locating developments close to existing towns and city centers reduces the effects of sprawl and minimizes the expansion of infrastructure that can increase harmful stormwater runoff.

REGULATIONS IMPACTING LAND USE AT THE STATE LEVEL

The Michigan Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended is the state's primary environmental legislation. The Michigan Department of Environmental Quality (MDEQ) regulates wetlands, sand dunes, soil erosion and sedimentation from earth change activities, inland lakes and streams, shorelines, and other land use decisions impacting water resources, including management of floodplain development, public health standards, subdivision rules, and stormwater discharges from municipal separate storm sewer systems (MS4). The state, however, does not oversee land use planning at the local level. The over 1,850 units of government in Michigan are responsible for protecting water resources through local regulations (Ardizone, 2010).

LAND USE PLANNING AT THE LOCAL LEVEL

Townships, cities, and villages are responsible for developing land use plans and zoning ordinances, as well as ensuring their implementation. Land use plans and zoning ordinances are the regulatory tools that can be used to protect surface water and groundwater. The planning and zoning process typically starts with a Master Plan, outlining the vision of how the residents and leaders want the communities to look in future years. The Master Plan is the foundation upon which the Code of Ordinances and zoning ordinances are developed. Formulation of a Master Plan is therefore of highest importance to the communities. A Master Plan should identify goals and a vision for future development in the community. The Code of Ordinances is intended to provide the rules and regulations preserving the peace, health, safety, and welfare of the inhabitants of the community. Design manuals and construction specifications for development guide the alterations of land and water necessary for growth in the community. All of these policies must be integrated to ensure their goals and objectives are compatible. The policy review requires the examination of all of these documents to be able to assess the capacity of the community to continue to grow and prosper while protecting the natural resources.

METHODOLOGY

POLICY REVIEW

Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) worked with the BCD to develop a worksheet that lists water quality issues and outlines accepted development principles. BCD and FTC&H met with Township officials to review the worksheet and obtain the Master Plan and collect other policies, standards, ordinances, and guidance the Township has for growth and infrastructure management. These one-on-one meetings with the Township helped ensure all documents were current and the intent of the development standards was understood. The following documents were reviewed:

- Burr Oak Township Land Use Plan, modified and adopted after the effective date of the new Michigan Planning Enabling Act, being P.A. 33 of 2008, replacing the Land Use Plan adopted in 1999 and reflecting a projection for future development to the year 2030
- Burr Oak Township Future Land Use Map, June 2012
- Burr Oak Township Zoning Ordinance, No. 2008-2, August 2008
- Branch-Hillsdale-St. Joseph Community Health Agency Policies and Permits
- St. Joseph County Road Commission's Requirements and Specifications for New Roads or Plat Roads
- St. Joseph County Recreation Plan

FTC&H reviewed the goals of the Master Plan and how other regulations succeed in upholding those goals. Additional documents were reviewed using the worksheet to evaluate their conformity to development principles for water resource protection.

Recommendations and suggestions for the Township to consider in their future updates and planning and zoning decisions are included in the Recommendations section of this report.

The detailed results of the policy review are in table format in Appendix 1.

RECOMMENDATIONS

LAND USE PLAN REVIEW

After completing the review of the Land Use Plan for the Township, a list of recommendations was developed and shared with the planning commission to consider. The Burr Oak Land Use Plan includes a section of "Goals and Objectives" based on the land uses identified in the Township. These are used as a guide to development decisions. Numerous objectives are listed in the Land Use Plan for each of the goals. Additional objectives, based on the results of this policy review, are suggested for each goal that would address resource protection and follow the Master Plan criteria for conformance with accepted development principles.

A. AGRICULTURAL DEVELOPMENT

GOAL: Preserve to the maximum extent possible the Township's most productive agricultural areas and to avoid conflicts between farm and non-farm uses.

Existing objectives meet development principles.

B. OPEN SPACE AND RECREATION

GOAL: Plan for adequate year-round open space areas to meet the needs of the residents of the Township and preserve and enhance the Township's natural features and rural character.

ADDITIONAL OBJECTIVE: **Land Conservation and Development Techniques**

- Encourage the use of conservation easements to conserve open space.

ADDITIONAL OBJECTIVE: **Woodlands**

- Preserve woodlands for their importance of stormwater infiltration, thus reducing flooding and minimizing water pollution.

ADDITIONAL OBJECTIVES: **Stormwater Management**

- Preserve natural features as parkland in open space development to help alleviate problems associated with stormwater runoff.
- Preserve natural features to maintain existing infiltration of stormwater.

ADDITIONAL OBJECTIVES: **Recreation Plan**

- Develop Recreation Plan and gain Michigan Department of Natural Resources and Environment (MDNRE) approval.

ADDITIONAL OBJECTIVE: **Animal Waste (Pets & Kennels)**

- Provide education about the availability, location, and requirements of properly disposing of pet waste in recreational areas.

C. RESIDENTIAL DEVELOPMENT

GOAL: Plan for a choice of housing types, locations, and environments to accommodate individual capabilities and preferences of current and future populations.

ADDITIONAL OBJECTIVES: **Impervious Surface Reduction**
- Encourage minimizing hard surfaces in new construction and redevelopment projects to reduce runoff and improve infiltration.
- Promote the reduction of impervious surfaces for the protection of water quality, natural features, and open space.

D. COMMERCIAL DEVELOPMENT

GOAL: Plan for suitable areas for the orderly development of a variety of commercial and service activities to serve the needs of the projected population.

ADDITIONAL OBJECTIVE: **Groundwater**
- Limit high-risk land use activities in groundwater recharge and wellhead protection areas.

ADDITIONAL OBJECTIVES: **Impervious Surface Reduction**
- Encourage minimizing hard surfaces in new construction and redevelopment projects to reduce runoff and improve infiltration.
- Promote the reduction of impervious surfaces for the protection of water quality, natural features, and open space.

ADDITIONAL OBJECTIVE: **Erosion and Sedimentation Control**
- Require erosion and sedimentation control as a mechanism to protect health, safety, and welfare of residents through protection of water and soil resources.

E. INDUSTRIAL DEVELOPMENT

GOAL: Industrial development should occur in locations which meet the following objectives.

ADDITIONAL OBJECTIVES: **Impervious Surface Reduction**
- Encourage minimizing hard surfaces in new construction and redevelopment projects to reduce runoff and improve infiltration.
- Promote the reduction of impervious surfaces for the protection of water quality, natural features, and open space.

ADDITIONAL OBJECTIVE: **Erosion and Sedimentation Control**
- Require erosion and sedimentation control as a mechanism to protect health, safety, and welfare of residents through protection of water and soil resources.

F. TRANSPORTATION

GOAL: Plan for efficient, safe, and convenient access to the transportation network.

Existing objectives meet development principles.

G. UTILITIES

GOAL: Plan for the timely development of necessary services - sewer, storm drains, and water lines - in accordance with present and planned future needs of the Township.

ADDITIONAL OBJECTIVES: **Stormwater Management**

- Assess future stormwater management needs and goals.
- Develop stormwater management policies including quality and quantity of stormwater.
- Encourage stormwater management for the protection of health, safety, and welfare of community residents.
- Encourage policies that use best management practices (BMPs) to minimize, collect, and treat stormwater.

OBJECTIVE: **Sanitary Sewer Planning and Infrastructure**

- Utilize the delineated Sewer Service Area to plan for growth and development.
- Identify areas that are suitable and unsuitable for septic systems.
- Identified and/or map designated county drainage system, including all points of discharge to natural systems.
- Encourage a program for identifying and eliminating illicit discharges.
- Encourage a program labeling outfall structures that discharge runoff to natural systems.

OBJECTIVE: **Renewable Energy**

- Identify and map potential areas for wind energy to be generated.

H. COMMUNITY FACILITIES

GOAL: Plan for a range of community facilities and services to meet the present and future needs of the residents of the Township.

Existing objectives meet development principles.

I. ENVIRONMENT

GOAL: Protect the community's natural features/resources.

OBJECTIVE: **Wetland Protection**

- Encourage the protection of, for the importance of the functions they play in protecting residents' health, safety, and welfare from problems such as flooding and poor water quality.
- Encourage wetlands protection within an ecosystem context (protecting adjacent uplands, waterways, and vegetated buffers as well).

OBJECTIVE: **Habitat Preservation**

- Develop a plan to protect high-priority areas.
- Encourage use of native vegetation to protect air, land, and water quality; buffer noise and air pollution; preserve wildlife habitat; and preserve aesthetic value and community beauty.

OBJECTIVE: **Greenways and Green Infrastructure**

- Create a greenways plan or encourage greenways and green infrastructure as important natural transportation corridors for wildlife, and for the protection of other natural features.

OBJECTIVE: **Groundwater**

- Protect groundwater for its importance to health, safety, and welfare of residents.
- Protect groundwater as an important natural resource.

OBJECTIVE: **Flood Control**

- Encourage coordination of efforts to protect floodplains with adjoining communities and the county.

The Burr Oak Land Use Plan includes a section, "Future Land Use," which describes how the Township can promote residential development and commercial and industrial uses along development corridors within the Township while preserving farmland. The designated land uses serve as the guidance for zoning decisions and are to be considered the starting point for review of any request for rezoning of property. The Future Land Use Plan describes the following land uses below, which are also illustrated on Figure 1.

A. Agricultural/Open Space
B. Limited Residential Development
C. Public
D. Residential - Low Density
E. Residential - Medium Density
F. Residential - High Density
G. Commercial
H. Industrial

Based on the policy review, an additional land use category of a Resource Protection Overlay Zone could be added increasing the Township's ability to provide greater resource protection. Example language is provided below:

I. Resource Protection Overlay Zone

The Township is fortunate to have several lakes and high quality streams providing recreational and aesthetic value. By identifying and delineating these areas, the Township can utilize an overlay zone to protect these natural resources. Properties included within these geographical areas retain their underlying zoning classification, but are subject to additional requirements specified in the overlay district ordinance. The Resource Protection Overlay Zone builds on established local preservation policies.

To create an overlay zone, characteristics of natural features and specific land uses can be identified and mapped, as described below.

Agriculture
Prime and unique agricultural lands are identified and mapped, with data available from the NRCS Soil Survey.

Surface Water
Several waterways flow through the Township. A buffer can be delineated along these waterways to protect them from pollutants, including increased temperatures, in stormwater runoff (Figure 2).

Groundwater
The geographic area of the zone is typically based on the groundwater recharge areas and the wellhead zone of contribution 10-year time of travel. This allows for zoning regulations to be placed directly on the wellhead protection area at risk (Figure 3).

Floodplains
Floodplains are identified with a naturally vegetated buffer that encompasses the 100-year floodplain.

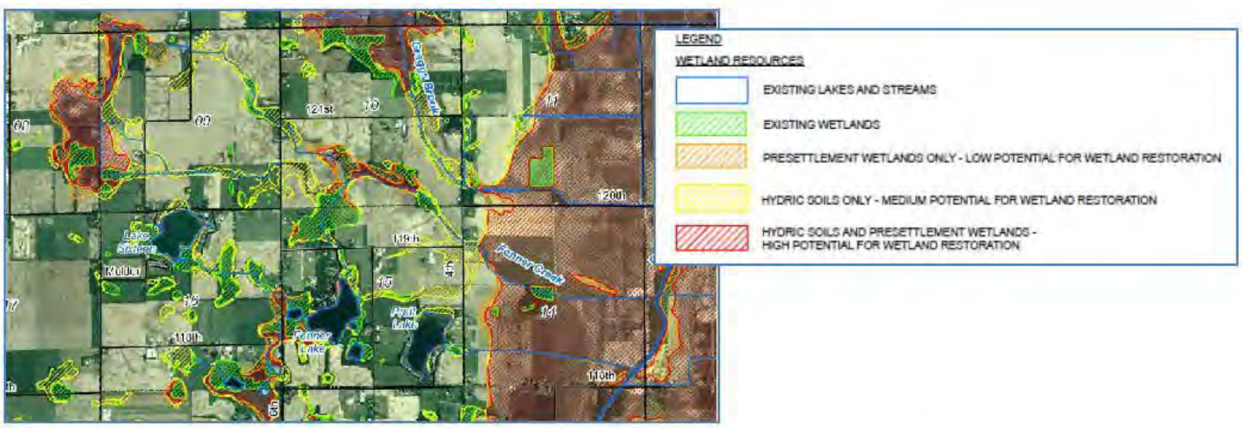
Woodlands
Existing woodlands are mapped and inventoried to create an existing woodlands map (Figure 4).

Utilities
Sewer Service Areas are delineated and mapped, including sewer service infrastructure attributes. Areas are identified that are suitable and unsuitable for septic systems (Figure 5).

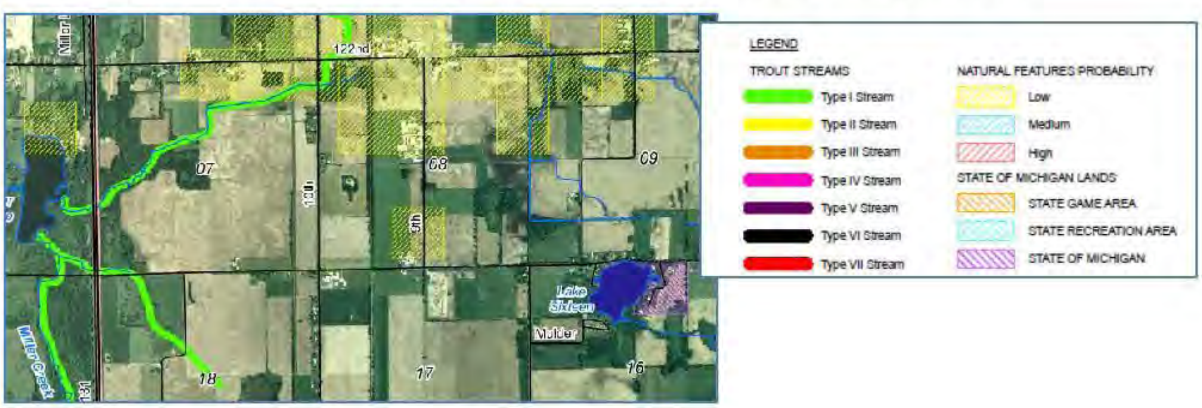
Wetlands
A wetlands map is created of existing wetlands (Figure 6). MDEQ provides additional information in mapping of wetlands potential restoration areas (Figure 7).

High-Priority Natural Lands
Other high-priority natural areas are mapped that are of special concern to the Township for protection and preservation. Watershed boundaries are identified to illustrate drainage areas (see Example 2).

Example 1 - Wetland Resources in Martin Township in Allegan County



Example 2 - High-Priority Natural Lands in Martin Township, Allegan County, Michigan



ZONING ORDINANCE REVIEW

A review of the Burr Oak Zoning Ordinances resulted in additional recommendations for the planning commission to consider incorporating into the existing Zoning Ordinances to improve measures for resource protection. The priority zoning concepts that provide the most benefit and protection of water resources include:

- Requiring building setbacks from water bodies (streams, rivers, lakes, wetlands) with a native vegetative buffer.
- Improve parking lot standards to reduce impervious surfaces (shared parking, parking space size, minimum parking requirements).
- Preserving open spaces by encouraging compact development in areas with existing infrastructure.
- Update road standards to allow more flexibility in design.
- Require minimum percentage of open space in PUDs.
- Improve site plan review (identification of natural features and review standards for protection).
- Encourage LID techniques to reduce runoff and increase infiltration.
- Coordinate Soil Erosion and Sedimentation Control (SESC) program with the county and reference compliance with standards.
- Encourage use of native species in landscaping to increase infiltration of stormwater.
- Improve private road standards to reduce impervious surfaces.
- Require a buffer between agriculture and residential uses to protect agricultural landowners.

The Southwest Michigan Planning Commission (SWMPC) has recognized and been promoting the opportunity to implement LID techniques averting the degradation of water resources that has been experienced in other areas of the state and country. LID is the most sensible approach when considering the benefit of clean water coupled with the fact that often these techniques can be less costly to the developer than conventional development (www.swpmc.org/lid.asp).

The priority zoning and LID concepts can be incorporated into the current Zoning Ordinances as demonstrated below with example language for the Planning Commission to consider.

(Additions are in bold italics.)

ARTICLE 2 - PURPOSE

D. To ***protect and*** conserve natural resources and energy;

ARTICLE 3 - DEFINITIONS

Low Impact Development (LID): an ecologically friendly approach to site development and stormwater management that aims to mitigate development impacts to land, water and air. LID emphasizes the integration of site design and planning techniques that conserve natural systems and hydrologic functions on a site by increasing infiltration and decreasing impervious surfaces.

Watershed: A watershed is the area of land bordered by hills and ridges that catches rain and snow and drains or seeps into a common outlet, such as a marsh, stream, river, lake or groundwater. Just as creeks drain into rivers, watersheds are nearly always part of a larger watershed. For example the Prairie River Watershed is part of the St. Joseph River Watershed, which is part of the Lake Michigan Watershed.

ARTICLE 4 - ZONING DISTRICTS

"A"	Agricultural District
"R-1"	Residential District
"R-2"	Residential Resort District
"R-3"	Residential Mobile Home Park District
"C"	Commercial District
"I"	Industrial District
"RPO"	***Resource Protection Overlay District***

Article 11 - "RPO" Resource Protection Overlay District

Section 11.1 - Description of District

This district is designed to preserve and enhance the recreational, ecological, and aesthetic values of the Township's natural resources for future generations by identifying specific areas in which special restrictions apply.

Section 11.2 - Permitted Uses

To be determined.

Section 11.3 - Special Exception Uses

To be determined.

Section 11.4 - Lot, Yard and Area Requirements

Example from Green Oak Township, Michigan: (Revise for Burr Oak usage)

- *Minimum setback for new buildings of 125 feet from the ordinary high water mark.*
- *Prohibiting cutting and/or filling for building on the floodplain and filling for buildings on the upland within 500 feet of the river's edge where the groundwater table is within six feet of the surface.*
- *Preserving a natural vegetation strip adjacent to the river on all private and publicly owned land.*
- *Restricting placement of septic system drain fields to 150 feet from the river.*
- *Prohibiting use of pesticides, herbicides, and fertilizers within the riparian zone.*

ARTICLE 13 - PRIVATE ROAD STANDARDS AND PROCEDURES

- ***Permit a minimum pavement width of 18-22 feet on low traffic, local streets in residential neighborhoods. Allow narrower pavement widths along sections of the roadway where there are no houses, buildings, or intersections and where on-street parking is not anticipated.***
- ***Permit the use of "open section" roadways with roadside swales. Do not require the use of conventional curbs for the full length of all streets in residential neighborhoods. Where curbs are deemed necessary to protect the roadway edge, allow the use of perforated curbs (that allow runoff to flow into swales) or invisible curbs (flush with the road surface).***
- ***Minimize the required radii for cul-de-sacs. A radius of 35 feet is optimal, depending on emergency vehicles.***
- ***Allow the creation of landscaped islands and bio-retention cells with cul-de-sacs.***
- ***Permit the use of one-way loop streets to eliminate turn-arounds.***
- ***Permit hammerhead turnarounds instead of cul-de-sacs.***

ARTICLE 18 - SUPPLEMENTARY REGULATIONS

Section 18.1 - Parking of Motor Vehicles

- ***Allow for flexibility in parking requirements to reduce impervious surfaces as much as possible and encourage shared parking.***
- ***Require some percentage of large parking lots to have landscaping to break up the impervious surfaces.***
- ***Require stormwater treatment for parking lot runoff in landscaped areas - encourage the use of parking lot islands as stormwater infiltration areas.***
- ***Require 30% of parking area to have spaces with smaller dimension for compact cars.***
- ***Require maximum parking spaces instead of minimum number of spaces.***
- ***Allow for driveways or overflow parking areas to be pervious or porous pavements.***

ARTICLE 20 - SITE PLAN REVIEW

A. Approval by the Planning Commission shall be contingent upon a finding that:

4. Preservation of natural features, such as lakes, ponds, streams, floodplains, floodways, wetlands, woodlands, steep slopes, and natural drainage patterns to the fullest extent possible and minimize site disturbance as much as possible.

C. Site Plan (Drawing[s] and Illustration[s] fully dimensioned)

- ***Coordinate with receipt of applicable county (drain, soil erosion) and state permits.***
- ***Show and label all stormwater best management practices on the site plan (rain gardens, swales, etc.).***
- ***Show all soil erosion and sedimentation control BMPs on the site plan.***
- ***Require the use of native or site suitable plants in all vegetative stormwater BMPs (to help reduce stormwater velocities, filter runoff, provide additional opportunities for wildlife habitat and prevent invasive species from being introduced into the Township).***
  - ***Require location of natural features, such as lakes, ponds, streams, floodplains, floodways, wetlands, woodlands, steep slopes, and natural drainage patterns be illustrated on site plan.***
- ***Require Drain Commissioner review in site plan process if site discharges to County Drain.***

ARTICLE 22 - RIPARIAN LOT USE REGULATIONS

Section 22.2 - Regulations

- ***Minimum setback for new buildings of 50 feet from the ordinary high water mark.***
- ***Prohibiting cutting and/or filling for building on the floodplain and filling for buildings on the upland within 500 feet of the river's edge where the groundwater table is within six feet of the surface.***
- ***Preserving a natural vegetation strip adjacent to the river on all private and publicly owned land.***
- ***Restricting placement of septic system drain fields to 150 feet from the waterbody or as far as possible away from waterbody.***
- ***Minimizing use of pesticides, herbicides, and fertilizers within the riparian zone.***

ARTICLE 23 - GROUNDWATER PROTECTION STANDARDS

Section 23.1 - Scope

The Provisions 1-3 shall apply to all businesses and facilities, including private and public facilities. ***Additional provisions 4-11 apply to facilities within the wellhead protection area of the Township,*** which use, store, or generate hazardous substances in aggregate quantities greater than 100 kilograms per month (equal to 25 gallons or 220 pounds), and which require site plan review under the provisions of this ordinance.

ARTICLE 25 - LOT, YARD, AND AREA REQUIREMENTS BY ZONING DISTRICT

Add Column for RPO (Resource Protection Zone).
Add setbacks for each Principle Structure as determined by the Planning Commission.
Add Rows for ***Natural Features***, with rows below for ***Wetlands, Rivers and Streams, Lakes***, and add setback for each zoning district.

IMPLEMENTATION

The WMP outlines recommendations to meet the goals and objectives identified by the Steering Committee. Land use planning was determined to be an important part of the sustainability of the watershed project since future growth is expected to occur around the urban and recreational areas. Several recommendations contained in this policy review could involve changes that may not be fully within the control of the Township. Some might require state approval or legislative action. This policy review is one component of the complex issue of land use planning, but will assist the Township in identifying the next step in the process.

COMMUNITY RESPONSIBILITIES

The Township developed a list of recommendations on how to implement the provisions of the Land Use Plan, including activities to achieve the Township goals and objectives. The implementation activities will enable coordination between the plan and the zoning districts and the uses intended to be supported in each classification. The implementation section of the Land Use Plan prioritizes those activities (A-E) for the Township to pursue. Additional guidance is provided to assist the Township in the implementation.

A. UPDATE ZONING ORDINANCE
Use information contained in this report to update zoning ordinance language for greater resource protection.

B. DEVELOP A CAPITAL IMPROVEMENT PROGRAM
Develop a Capital Improvement Program working with the zoning ordinance as a guide for economic development and capital improvement projects. Include opportunities for incorporating green infrastructure into identified projects.

C. UPDATE COMMUNITY RECREATION PLAN
Revise the Community Recreation Plan to include a process for identification and acquisition of open space to increase recreational opportunities. The plan should be reviewed annually and updated every five years to maintain approval by MDNRE and eligibility for the various grant programs.

D. FARMLAND PRESERVATION PROGRAMS
Review existing County Farmland Preservation Ordinance and ensure the existing township zoning ordinance is consistent with the county ordinance. Consider having a representative of the Township serve on the County Agricultural Preservation Board.

E. DEVELOP SUBDIVISION (AND CONDOMINIUM) REGULATIONS/ORDINANCE
Developing a PUD ordinance would allow the flexibility required to implement LID techniques in new developments and open space requirements.

CONCLUSIONS

The recommendations listed in this report would improve plans and policies in the Township to better protect water quality and natural resources. The Township is currently updating the Land Use Plan and the intent of this report is to provide additional guidance in completing that update.

Introducing new concepts to local officials requires substantial time and effort spent on presenting information to gain a level of comfort with the new techniques. The policy review spreadsheet (Appendix 1) can continue to guide future work for both an updated Land Use Plan and zoning ordinances. This document and the policy review spreadsheet should be used as a review tool and the language developed for the Township could be applicable to other communities within the county.

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of watershed protection and other areas that could be enhanced for greater resource protection. Assessing the current development rules and the identification of the impediments to innovative site design will assist the community to create and implement better development designs.

fTC&h

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Appendix 1

Burr Oak Township Planning Workshop

February 18, 2013

1. Prioritize Goals and Objectives from Land Use Plan:

A. AGRICULTURAL DEVELOPMENT

GOAL: Preserve to the maximum extent possible the Township's most productive agricultural areas and to avoid conflicts between farm and non-farm uses.

B. OPEN SPACE AND RECREATION

GOAL: Plan for adequate year-round open space areas to meet the needs of the residents of the Township and preserve and enhance the Township's natural features and rural character.

C. RESIDENTIAL DEVELOPMENT

GOAL: Plan for a choice of housing types, locations, and environments to accommodate individual capabilities and preferences of current and future populations.

D. COMMERCIAL DEVELOPMENT

GOAL: Plan for suitable areas for the orderly development of a variety of commercial and service activities to serve the needs of the projected population.

E. INDUSTRIAL DEVELOPMENT

GOAL: Industrial development should occur in locations which meet the following objectives.

F. TRANSPORTATION

GOAL: Plan for efficient, safe, and convenient access to the transportation network.

G. UTILITIES

GOAL: Plan for the timely development of necessary services - sewer, storm drains, and water lines - in accordance with present and planned future needs of the Township.

H. COMMUNITY FACILITIES

GOAL: Plan for a range of community facilities and services to meet the present and future needs of the residents of the Township.

I. ENVIRONMENT

GOAL: Protect the community's natural features/resources.

Appendix 5

Prairie River Watershed
Steering Committee
Key Agencies

Steering Committee for the Prairie River Watershed

Prairie River Watershed Steering Committee Participants				
First Name	*Last Name*	*Organization*		
Trent	Arver	Branch County Road Commission		
Chris	Bauer	Michigan Department of Environmental Quality		
Jim	Coury	I69 Heritage Route		
Josh	Crandall	St. Joseph County NRCS		
Geoff	Cripe	Southwest Michigan Land Conservancy		
Bill	Dobrowski	Nottawa Township		
Brian	Gunderman	Michigan Department of Natural Resources		
Mike	Hard	Branch County Drain Commissioner		
Derrick	Harmon	Branch County NRCS		
Kayleen	Hart	Steuben County Soil & Water Conservation District		
Tony	Headley	Branch, St. Joseph, Hillsdale County Health Dept		
Carol	Higgins	St. Joseph County Conservation District		
Jack	Knorek	Michigan Dept of Agriculture & Rural Development		
Ed	McLacher	Potawatomi RC&D		
Jennifer	Miller	St. Joseph County Conservation District		
John	Mitchell	Branch County Conservation District		
John	Nelson	St. Joseph County Conservation District		
Mary Ellen	Newton	Branch County Conservation District		
Bud	Norman	Branch County		
Jack	Rote	Lake Templene Property Owners Associaton		
Melanie	Stoughton	Friends of the St. Joseph River Association		
Bob	Sweet	Michigan Department of Environmental Quality		
Jeff	Wenzel	St. Joseph County Drain Commissioner		
Kathy	Worst	Branch County Conservation District		
Rob	Zbiack	Michigan Department of Environmental Quality		
Ray	Reinertson	Lake Templene Property Owners Associaton		
George	Letts	Burr Oak Township		
Judy	Sabaitis	Ovid Township		

Key Agencies & Organizations

Branch Conservation District

Led by an elected Board of Directors, the Conservation District has been creating an awareness of conservation issues while being a leader in providing innovative assistance throughout the County since 1948. The Conservation District hosted the Prairie River Watershed Planning Project (PRWPP) and assisted as needed in all facets of the project.

Friends of the St. Joe River Association

Established in 1994 to bring together communities of the St. Joseph River Watershed to work as one unit to clean and restore the river and all the lakes, streams and rivers within the watershed. The FotSJR is an outreach and education resource for partners throughout the watershed. They provide tools to help target and fund implementation projects throughout the St. Joe River Watershed. The Prairie River Watershed Planning Project is a sub-watershed to the St. Joe River Watershed and FotSJR provided a tremendous amount of information related to the area as well as provided technical support for the Prioritization Model in the Prairie River Watershed Management Plan. They currently host an EPA grant related to identifying wetlands and wetland functions in the area and the PRWPP utilized information gathered through this project.

Southwest Michigan Land Conservancy

Governed by a Board of Directors the nonprofit land conservancy was created in 1991 and works throughout nine counties in southwest Michigan. Their staff helps individuals and organizations preserve land important to wildlife and people, encourage ecologically sound land practices and provide opportunities for education, research, recreation and nature study. For the PRWPP, the conservancy has provided help in identifying areas of protection in the watershed as well as compiling land use planning documents for Townships within the Prairie River Watershed.

St. Joseph County Conservation District

Guided by a Board of Directors the Conservation District provides assistance to landowners and communities within the County. As part of the PRWPP they provided technical assistance, distributed information as needed and supported watershed events. The PRW has the majority of its acreage in St. Joe County and therefore had the ability to reach a great amount of the watershed population because of this partnership.

Natural Resources Conservation Service

A division of the United States Department of Agriculture, they provide technical and financial assistance through the Farm Bill to residents in the region and nationally. For the PRWPP, assistance related to Farm Bill programs and other technical needs was contributed through District Conservationists and Soil Conservationists. In addition, expertise and information was used when developing and suggesting best management practices for agricultural lands.

Michigan Department of Natural Resources

This agency is tasked with managing and protecting natural resources throughout the state. During the PRWPP, they were utilized for knowledge of natural resources in particularly fisheries. Additionally, they also helped identify lands within the watershed managed by DNR.

St. Joseph County Drain Commissioner
Responsible for managing over 180 county drains and all lakes that have court ordered lake levels with in St. Joseph County, MI. This office provided the needed information related to dam operations and design/structure standards used throughout the county.

Branch County Drain Commissioner
Responsible for managing over 180 county drains and all lakes that have court ordered lake levels with in Branch County, MI. This office provided the needed information related to dam operations and design/structure standards used throughout the county.

Lake Templene Property Owners Association
This is a group of property owners in the Lake Templene area that maintain and keep aware of concerns within their lake area. This group has completed management plans and other surveys/studies that were utilized to identify efforts already made in the area.

Michigan Department of Environmental Quality
A State Agency that promotes wise management of Michigan's air, land and water resources to support a sustainable environment, healthy communities as well as a vibrant economy. They provided direct oversight to the Prairie River Watershed Planning Project lending a hand with technical assistance and other grant related responsibilities.

Appendix 6

Prairie River Watershed

Inventories and Data Compiled

Appendix 6.1

Prairie River Watershed
Road Stream Crossing Inventory

At the beginning of the project an inventory was completed on road stream crossings in the Prairie River Watershed. 115 sites were evaluated for:

- Nearest Intersection (direction to intersection) - ****This means the direction from the road stream crossing to the nearest road crossing intersection.***
- Culvert size
- Stream Depth
- Make up of bottom of river
- Special animals and plants
- Farms/field (noted practice information)
- Roadside Runoff (presence of)
- Other (items of special interest)

Site maps are included in this section

Dirt Road Stream Crossing in the Prairie River Watershed (Cemetery Rd.)

PRW RSC Field Inventory

Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
HW1	Dragon Lk Shore	Copeland Rd (N)	Yes	Few inches	small stones/sand			Yes	Recently replaced Culvert, gully erosion present, no silt fence/stream bank erosion from equipment. Property seeded and with hay on it
HW2	Grass Lk Rd	Copeland Rd (S)	15	1ft	muck & stone		corn/soybean	No	
HW3	Walker Rd	Southern Rd (S)	48		sandy muck		Soybeans	No	
HW4	Southern Rd	Walker Rd (W)	36	couple inches		Jewelweed	Corn	No	
HW5	Herl	Southern Rd (S)	No	6 inches	sandy, small pebbles	Jewelweed-Joe pye weed		Yes	
HW6	Thompson #1	Herl Rd (E)	24				corn/soybean		
HW7	Thompson #2	Block Rd (W)	60	3.5ft	large stone/sand		no		Unrestricted Livestock Access
HW8	Block Rd #1	Hoopingamer (N)	60	1ft	large stone	Milkweed	no	no	
HW9	Copeland	Block Rd (W)	48	6 inches	sand	Milkweed/Jewelweed	Soybeans		Odd pile of asphalt. Looks like it was leftover, then just piled on the roadside
HW10	Block Rd #2	W Adams Rd (N)	24	6 inches	sandy	Phragmites		no	
HW11	Maplegrove	W Adams Rd (N)	48	1ft	Muck		No	yes	erosion present
HW12	Adams Rd	Steffey Rd (W)	24	8 inches	Muck		no	no	
HW13	Bowers Rd	Adams Rd (S)	12						
HW14	Steffy Rd	Adams Rd (S)		1ft	muck		corn	no	
HW15	Southern Rd	Steffey Rd (W)	24	1ft	muck		corn		Farmed right to riverbank
HW16	Southern Rd	Steffey Rd (E)	36	1ft	muck		soybeans	NO	Field tile present….submerged under water
HW17	Southern Rd	Bowers (W)	24	6 inches	muck		soybeans	NO	Farmed right to riverbank
HW18	Booth Rd	Bowers (W)	24	6 inches	lots of aquatic veg		corn/soybeans	NO	No veg buffer
HW19	Booth Rd	Steffey (E)	36	10	silt/sand		corn	NO	Little veg buffer

Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
HW20	Booth Rd	Steffey (W)	24	dry					
HW21	Steffey Rd	Hoopingamer (N)	60	1ft	sand	Joe Pye Weed/Purple Loosestrife	soybeans		Good Filter strip
HW22	Rubley Rd	Bowers (W)	36	2ft		Joe Pye Weed/Milkweed	Soybeans	NO	Good Filter strip/Cloudy water
HW23	Slisher Rd #1	Bowers (W)	24	8	silt/sand				Rusted out culvert
GL24	Slisher #2	Snow Prairie (W)	60	4.5ft	sand/small stone	Purple loosestrife	corn		
GL25	Snow Prairie	Slisher (S)		3.5ft	sand/muck	Joe Pye Weed			unrestricted livestock access
GL26	Slisher	Cemetary (W)	48	dry			Soybeans	NO	
GL27	Cranson	Cemetary (W)	36	4 inches	muck		corn	NO	Lots of Aquatic plants
GL28	Cranson	Gilead Lake (N) (S)		3ft	small stones		Soybeans		Irrigation System W Diesel tank
GL29	Kosmerick	Gilead Lake (E)	24	dry	lots of aquatic veg		corn		
GL30	Parham	Cranson (S)		3ft	Large rock	Joe Pye Weed/Jewelweed	corn	NO	
GL31	Rierson	Kosmerick (N)		4ft	muck	Joe Pye Weed	corn/soybeans	NO	
GL32	Cemetary	Kosmerick (N)	24	1.5ft	muck	Joe Pye Weed	corn/soybeans		Irrigation Pump
GL33	Kosmerick	Orland (W)	24		muck	jewelweed	Soybeans	NO	
GL34	Cemetary	Kosmerick (S)	24			jewelweed	corn/soybeans	NO	
GL35	Parham	Sikorski (N)	36	1ft	muck				mowed to edge/minimal buffer
GL36	Gilead Lake	Sikorski (N)				Ironweed /milkweed	Soybeans/alfalfa	NO	
GL37	Sikorski	Gilead Lake (E)	24				corn/soybeans		Lots of algae, erosion present, manure pile upslope about 100ft from river
GL38	Schmidt	Parham (W)	36			Boneset	Soybeans	NO	
GL39	Parham	Schmidt (E)						NO	
GL40	Cemetary	Grant St (N)	36				Soybeans	NO	lots of algae, no buffer

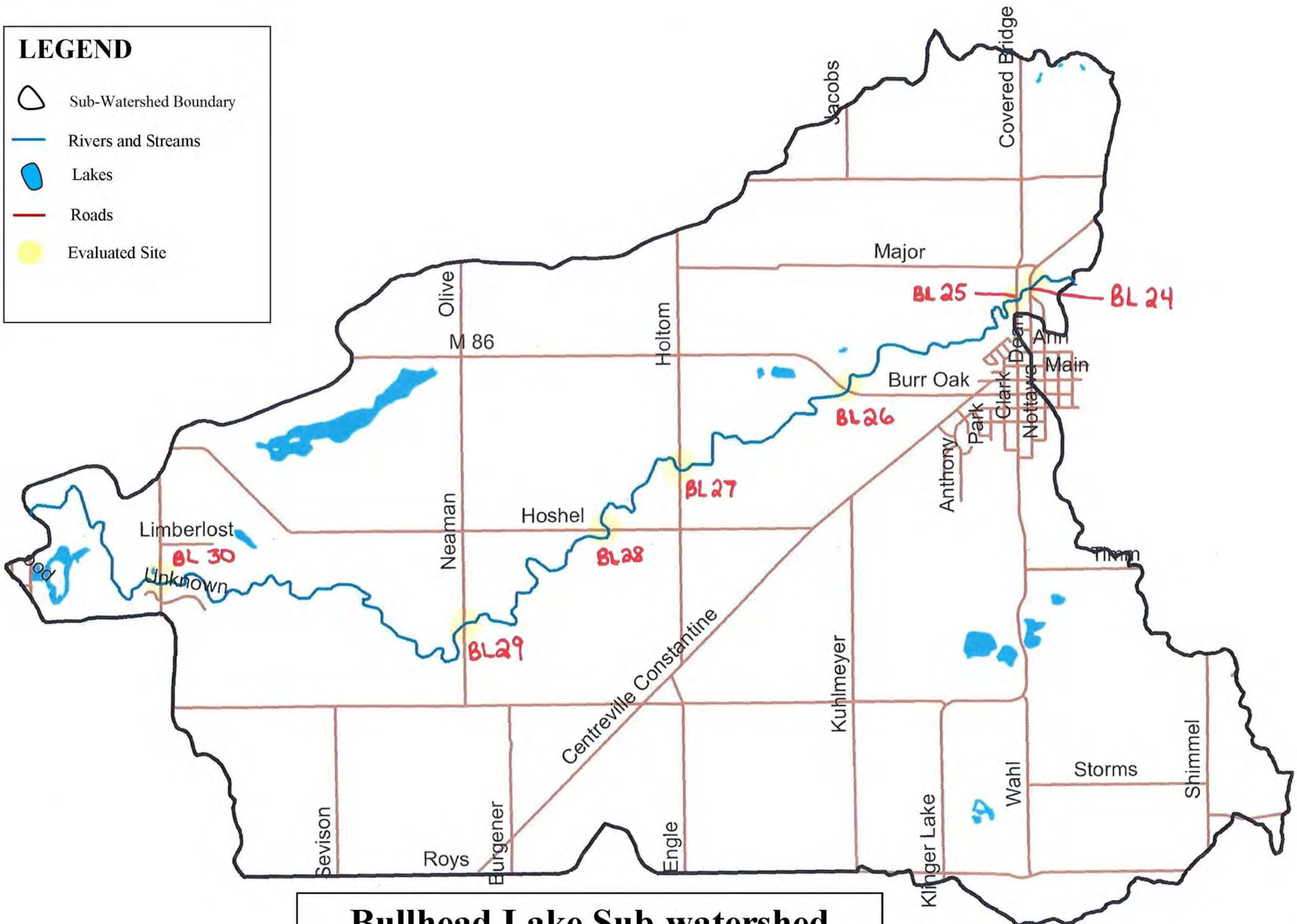
Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
GL41	Orland	Dewsenberry (S)	60	6 inches	muck	blue heron spotted, joe pye weed	corn/soybeans	NO	
GL42	Weaver	US 12 (S)	48	dry			corn/soybeans	NO	
GL43	US 12	Prairie River Rd (W)						NO	
GL44	Prairie River Rd	US 12 (N)	48	6 inches	sand/medium stone	cardinal flower	corn	NO	
GL45	Bawden #1	Dewsenberry (S)	48	6 inches	sandy	joe pye weed	corn	NO	mowed to edge
GL46	Bawden #2	Dewsenberry (N)				blue vervain	corn/pasture	NO	
GL47	Bawden #3	Kosmerick (S)	12			blue heron spotted	pasture		Unrestricted Livestock Access, erosion present
GL48	Bawden #4	Douglas (S)	36	dry		blue heron spotted	corn/pasture	NO	
GL49	Bawden #5	Slisher (N)	24	6 inches	small stone	jewelweed	corn/soybeans	NO	
GL50	George Rd	Blosser (N)		dry			soybeans	NO	culvert buried
GL51	Slisher Rd	Lilly (W)	36	1ft	sand/muck		corn/soybeans	NO	
GL52	Prairie River Rd	Douglas (N)	24	1ft	small stone	joe pye weed	corn		golf course
GL53	Prairie River Rd	Douglas (S)	12	5ft	large stone				golf course, erosion present
GL54	Douglas	Lilly (W)	36	1ft		blue vervain	corn/soybeans		lots of algae
GL55	Carpenter	US 12 (W)			silt/small stone	milkweed	beans		Irrigation System / tile present
GL56	Dale	UNDER ROAD CONSTRUCTION NOT ACCESSIBLE							
SLD57	Siekens	Himebaugh (E)		dry			corn		
SLD58	St. Joe Rd	Siekens (N)	24			jewelweed	corn	NO	stagnant water
SLD59	Not safe to stop due to traffic								
SLD60	St. Joe Rd	Ackey (S)	48	3ft	large stone/muck	joe pye weed	pasture		Stream bank recently graded, no silt fence, runoff present
SLD61	Burr Oak Rd	Ackey (N)	48	6 inches	sandy	jewelweed	soybeans	NO	erosion present
SLD62	Burr Oak Rd #1	Clinton (S)			large stone				erosion present, local park, structure created under bridge that speeds flow creating heavy streambank erosion
SLD63	Front St	Highland (W)	48			blue lobelia, jewelweed	corn		limited buffer. Very steep slopes

Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
SLD64	Highland	Maystead (S)			sandy	boneset, joe pye weed			mowed to edge
SLD65	Carpenter	Witt Lake (N)				boneset, compass plant	corn		mowed to edges
SLD66	Witt Lake	Carpenters (W)	36	1ft	muck	jewelweed, compass plant	corn	NO	irrigation system, minimal buffer
SLD67	Kelly	Carpenters (W)	36	4ft		jewelweed	corn	NO	irrigation system
SLD68	Maystead	Needham (E)	36	2ft	muck		corn/soybeans	NO	irrigation system
SLD69	Needham	Cowles (S)		1.5ft	sand	cardinal flower			Unrestricted & Restricted livestock access
SLD70	Cowles	Needham (E)	60				corn		Unrestricted Livestock Access, erosion present
PRL71	McKale	Cowles (S)		1ft	sandy	cardinal flower			
PRL72	Hackman	McKale (W)							
PRL1	Prairie River Rd	Maystead (S)		3ft	sand/muck	purple loosestrife		NO	
PRL2	Hackman	Happel (E)		3ft	sand/muck	joe pye weed		Yes	Popular kayak/canoe area, lots of fishing trash (bait containers, fishing line, etc)
PRL3	Banker St.	Rommel (S)	24	1ft	silt/sand	jewelweed			
PRL4	M66	Findley (N)		4ft			Corn	NO	USGS Gauge Site
PRL5	Lepley	Wagner (N)	24				corn/soybeans	NO	
PRL6	M66 #1	Borham (N)					corn	NO	Very vegetated, hard to get to water
PRL7	Londick	Fillmore (W)	12	2ft	silt		pasture	Yes	Dirt road with runoff visible, unrestricted livestock access, algae
	Marsh Rd	NOT FOUND							
SC9	Farrand	Fairfax (N)						NO	Good Buffer
SC10	Fairfax	Farrand (E)		6 inches			corn	NO	
SC11	Spring Creek #2	M86 (S)	24	1ft	sand/silt				
SC12	M86#1	Lepley (W)				milkweed	corn/soybeans	NO	Huge residential pond to north

Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
SC13	M66 #2	Spring Creek (N)						NO	VERY steep slope (100-150ft), some sort of pond on the west side, backhoe located and lots of soil (potential dredging/pond digging?)
SC14	M66#3	Spring Creek (N)							Too steep to get to, very vegetated
SC15	Wasepi	Nottawa (W)	24	1ft	muck		corn/soybeans/pasture	Yes	Large livestock farm to North and East
SC16	Nottawa Rd	Wasepi (S)		2ft	muck			Yes	Low lying area prone to flooding, unrestricted livestock access
SC17	Nottawa Rd#1	Spring Creek (S)	36				corn	NO	good buffer
SC18	Butler	Walterspaugh (E)	36	2ft				NO	
SC19	Walterspaugh	Butler (S)	36	2ft			corn/soybeans	NO	
SC20	Bucknell #1	NOT FOUND ---marshy area							
SC21	Spring Creek #3	Bucknell (E)	24	1ft	muck/sand		corn/soybeans	NO	
SC22	Bucknell	Walters (S)		1ft	small stone/sand	joe pye weed, jewelweed	Amish	Yes	Wire fence crossing river, cant tell if it is restricted access or unrestricted, lots of aquatic plant
SC23	Rambadt	Walters (S)		1ft	medium stone	joe pye weed, jewelweed	Amish/corn	NO	Irrigation System, lots of algae
BL24	Angling Rd	Major (N)		1ft	small stone			Yes	Stones being placed under bank in an effort to stabilize, erosion is not significant in this area, just normal bend erosion
BL25	Covered Bridge	Major (N)		2ft					
BL26	M86	Holtom (W)		2ft					
BL27	Holtom	Hosel (S)		2ft	small stone/sand		corn	Yes	mowed to edge, lots of aquatic plants

Site #	Road Name	Nearest Intersection (direction to intersection)	Culvert *(Inches in Diameter)*	Depth	Make up of bottom of river	Special Animals/plants	Farms/Field	Roadside Runoff	Other
BL28	Hoshel	Holtom (E)		2ft	small stone/sand			Yes	Canoe Park, soil compaction, mowed to edges
BL29	Neaman	Hosel (N)		2ft	small stone				lots of aquatic plants, canoe/kayak put in
BL30	Lutz	Limberlost (N)		2ft	small stone/sand				recent work done (silt fence), golf course
LT31	Rambadt Rd	M86 (S)		2ft	small stone/sand			No	Greenhouse to the north
LT32	LAKE TEMPLENE DAM SITE								
LT33	Nottawa Rd #2	M86 (N)		4ft	silt			Yes	Nottawa Boat Launch site, Gully erosion present, lots of trash, mowed to edges
LT34	Sauger Lake Rd	Fish Lake (W)	12	3 inches	muck			No	Fairly dry, lake draw down
	Marvin Rd	NOT FOUND							
PRL36	Findley Rd	4ft	small stones/muck		pasture		Cattle visible but cannot tell if they have access to water from RSC		
SC37	Marvin Rd #1	Nottawa (W)			muck		Corn/pasture	NO	Looks to pond on south side, possibly for irrigation system
SC38	Wasepi #1	Walterspaugh (W)	24	1ft	silt		corn/soybeans	NO	
SC39	Spring Creek #4	NOT FOUND							
SC40	Fairfax #1	Mountain (S)	24	2ft			corn/soybeans	NO	livestock farm to north
SC41	Moutain Rd	Lepley (W)		2ft			corn/soybeans	NO	minimal buffer, tile visible, deep trench
SC42	Walterspaugh #1	Wasepi (S)			small stone/muck		corn/soybeans	NO	mowed to edge, minimal buffer
SC43	Lepley #1	Marsh (S)		dry					

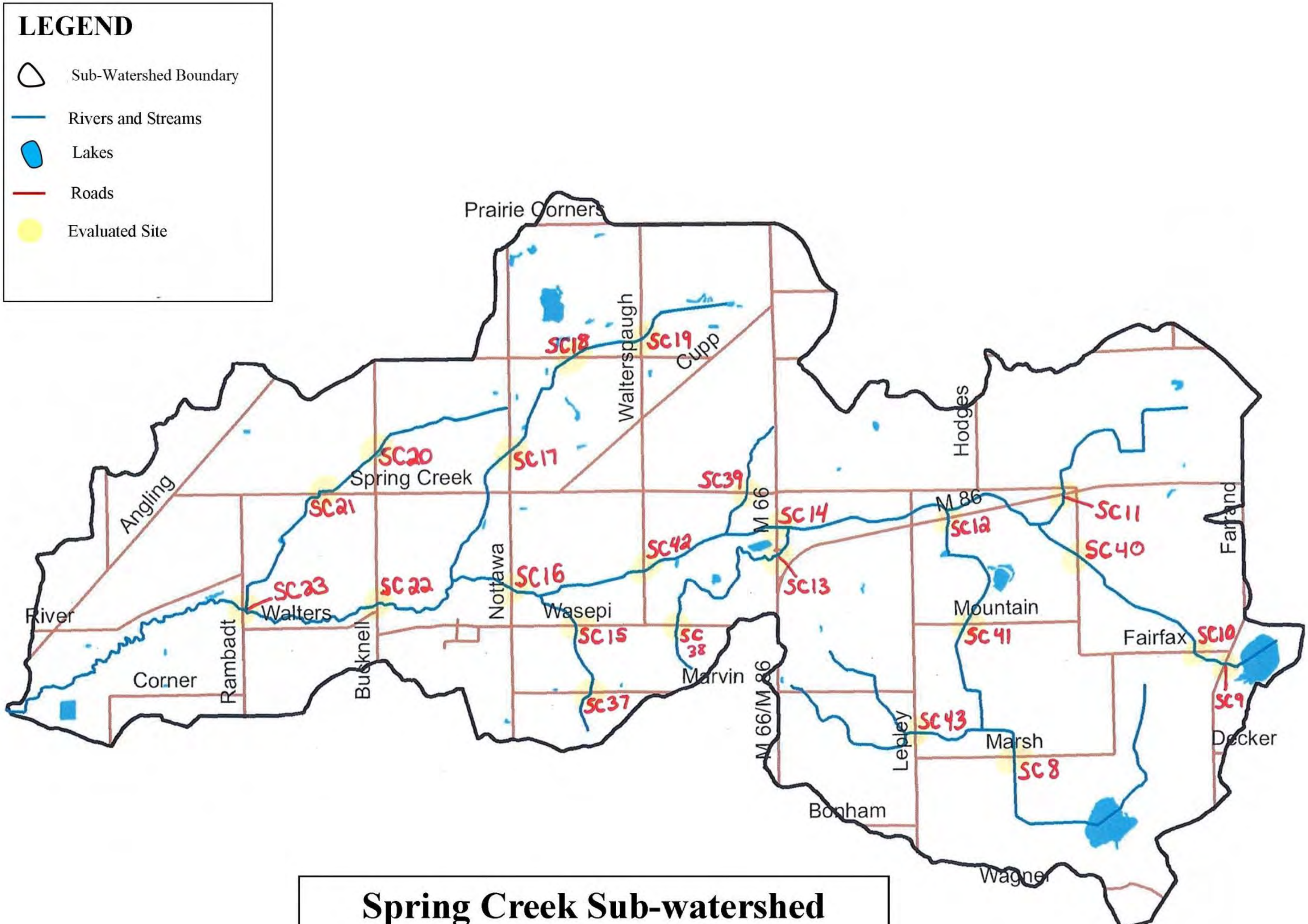
PRW RSC Field Inventory



Bullhead Lake Sub-watershed

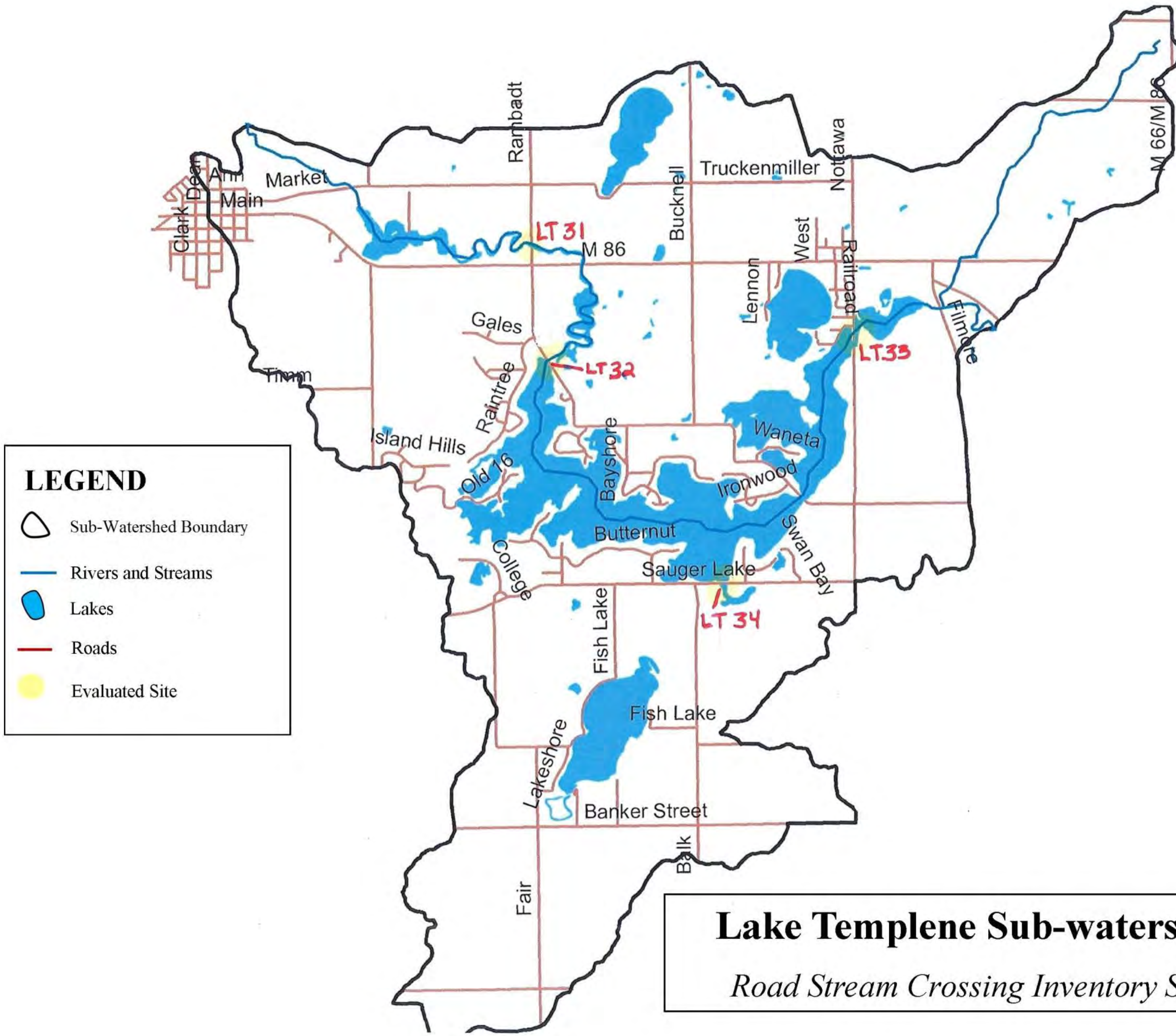
Road Stream Crossing Inventory Sites

Appendix 6
6.1-2



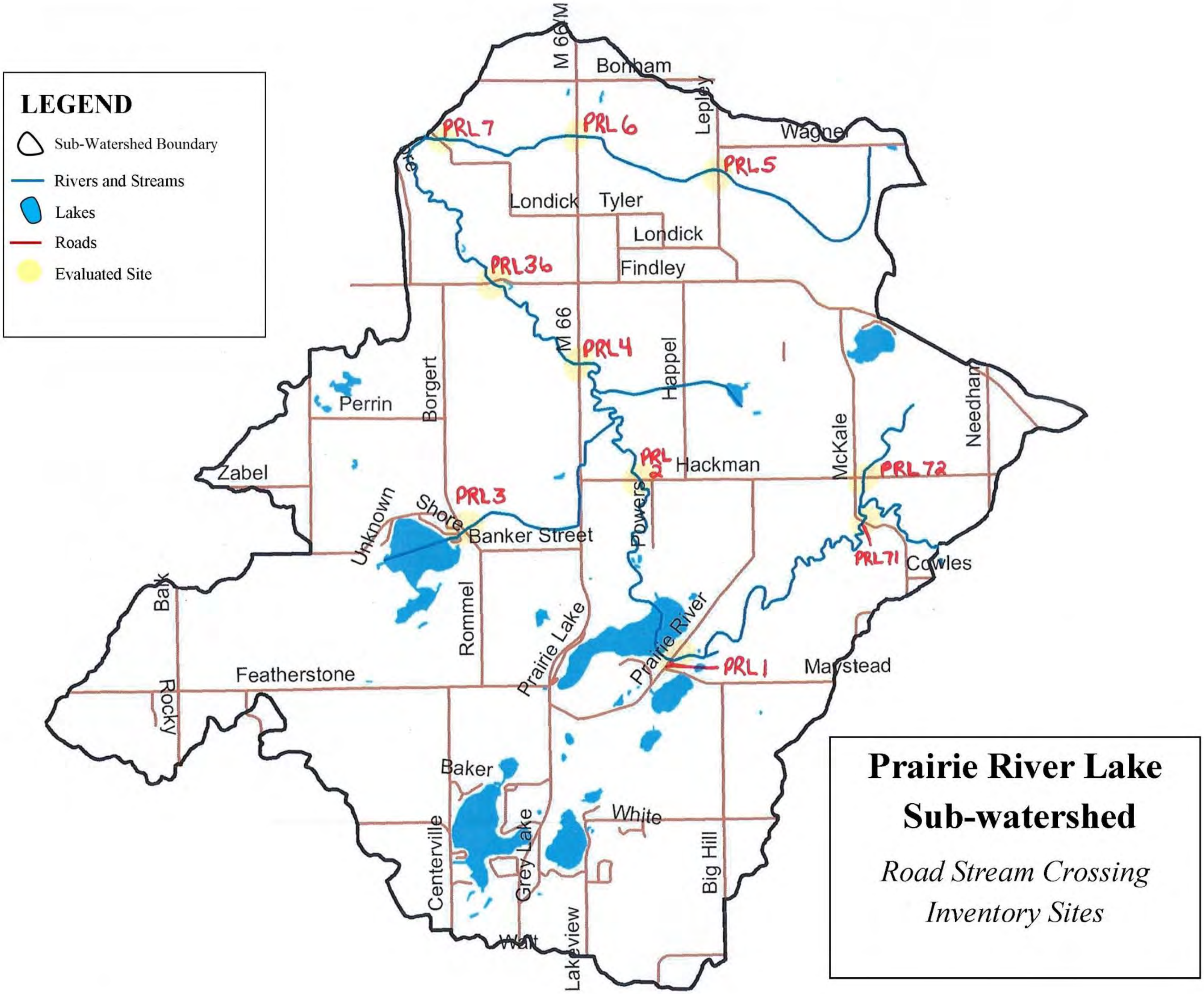
Spring Creek Sub-watershed

Road Stream Crossing Inventory Sites



Lake Templene Sub-watershed

Road Stream Crossing Inventory Sites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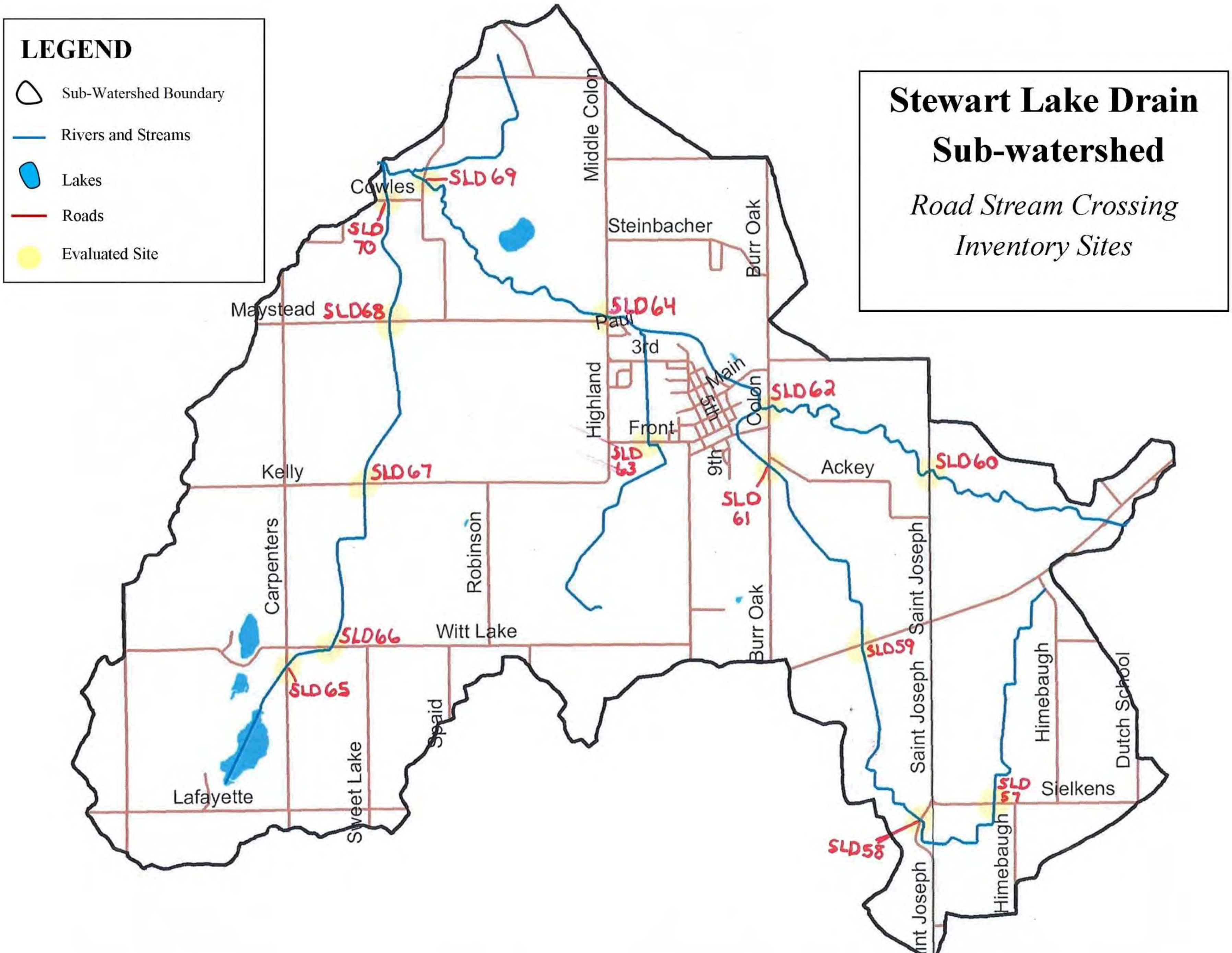
Sub-Watershed Boundary
Rivers and Streams
Lakes
Roads
Evaluated Site
Prairie River Lake
Sub-watershed
Road Stream Crossing
Inventory Sites
M 66/M
Bonham
Lepley
Wagner
PRL7
PRL6
PRL5
Londick
Tyler
Londick
Findley
PRL36
M 66
PRL4
Happel
Perrin
Borgert
Zabel
McKale
Needham
PRL 72
PRL 2
Hackman
PRL3
Unknown
Shore
Banker Street
Powers
PRL71
Cowles
Balk
Rommel
Prairie Lake
Prairie River
PRL1
Maystead
Featherstone
Rocky
Baker
White
Centerville
Grey Lake
Big Hill
Walt
Lakeview



LEGEND
Sub-Watershed Boundary
Rivers and Streams
Lakes
Roads
Evaluated Site
Stewart Lake Drain
Sub-watershed
Road Stream Crossing
Inventory Sites
Middle Colon
Cowles
SLD69
SLD 70
Steinbacher
Burr Oak
Maystead
SLD68
SLD64
Paul
3rd
Highland
Main
5th
Colon
SLD62
Front
SLD 63
9th
Ackey
SLD 61
SLD60
Kelly
SLD67
Robinson
Carpenters
Saint Joseph
SLD66
Witt Lake
SLD59
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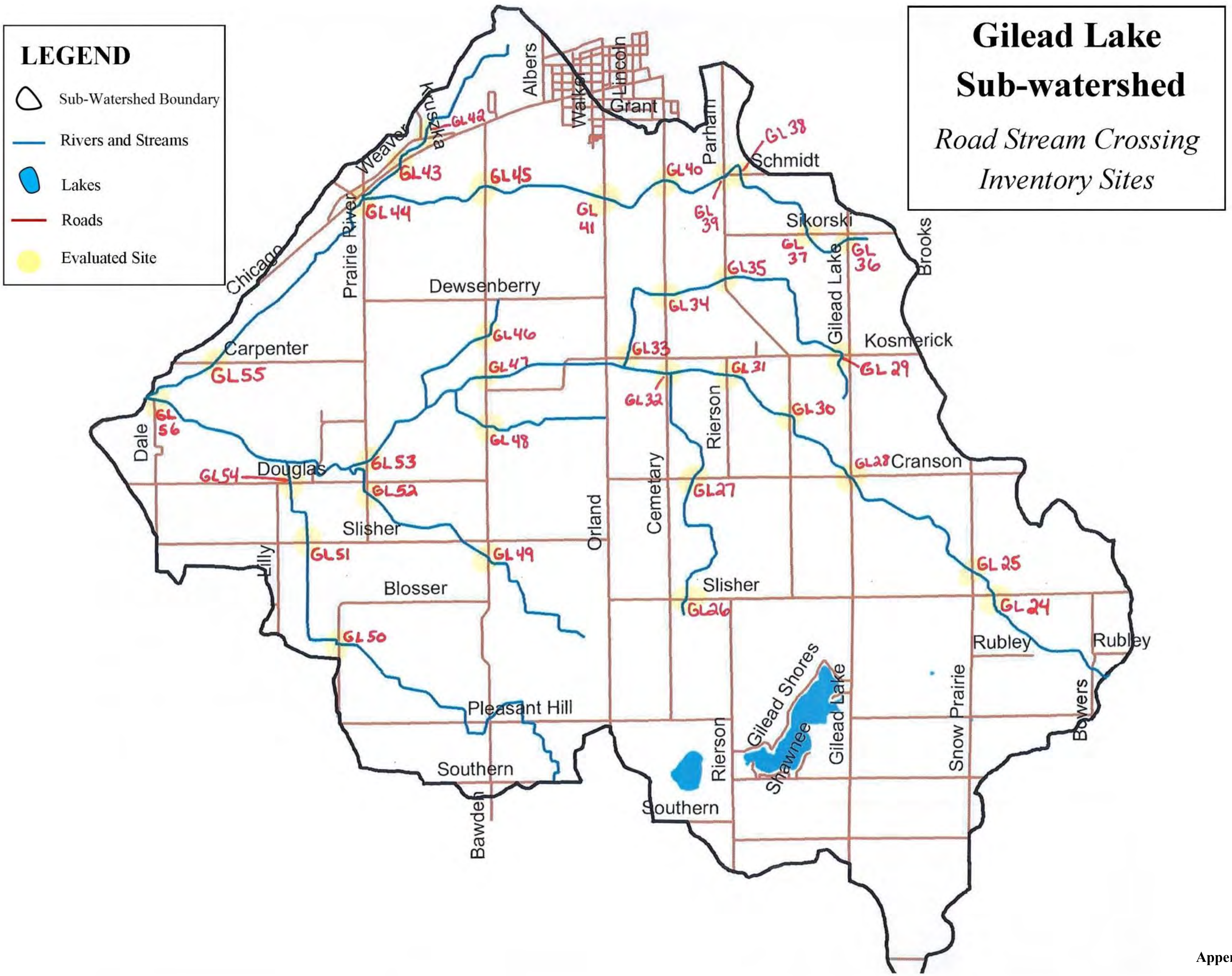
Dutch School
Lafayette
Sweet Lake
SLD 57
Sielkens
SLD58


LEGEND
Sub-Watershed Boundary
Rivers and Streams
Lakes
Roads
Evaluated Site
Gilead Lake
Sub-watershed
Road Stream Crossing
Inventory Sites
Albers
Walker
Lincoln
Grant
Parham
Schmidt
Kuszka
Weaver
Prairie River
Chicago
Dewsenberry
Carpenter
Sikorski
Brooks
Gilead Lake
Kosmerick
Rierson
Cemetary
Orland
Cranson
Dale
Douglas
Slisher
Lilly
Blosser
Pleasant Hill
Southern
Bawden
Rubley
Bowers
Snow Prairie
Gilead Shores
Shawnee
GL 24
GL 25
GL 26
GL 27
GL 28
GL 29
GL 30
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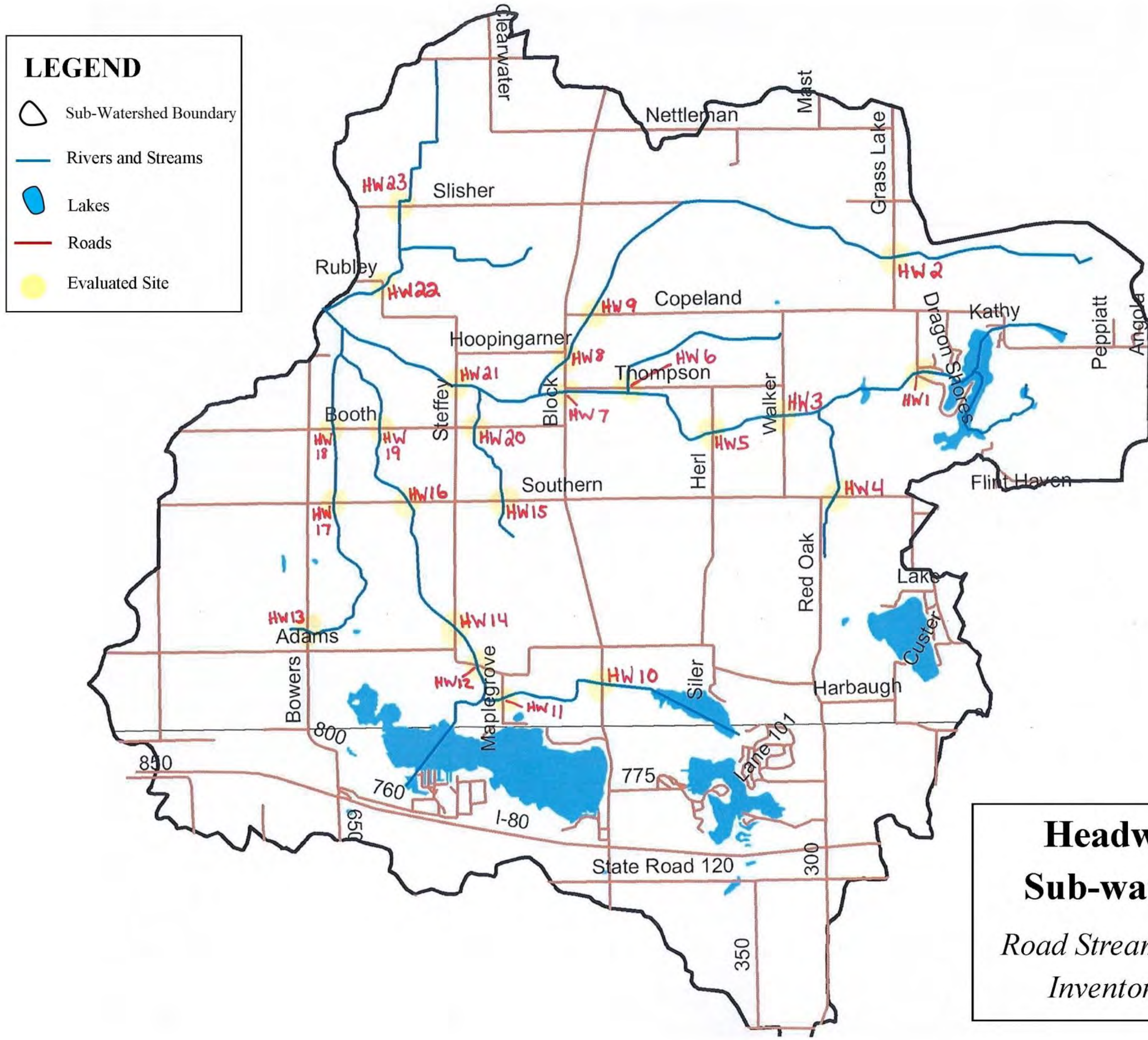


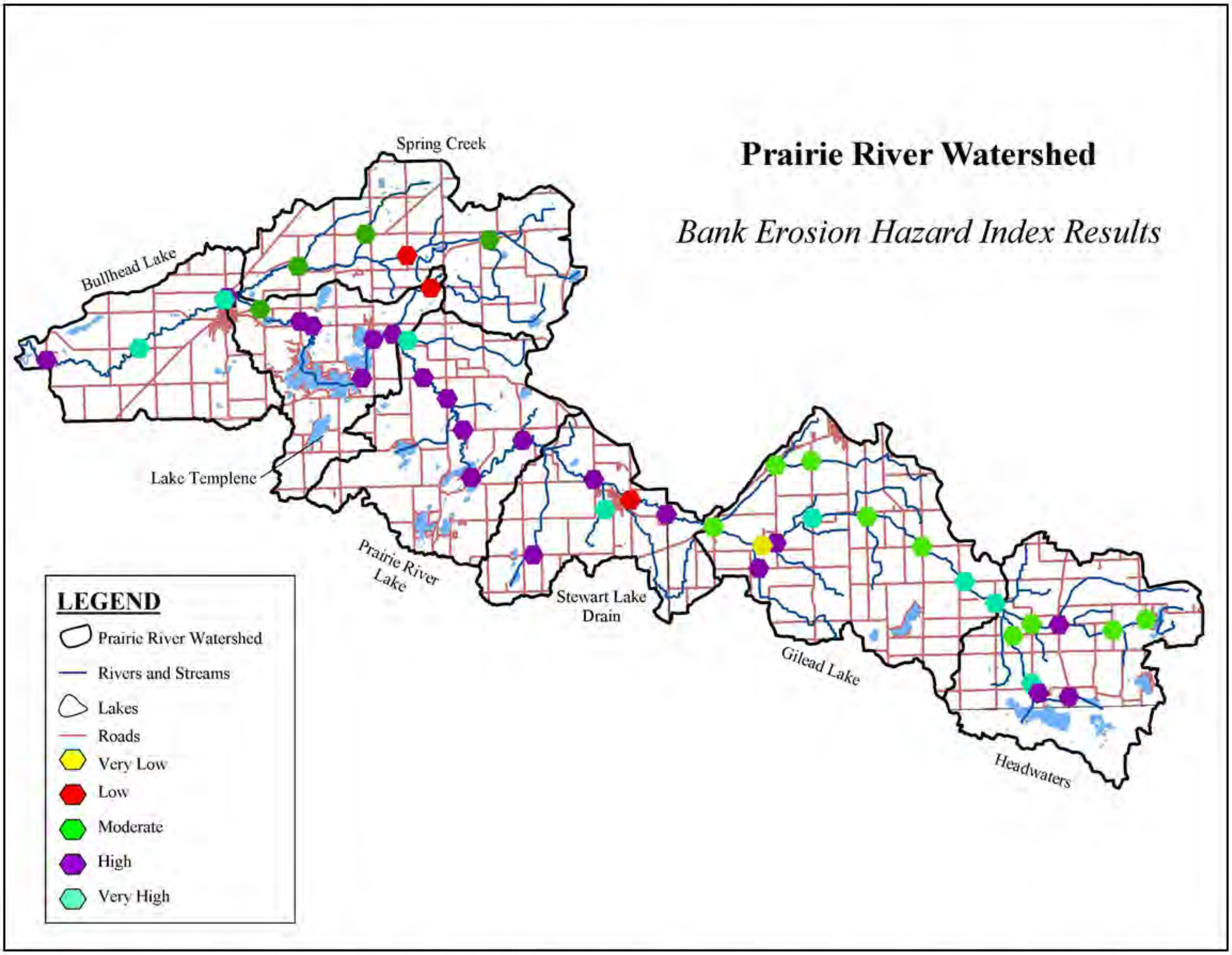
Headwaters Sub-watershed

Road Stream Crossing Inventory Sites

Appendix 6.2

Prairie River Watershed

Bank Erosion Hazard Index



The Bank Erosion Hazard Index (BEHI) is a system for surveying streambank sites and ranking the severity of erosion at specific sites throughout the watershed. BEHI uses a variety of factors to determine the hazard of erosion at a site including root depth of vegetation, bank angle and soil material to name a few.

The following pages are results from the BEHI inventory completed on the Prairie River Watershed in 2011 completed by a small group of volunteers.

A. Complete BEHI Procedure

The complete BEHI procedure consists of five metrics; four observational and one requiring some measurements. They are:

1. Ratio of bank height to bankfull height
2. Ratio of root depth to bank height
3. Root density, in percent
4. Bank angle, in degrees
5. Surface protection, in percent

Brief descriptions of each metric are provided below.

Point values for these metrics (Table 1) should only be assigned after a sufficient length of the stream channel (the 'stream reach') has been examined (at least 100'; 2 to 3 meander lengths is preferable), so that representative conditions are identified. Conditions on both banks should be assessed, and scored separately if they are consistently different. See Section 4 for further advice on where to make – and not make – the observations.

<u>Ratio of bank height to bankfull height.</u> This is the most challenging of the BEHI metrics, as it requires accurate identification of bankfull indicators. A full discussion of different bankfull indicators is beyond the scope of this SOP, but it is thoroughly discussed in Williams (1978), and a useful free video is available from the U.S. Forest Service (2003). Common bankfull indicators in stable southern Michigan streams include top of bank, top of point bars, and other changes in channel slope. Vegetative indicators are seldom useful in southern Michigan streams. Bankfull indicators in unstable streams (i.e., incising or aggrading streams) can be more difficult to identify, but are usually less than top of bank.

<u>Ratio of root depth to bank height.</u> Root depth is the ratio of the <u>average</u> plant root depth to the bank height, expressed as a percent (e.g., roots extending 2' into a 4' tall bank = 0.50.)

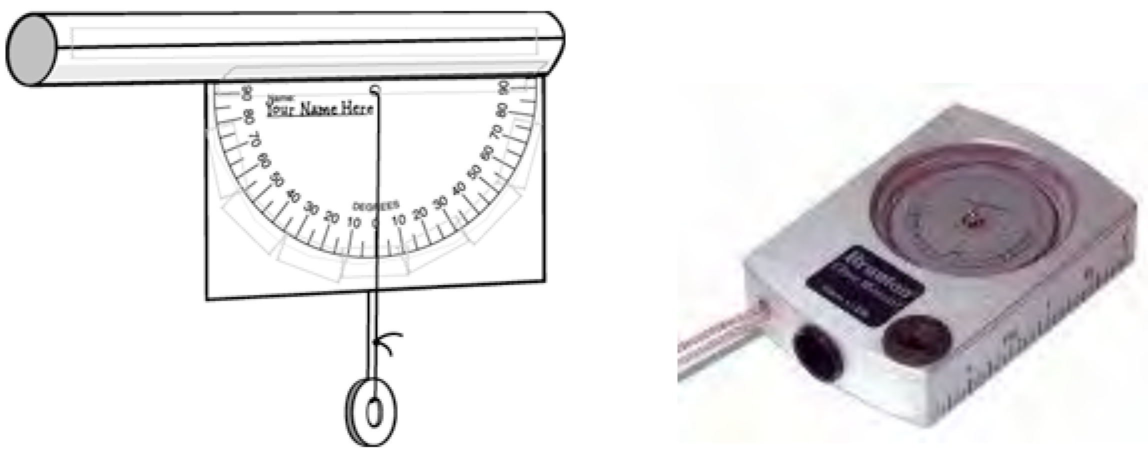
<u>Root density.</u> Root density, expressed as a percent, is the proportion of the stream bank surface covered (and protected) by plant roots (e.g., a bank whose slope is half covered with roots = 50%).

<u>Surface protection.</u> Surface protection is the percentage of the stream bank covered (and therefore protected) by plant roots, downed logs and branches, rocks, etc. In many streams in southern Michigan, surface protection and root density are synonymous.

<u>Bank angle.</u> Bank angle is the angle of the "lower bank" – the bank from the waterline at base flow to the top of the bank, as opposed to benches that are higher on the floodplain. Bank angles great than 90º occur on undercut banks. Bank angle can be measured with

an inclinometer (Figure 1), though given the broad bank angle categories (Table 1), visual estimates are generally sufficient. Bank angle is perhaps the metric most often estimated incorrectly.

Figure 1. Simple and More Expensive (~ $100) Inclinometers



B. Modified BEHI Procedure

If the field staff lack experience with identifying bank full indicators, it is recommended that the bank height/bankfull height ratio metric be dropped from the BEHI calculation, leaving four metrics:

1. Ratio of root depth to bank height
2. Root density, in percent
3. Surface protection, in percent
4. Bank angle, in degrees

Observations for these metrics are made as described in Section 2A, and the overall BEHI score is calculated using Table 2.

3.0 Data Calculation and Interpretation

A draft field sheet for recording observations for the modified BEHI procedure is in Appendix 1. Overall scores for the Complete BEHI are calculated by summing the scores for each individual metric using the values in Table 1, and scores for the Modified BEHI are similarly calculated using the values in Table 2. The overall BEHI score corresponds to an erosion hazard category. It should be noted that the overall BEHI scores and categories were created by Rosgen's work in the Rocky Mountain states, and in the future these may be modified for conditions in Michigan. Illustrated examples from southern Michigan streams are in Appendix 2.

BEHI scores have several potential uses, including ranking multiple stations for further study or remedial actions (Figure 2).

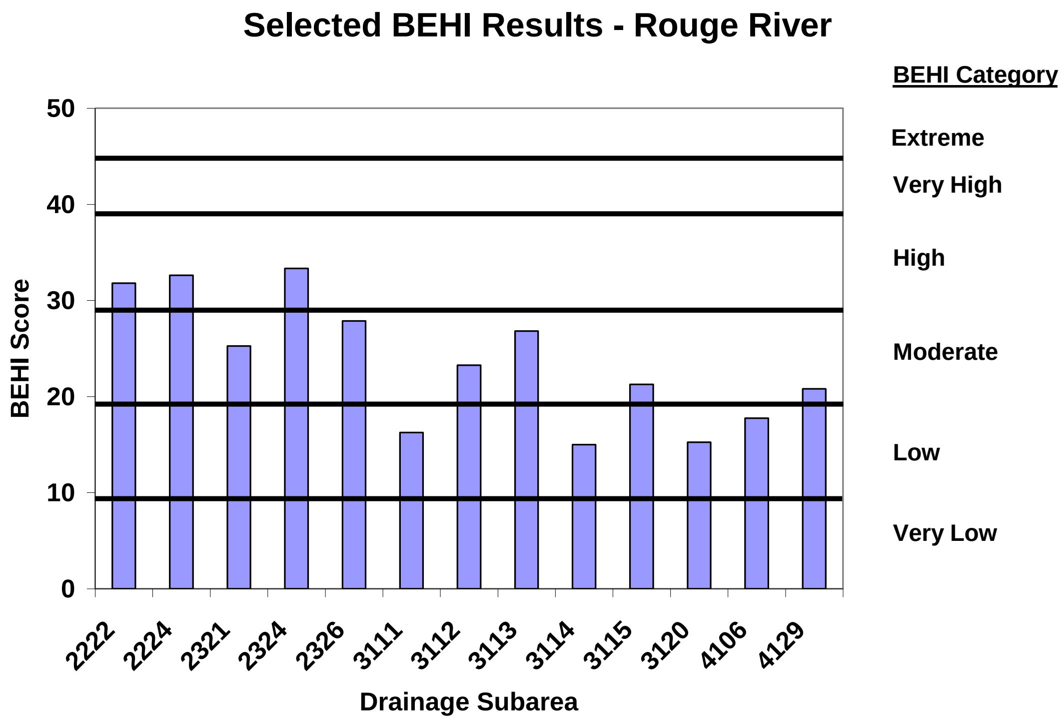
Table 1. Scores for the Complete BEHI.

BEHI Category	Bank Height/ Bankfull Height	BH/BFH Score	Root Depth (% of BFH)	Root Depth Score	Root Density (%)	Root Density Score	Surface Protection (Avg. %)	Surface Protection Score	Bank Angle (degrees)	Bank Angle Score	Total Score, by Category
Very low	1.0-1.1	1.45	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤ 7.25
Low	1.11-1.19	2.95	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	7.26 – 14.75
Moderate	1.2-1.5	4.95	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	14.76 – 24.75
High	1.6-2.0	6.95	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	24.76 – 34.75
Very high	2.1-2.8	8.5	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	34.76 – 42.50
Extreme	>2.8	10	< 5	10	< 5	10	< 10	10	> 119	10	42.51 - 50

Table 2. Scores for the Modified BEHI.

BEHI Category	Root Depth Values	Root Depth Scores	Root Density (%)	Root Density Scores	Surface Protection (Avg. %)	Surface Protection Scores	Bank Angle (degrees)	Bank Angle Scores	Total Score, by Category
Very low	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤ 5.8
Low	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	5.8 – 11.8
Moderate	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	11.9 – 19.8
High	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	19.9 – 27.8
Very high	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	27.9 – 34.0
Extreme	< 5	10	< 5	10	< 10	10	> 119	10	34.1 - 40

Figure 2. BEHI Score Example



4.0 Quality Control Issues

(1) Accuracy: Accuracy as traditionally defined is difficult to assess for this largely subjective, observational procedure. When performed by volunteers, however, the accuracy of their observations can be maximized by training from others more experienced in river morphology studies, and verified by spot-checks of their work by the trainers.

(2) Precision: Precision as traditionally defined is also difficult to assess for this largely subjective, observational procedure. Spot-checks within a few weeks of volunteer observations can be used to assess precision as well as accuracy.

(3) Reference reaches: In addition to the erosion hazard categories generated by this procedure, it can also be useful to make these observations at reference reaches – stream reaches in portions of the same watershed, or an adjacent watershed, that are believed to be (relatively) undisturbed by urban development, stream channelization, etc. A good document describing how to choose and document conditions at a reference site is the U.S. Forest Service report by Harrelson, et al. (1994). Alternatively, contact the author of this SOP for advice on selecting a representative reference reach. In general, reference reaches are best established in the same watershed as the stream reach of interest, in a stream of the same size (e.g., same stream order, or baseflow wetted width) and with similar soil type and channel slope.

(4) Stream reach selection (Representativeness): Selection of specific stream reaches for BEHI observations will depend on the objectives of the study, but a few general rules apply:

- Stream bank conditions are naturally variable even in stable streams, and to characterize a stream reach it is recommended that at least 200' of the stream reach be viewed before the BEHI observations are made.
- Stream banks adjacent to riffle areas tend to be the most stable section of a stream channel, while banks in meander bends tend to have the highest erosion rates – even in geomorphically stable streams.
- Stream banks in 'high traffic' areas (parks, livestock crossings, etc.) are not representative of average conditions and should be avoided – unless they are the specific focus of the study.

While volunteers can collect large amounts of useful BEHI data with adequate training and supervision, experience has shown that they are prone to overemphasizing small, atypical bank erosion "hot spots," even when asked to score more representative banks.

5.0 References

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SOP Prepared by:

Joe Rathbun
Michigan Department of Environmental Quality – Water Bureau – Nonpoint Source Unit
(517) 373-8868 rathbunj@michigan.gov

Modified Bank Erosion Hazard Index (BEHI) Field Form

Date:____________________ **Personnel:**____

Location:____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments:

Date:____________________ **Personnel:**____

Location:____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments:

Date:____________________ **Personnel:**____

Location:____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments:____

Appendix 2. Examples of Different Bank Conditions in Southern Michigan Streams

Figure A. Tributary, Kalamazoo River watershed

Bank Height/Bankfull Height ≈ 1.0-1.1

Root Depth/Bank Height ≈ 0.9-1.0

Root Density ≈ 80-100%

Bank Angle ≈ 0-20º ?

Surface Protection ≈ 80-100%

BEHI Score = 7.25 (Very low)

Figure B. Kalamazoo River

Bank Height/Bankfull Height ≈ 1.0-1.1

Root Depth/Bank Height ≈ 0.9-1.0

Root Density ≈ 30-54%, not counting sod slump

Bank Angle ≈ 81-90º

Surface Protection ≈ 30-54%

BEHI Score = 19.75 (Moderate)

Note sod slumping into channel – a sure indication of an unstable bank, presumably because streamside vegetation = mowed grass, not woody vegetation. Otherwise the channel is in pretty good shape.

Figure C. Rouge River

<u>Bank Height/Bankfull Height</u> ≈ 1.0-1.1 (assuming top of bank = bankfull)

<u>Root Depth/Bank Height</u> ≈ 0.9-1.0

<u>Root Density</u> ≈ 5-14%

<u>Bank Angle</u> ≈ 81-90º

<u>Surface Protection</u> ≈ 10-14%

<u>BEHI Score</u> = 26.85 (High)

Interesting site – roots extend to waterline, but are so few that they provide minimal bank protection. Also, this site is downstream from a dam, where erosion is usually atypically high due to "hungry water" created by the impoundment.

Figure D. Hagar Creek , Ottawa County

<u>Bank Height/Bankfull Height</u> ≈ > 2.8

<u>Root Depth/Bank Height</u> ≈ 0.3-0.49 at best

<u>Root Density</u> ≈ 5-14%

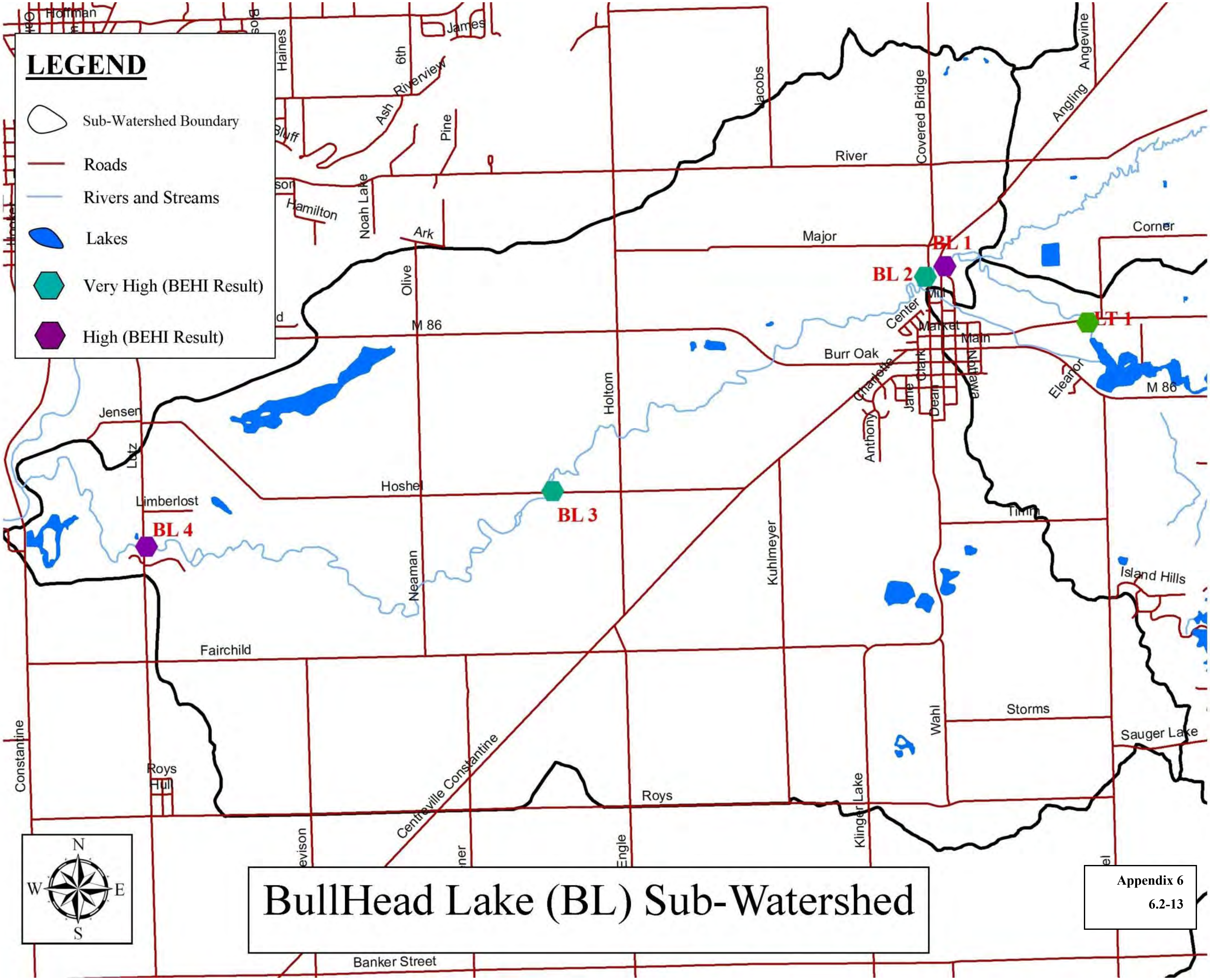
<u>Bank Angle</u> ≈ 81-90º

<u>Surface Protection</u> ≈ 10-14%

<u>BEHI Score</u> = 38.9 (Very high)

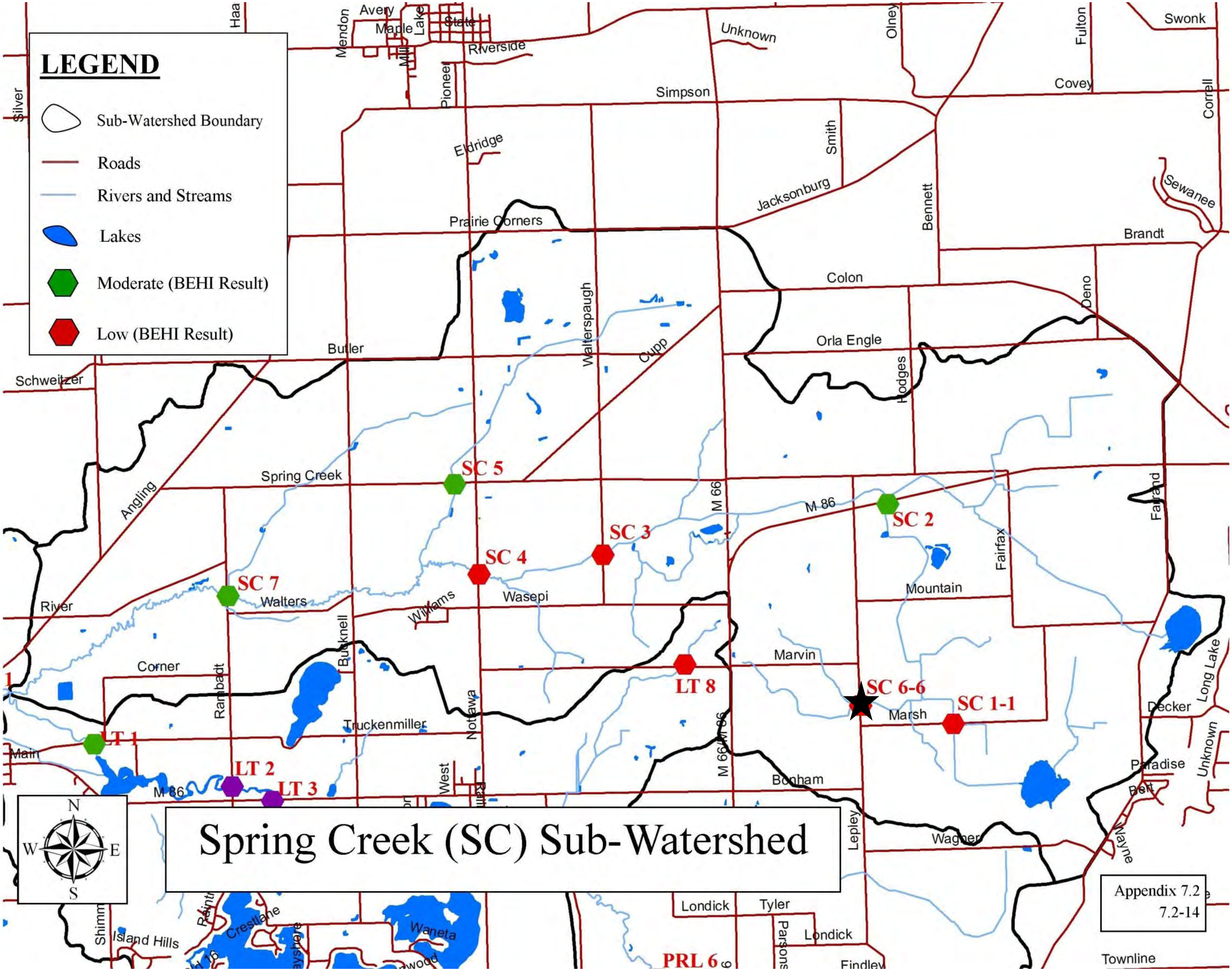
Sub Watershed	Site Name	Road	Nearest Crossroad	Erosion?	Potential Cause	BEHI score	MISC
Bullhead Lake	BL 1	Angling Rd	Major St (N)	yes		28 -- High	
	BL 2	Covered Bridge	Main St (S)	yes	foot traffic/road runoff	33.5 -- Very High	Boat Launch
	BL 3	Hoshel	Holtom Rd (E)	yes	canoe lanch	34 -- Very High	Mowed to edge
	BL 4	Lutz	Limberlost (N)	yes	foot traffic	26 -- High	Golf Course
Spring Creek	SC 1 - 1	Marsh	Lepley (W)			9 -- Low	
	SC2	M 86	Lepley (W)	yes	road runoff	24.5 -- Moderate	
	SC 3	Walterspaugh	Wasepi (S)	yes	road runoff	11 -- Low	
	SC 4	Nottawa	Wasepi (S)			9 -- Low	Cattle in stream
	SC 5	Spring Creek	Nottawa (E)			25.5 -- Moderate	Fuel Present
	SC 6-6	Lepley	Marsh - (Removed - is a wetland)				
	SC 7	Rambadt	Walters (S)		fast moving water	19 -- Moderate	Scour pool present
Lake Templene	LT 1	Truckenmiller	Corner (E)	yes	no vegetation	17.5 -- Moderate	irrigation present/nutrients high
	LT 2	Rambadt	M 86 (S)	yes	human impact/fishing	21 -- High	greenhouse/mowing/boat launch
	LT 3	M 86	Rambadt (W)			21 -- High	Wetland area, major highway
	LT 4		Lake Templene Dam Site				
	LT 5	Findley	Nottawa (E)	yes		26 -- High	
	LT 6	Nottawa	M 86 (N)	yes	Massive Gully Erosion	26 --High	Boat Launch/Trash/Sediment
	LT 7	Fillmore	M 86 (N)			22.5 -- High	
	LT 8	Marvin	M 66 (E)	yes	road runoff	17.5 -- Low	
Prairie River Lake	PRL 1	Cowles	Needham (E)	yes	Cattle access	22.5 -- High	2 cattle present/property on hill sloping to river
	PRL 2	McKale	Hackman (N)		previous erosion site	22.5 -- High	
	PRL 3	Prairie River	Maystead (S)	yes	road runoff	28 -- High	kayak put in/large trees, little understory/Trumpeter Swan
	PRL 4	Hackman	Happel (E)		some foot traffic	24 -- High	lots of trash/kayak put in
	PRL 5	M 66	Findley (N)	yes	mowing/large farm fields	27.5 -- High	USGS Gauge Site
	PRL 6	Findley	M 66 (E)		road runoff	24 -- High	
	PRL 7	Londick	Fillmore (W)	yes	Cattle access	26 --Very High	Slope to river, sparse plants

Sub-Watershed	Site Name	Road	Nearest Crossroad	Erosion?	Potential Cause	BEHI score	MISC
Stewart Lake Drain	SLD 1		DOUBLED NUMBER -- Same as GL 1 (this one removed)				
	SLD 2	St. Joseph	Ackey (S)	yes	runoff	22.5 -- High	
	SLD 3	Burr Oak	Clinton (S)	yes	Fast moving water	13 -- Low	Major erosion near & around bridge.Sped river up under bridge
	SLD 4	Front	Highland (W)	yes	road runoff/steep slope	34 -- Very High	tile present/large veg removed
	SLD 5	Middle Colon	Maystead (S)	yes	road runoff	20.5 -- High	
	SLD 6	Witt Lake	Carpenters (W)	no	road runoff	21 -- High	
Gilead Lake	GL 1	Dale	US 12 (N)			19 -- Moderate	
	GL 2	Prairie River	US 12 (N)			19 -- Moderate	
	GL 3	Bawden	US 12 (N)			19 -- Moderate	
	GL 4	Bawden	Kosmerick (S)		Livestock	34 -- Very High	
	GL 5	Prairie River	Douglas (S)			24 -- High	
	GL 6	Brink	Douglas (S)			9 -- Very Low	
	GL 7	Slisher	Lilly (W)			24 -- High	
	GL 8	Cemetery	Kosmerick (N)			19 -- Moderate	
	GL 9	Gilead Lake	Cranson			19 -- Moderate	
	GL 10	Slisher	Snow Prairie (W)			24 -- High	
	GL 11	Bowers	Rubley (N)			24 -- High	
Headwaters	HW 1	Block	Thompson (N)		Livestock	28 -- High	
	HW 2	Steffey	Hoopingarner (N)			19 -- Moderate	
	HW 3	Booth	Steffey (E)			19 -- Moderate	
	HW 4	Steffey	Adams (S)			29 -- Very high	
	HW 5	Adams	Steffey (E)			24 -- High	
	HW 6	Block	Adams (N)			24 -- High	
	HW 7	Walker	Thompson (N)			19 -- Moderate	
	HW 8	Dragon Lake	Copeland (N)	yes	no silt fence, mowed,	19 -- Moderate	recent construction

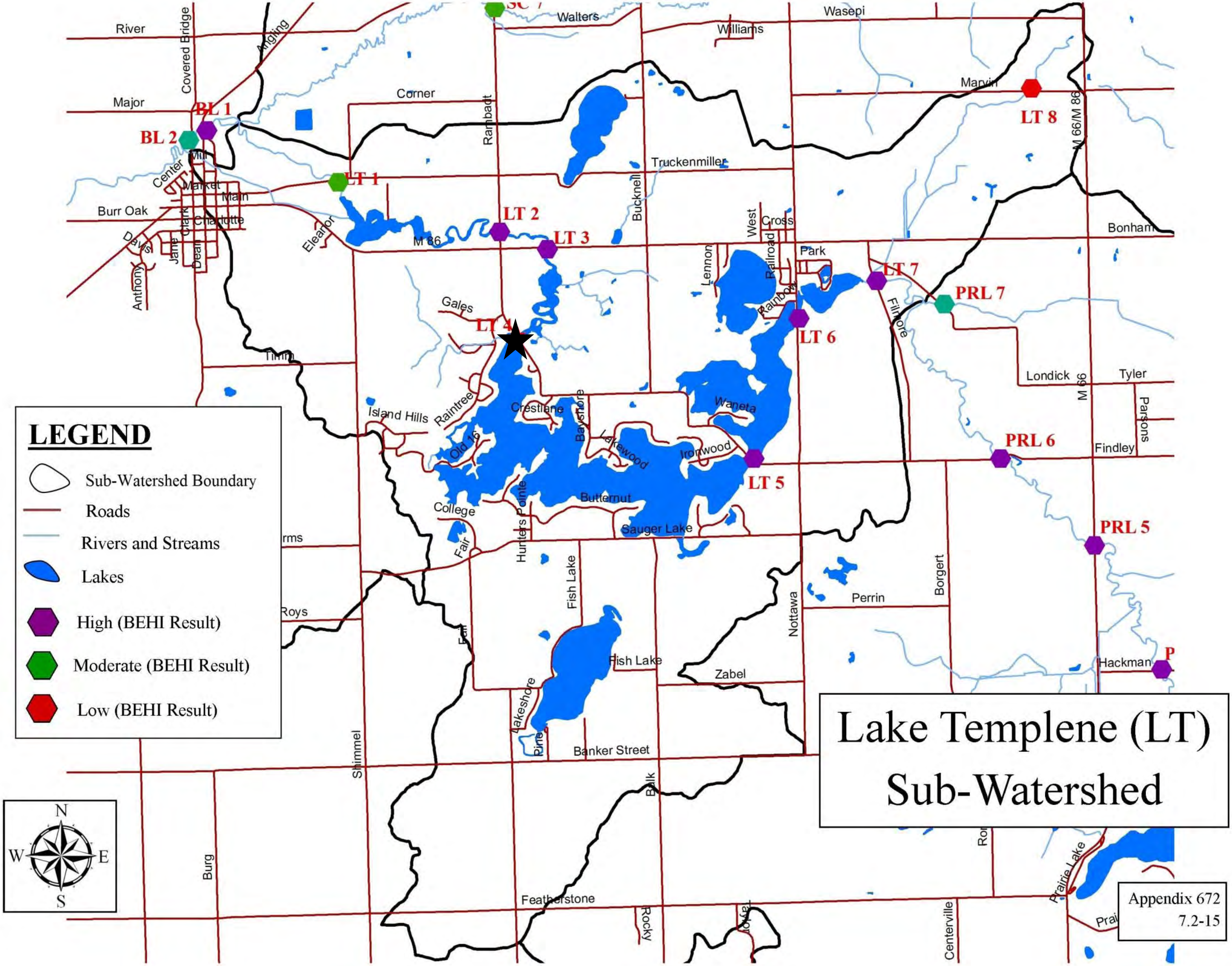


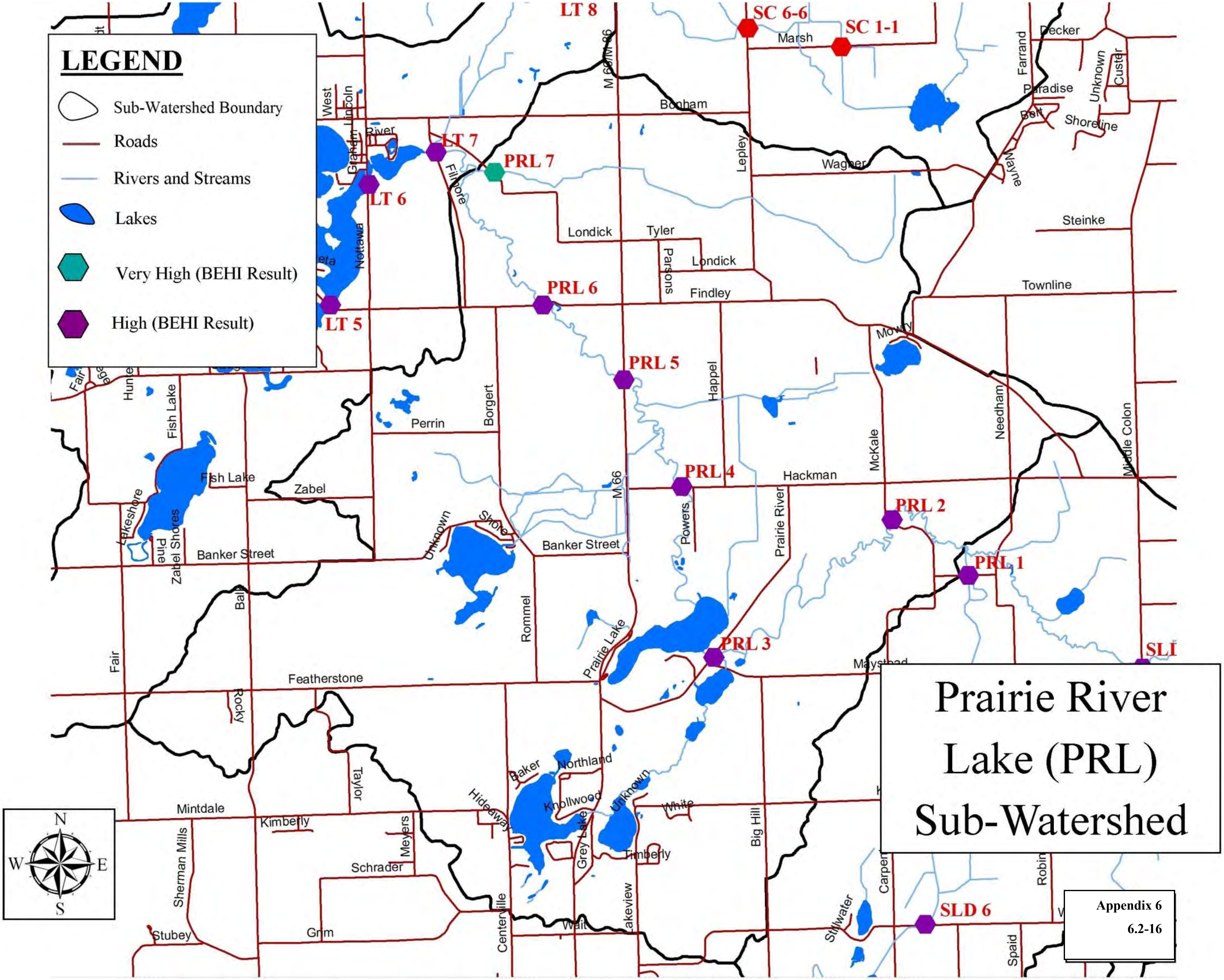
BullHead Lake (BL) Sub-Watershed

Appendix 6
6.2-13



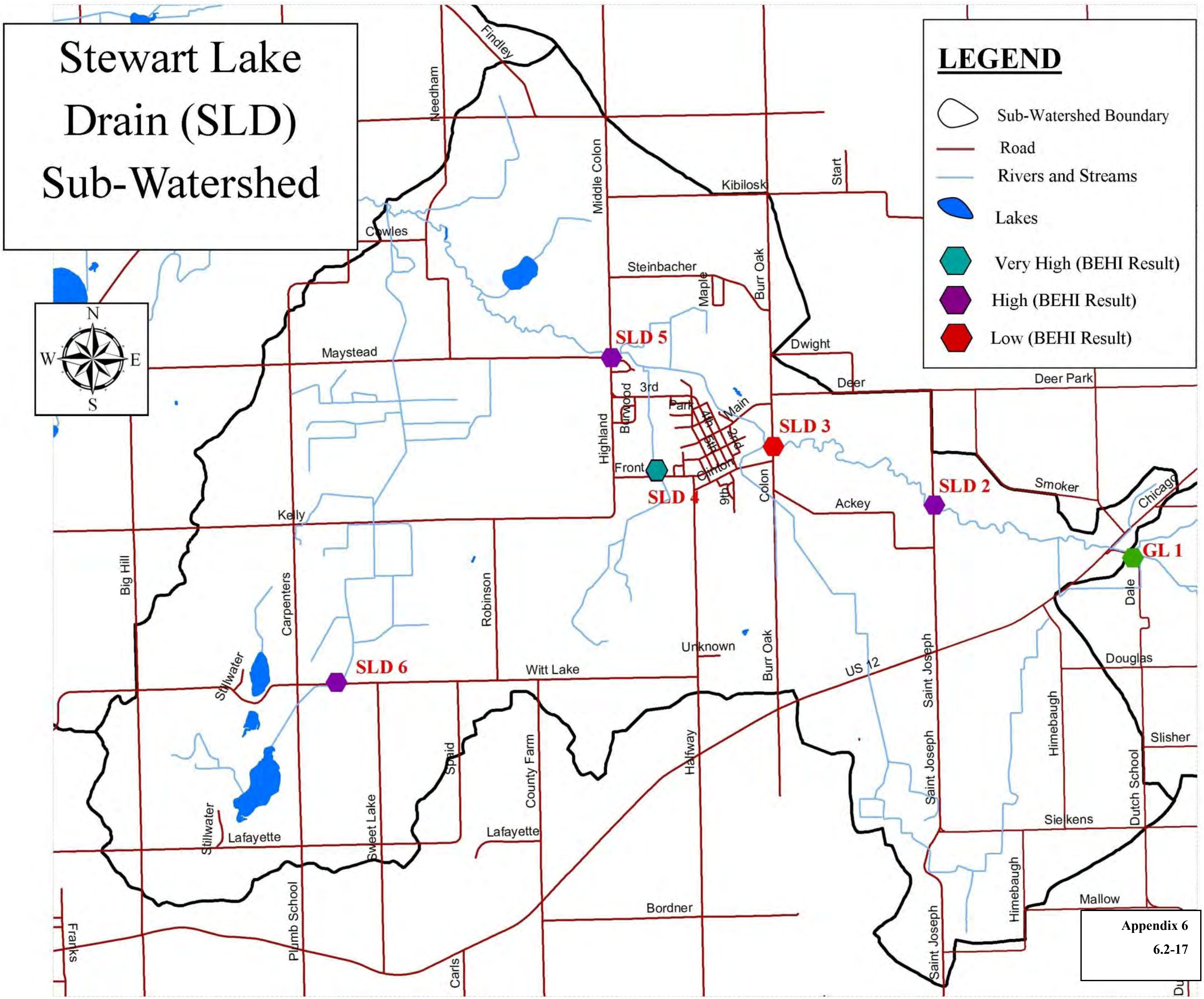
Appendix 7.2
7.2-14


Lake Templene (LT) Sub-Watershed
LEGEND
Sub-Watershed Boundary
Roads
Rivers and Streams
Lakes
High (BEHI Result)
Moderate (BEHI Result)
Low (BEHI Result)
N
S
E
W
BL 1
BL 2
LT 1
LT 2
LT 3
LT 4
LT 5
LT 6
LT 7
LT 8
PRL 7
PRL 6
PRL 5
River
Covered Bridge
Major
Walters
Wasepi
Williams
Corner
Rambadt
Marvin
Truckenmiller
Bucknell
Center
Mill
Market
Main
Burr Oak
Charlotte
Clark
Davis
Jane
Dean
Anthony
Eleanor
M 86
West
Cross
Park
Lennon
Railroad
Rainbow
Fillmore
Bonham
M 66/M 86
Gales
Timm
Island Hills
Raintree
Crestline
Bayshore
Old 16
Lakewood
Ironwood
Waneta
Londick
Tyler
M 66
Parsons
Findley
College
Butternut
Sauger Lake
Hunters Pointe
Fair
Fish Lake
Perrin
Borgert
Nottawa
Roys
Zabel
Hackman
Lakeshore
Pine
Banker Street
Shimmel
Balk
Burg
Featherstone
Rocky
Centerville
Prairie Lake
Appendix 672
7.2-15

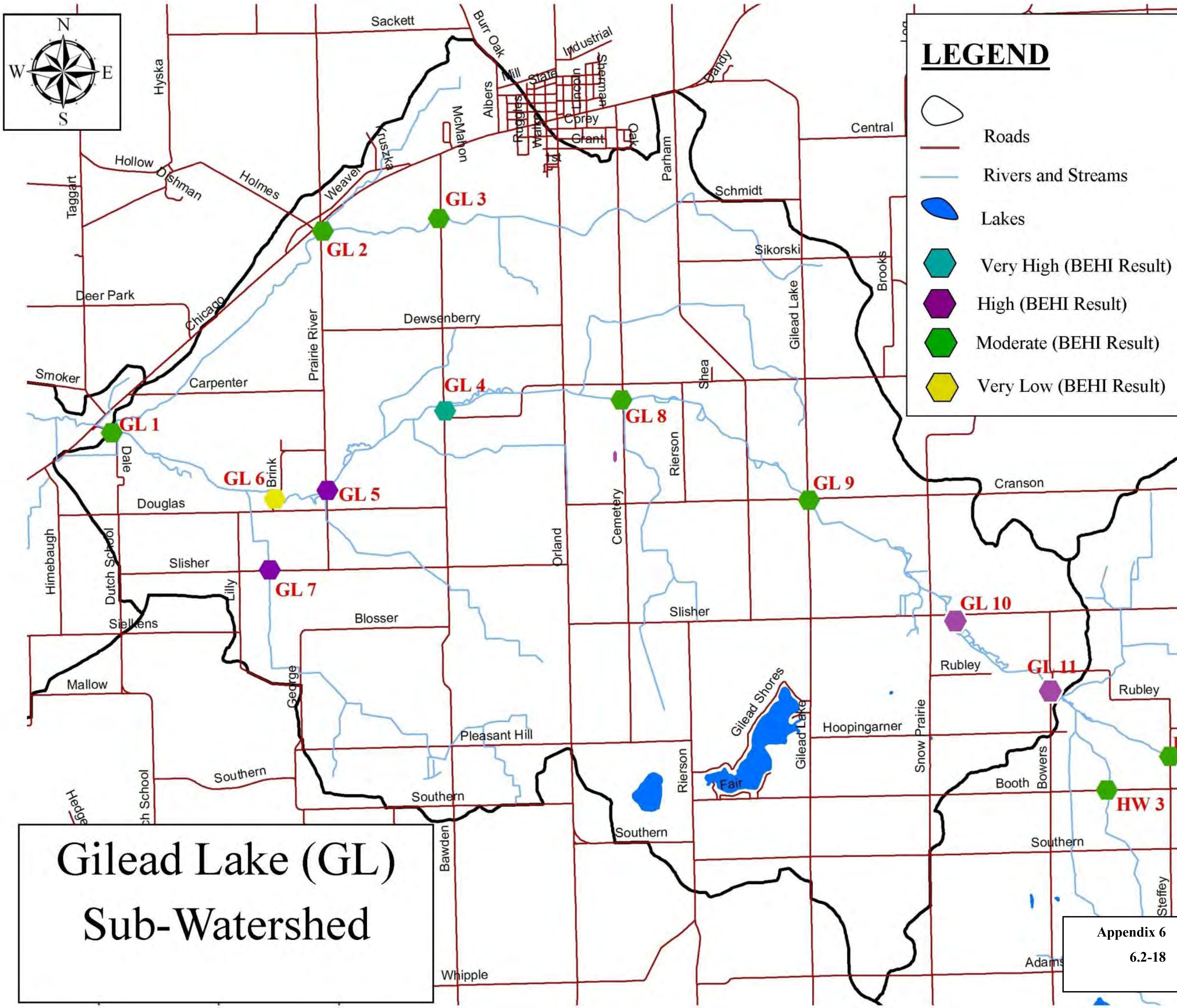


Prairie River Lake (PRL) Sub-Watershed
LEGEND
Sub-Watershed Boundary
Roads
Rivers and Streams
Lakes
Very High (BEHI Result)
High (BEHI Result)
LT 8
SC 6-6
SC 1-1
LT 7
PRL 7
LT 6
PRL 6
LT 5
PRL 5
PRL 4
PRL 2
PRL 1
PRL 3
SLD 6
Marsh
Decker
Farrand
Paradise
Unknown
Custer
Shoreline
Bonham
Lepley
Wagner
Wayne
West
Lincoln
River
Graham
Fillmore
Nottawa
Londick
Tyler
Parsons
Findley
Steinke
Townline
Mowry
Happel
Perrin
Borgert
Hunter
Fish Lake
Zabel
Needham
McKale
Middle Colon
Hackman
M 66
Powers
Prairie River
Unknown
Shore
Banker Street
Lakeshore
Pine
Zabel Shores
Ball
Rommel
Prairie Lake
Maystead
Fair
Featherstone
Rocky
Taylor
Baker
Northland
Hideaway
Knollwood
Unknown
White
Mintdale
Kimberly
Meyers
Sherman Mills
Schrader
Grey Lake
Timberly
Big Hill
Stillwater
Carpenter
Robin
Stubey
Grim
Centerville
Wait
Lakeview
Spaid
N
S
E
W

Stewart Lake Drain (SLD) Sub-Watershed

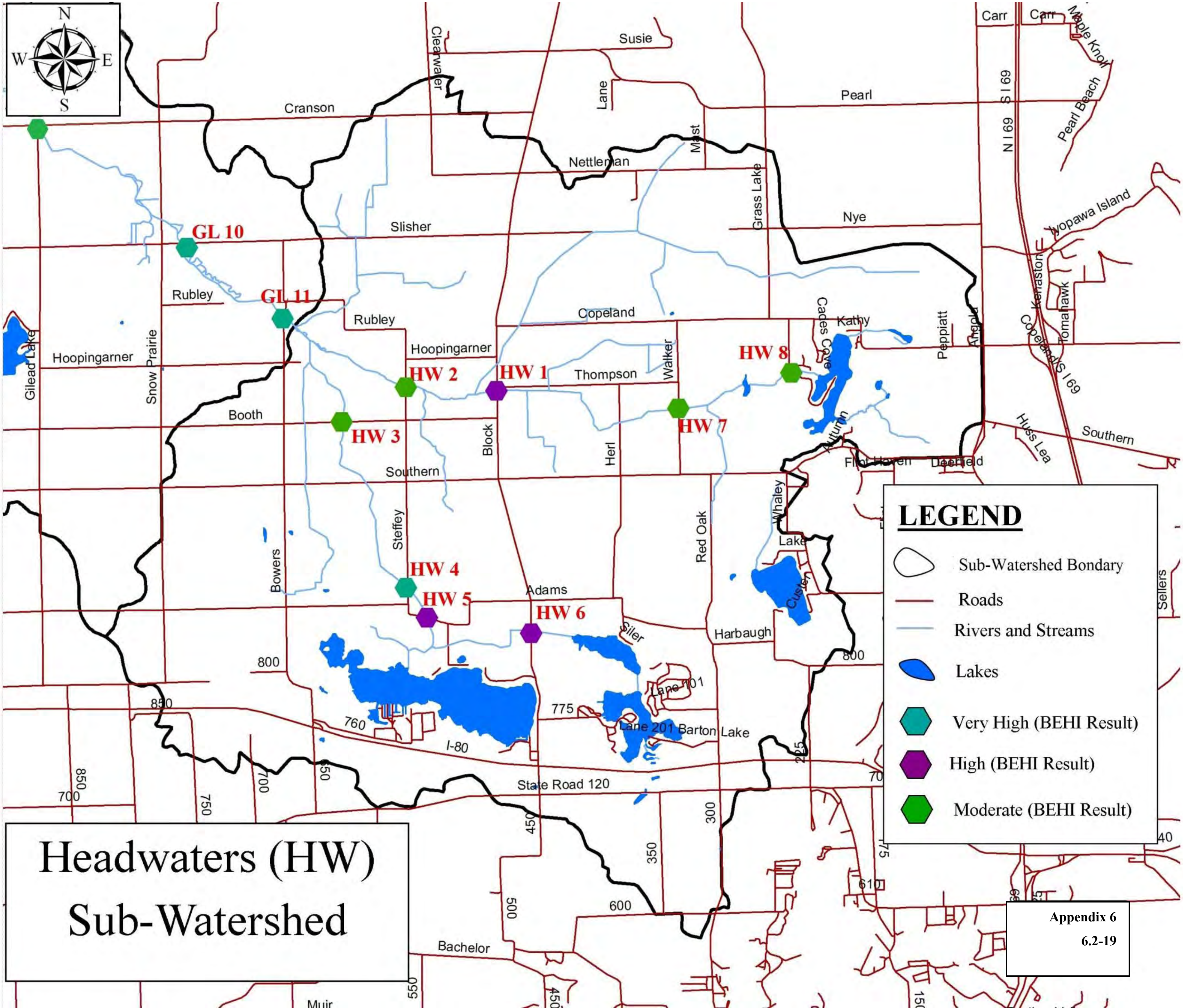


Appendix 6
6.2-17



Gilead Lake (GL) Sub-Watershed

Appendix 6
6.2-18



Headwaters (HW) Sub-Watershed

Appendix 6.3

Prairie River Watershed

Fish Migration Inventory

Utilizing the same approach as "The St. Joseph River Watershed Fish Migration Barrier Inventory" (2011) completed by the Potawatomi Resource and Development Council (RC&D), a fish migration inventory was completed on the PRW.
Results from the St. Joseph inventory only identified dam structures as barriers so it was determined it would be ideal to complete a full inventory for specific results to the PRW.

The following is the worksheet utilized and a spreadsheet including the pertinent information and the mapped locations of perched culverts and scour pools discovered during the inventory.

Overall, the largest obstructions were the four dams identified on the mainstem of the Prairie River. However, five perched culverts were located as well as 16 scour pools.

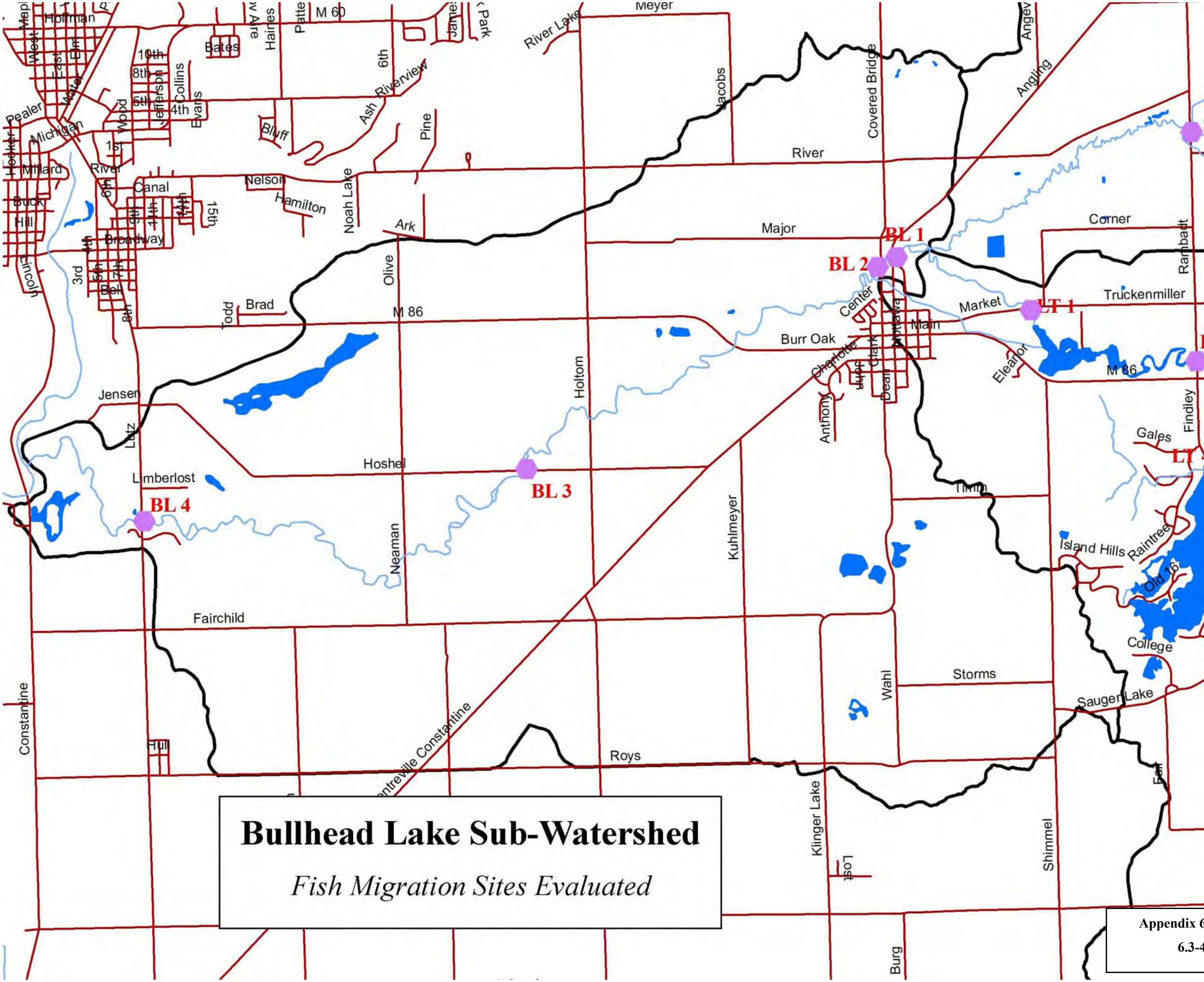
Fisheries & Oceans Division of the Government of Canada (www.nfl.dfo-mpo.gc.ca/e000527)

Appendix 6.3

Potawatomi Resource and Development Council, 2011. "St. Joseph River Watershed Fish Migration Barrier Inventory:

	Site	Road	Nearest Intersection (direction)	Road Surface	Road Type (County, State)	Structure Type	Structure Shape	Structure Material	Structure Interior *(S=smooth C=corrugated)*	General Condition	Structure Length *(feet)*	Structure Width *(feet)*	Scour Pool	Perched ?	Substrate through Structure?
Bullhead Lake	BL 1	Angling Rd	Major St (N)	Paved	County	Bridge		Wood		Fair	50	25	No	N/A	
	BL 2	Covered Bridge	Main St (S)	Paved	County	Bridge		Concrete		Good	54	24	No	N/A	
	BL 3	Hoshel	Holtom Rd (E)	Paved	County	Bridge		Wood		Poor	56	24	No	N/A	
	BL 4	Lutz	Limberlost (N)	Paved	County	Bridge		Concrete		New	86	28	No	N/A	
Spring Creek	SC 1-1	Marsh	Lepley (W)												
	SC 2	M 86	Lepley (W)	Paved	State	Culvert	Square	Concrete	S	Good	50	10	Yes	No	Yes
	SC 3	Walterspaugh	Wasepi (S)	Sand	County	Bridge		Wood		Poor	20	14	No	N/A	
	SC 4	Nottawa	Wasepi (S)	Paved	County	Culvert	Round	Metal	C	Fair	30	5	No	No	No
	SC 5	Spring Creek	Nottawa (E)	Paved	County	Culvert	Round	Metal	C	Good	60	4	No	No	No
	SC 6-6	Lepley	Marsh (S)	Gravel	County	Culvert	Round	Metal	C	Fair	33	4	No	No	No
	SC 7	Rambadt	Walters (S)	Gravel	County	Bridge		Wood		Good	24	24	No	N/A	N/A
Lake Templene	LT 1	Truckenmiller	Corner (E)	Paved	County	Bridge		Concrete		Good	54	20	No	N/A	N/A
	LT 2	Rambadt	M 86 (S)	Paved	County	Bridge		Wood		Good	54	24	No	N/A	N/A
	LT 3	M 86	Rambadt (W)	Paved	State	Bridge		Metal		Good	50	30	No	N/A	N/A
	LT 4	Lake Templene Dam Site													
	LT 5	Findley	Nottawa (E)	Paved	County	Bridge		Wood		Good	74	21	No	N/A	N/A
	LT 6	Nottawa	M 86 (N)	Paved	County	Bridge		Concrete		Good	44	26	Yes	N/A	N/A
	LT 7	Fillmore	M 86 (N)	Paved	County	Bridge		Wood		Good	50	23	No	N/A	N/A
	LT 8	Marvin	M 66 (E)	Paved	County	Culvert	Round	Metal	C	Fair	25	4	No	No	No
Prairie River Lake	PRL 1	Cowles	Needham (E)	Sand	County	Culvert	Round	Metal	C	Good	35	8	Yes	ant get to, fenced at ro	
	PRL 2	McKale	Hackman (N)	Sand	County	Bridge		Wood		Good	32	19	No	N/A	N/A
	PRL 3	Prairie River	Maystead (S)	Paved	County	Bridge		Wood		Good	40	24	Yes	N/A	N/A
	PRL 4	Hackman	Happel (E)	Paved	County	Bridge		Wood		Good	50	22	No	N/A	N/A
	PRL 5	M 66	Findley (N)	Paved	State	Bridge		Concrete		Good	46	36	No	N/A	N/A
	PRL 6	Findley	M 66 (E)	Paved	County	Bridge		Wood		Fair	52	22	No	N/A	N/A
	PRL 7	Londick	Fillmore (W)	Paved	County	Culvert	Round	Metal	C	Good	50	4	Yes	Yes	No

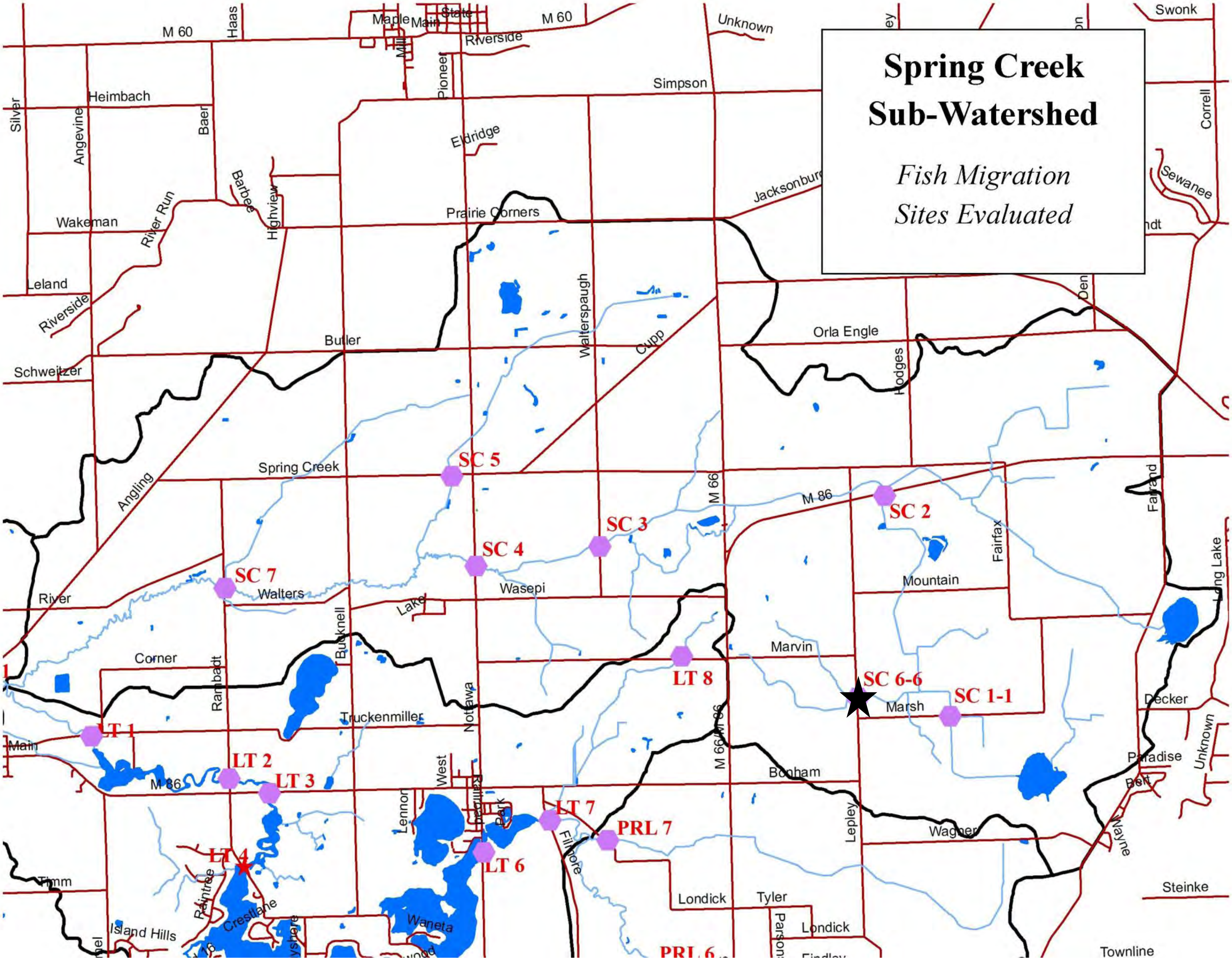
	Site	Road	Nearest Intersection (direction)	Road Surface	Road Type (County, State)	Structure Type	Structure Shape	Structure Material	Structure Interior *(S=smooth C=corrugated)*	General Condition	Structure Length *(feet)*	Structure Width *(feet)*	Scour Pool	Perched ?	Substrate through Structure?
Stewart Lake Drain	SLD 1	Double Number-- Same as GL 1													
	SLD 2	St. Joseph	Ackey (S)	Gravel	County	Culverts (3)	Round	Metal	C	Good	30	12 (each)	No	No	No
	SLD 3	Burr Oak	Clinton (S)	Paved	County	Bridge		Concrete		Good	55	30	Yes	N/A	N/A
	SLD 4	Front	Highland (W)	Paved	County	Culvert	Round	Metal	C	Good	5	5	Yes	Yes	No
	SLD 5	Middle Colon	Maystead (S)	Paved	County	Bridge		Wood		Good	34	20	Yes	N/A	N/A
	SLD 6	Witt Lake	Carpenters (W)	Paved	County	Culvert	Round	Metal	C	Fair	35	5	Yes	Yes	No
Gilead Lake	GL 1	Dale	US 12 (N)	Paved	Federal	Bridge		Concrete		New	50	7	No	N/A	N/A
	GL 2	Prairie River	US 12 (N)	Paved	County	Culvert	Round	Metal	C	Good	35	7	No	No	No
	GL 3	Bawden	US 12 (N)	Paved	County	Culvert	Round	Metal	C	Good	34	6	No	No	No
	GL 4	Bawden	Kosmerick (S)	Paved	County	Culvert	Round	Metal	C	New	60	7	Yes	Yes	No
	GL 5	Prairie River	Douglas (S)	Paved	County	Culvert	Round	Metal	C	Good	40	12.5	Yes	No	No
	GL 6	Brink	Douglas (S)	Gravel	County	Bridge		Metal		Fair	34	16	Yes	No	Yes
	GL 7	Slisher	Lilly (W)	Gravel	County	Culvert	Round	Metal	C	Good	50	50	Yes	No	No
	GL 8	Cemetery	Kosmerick (N)	Gravel	County	Culvert	Round	Metal	C	Good	50	10	Yes	No	No
	GL 9	Gilead Lake	Cranson	Paved	County	Bridge		Concrete		New	48	6	No	N/A	N/A
	GL 10	Slisher	Snow Prairie (W)	Gravel	County	Culverts (2)	Round	Metal	C	Fair			No	No	No
	GL 11	Bowers	Rubley (N)	Gravel	County	Culvert	Round	Metal	C	Good	50	8	No	No	No
Headwaters	HW 1	Block	Thompson (N)	Paved	County	Culvert	Round	Metal	C	Good	60	6	Yes	Yes	No
	HW 2	Steffey	Hoopingarner (N)	Gravel	County	Culvert	Round	Metal	C	Good	60	7	Yes	No	No
	HW 3	Booth	Steffey (E)	Paved	County	Culvert	Round	Metal	C	Good	60	4	No	No	No
	HW 4	Steffey	Adams (S)	Gravel	County	Culvert	Round	Metal	C	Good	60	5	No	No	No
	HW 5	Adams	Steffey (E)	Gravel	County	Culvert	Round	Metal	C	Good	60	5	No	No	Yes
	HW 6	Block	Adams (N)	Paved	County	Culvert	Round	Metal	C	Good	60	4	No	No	No
	HW 7	Walker	Thompson (N)	Paved	County	Culvert	Round	Metal	C	Good	60	5	No	No	Yes
	HW 8	Dragon Lake	Copeland (N)	Gravel	County	Culvert	Round	Metal	C	New	50	3	No	No	No



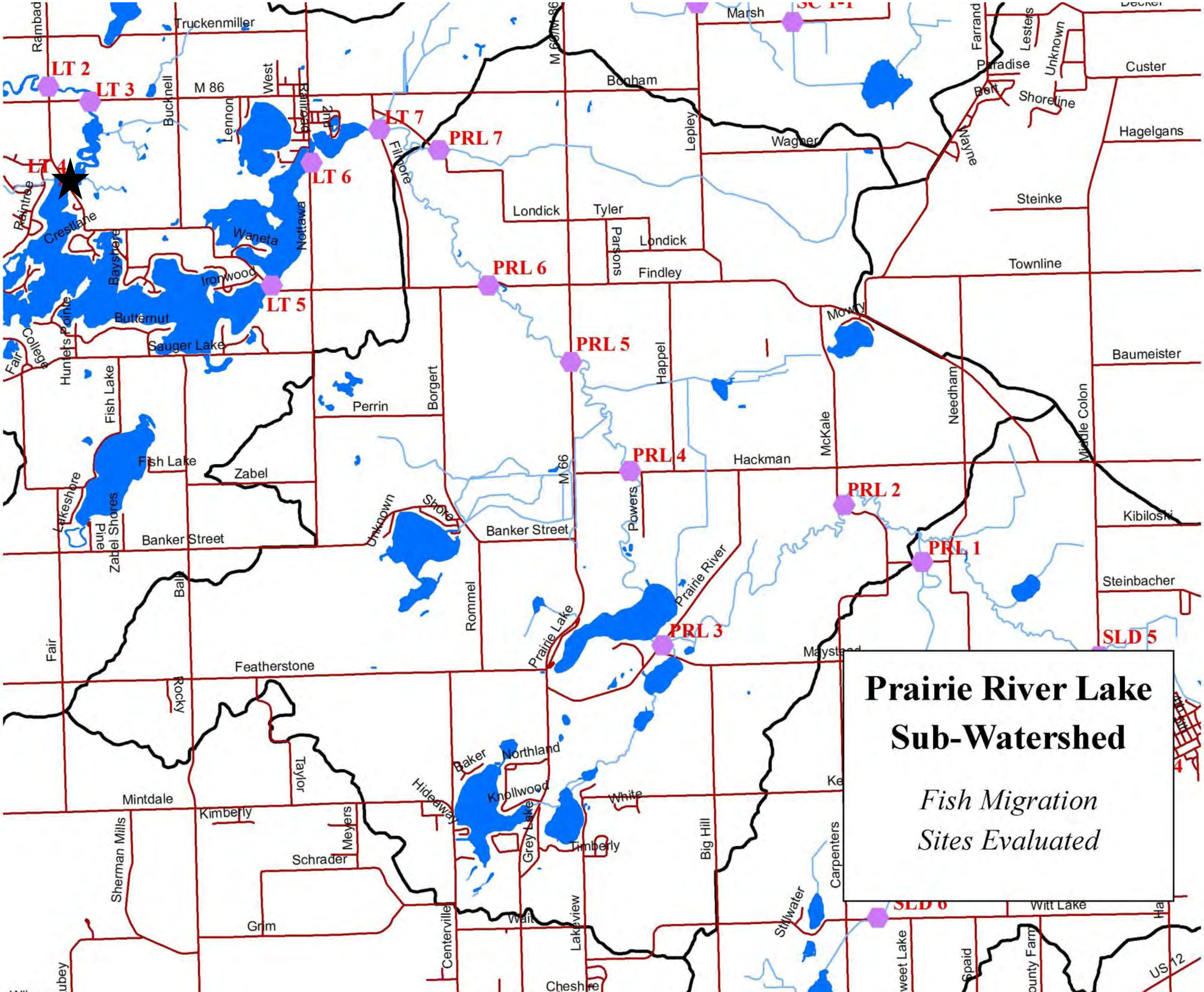
Bullhead Lake Sub-Watershed

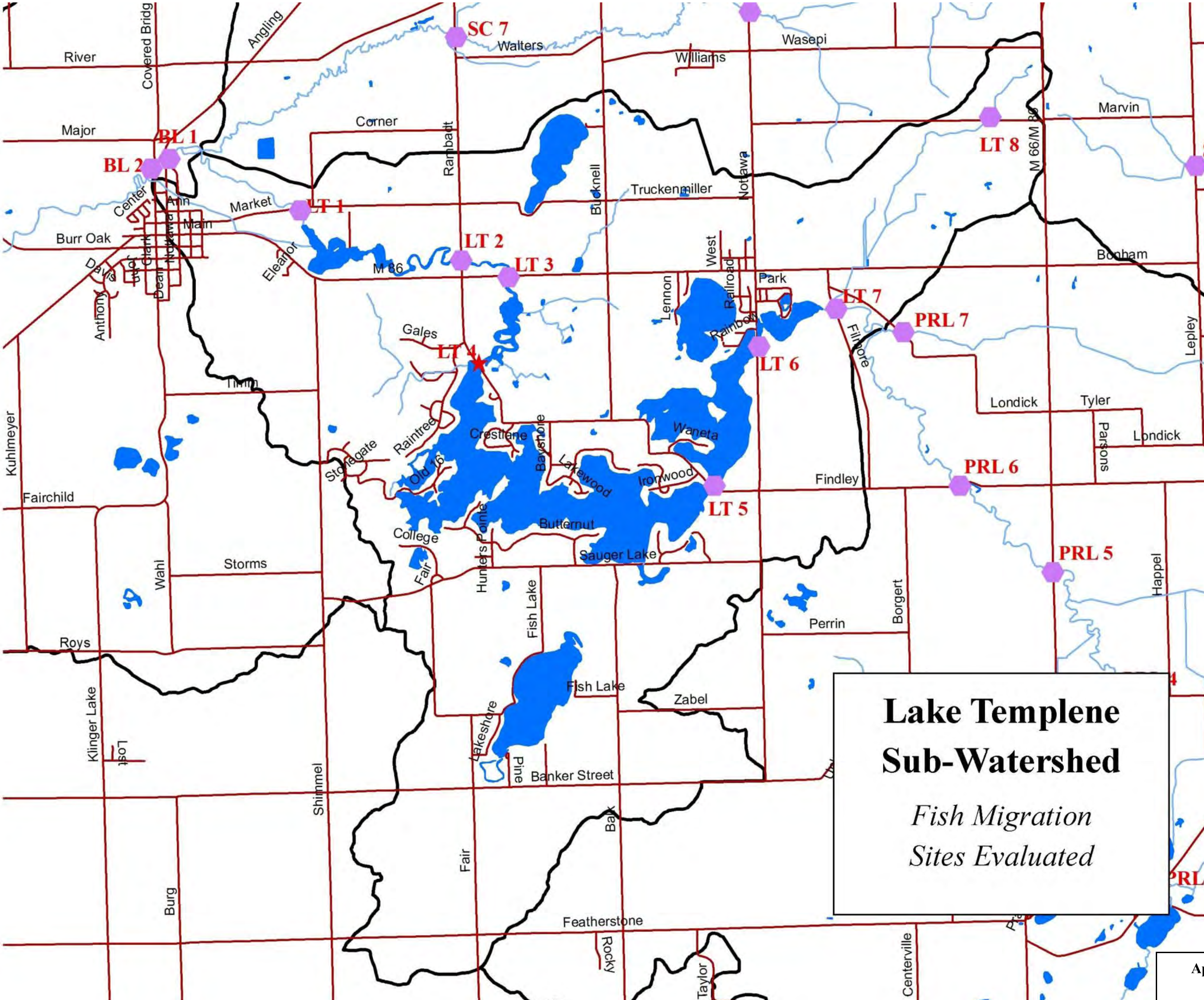
Fish Migration Sites Evaluated

Appendix 6
6.3-4



Spring Creek
Sub-Watershed
Fish Migration
Sites Evaluated
SC 1-1
SC 2
SC 3
SC 4
SC 5
SC 6-6
SC 7
LT 1
LT 2
LT 3
LT 4
LT 6
LT 7
LT 8
PRL 7
M 60
M 86
M 66
Spring Creek
Simpson
Prairie Corners
Butler
Orla Engle
Mountain
Marvin
Marsh
Bonham
Wagner
Truckenmiller
Corner
River
Walters
Wasepi
Lake
Angling
Cupp
Jacksonburg
Heimbach
Wakeman
Leland
Riverside
Schweitzer
Eldridge
Waterspaugh
Hodges
Fairfax
Fairland
Long Lake
Decker
Paradise
Bent
Wayne
Steinke
Townline
Londick
Tyler
Lepley
Fillmore
Notawa
Bucknell
Rambadt
Lennon
West
Park
Crestlane
Waneta
Island Hills
Timm
Main
Silver
Angevine
Baer
Barbee
Highview
River Run
Haas
Maple
Mill
Pioneer
State
Riverside
Unknown
Swonk
Correll
Sewanee
Den


Prairie River Lake
Sub-Watershed
Fish Migration
Sites Evaluated
LT 2
LT 3
LT 4
LT 5
LT 6
LT 7
PRL 1
PRL 2
PRL 3
PRL 4
PRL 5
PRL 6
PRL 7
SLD 5
Truckenmiller
M 86
Bucknell
Lennon
West
Railroad
Fillmore
Bonham
Lepley
Marsh
Wagner
Farrand
Lesters
Unknown
Paradise
Custer
Shoreline
Wayne
Hagelgans
Steinke
Londick
Tyler
Parsons
Findley
Townline
Raintree
Crestlane
Waneta
Nottawa
Bayshore
Ironwood
Butternut
Sauger Lake
Hunters Pointe
College
Fair
Mowry
Baumeister
Needham
Happel
McKale
Perrin
Borgert
Fish Lake
Zabel
Lakeshore
Zabel Shores
Pine
Banker Street
Hackman
M 66
Powers
Middle Colon
Kibiloski
Steinbacher
Shore
Unknown
Prairie River
Prairie Lake
Rommel
Ball
Featherstone
Rocky
Taylor
Mintdale
Kimberly
Meyers
Schrader
Sherman Mills
Hideaway
Baker
Northland
Knollwood
Grey Lake
White
Timberly
Big Hill
Carpenters
Stillwater
Grim
Centerville
Lakeview
Cheshire
Witt Lake
Sweet Lake
Spaid
County Farm
US 12
Wilson


Lake Templene
Sub-Watershed
Fish Migration
Sites Evaluated
SC 7
BL 1
BL 2
LT 1
LT 2
LT 3
LT 4
LT 5
LT 6
LT 7
LT 8
PRL 7
PRL 6
PRL 5
River
Covered Bridg
Angling
Walters
Williams
Wasepi
Major
Corner
Rambadt
Bucknell
Truckenmiller
Notawa
M 66/M 86
Marvin
Center
Ann
Market
Main
Burr Oak
Eleanor
M 86
West
Railroad
Park
Lennon
Rainbow
Fillmore
Bonham
Lepley
David
Anthony
Clark
Dean
Gales
Timm
Raintree
Stonegate
Crestlane
Bayshore
Waneta
Lakewood
Ironwood
Findley
Londick
Tyler
Parsons
Kuhlmeyer
Fairchild
Old 16
College
Butternut
Sauger Lake
Hunters Pointe
Fair
Storms
Wahl
Fish Lake
Perrin
Borgert
Happel
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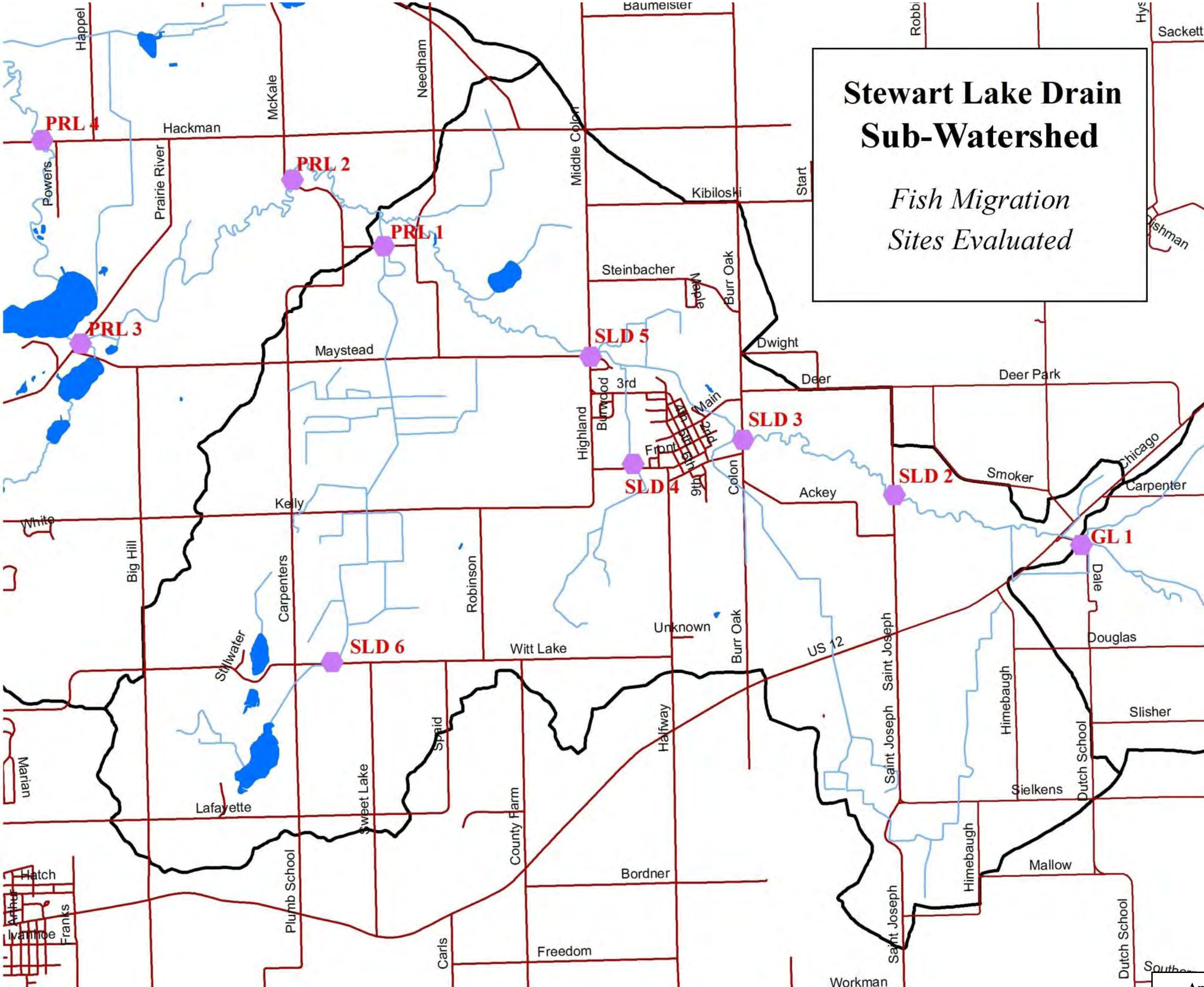
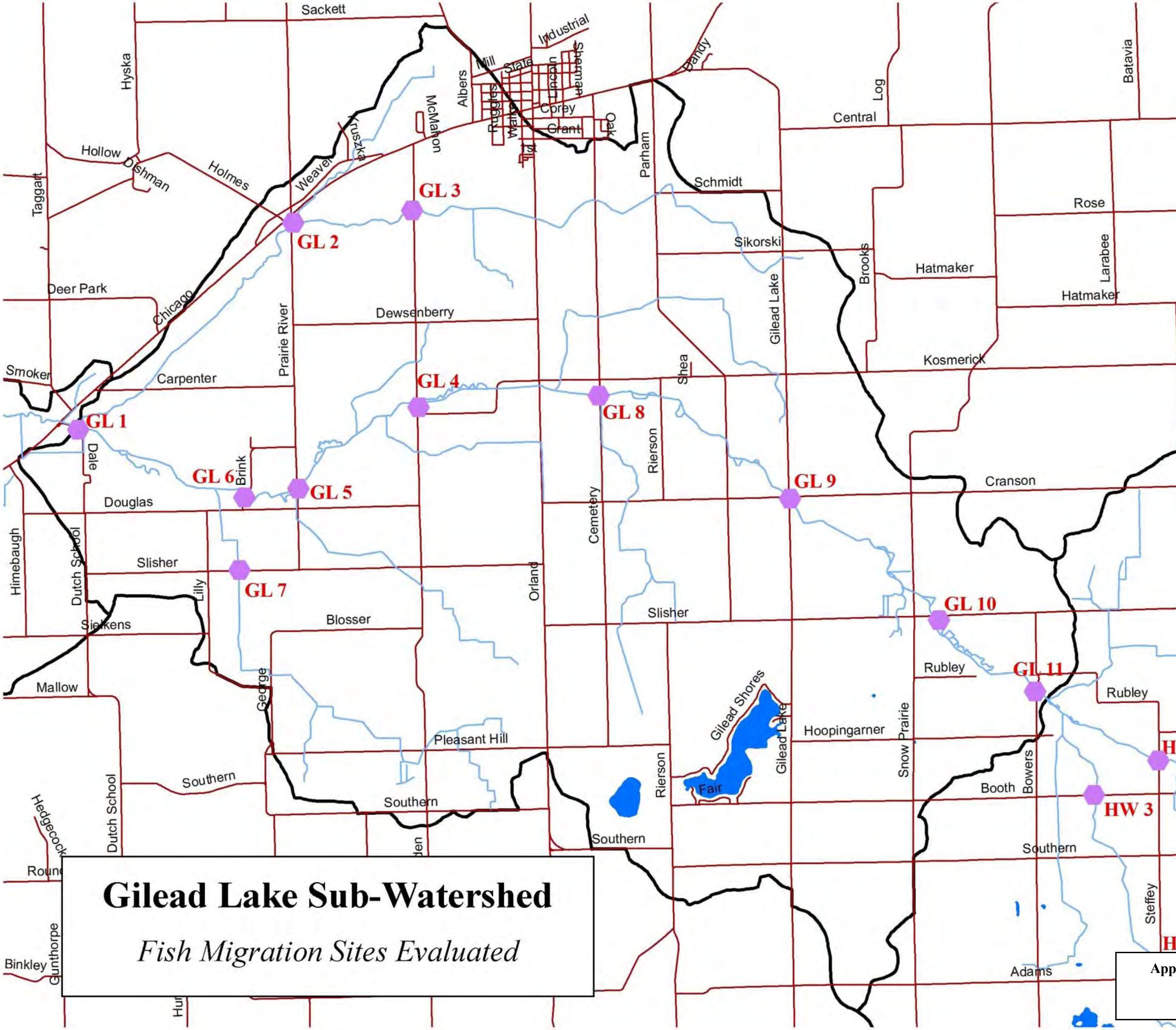
Lakeshore
Pine
Banker Street
Shimmel
Burg
Bak
Featherstone
Rocky
Taylor
Centerville


Stewart Lake Drain
Sub-Watershed
Fish Migration
Sites Evaluated
PRL 4
PRL 2
PRL 1
PRL 3
SLD 5
SLD 3
SLD 4
SLD 2
GL 1
SLD 6
Baumeister
Sackett
Happel
McKale
Needham
Middle Colon
Hackman
Kibiloski
Start
Powers
Prairie River
Steinbacher
Maple
Burr Oak
Dwight
Maystead
Deer
Deer Park
3rd
Burwood
Highland
Main
Front
Colon
Ackey
Smoker
Chicago
Carpenter
Kelly
White
Big Hill
Carpenters
Robinson
Dale
Unknown
Douglas
US 12
Saint Joseph
Stillwater
Witt Lake
Halfway
Himebaugh
Slisher
Spaid
Sweet Lake
Dutch School
Sielkens
Marian
Lafayette
County Farm
Mallow
Hatch
Plumb School
Bordner
Franks
Carls
Freedom
Workman

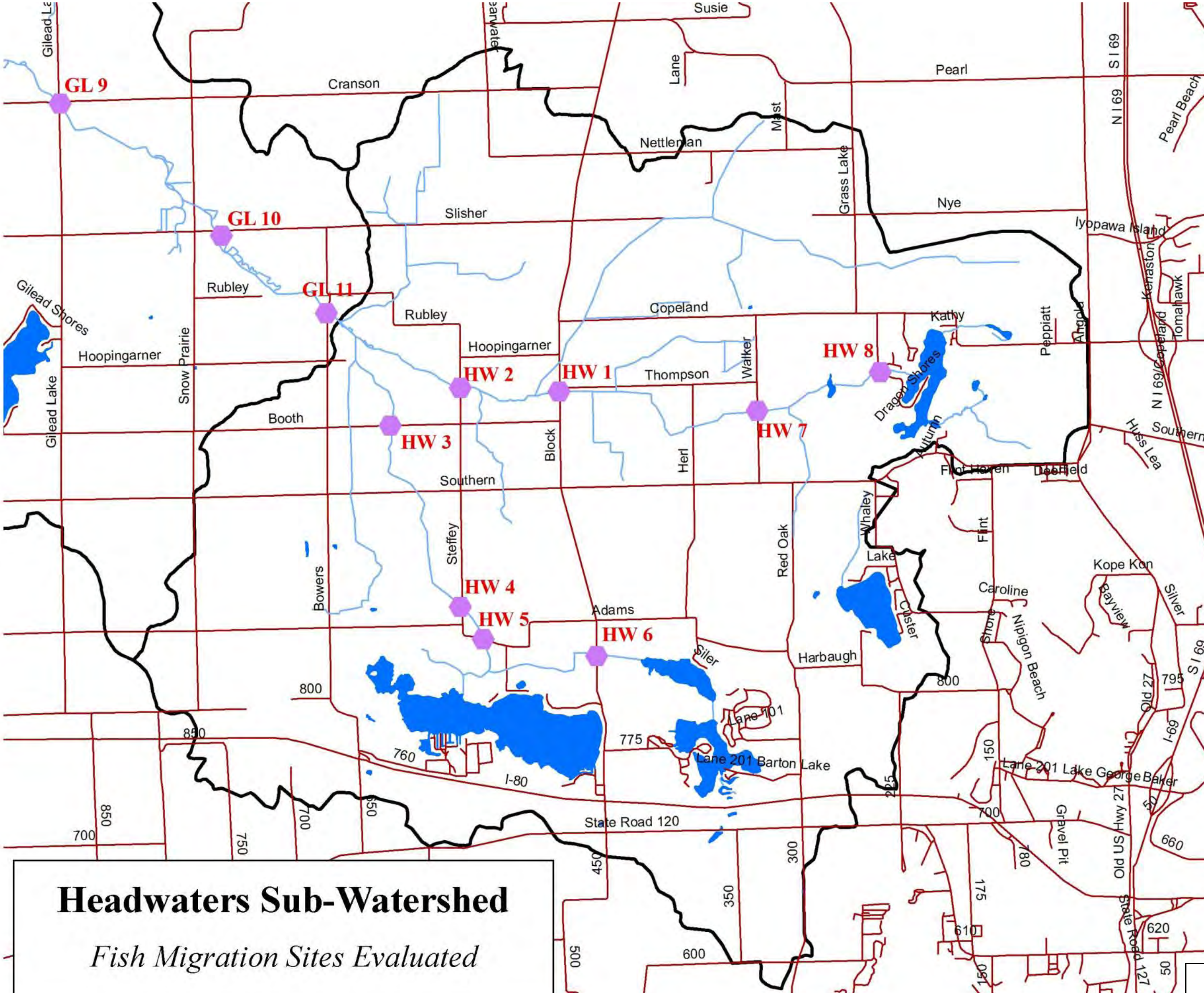


Gilead Lake Sub-Watershed

Fish Migration Sites Evaluated

Appendix 6
6.3-9

0



Headwaters Sub-Watershed

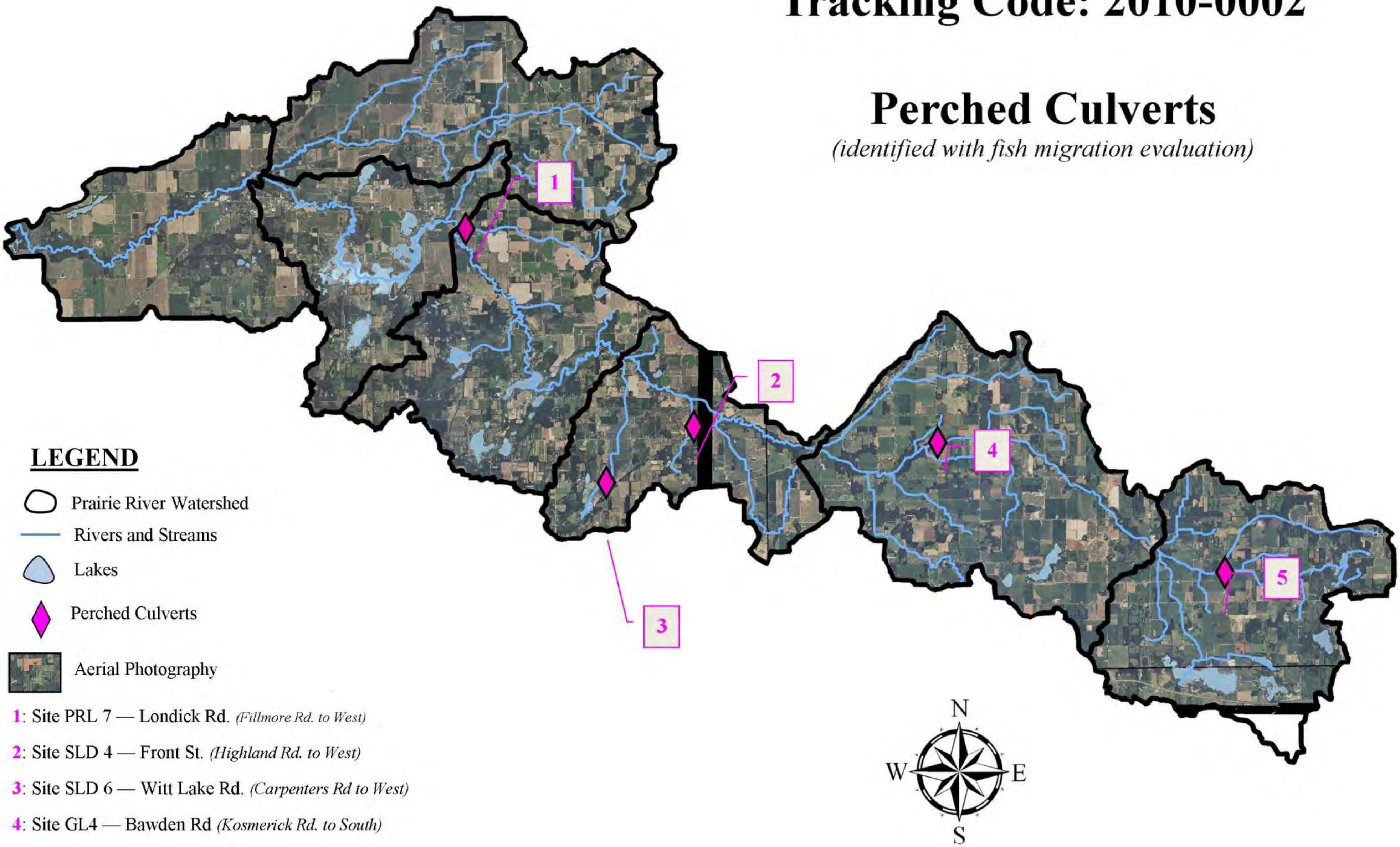
Fish Migration Sites Evaluated

Appendix 6
6.3-10

Prairie River Watershed
Tracking Code: 2010-0002

Perched Culverts

(identified with fish migration evaluation)



LEGEND

Prairie River Watershed

Rivers and Streams

Lakes

Perched Culverts

Aerial Photography

1: Site PRL 7 — Londick Rd. *(Fillmore Rd. to West)*

2: Site SLD 4 — Front St. *(Highland Rd. to West)*

3: Site SLD 6 — Witt Lake Rd. *(Carpenters Rd to West)*

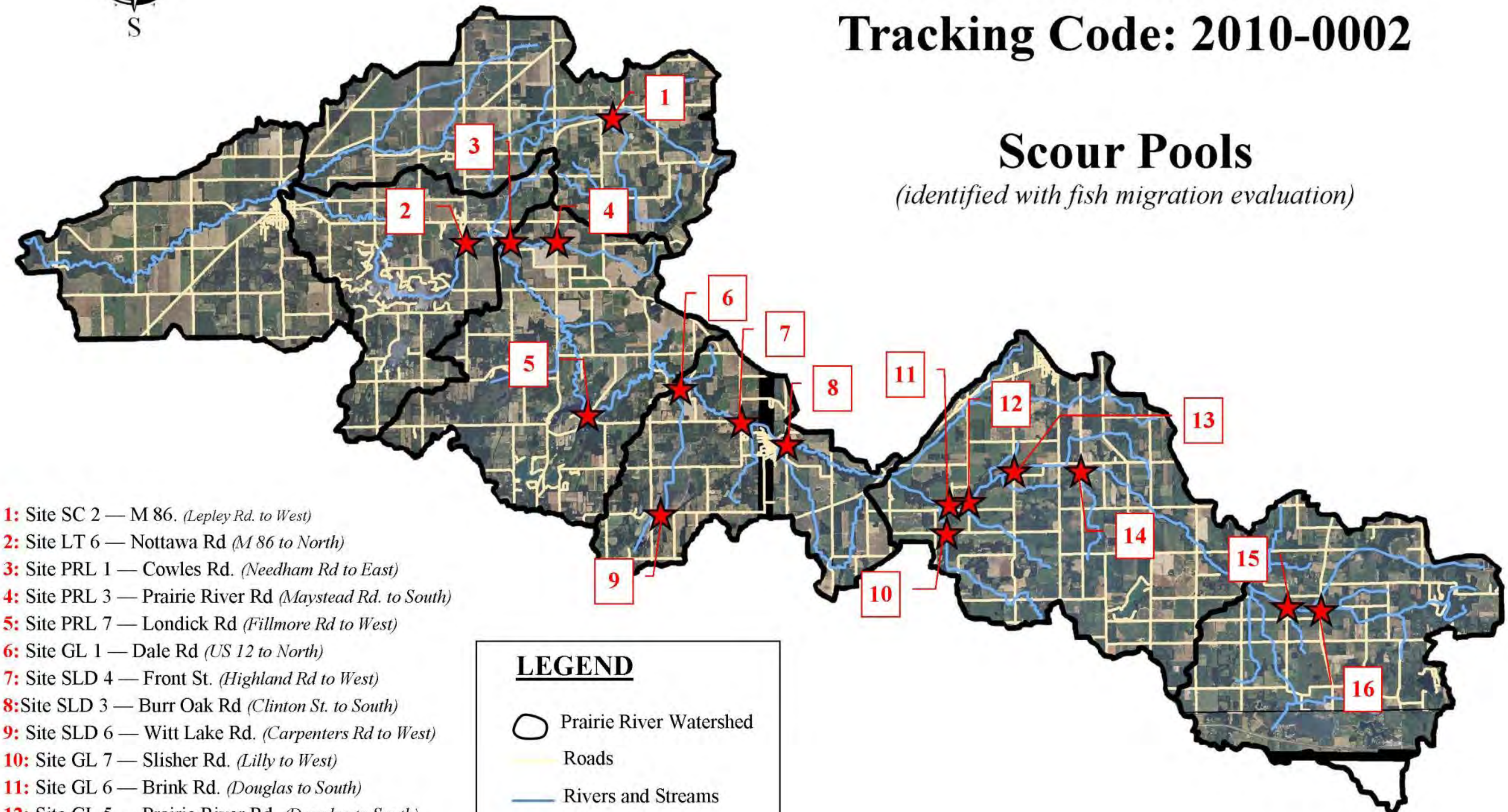
4: Site GL4 — Bawden Rd *(Kosmerick Rd. to South)*

5: Site HW 1 — Block Rd *(Thompson Rd to North)*

Prairie River Watershed
Tracking Code: 2010-0002

Scour Pools

(identified with fish migration evaluation)



1: Site SC 2 — M 86. *(Lepley Rd. to West)*
2: Site LT 6 — Nottawa Rd *(M 86 to North)*
3: Site PRL 1 — Cowles Rd. *(Needham Rd to East)*
4: Site PRL 3 — Prairie River Rd *(Maystead Rd. to South)*
5: Site PRL 7 — Londick Rd *(Fillmore Rd to West)*
6: Site GL 1 — Dale Rd *(US 12 to North)*
7: Site SLD 4 — Front St. *(Highland Rd to West)*
8:Site SLD 3 — Burr Oak Rd *(Clinton St. to South)*
9: Site SLD 6 — Witt Lake Rd. *(Carpenters Rd to West)*
10: Site GL 7 — Slisher Rd. *(Lilly to West)*
11: Site GL 6 — Brink Rd. *(Douglas to South)*
12: Site GL 5 — Prairie River Rd. *(Douglas to South)*
13: Site GL 4 — Bawden Rd. *(Kosmerick to South)*
14: Site GL 8 — Cemetery Rd. *(Kosmerick to North)*
15: Site HW 2 — Steffey Rd. *(Hoopingarner to North)*
16: Site HW 1 — Block Rd. *(Thompson to North)*

LEGEND

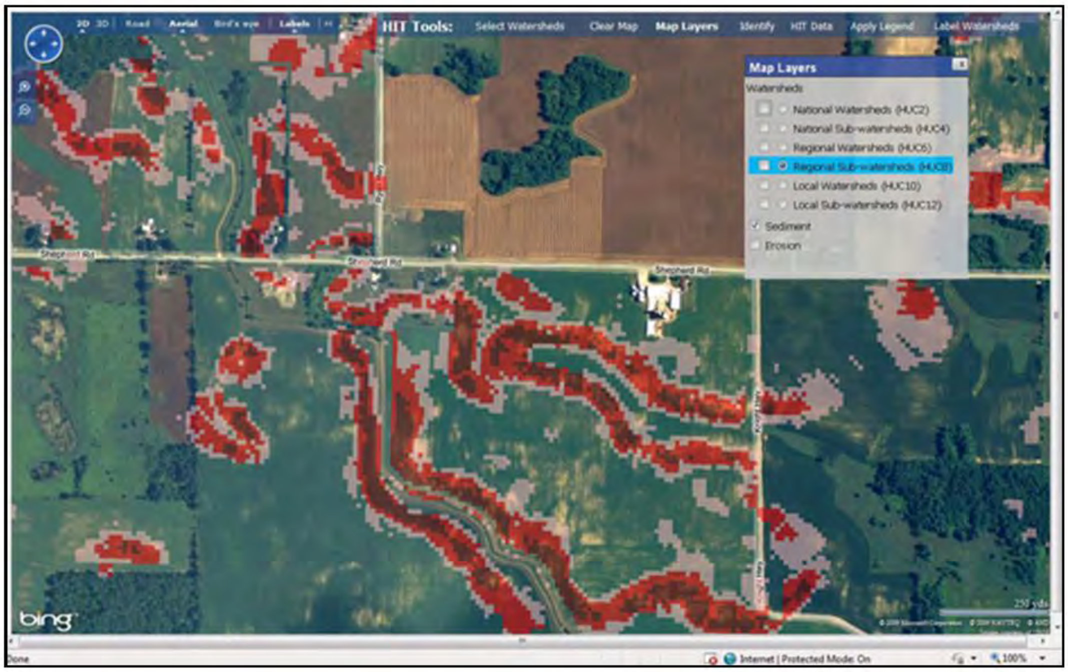
- Prairie River Watershed
- Roads
- Rivers and Streams
- Lakes
- Scour Pools
- Aerial Photography

Appendix 6
6.3-12

Appendix 6.4

Prairie River Watershed

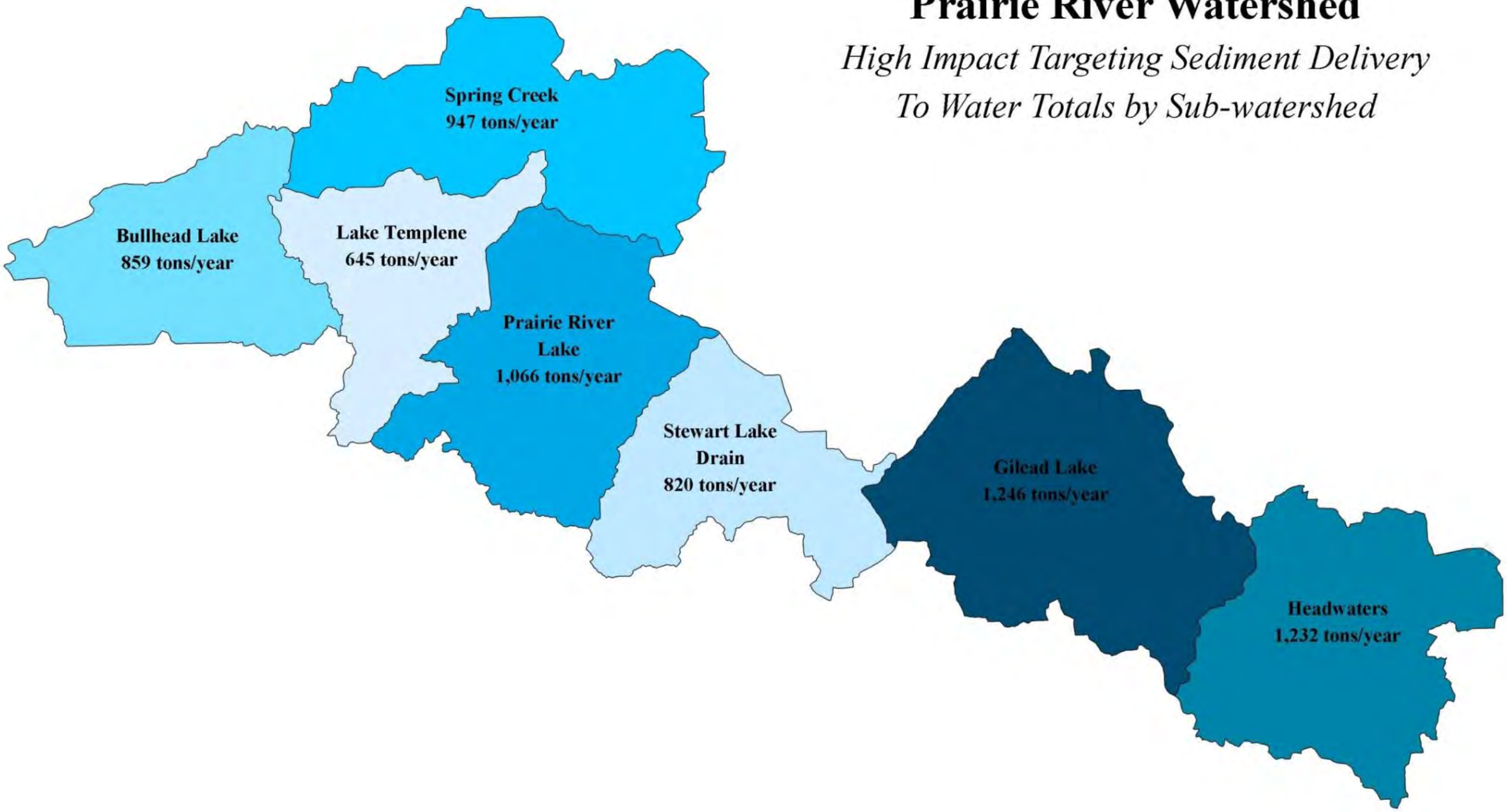
High Impact Targeting



Appendix 6.4

Prairie River Watershed

High Impact Targeting Sediment Delivery To Water Totals by Sub-watershed



PRAIRIE RIVER WATERSHED MSU HIGH IMPACT TARGETING RESULTS

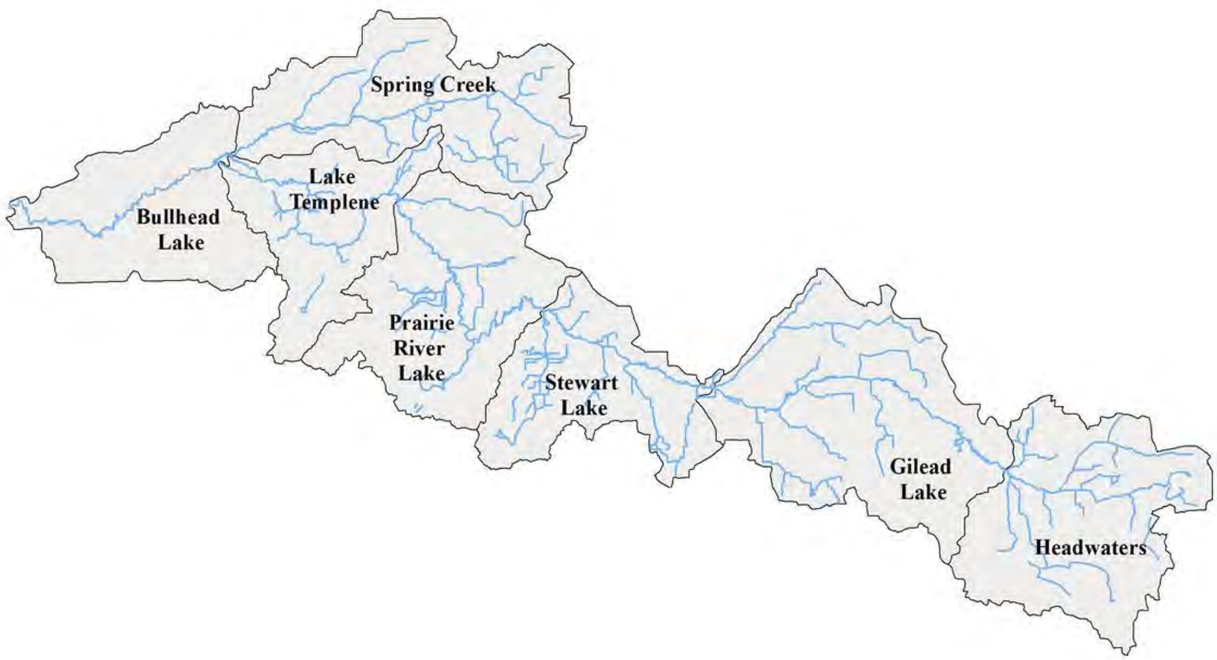
Sub-watershed	Acres	Sediment Totals (tons/year)	BMP: Mulch Till on the Worst 5% of area				BMP: No till on the Worst 5% of area				BMP: Grass on the Worst 5% of area			
			Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $10 per acre	BMP Cost benefit ($/ton reduced)	Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $14 per acre	BMP Cost benefit ($/ton reduced)	Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $44 per acre	BMP Cost benefit ($/ton reduced)
Headwaters	18,791	1,232	194	16%	$9,396	$48	453	37%	$13,154	$29	663	54%	$41,341	$62
Gilead Lake	23,381	1,246	223	18%	$11,690	$52	520	42%	$16,366	$31	761	61%	$51,437	$68
Stewart Lake	12,870	820	128	16%	$6,435	$50	298	36%	$9,009	$30	436	53%	$28,313	$65
Prairie River Lake	17,711	1,066	181	17%	$8,856	$49	422	40%	$12,398	$29	618	58%	$38,964	$63
Lake Templene	11,691	645	103	16%	$5,846	$57	241	37%	$8,184	$34	353	55%	$25,721	$73
Spring Creek	18,314	947	144	15%	$9,157	$64	336	36%	$12,820	$38	492	52%	$40,292	$82
Bullhead Lake	13,907	859	143	17%	$6,953	$49	333	39%	$9,735	$29	488	57%	$30,595	$63

Sub-watershed	Acres	Sediment Totals (tons/year)	BMP: Mulch Till on the Worst 10% of area				BMP: No till on the Worst 10% of area				BMP: Grass on the Worst 10% of area			
			Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $10 per acre	BMP Cost benefit ($/ton reduced)	Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $14 per acre	BMP Cost benefit ($/ton reduced)	Total Sediment Reduction (tons/year)	% Reduction	BMP Cost@ $44 per acre	BMP Cost benefit ($/ton reduced)
Headwaters	18,791	1,232	249	20%	$18,791	$75	581	47%	$26,308	$45	851	69%	$82,682	$97
Gilead Lake	23,381	1,246	270	22%	$23,381	$87	630	51%	$32,733	$52	922	74%	$102,875	$112
Stewart Lake	12,870	820	166	20%	$12,870	$77	388	47%	$18,017	$46	568	69%	$56,626	$100
Prairie River Lake	17,711	1,066	220	21%	$17,711	$81	513	48%	$24,796	$48	751	70%	$77,929	$104
Lake Templene	11,691	645	131	20%	$11,691	$89	306	47%	$16,368	$54	448	69%	$51,442	$115
Spring Creek	18,314	947	186	20%	$18,314	$98	434	46%	$25,640	$59	636	67%	$80,583	$127
Bullhead Lake	13,907	859	178	21%	$13,907	$78	416	48%	$19,469	$47	609	71%	$61,189	$101

Appendix 7

Prairie River Watershed

Water Quality Summary by Sub-watersheds



Appendix 7
Prairie River Watershed
Water Quality Summary by Sub-Watershed

In this section, water quality will be examined for each sub-watershed in the PRW utilizing information retained from project inventories, evaluations and documents pertinent to the PRW. Each sub-watershed summary includes details on impaired and/or potentially impacted designated uses, associated pollutants and the known or suspected sources and causes of the pollutants. Information from the analyses and evaluations described below were incorporated into prioritization models to establish focus areas for future implementation and funding efforts. Note that pollutants and potential designated use impacts vary amongst the sub-watersheds. Therefore, if a designated use or pollutant is not mentioned, it is not believed to be a current concern for the sub-watershed.

Bullhead Lake Sub-Watershed

Bullhead Lake sub-watershed is the western most sub-watershed and is located in the St. Joseph County portion of the PRW (See Figure 1). This sub-watershed drains to the mainstem of the Prairie River and is more impacted by cumulative upstream conditions than those in other sub-watersheds of the PRW. The river flows primarily in a southwest direction through Nottawa and Lockport Townships until it converges with the St. Joseph River south of Three Rivers, MI. The primary designated uses at risk for this sub-watershed are warmwater fisheries and other indigenous aquatic life/wildlife due to sediment, pesticide and nutrient loading.

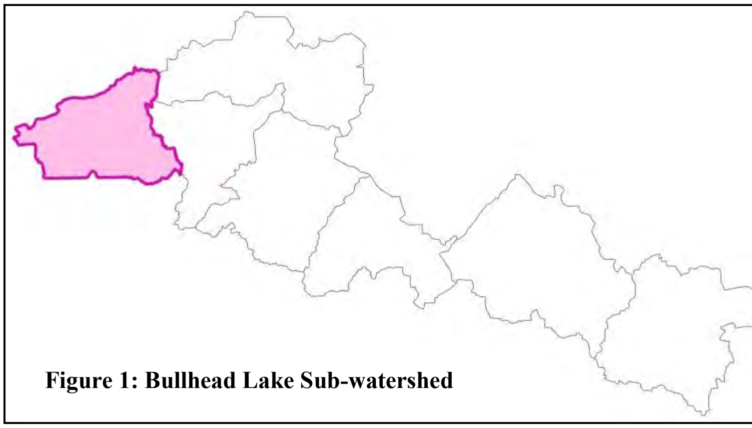


Figure 1: Bullhead Lake Sub-watershed

Bullhead Lake sub-watershed consists of 72% agricultural land use and cultivating these areas for production is suspected of contributing excessive amounts of sediment, pesticides and nutrients. According to the High Impact Targeting (HIT) model analysis, Bullhead Lake sub-watershed contributes 859 tons of sediment directly to waterways annually. In comparison to the other sub-watersheds, this ranks 5th overall and 3rd on a per acre basis in sediment delivery. However, considering this sub-watershed only contains the mainstem, all sediment being delivered is directly impacting the main stretch of the Prairie River. The suspected sediment loading is exacerbated by the lack of riparian buffers in this sub-watershed. Through field inspections much of this stretch was observed to have limited riparian buffers putting water quality at risk from runoff containing pesticides, nutrients and sediment. These limited riparian buffers were in areas of agricultural use as well as residential developments along the river.

Additionally, a form of nitrogen (nitrates) commonly found in chemical fertilizers is easily absorbed by crops or lawns. However, in an occurrence of over application, not all applied nitrogen can be absorbed and consequently leaches through the soil into groundwater. For humans, excess nitrogen (nitrates) found in groundwater/drinking water can be harmful by restricting oxygen transport in the blood stream. A nitrate leaching assessment was conducted on Bullhead Lake sub-watershed and found that 50% of the sub-watershed was ranked high for leaching potential. Runoff of excess phosphorus, also in chemical fertilizers, can overstimulate growth of algae in surface water which can block light to deeper waters as well as use up dissolved oxygen as plants decompose. This reduction of dissolved oxygen also leads to eutrophication in lake environments if not managed properly. It is important for chemical applications to be applied at the appropriate time (for adequate absorption/limited runoff potential) as well as to calibrate applicators regularly to ensure appropriate amounts are being applied. This is additionally important when applying nutrients (manure) and pesticides. Often time's sprayers are not calibrated regularly throughout cropping season and can lead to an excess or under application of nutrients, nitrogen and pesticides. Over applying nutrients and pesticide leads to runoff which is suspected of impacting water quality in this sub-watershed.

Overall, urban land uses are minimal in the sub-watershed; however, an evaluation of land use also showed that Bullhead Lake sub-watershed contains the second greatest amount of developed land with 4.9%. This developed area is, in part, due to the Village of Centreville along its eastern border. This sub-watershed sees a large influx of recreational users that paddle from the Village of Centreville to Three Rivers, MI and for this reason maintaining a healthy natural corridor will benefit wildlife and scenic beauty for this sub-watershed. The main “put-in” for recreational users is Lions Club Park (Specific Sites, Section 8.4) located within the Village of Centreville. This park has been observed contributing runoff during wet seasons due to soil compaction from foot traffic that has resulted in limited vegetative growth along the river’s edge furthering runoff.

Along the western edge of Bullhead Lake sub-watershed lies one of four golf courses within the PRW, Sauganash Golf Club. This 100 acre golf course contains the mainstem of the Prairie River and due to the intensely manicured grounds is believed to contribute NPS pollutants typical of golf courses (pesticides, fertilizers, herbicides). Water quality is a concern in this area because of contributing runoff containing pollutants. This golf course maintains woody vegetative buffers however much of the slope in this area is directed towards the Prairie River. If over application takes place, contaminated runoff has the potential to impact water quality and its designated uses.

Lastly, the impervious surfaces in this sub-watershed contribute contaminated runoff during rain events and increase flow to the water system. While the urban influence is small, it was identified that traditional storm water management methods, which focus on moving stormwater away quickly rather than infiltrating or treating stormwater are utilized in this developed area. This area may benefit from the implementation of low impact design BMPs for retrofits and future development. Such methods have been added to the Implementation Strategy and I&E strategy of this plan.

Although not a direct NPS issue, irrigation systems were found within this sub-watershed and contribute to sediment loading and streambank erosion as a result of installation, use and placement into the river system. The removal of vegetation prior to the installation of these systems creates unstable streambanks which can exacerbate existing conditions such as runoff from fields and streambank erosion as well as remove shade that is important for aquatic species.

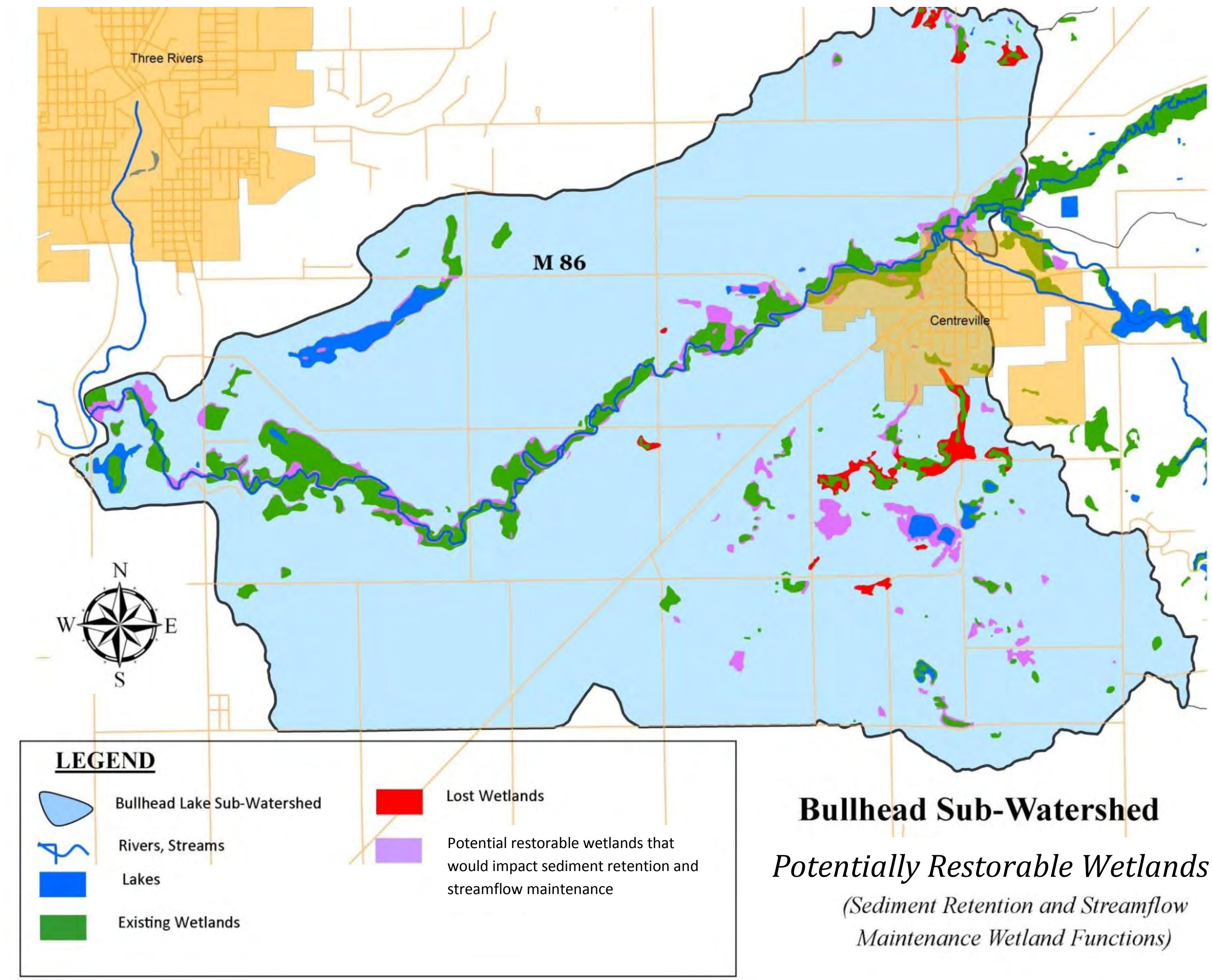
Throughout the PRW, the local excessive growth of aquatic vegetation could be a sign of E. coli and potentially other bacterial and pathogenic contamination. E. coli is typically found in the digestive tract of warm blooded animals; its presence in water is therefore an indication of recent contamination by human, bird or animal waste. These wastes are also high in nutrients and thus accelerate the growth of aquatic vegetation. It should be noted that lush aquatic vegetation is often, but not always, an indication of bacterial or pathogenic contamination.

The PRW inventory noted several areas where livestock had uncontrolled in-stream access, and some indications of septic system failures were noted in the social survey. Waterfowl are also a known bacterial source in adjacent watersheds. Because of these known sources, water quality monitoring of the PRW in all sub-watersheds is highly recommended to determine the sources and relative importance of E. coli and nutrients.

A wetland status and trend assessment was completed for Bullhead Lake sub-watershed. Wetland loss is substantially less compared to other sub-watersheds in the PRW with 609 acres lost (36.1%) and 1,079 acres remaining. This loss is among the lowest of the PRW sub-watersheds (6 of 7). However, the majority of loss is located in the river corridor only furthering the sediment loading, flow fluctuations and contaminated runoff from the agricultural areas as well as streambank erosion.

Priority wetland functions of the LLWFA tool were determined based on water quality findings and with the help of the steering committee and participating partners. The results indicated that sediment retention and streamflow maintenance were the most important functions for the PRW. Lost wetlands in Bullhead Lake sub-watershed that could improve sediment retention and streamflow maintenance if restored are identified in Figure 2.

Figure 2: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



Spring Creek Sub-Watershed

Spring Creek sub-watershed is located in the northern most portion of the PRW in St. Joseph County (See Figure 3). The mainstem of the Prairie River does not flow through this sub-watershed however Spring Creek, an identified tributary, flows southwesterly out of its headwaters near Colon, MI. The primary designated uses at risk for the sub-watershed are other indigenous aquatic life/wildlife, total and partial body contact recreation and warmwater fisheries.

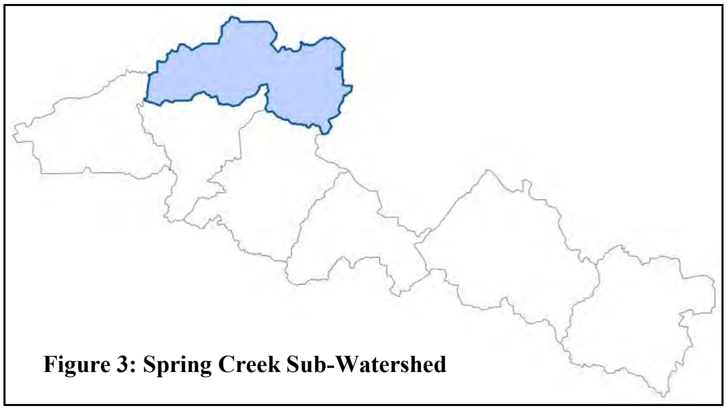


Figure 3: Spring Creek Sub-Watershed

Spring Creek sub-watershed contains the second highest amount of agricultural land with 75%. Agricultural production in this sub-watershed is suspected to contribute excess sediment, pesticide, nutrient and bacteria/pathogen loading through runoff. According to HIT model analysis, Spring Creek sub-watershed contributes 947 tons of sediment to waterways each year. In comparison to other sub-watersheds in the PRW, Spring Creek is ranked 4th in total sediment loading to the waterways but it has the lowest loading rate of all the sub-watersheds on a per acre basis.. However, with 10 first order streams this sub-watershed has the potential to impact important aquatic habitat if not managed properly. Runoff containing excess sediment, pesticides, bacteria/pathogens and nutrients can negatively impact sensitive aquatic habitats and impact downstream conditions. Additionally, the limited amount of riparian buffers in this sub-watershed leads to excess loading from surrounding agricultural fields contaminated with sediment, pesticides and nutrients.

A nitrate (nitrogen) leaching assessment was completed on Spring Creek sub-watershed and determined that an area around Beaver Lake ranked high to medium for leaching potential making it important to consider when applying chemicals or manure to agricultural land in this area due to potential impacts on drinking water. The remainder of the watershed ranked medium in concern but it should be noted that no area in the PRW ranked lower than medium for nitrate leaching concern. As described previously for Bullhead Lake sub-watershed, calibration and timing are vital components to consider when making applications to the land to reduce both nitrogen leaching potential and phosphorous runoff potential.

During field investigations, one unrestricted livestock access site was identified. These areas present a direct concern for water bodies due to the heavy use (hoof on land) compaction/breaking up of soil and water access which are typically all located near the surface water. This unrestricted livestock access site is suspected to contribute sediment, nutrients and bacteria/pathogens to the waterway due to streambank erosion, contaminated runoff and improper animal waste storage.

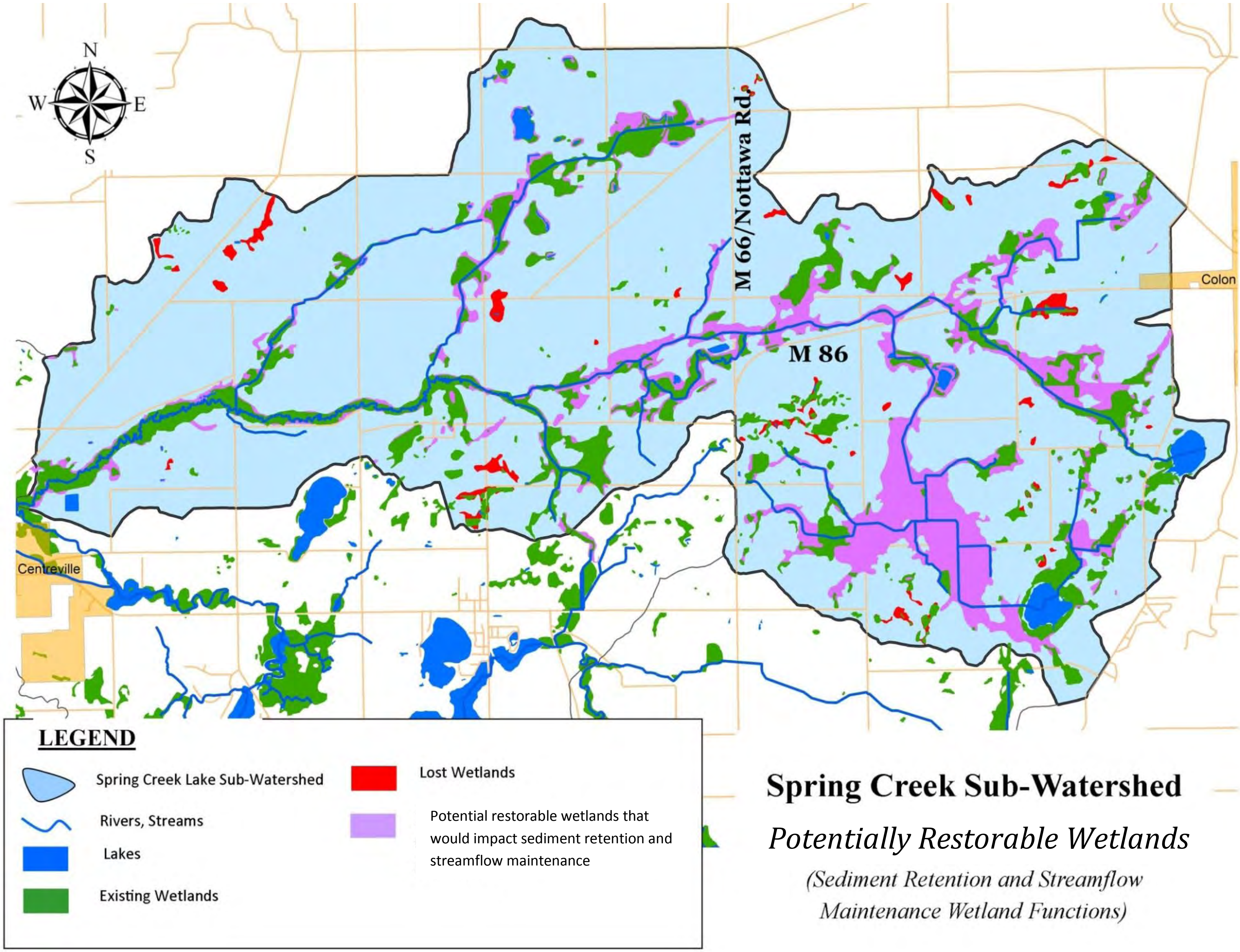
While developed land accounts for only 2.8% of this sub-watershed there is concern for the potential of water quality impacts from failed and failing septic systems. Such systems can be sources of pathogens and excess nutrients. The concern for this sub-watershed is based on the amount of hydric soils (notoriously unsuited for septic systems) in the Eastern portion of the sub-watershed and the cluster of older homes (constructed prior to 1950) in the Southwestern portion of the sub-watershed. Water quality monitoring is highly recommended to determine the extent of potential additional unrestricted livestock crossings and septic system failures.

In addition, a wetland status and trend assessment was completed for Spring Creek sub-watershed. Wetland loss amounts are ranked third for both total acres lost and percent wetland lost compared to other sub-watersheds in the PRW with 1,972 acres (52.5% lost). One thousand seven hundred eighty seven wetland acres remain. Most of the wetland loss areas in this sub-watershed are found in the eastern region with a large expanse near the southeastern border which was drained for agricultural use.

Wetland loss results in losing the water quality or ecological functions (or job) they serve such as shoreline stabilization or floodwater storage. Priority wetland functions were determined based on water quality findings and with the help of the steering committee and participating partners. Sediment retention and streamflow maintenance were determined to be the most important functions for the PRW. Wetlands that would improve sediment retention and streamflow maintenance if restored are identified in Figure 4.

In addition, there is a growing concern related to irrigation systems that withdraw directly from the river in this sub-watershed. The installation and large pumping capacity (400-500 gallons per minute average) of these systems can contribute sediment into the waterway as well as impact temperature of the river due to lower water levels and slower flow. Only two irrigation sites were identified in this sub-watershed but these inventories were not designed for identification of irrigation systems and may not be representative of withdrawals in the sub-watershed as a whole.

Figure 4: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



Lake Templene Sub-Watershed

Lake Templene sub-watershed is located to the south of Spring Creek sub-watershed in St. Joseph County (See Figure 5). This is the smallest sub-watershed in the PRW with 11,691 acres and the Lake Templene impoundment of the Prairie River, is by far the largest feature. The river flows westerly through Sherman and Nottawa Townships and the mainstem and one 1st order stream are found in this sub-watershed. It is home to several large populated lakes including Lake Templene, Fish Lake, Evans Lake and Sand Lake (known to exceed pathogens water quality standard for *E. coli*) as well as a local campground at Nottawa Beach Park. The primary designated uses at risk for the sub-watershed are other indigenous aquatic life/wildlife and warmwater fisheries.

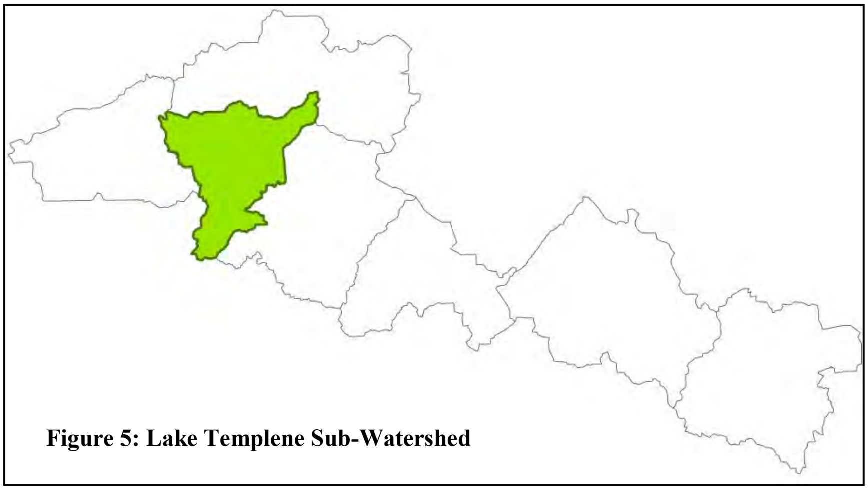


Figure 5: Lake Templene Sub-Watershed

Lake Templene sub-watershed consists of 54.7% agricultural land use and cultivating these areas for production are suspected of contributing excess amounts of sediment, pesticides and bacteria/pathogens. According to HIT model analysis, Lake Templene sub-watershed contributes 645 tons of sediment annually to the waterways. This is especially important considering there is a 1st order stream located in its northeast corner where pollutants can impact habitat and water quality. In addition, this amount of sediment loading essentially becomes trapped in the impoundment at Lake Templene leading to expensive dredging costs. Field observations show that this portion of the Prairie River has suffered loss of riparian buffers which puts the water quality at risk from runoff containing pesticides, nutrients, bacteria/pathogens and sediment. This limited use of riparian buffers was observed on both agricultural lands as well as residential developments including both riverfront and lakefront properties. Vegetative buffers in this sub-watershed would substantially reduce runoff from surrounding lands.

A nitrate leaching assessment was completed for the Lake Templene sub-watershed which identified the southern portion of the sub-watershed to be ranked as high for leaching concern. The remainder of the sub-watershed was ranked medium for leaching concern. Nitrate leaching is a concern for those who draw drinking water from groundwater wells.

In addition, the Lake Templene sub-watershed contains the most developed area compared to the rest of the PRW with 8.4% of total land use (984 acres). This developed area consists of two golf courses, restaurant, campground, eastern portion of the Village of Centreville, a developed area near Sand Lake, and development around the lakes and along the road system. Current watershed models show that when a watershed reaches 10% impervious surface area, the impacts on hydrology are substantial and irreversible. This sub-watershed has and will continue to see new development, therefore using low impact development practices (I&E Strategy) and other alternative methods to minimize stormwater runoff impacts will be important to maintaining a healthy watershed.

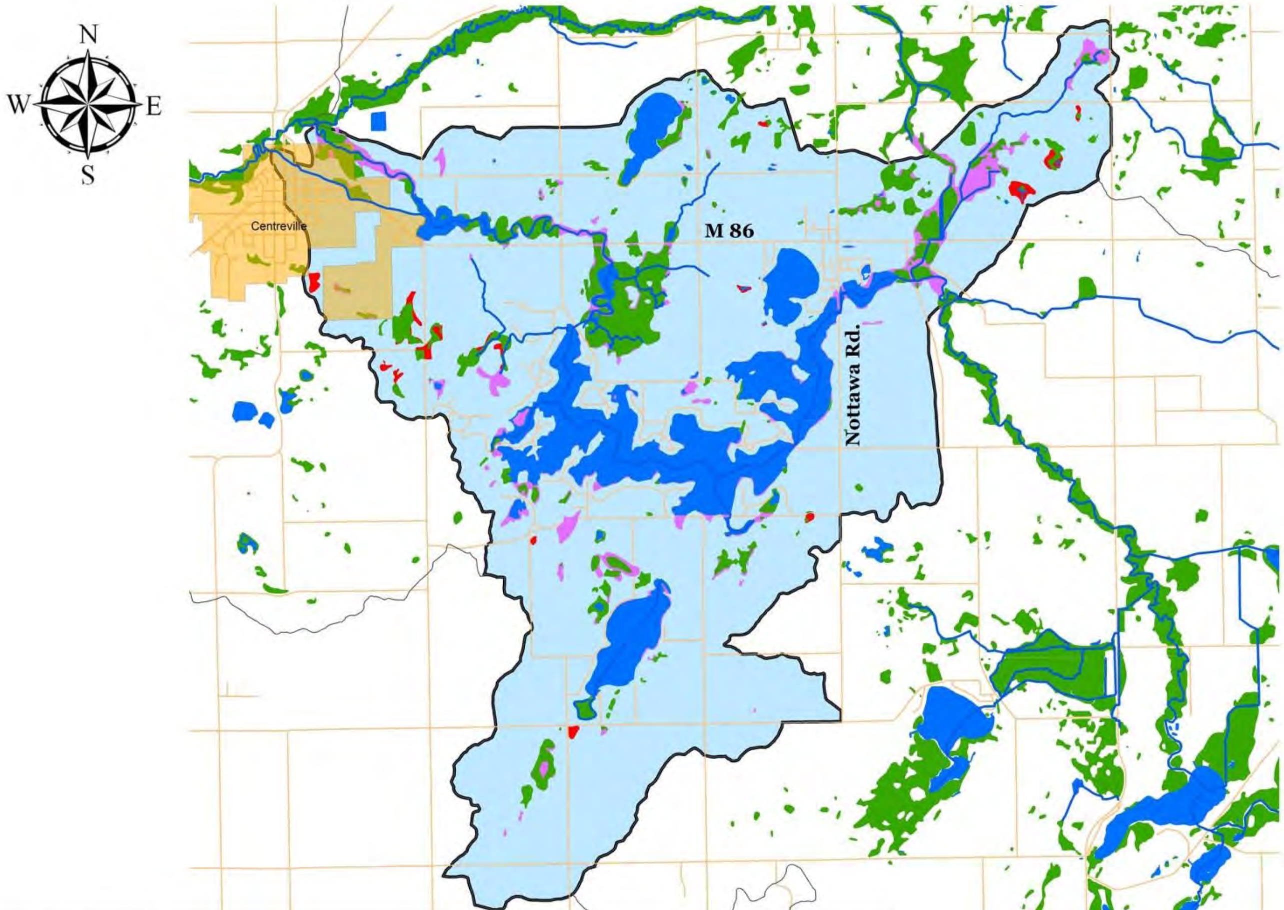
The lake communities in this region, particularly Sand Lake and Lake Templene are suspected of contributing bacteria/pathogens into this sub-watershed. Lake Templene has become a desirable location for out-of-town residents to maintain a vacation home. Many of these original dwellings on the lots are aged and likely resulted in undersized septic systems when original dwellings were removed and new, larger structures were constructed. Unfortunately, no data were available on rate of septic system failure in this region; however, identifying and correcting failing septic systems in this area is expected to reduce risk to water quality. For these reasons as well as those previously discussed for the PRW, additional water monitoring is recommended.

The Lake Templene sub-watershed is also home to the largest golf course in the PRW at 220 acres, Island Hills Golf Club as well as the St. Joe Valley Golf Course. These areas are suspected of contributing sediment, pesticides and nutrients typical of golf courses. Areas within Island Hills Golf Course are often flooded during wet seasons, which further the pollutant concerns. The intensely manicured grounds and lack of riparian buffers and turf grass that has limited infiltration allows for runoff directly to the mainstem of the Prairie River. Additionally, the construction of golf villas has been proposed and approved by the Township with the expectation of 14 villas. This construction without proper management could potentially lead to excess sediment as well as additional impervious surfaces that lead to contaminated stormwater runoff.

In addition, a wetland status and trend assessment was completed for Lake Templene sub-watershed. Wetland loss amounts are ranked fifth compared to other sub-watersheds in the PRW with 1,214 acres and fourth in terms of percent loss (51.1% lost). The wetlands lost are primarily in the center of this sub-watershed, where Lake Templene (883 acres) was impounded. It is unlikely that dam removal would be considered due to the highly developed shoreline; however, interest has been shown for improving habitat (fisheries). A dredging plan has been compiled by the Lake Templene Property Owners Association and implementation began in 2012.

Lost wetlands in the Lake Templene sub-watershed that would improve sediment retention and streamflow maintenance if restored are identified in Figure 6.

Figure 6: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



LEGEND

- Lake Templene Sub-Watershed
- Rivers, Streams
- Lakes
- Existing Wetlands
- Lost Wetlands
- Potential restorable wetlands that would impact sediment retention and streamflow maintenance

Lake Templene Sub-Watershed

Potentially Restorable Wetlands

(Sediment Retention and Streamflow Maintenance Wetland Functions)

Prairie River Lake Sub-Watershed

The Prairie River Lake sub-watershed is located to the east of the Lake Templene sub-watershed in the southeast portion of St. Joseph County (See Figure 7). This sub-watershed contains the most lakes of all sub-watersheds in the PRW and the mainstem flows primarily northwest through Burr Oak, Sherman and Nottawa Townships. The primary designated uses at risk for this sub-watershed are other indigenous aquatic life/wildlife, total and partial body contact recreation as well as cold and warmwater fisheries.

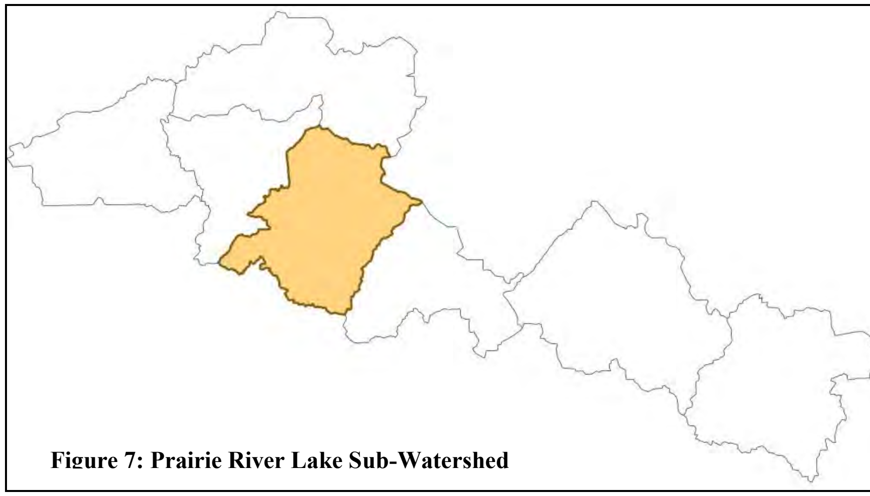


Figure 7: Prairie River Lake Sub-Watershed

Prairie River Lake sub-watershed contains 57% agricultural land that is cultivated for agricultural production. These agricultural areas are suspected of contributing sediment, bacteria/pathogens, nutrients and pesticides through runoff. According to HIT model analysis, this sub-watershed contributes 1,066 tons of sediment to the waterways annually which makes it the third greatest contributor in the PRW but 4th on a tons per acre basis. This sediment loading has the potential to impact the four 1st order stream habitats as well as mainstem Prairie River habitats including a designated trout stream. As determined through field observations and satellite photography, the agricultural regions have limited riparian buffers which contribute to runoff containing sediment, pesticides and nutrients.

A nitrate leaching assessment identified areas in the southern portion of the sub-watershed near a cluster of lakes as high leaching concern. The location of this high area of concern can put drinking water at risk for the lakefront properties making chemical applications to agricultural fields especially important. As discussed before, agricultural calibration and timing for applications is important to reduce over applying nitrogen.

Being that this sub-watershed contains the greatest amount of lakes in comparison to other sub-watersheds in the PRW, the lake communities are suspected of contributing sediment, bacteria/pathogens, pesticides and nutrients. Much like agricultural areas, homeowners have the potential to over apply fertilizers containing nitrogen if not managed and timed properly. In addition, mowing to the water's edge is a standard lakefront practice which limits infiltration and leads to contaminated runoff. Naturalization of shorelines help to reduce runoff into waterways and allow a location for wave action to disperse its energy. In addition, these lake communities are a mixture of old and newer construction and being a desirable location for vacation homes, many of these areas are suspected of contributing bacteria/pathogens through unmaintained, undersized or failing septic systems. Many of these lakes have seen newer, larger construction for year-round use leaving the septic system at risk of being undersized for the new structure. Lastly, this area contains several "put-in" locations for recreational users as well as a DNR managed boat launch. The "put-in" locations see heavy foot traffic and in several locations, compacted soil that has resulted in limited vegetation growth along the river's edge.

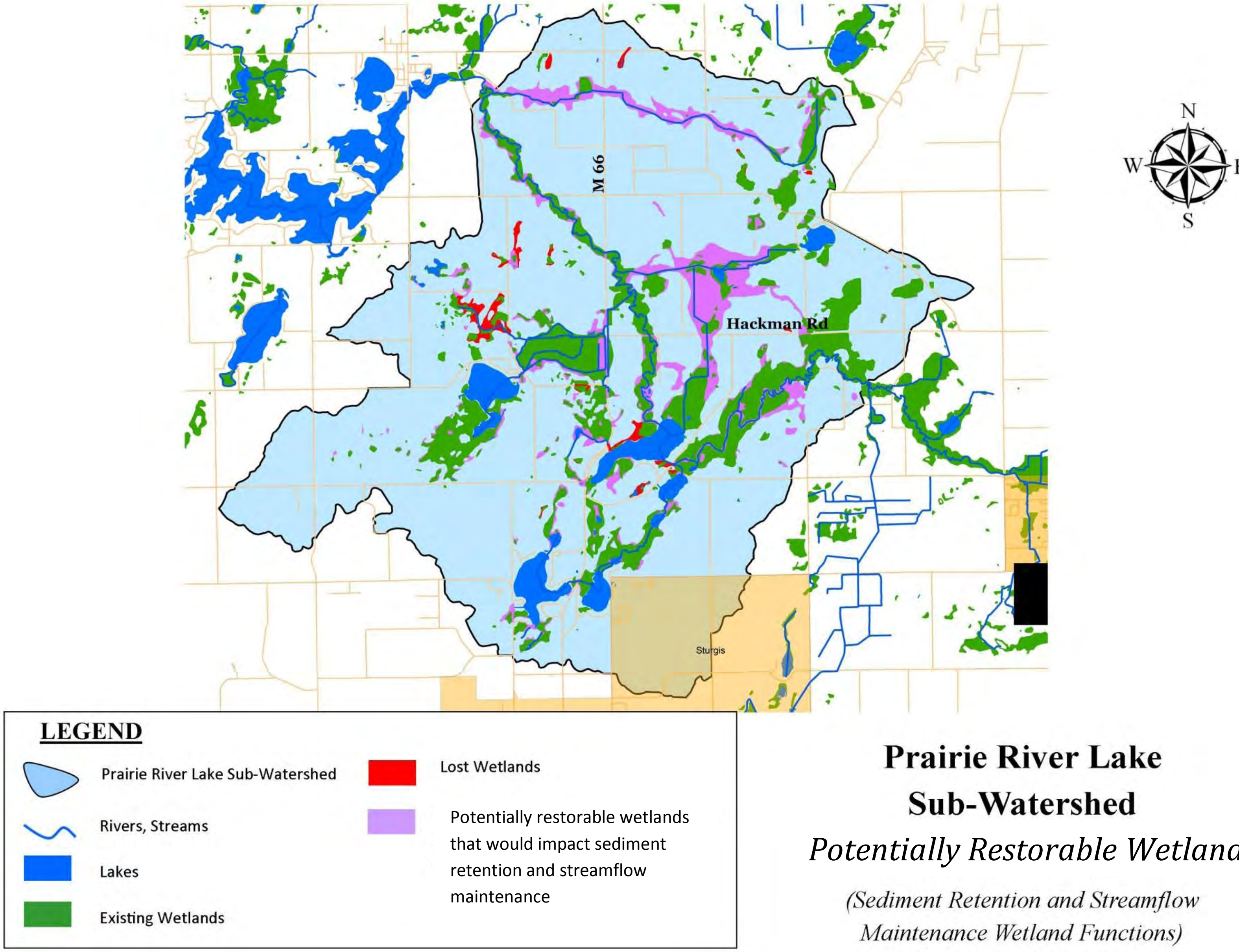
One unrestricted livestock access was identified during field investigations. This area is described in Section 8 poses direct concern for waterbodies due to heavy use, water access, limited riparian vegetation and slope from farm which can result in sediment, bacteria/pathogen and nutrient loading. Additional water monitoring is recommended, because of these issues as well as those previously discussed possibilities including septic system failures.

Lastly, a wetland status and trend assessment was completed for this sub-watershed. Wetland loss amounts in this area are ranked sixth when compared to other sub-watersheds in the PRW with 1,198 acres lost or 33.6%. This is the lowest percentage loss of all the PRW sub-watersheds. The largest complex lost was in the northeast region of this sub-watershed as well as areas in the northern portion of the sub-watershed which was drained for agricultural use.

Wetland loss results in losing the water quality ecological functions (or job) the wetland serves in that area. Priority wetland functions in the PRW were determined to be sediment retention and streamflow maintenance. Lost wetlands that would improve sediment retention and streamflow maintenance if restored are identified in Figure 8.

Although not a direct NPS issue, irrigation was observed in this sub-watershed. There were six crop irrigation systems identified that withdraw surface water. The irrigation withdrawal capacity is large (average of 400-500 gallons per minute) and impact hydrologic flow in this sub-watershed.

Figure 8: Potential restorable wetlands that would benefit sediment retention and streamflow mainter



Prairie River Lake Sub-Watershed

Potentially Restorable Wetlands

(Sediment Retention and Streamflow Maintenance Wetland Functions)

Stewart Lake Drain

Stewart Lake Drain sub-watershed is located in the center of the PRW along the St. Joseph County and Branch County border (See Figure 9). The mainstem of the Prairie River in this sub-watershed is a designated trout stream and flows northwesterly through Bronson and Burr Oak Townships. The primary designated uses at risk in this sub-watershed are other indigenous aquatic life/wildlife, cold and warmwater fisheries and total and partial body contact recreation as a result of changes made on the land.

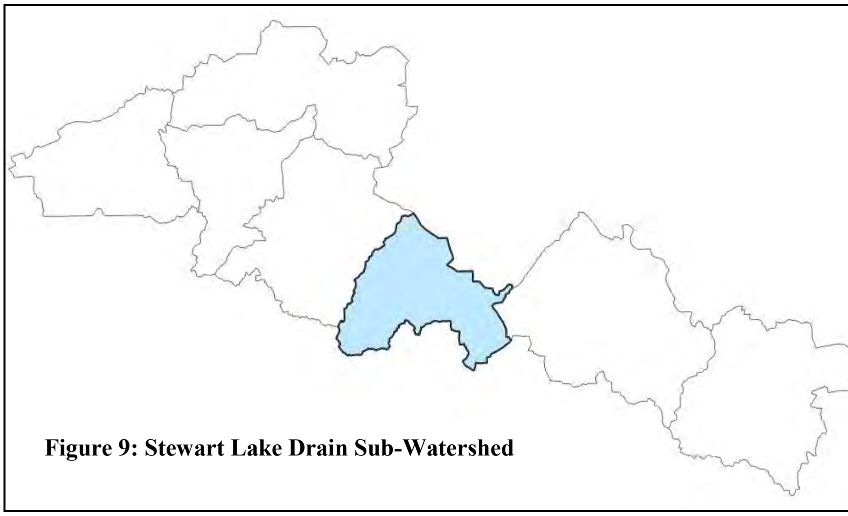


Figure 9: Stewart Lake Drain Sub-Watershed

Stewart Lake Drain sub-watershed consists of 72% agricultural land use and cultivating these areas for production is suspected of contributing excessive amounts of sediment, pesticides and nutrients to waterways. According to the HIT model analysis, this sub-watershed contributes 820 tons of sediment into the waterways annually. In comparison to the other sub-watersheds in the PRW, this ranks 6th overall in sediment delivery, but second highest on a per acre basis. This is particularly important due to the designated trout stream. Excess sediment can impact habitat and spawning grounds for aquatic species including trout. During field investigations of this sub-watershed many areas were observed to have limited to no riparian buffer which puts water quality at risk from runoff containing sediment, pesticides and nutrients.

Additionally, a nitrate leaching assessment was completed for the sub-watershed indicating areas within the wellhead protection area of the Village of Burr Oak were ranked high to medium for leaching potential. Nitrates leaching into groundwater can put drinking water at risk and given the amount of agricultural land use in this sub-watershed proper application of chemicals is an important component to reducing polluted runoff and ground water impacts from leaching.

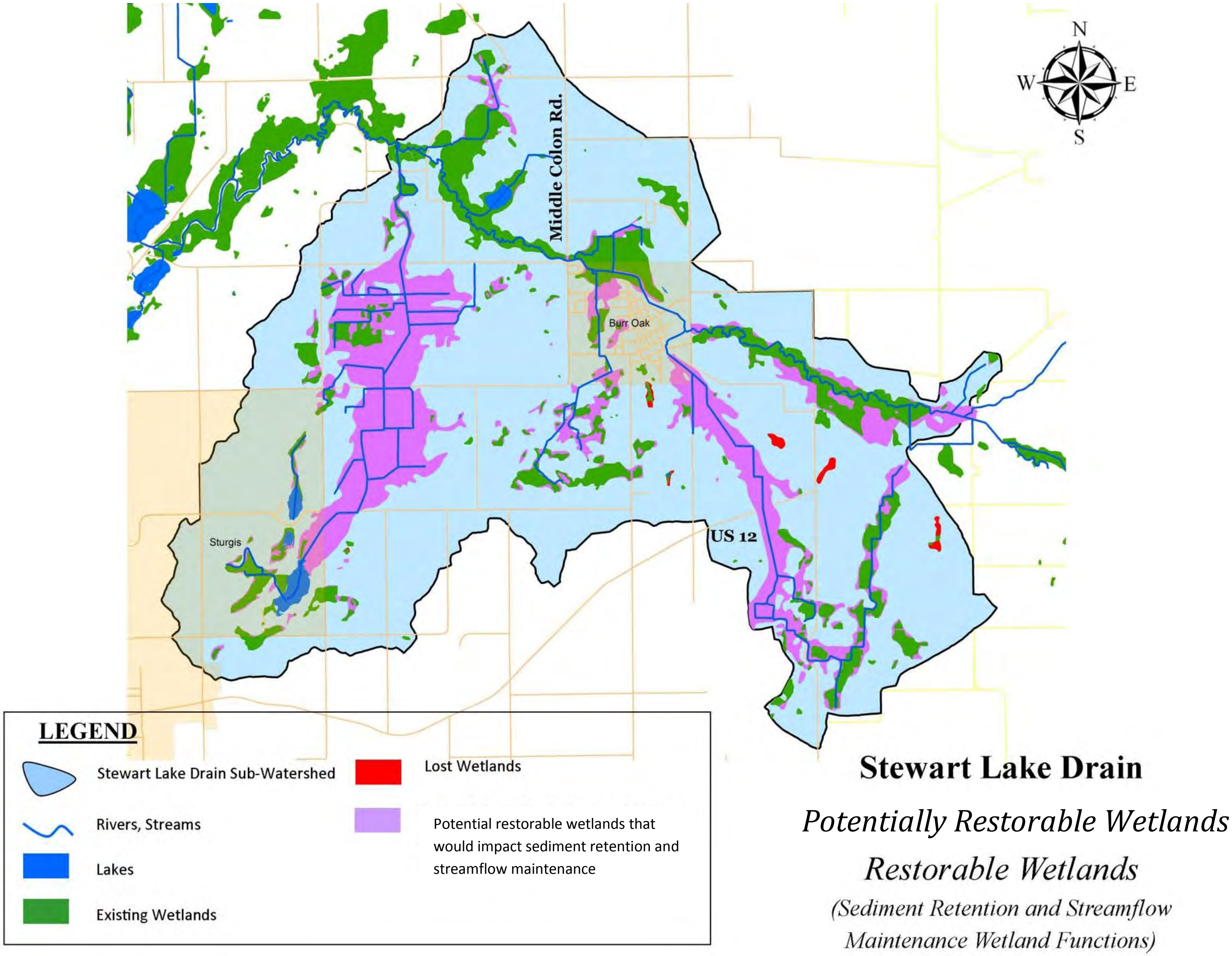
As with most of the PRW few sources of septic failure were known or identified. Adding the potential for runoff contamination from agricultural areas it is recommended the additional monitoring be done within this sub-watershed to identify potential bacterial, nutrient and pathogenic contaminant sources.

With the Village of Burr Oak in this sub-watershed, it is ranked 3rd in amount of developed land (559 acres or 4.3%). Impervious surfaces in this sub-watershed are suspected of contributing contaminated runoff during rain events and increasing flow to the water system. Although the urban influence is small, use of low impact development stormwater management for new development or retrofits in this sub-watershed may help to minimize impacts from stormwater. These items have been added to the Recommended Implementation Strategy and I&E strategy of this plan.

A wetland status and trend assessment was completed for this sub-watershed. Wetland loss amounts are ranked fourth in total acres when compared to other sub-watersheds in the PRW with 1,903 acres or 57.9% lost. The percentage of wetland loss is the second highest of the 7 Prairie River sub-watersheds. The wetland loss in this sub-watershed is substantial in two primary areas; however, other sporadic loss can be found throughout the sub-watershed. One large wetland complex was lost along the Stewart Lake Drain which flows out of Stewart Lake and was drained for agricultural use. Additionally, a large complex in the southeast portion of the sub-watershed experienced substantial loss. Both contribute to changes in hydrologic flow in this sub-watershed.

Priority wetland functions in the PRW were determined to be sediment retention and streamflow maintenance. Figure 10 identifies the lost wetlands in this sub-watershed that would improve sediment retention and streamflow maintenance if restored.

Figure 10: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



Gilead Lake Sub-Watershed
The Gilead Lake sub-watershed is located east of the Stewart Lake Drain sub-watershed in the southwest corner of Branch County, MI (See Figure 11). The mainstem of the Prairie River flows northwesterly through Gilead, Bethel, Bronson and Noble Townships. Additionally, sections of the mainstem in this sub-watershed are managed as a Type 4 trout stream. The primary designated uses at risk are total and partial body contact recreation, other indigenous aquatic life/wildlife, coldwater and warmwater fisheries due to sediment, bacteria/pathogen, nutrient, and pesticide loading and hydrologic flow and temperature changes.

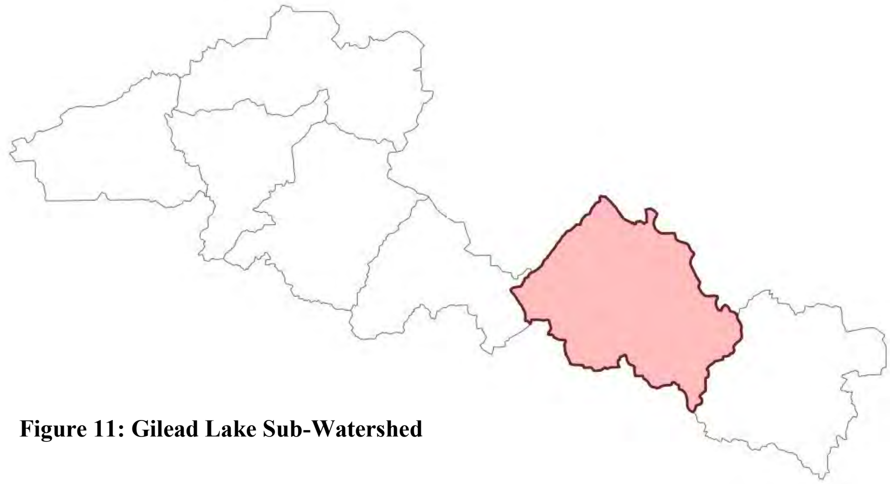


Figure 11: Gilead Lake Sub-Watershed

Gilead Lake sub-watershed contains the greatest amount of agricultural land with 78.1%. Agricultural production in this sub-watershed is suspected to contribute excess sediment, pesticides, nutrients and bacteria/pathogens through runoff occurring on the land. According to the HIT model analysis, Gilead Lake sub-watershed contributes 1,246 tons of sediment to waterways each year, making it the largest contributor in the PRW. This is not surprising as it is also the largest sub-watershed. The Gilead Lake sub-watershed ranks 6^{th} out of 7 for sediment loading when sediment is considered on a tons per acre basis. Runoff containing sediment, pesticides, nutrients and bacteria/pathogens put water quality at risk if lands are not managed properly with BMP's. Through field investigations and satellite photography it was determined that this sub-watershed has limited riparian buffers which likely contribute to sediment loading. Furthermore, runoff containing excessive amounts of sediment can bury important aquatic habitats and spawning areas which was observed in the Fall of 2012 when a pollution event deposited sediment from Cemetery Road to Parham Road potentially impacting the cold and warmwater fisheries designated uses. Additional sediment loading is suspected to be from field stream crossings which are areas that appear to have equipment or vehicles cross through the river or stream multiple times to reach the other side; however, further investigation would need to take place to determine the exact cause.

A nitrate leaching assessment was completed for the Gilead Lake sub-watershed and identified that the majority of this sub-watershed is ranked medium concern for drinking water. However, small sections along the mainstem in the eastern region and a small portion on an unnamed tributary ranked high to medium concern which makes it important for managing chemical applications in this sub-watershed. Calibrating and timing applications to agricultural fields and residential areas are important to reduce potential for nitrate leaching, as well as nutrient-contaminated runoff.

Although this sub-watershed is ranked fourth in amount of developed land (889 acres or 3.8%) it does contain a populated lake (Gilead Lake) as well as an 18-hole golf course. Both areas suffer from limited riparian buffers which lead to streambank degradation and runoff containing pesticides, nutrients and sediment. This area is suspected of contributing sediment, pesticides and nutrients typical of golf courses. The intensely manicured grounds and lack of riparian buffers and turf grass that has limited infiltration allows for contaminated runoff to reach the waterways. In addition, the lake developments are suspected of contributing bacteria/pathogens in this sub-watershed due to unmaintained or failing septic systems.

During field investigations, two unrestricted livestock sites were identified in this sub-watershed. These areas, described in Section 8, pose direct concern for water bodies due to heavy use, water access and limited riparian vegetation, which results in sediment, bacteria/pathogen and nutrient loading. These unrestricted livestock access sites are suspected to be contributing undesirable amounts of sediment, nutrients and bacteria/pathogens to the waterway due to streambank erosion, contaminated runoff and improper animal waste storage. Additional water monitoring is highly recommended to discover the sites and source of potential pollutants, because of these issues as well as the possibility of septic system failures.

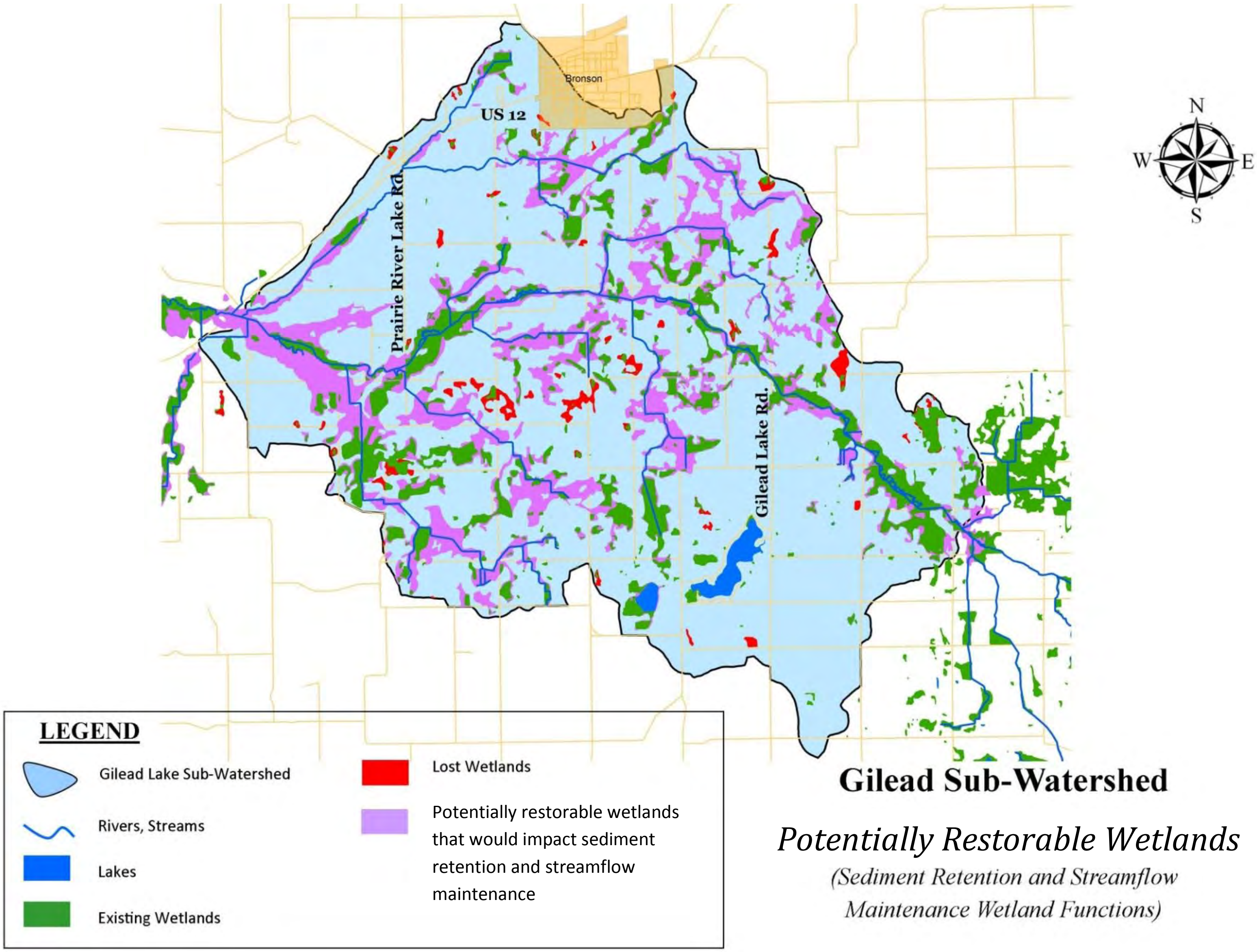
A wetland status and trend assessment was completed for Gilead Lake sub-watershed. Wetland loss in this sub-watershed is the greatest in terms of total acres as well as on a percentage basis when compared to other sub-watersheds in the PRW with

3,863 acres or 60.5% lost. The loss is consistent across the watershed with a substantial complex lost in the western region and northern region as well.

Priority wetland functions in the PRW were determined to be sediment retention and streamflow maintenance. Wetlands that would improve these functions if restored are shown in Figure 12.

Lastly, although not an NPS concern, irrigation systems were readily apparent in this sub-watershed. The lack of vegetative buffers and irrigation installation and capacity can contribute to sediment loading, change hydrologic flow and temperature as well as create concerns for potential spills on streambanks as is the case at one observed irrigation site. These systems operate on electricity or diesel and one system in this sub-watershed was identified to have a diesel system upslope from the mainstem of the Prairie River. This puts the river and its designated uses at risk if a tank should fail. The installation of these systems also require streambank clearing which can result in streambank erosion as well as eliminating shade that could be vital for aquatic species including warm and coldwater species.

Figure 12: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



Headwaters Sub-Watershed

The Headwaters sub-watershed is located in the southwest corner of Branch County, MI (See Figure 13). The mainstem of the Prairie River begins in the lakes of Kinderhook Township flowing in a westerly direction through Gilead Township. The primary designated uses at risk for the sub-watershed are other indigenous aquatic life/wildlife, warmwater and coldwater fisheries as a result of sediment and nutrient loading, pesticide contamination, hydrologic flow and temperature alterations caused by changes on the land.

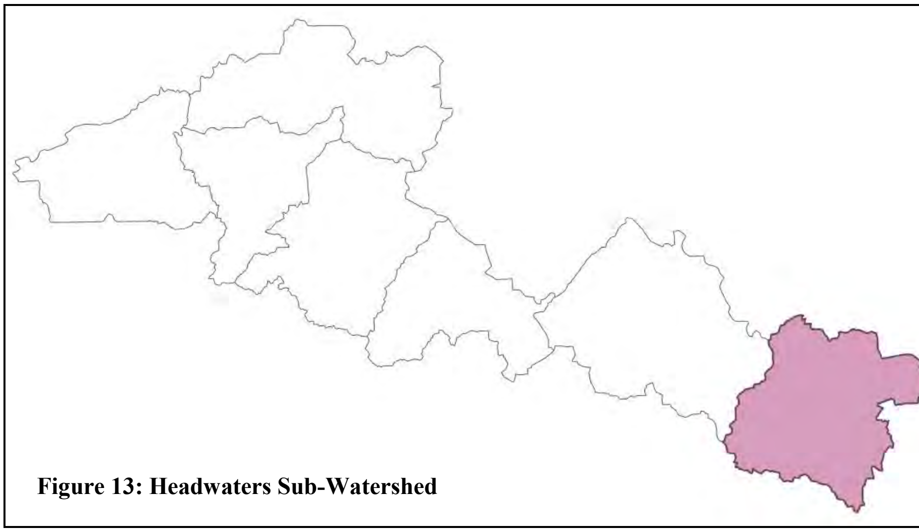


Figure 13: Headwaters Sub-Watershed

The Headwaters sub-watershed consists of 66% agricultural land use and cultivating these areas for production is suspected of contributing sediment, nutrients, pesticides and bacteria/pathogen. According to the HIT model analysis, the Headwaters sub-watershed is ranked second with 1.232 tons of sediment delivered to the waterways annually. This sub-watershed ranks first for sediment loading on a tons per acre basis. Runoff containing sediment, pesticides, nutrients and bacteria/pathogens can put water quality at risk if lands are not managed properly with BMP's. Through field investigations and satellite photography it was determined that this sub-watershed has limited riparian buffers which allow runoff from surrounding lands. Additional sediment loading is suspected to be from field stream crossings which are areas that appear to have equipment or vehicles cross through the river or stream multiple times to reach the other side however; further investigation would need to take place to determine the exact issue.

Additionally, a nitrate leaching assessment was completed in the Headwaters sub-watershed which determined that the majority of the sub-watershed is a medium leaching concern for ground water. In comparison to other sub-watersheds, the Headwaters sub-watershed ranked the lowest in leaching concern however; no area in the PRW was ranked lower than medium.

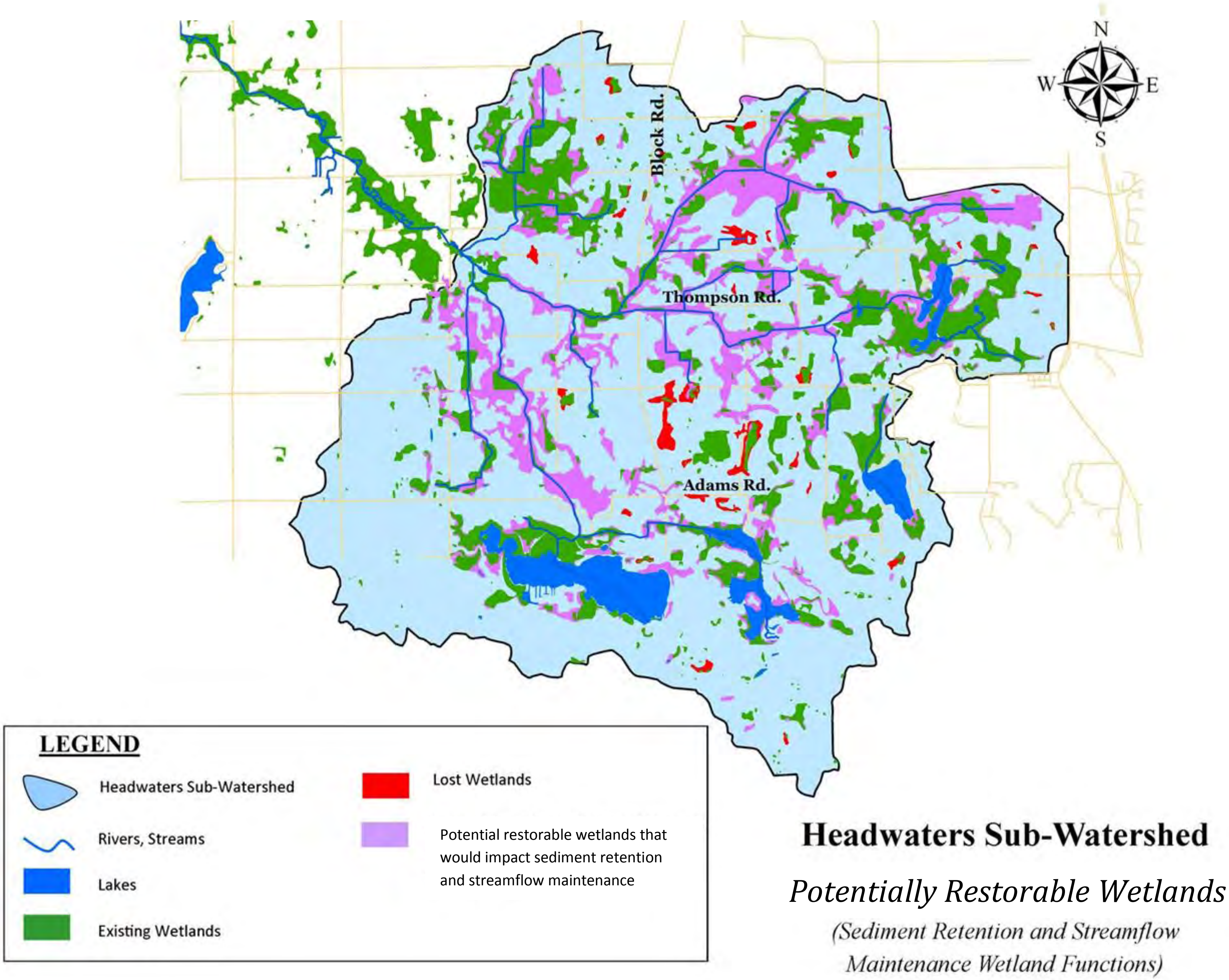
This sub-watershed contains only 3.5% (651 acres) developed land, however; it is primarily small communities surrounding lakes. These areas are suspected of contributing bacteria/pathogens, nutrients and pesticides to the waterway. Water quality can be at risk when homeowner lawn care practices result in over application of chemicals and limited riparian buffers are present, as well as when unmaintained or failing septic systems are present. As discussed earlier, additional water monitoring is recommended to discover the sites and source of potential pollutants for reasons mentioned here as well as those previously discussed.

A wetland status and trend assessment was completed for the Headwaters sub-watershed. Wetland loss in this sub-watershed is the second highest in comparison to other sub-watersheds in the PRW with 2,590 acres lost but among the lowest on a percentage basis (44.5% or fifth of the 7 sub-watersheds). The loss is sporadic throughout the watershed with clusters in the northern and central region.

Priority wetland functions in the PRW were determined to be sediment retention and streamflow maintenance. Wetlands that would improve sediment retention and streamflow maintenance if restored are indicated in Figure 14.

Although not an NPS issue, combining the loss of wetlands, lack of vegetative buffers with the increasing need for irrigation systems could potentially impact the temperature and hydrologic flow in this area. A growing trend in the watershed has been the use of large scale center pivot irrigation systems that can withdrawal water at a minimum rate of 70 gallons per minute, but on average 400-500 gallons per minute. Withdrawing water at large capacities could reduce flow significantly as well as impact temperature due to more shallow conditions in this area if the trend continues. This could impact downstream volumes which could compound the negative effects as a substantial number of irrigation systems are found downstream of this area. In addition, the installation of these devices requires clearing of streambanks for surface withdrawal, which can risk streambank stability and create erosion. There was only one surface withdrawal irrigation system identified in this sub-watershed; however, the inventories weren't designed to identify irrigation systems, therefore these data are not representative of the entire sub-watershed.

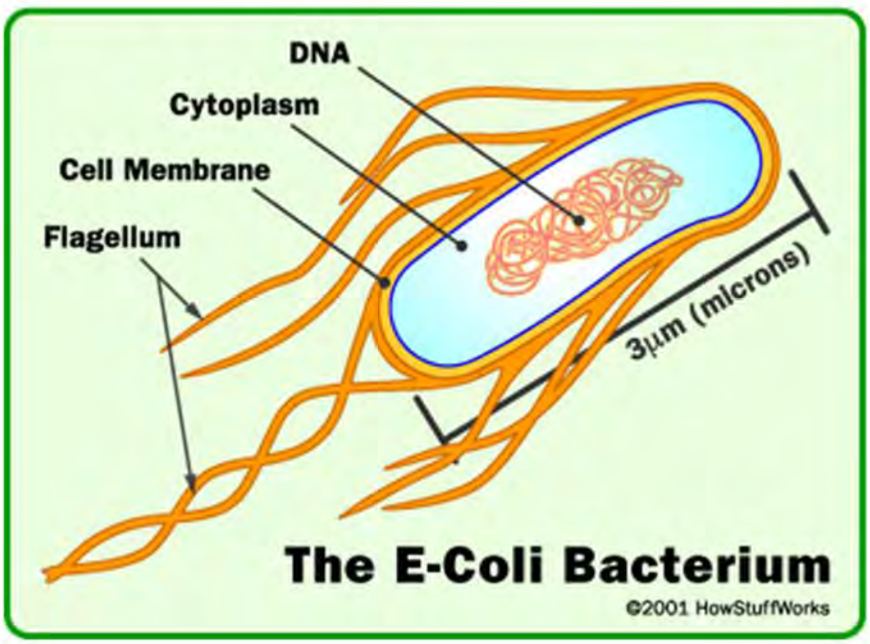
Figure 14: Potential restorable wetlands that would benefit sediment retention and streamflow maintenance functions



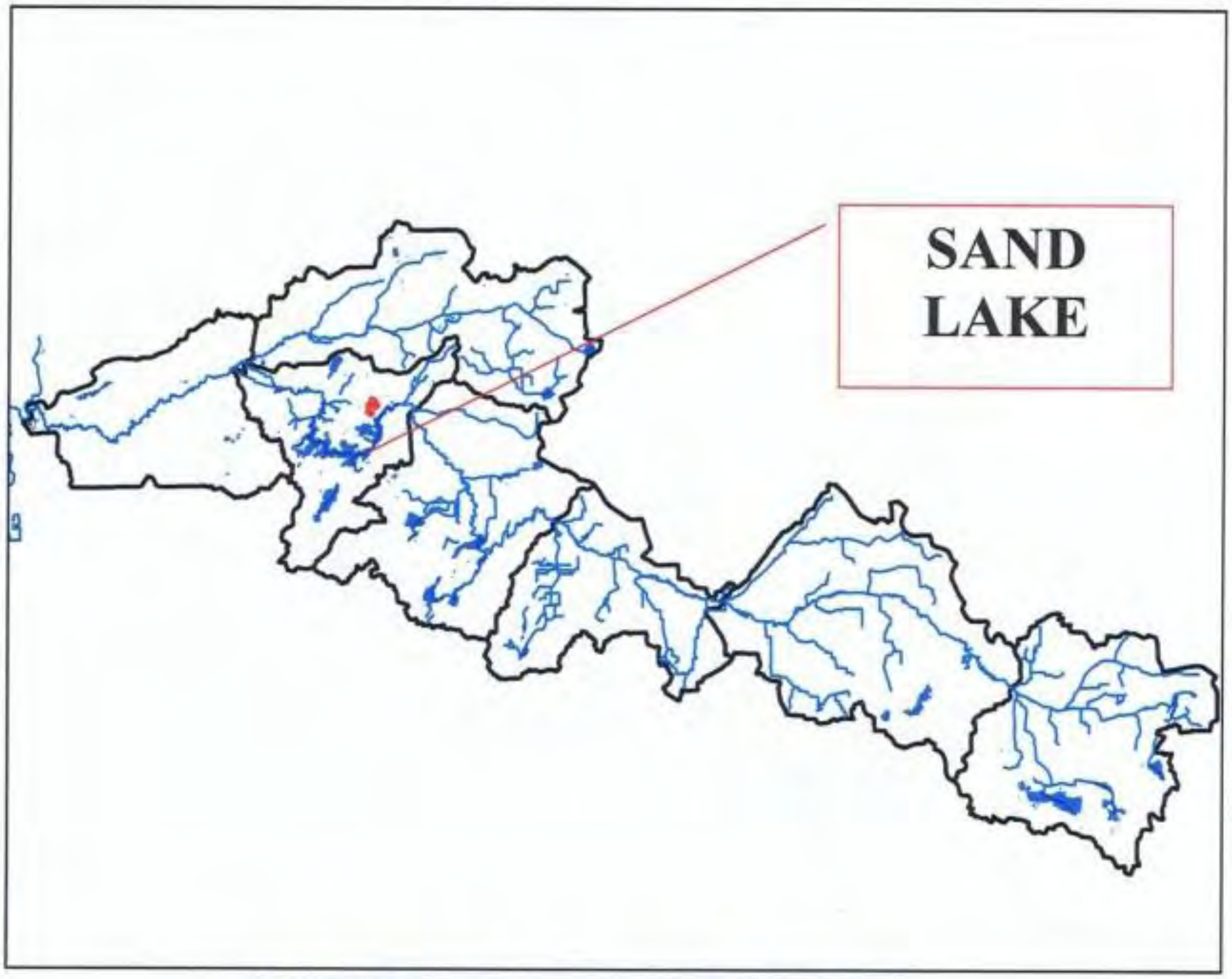
Appendix 8

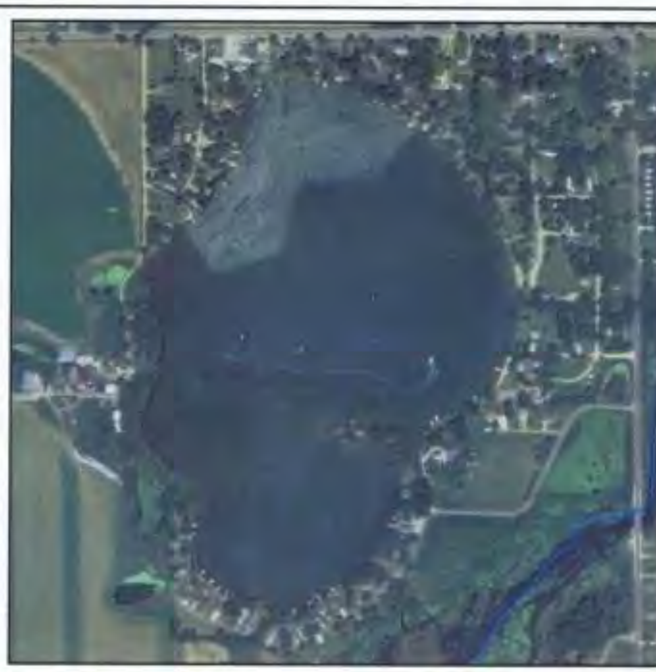
Prairie River Watershed

E.Coli Data for Sand Lake



Sand Lake





E.Coli Data for Sand Lake provided by Michigan Department of Environmental Quality

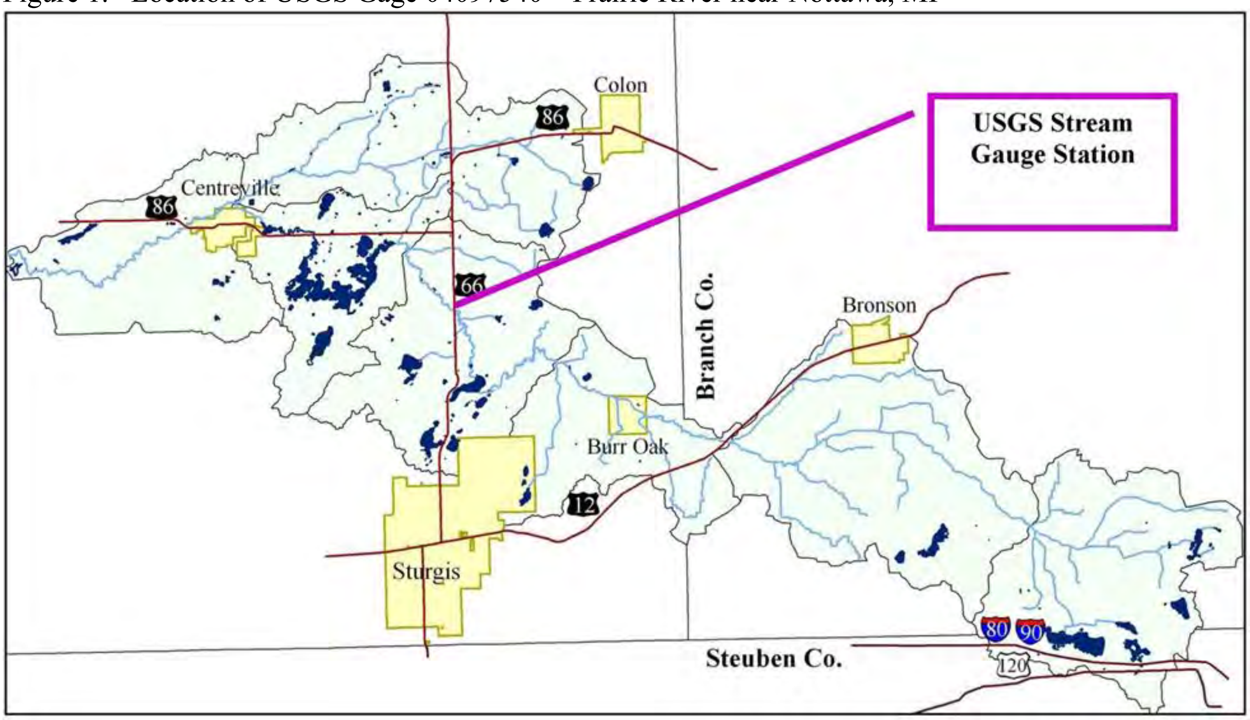
Year	Date	Daily Mean	30-Day Mean
2004	5/24/2004	6.3/100mL	
	6/1/2004	21.4/100mL	
	6/7/2004	4.6/100mL	
	6/14/2004	110/100mL	
	6/22/2004	22.4/100mL	17.2 /100mL
	6/28/2004	13.6/100mL	20.1/100mL
	7/6/2004	54.7/100mL	24.2/100mL
	7/12/2004	180.6/100mL	50.6/100mL
	7/20/2004	210.5/100mL	57.6/100mL
	7/26/2004	257.6/100mL	93.8/100mL
	8/6/2004	240.6/100mL	
	8/9/2004	86.7/100mL	**183/100mL**
	8/11/2004	23.4/100mL	129.8/100mL
	8/12/2004	11.4/100mL	79.1/100mL
	8/16/2004	12.8/100mL	61/100mL
	8/23/2004	10.9/100mL	39.9/100mL
	8/30/2004	40.7/100mL	30.7/100mL
2008	6/16/2008	3.5/100mL	
	6/23/2008	232.9/100mL	
	6/30/2008	42.1/100mL	
	7/7/2008	25.2/100mL	
	7/9/2008	12.7/100mL	25.7/100mL
	7/14/2008	18.1/100mL	35.7/100mL
	7/21/2008	28.8/100mL	23.5/100mL
	7/28/2008	5.2/100mL	15.5/100mL
	8/4/2008	12.2/100mL	13.4/100mL
	8/7/2008	6.2/100mL	11.6/100mL
	8/11/2008	4.3/100mL	8.7/100mL
	8/18/2008	7.4/100mL	6.6/100mL
	8/28/2008	35.2/100mL	13.2/100mL

Appendix 9

Prairie River Watershed
Flow and Flashiness

The Prairie River houses a U.S. Geological Survey stream gage station located in the lower third of the watershed at the river crossing with M-66 just north of Sturgis, (near Nottawa) Michigan (Figure 1). The gage (site ID 04097540) has been in operation since October 1, 1962. Daily discharge data, statistics, and other information for this site is available on the USGS website: http://waterdata.usgs.gov/nwis/nwisman/. The following information has been compiled from this gage station. Information concerning the year 2012 is a focus due to the extreme low water levels experienced in July of that year.

Figure 1. Location of USGS Gage 04097540 – Prairie River near Nottawa, MI



The following three pages are the annual report for Water Year 2012 for the Prairie River gage. Similar reports for other years or locations are available from the USGS website: http://wdr.water.usgs.gov/wy2012/search.jsp. The annual report includes daily discharge means for each day of the water year (October 1st through the following September 30th) as well as basic information about the gage, monthly means, maximums and minimums over the sites entire record, and summary statistics for comparison to the previous calendar year and the full record. Note the remark section on page 1 which includes the following statement: “Since 1987 some diversion by pumping for sprinkler irrigation”.

Water-Data Report 2012

04097540 PRAIRIE RIVER NEAR NOTTAWA, MI

Southeastern Lake Michigan Basin
St. Joseph Subbasin

LOCATION.--Lat 41°53'18", long 85°24'34" referenced to North American Datum of 1927, in NW ¼ SW ¼ sec.6, T.7 S., R.9 W., St. Joseph County, MI, Hydrologic Unit 04050001, on left bank 10 ft upstream from bridge on State Highway 66, 3.0 mi upstream from unnamed tributary, and 3.0 mi southeast of Nottawa.

DRAINAGE AREA.--106 mi².

SURFACE-WATER RECORDS

PERIOD OF RECORD.--October 1962 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 850 ft above NGVD 29, from topographic map.

REMARKS.--Records fair. Since 1987, some diversion by pumping for sprinkler irrigation.

Suggested citation: U.S. Geological Survey, 2013, Water-resources data for the United States, Water Year 2012: U.S. Geological Survey Water-Data Report WDR-US-2012, site 04097540, accessed at http://wdr.water.usgs.gov/wy2012/pdfs/04097540.2012.pdf

04097540 PRAIRIE RIVER NEAR NOTTAWA, MI—Continued

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2011 TO SEPTEMBER 2012
DAILY MEAN VALUES
[e, estimated]

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	80	95	256	171	227	196	182	125	71	18	13	28
2	78	92	280	176	223	214	178	126	72	18	11	28
3	73	90	275	173	219	222	191	122	72	20	10	27
4	67	87	270	164	211	224	208	132	70	20	9.2	27
5	63	85	275	156	201	223	198	137	69	17	11	26
6	58	84	285	152	193	215	181	140	68	14	10	26
7	54	82	279	149	185	204	168	141	64	11	10	27
8	52	84	259	146	180	198	158	138	61	11	9.3	30
9	50	86	238	143	174	196	150	135	57	8.3	12	32
10	48	89	216	138	170	193	144	130	54	7.3	17	32
11	47	95	196	134	167	187	139	122	51	4.2	22	32
12	46	97	182	133	163	185	135	115	53	2.7	25	30
13	46	97	173	134	160	192	131	111	51	2.4	28	29
14	50	99	182	135	158	203	131	105	47	2.5	35	31
15	52	109	225	e132	157	217	135	99	43	3.2	38	31
16	53	115	258	131	163	215	142	96	39	2.3	38	30
17	54	114	306	153	168	212	140	93	40	2.2	38	29
18	54	110	306	182	169	207	134	89	40	2.6	36	30
19	59	105	278	208	165	196	128	84	38	12	35	29
20	98	100	252	e204	161	186	124	82	34	17	32	28
21	129	97	234	e205	157	177	121	81	32	21	30	27
22	136	99	219	e214	156	170	117	79	35	24	28	29
23	129	125	205	e223	157	167	113	77	37	24	24	31
24	123	142	190	238	163	181	110	75	38	23	19	31
25	117	154	178	254	170	209	110	74	36	22	14	30
26	113	151	169	256	173	219	113	72	32	20	15	30
27	110	147	166	258	174	208	113	71	28	19	21	29
28	107	147	164	257	172	191	113	68	24	19	27	29
29	102	174	161	256	183	178	112	66	21	19	29	29
30	99	219	160	240	---	175	118	65	20	17	29	28
31	97	---	167	231	---	178	---	64	---	15	29	---
Total	2,444	3,370	7,004	5,746	5,119	6,138	4,237	3,114	1,397	418.7	704.5	875
Mean	78.8	112	226	185	177	198	141	100	46.6	13.5	22.7	29.2
Max	136	219	306	258	227	224	208	141	72	24	38	32
Min	46	82	160	131	156	167	110	64	20	2.2	9.2	26
Cfsm	0.74	1.06	2.13	1.75	1.67	1.87	1.33	0.95	0.44	0.13	0.21	0.28
In.	0.86	1.18	2.46	2.02	1.80	2.15	1.49	1.09	0.49	0.15	0.25	0.31

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1963 - 2012, BY WATER YEAR (WY)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	65.2	82.4	107	115	123	156	155	126	102	64.9	53.5	55.6
Max	150	222	226	305	304	336	262	229	254	144	148	135
(WY)	(1987)	(1993)	(2012)	(2008)	(2008)	(1982)	(2009)	(2009)	(1989)	(1986)	(1981)	(1997)
Min	17.2	22.9	25.2	29.7	29.1	47.2	75.6	58.7	32.9	13.3	15.8	14.1
(WY)	(1965)	(1965)	(1964)	(1963)	(1963)	(1964)	(1964)	(1963)	(1964)	(1988)	(1964)	(1964)

Water-Data Report 2012

04097540 PRAIRIE RIVER NEAR NOTTAWA, MI—Continued

SUMMARY STATISTICS

	Calendar Year 2011		Water Year 2012		Water Years 1963 - 2012	
Annual total	39,766		40,567.2			
Annual mean	109		111		100	
Highest annual mean					160	2008
Lowest annual mean					33.5	1964
Highest daily mean	318	May 30	306	Dec 17	782	Feb 26, 1985
Lowest daily mean	29	Aug 22	2.2	Jul 17	2.2	Jul 17, 2012
Annual seven-day minimum	33	Aug 17	2.6	Jul 12	2.6	Jul 12, 2012
Maximum peak flow			[a]319	Dec 17	797	Feb 26, 1985
Maximum peak stage			[b]5.39	Jan 20	6.30	Feb 26, 1985
Instantaneous low flow			1.6	Jul 17	1.6	Jul 17, 2012
Annual runoff (cfsm)	1.03		1.05		0.947	
Annual runoff (inches)	13.96		14.24		12.86	
10 percent exceeds	201		215		180	
50 percent exceeds	95		110		86	
90 percent exceeds	42		20		36	

[a] Gage height 5.31 ft.
[b] Backwater from ice.

The annual water data report also includes a graph of the daily mean discharge for the water year. This graph was deleted and is replaced by Figure 2, 3 and 4. Figure 2 compares monthly mean flows for calendar year 2012 to the monthly mean flows from 1963 to 2012. Monthly minimums and maximums are also included. Figure 2 indicates that the mean monthly discharge fell below the long term mean in April, set a new minimum in July and remained below the monthly mean for the remainder of the year.

Figure 2.

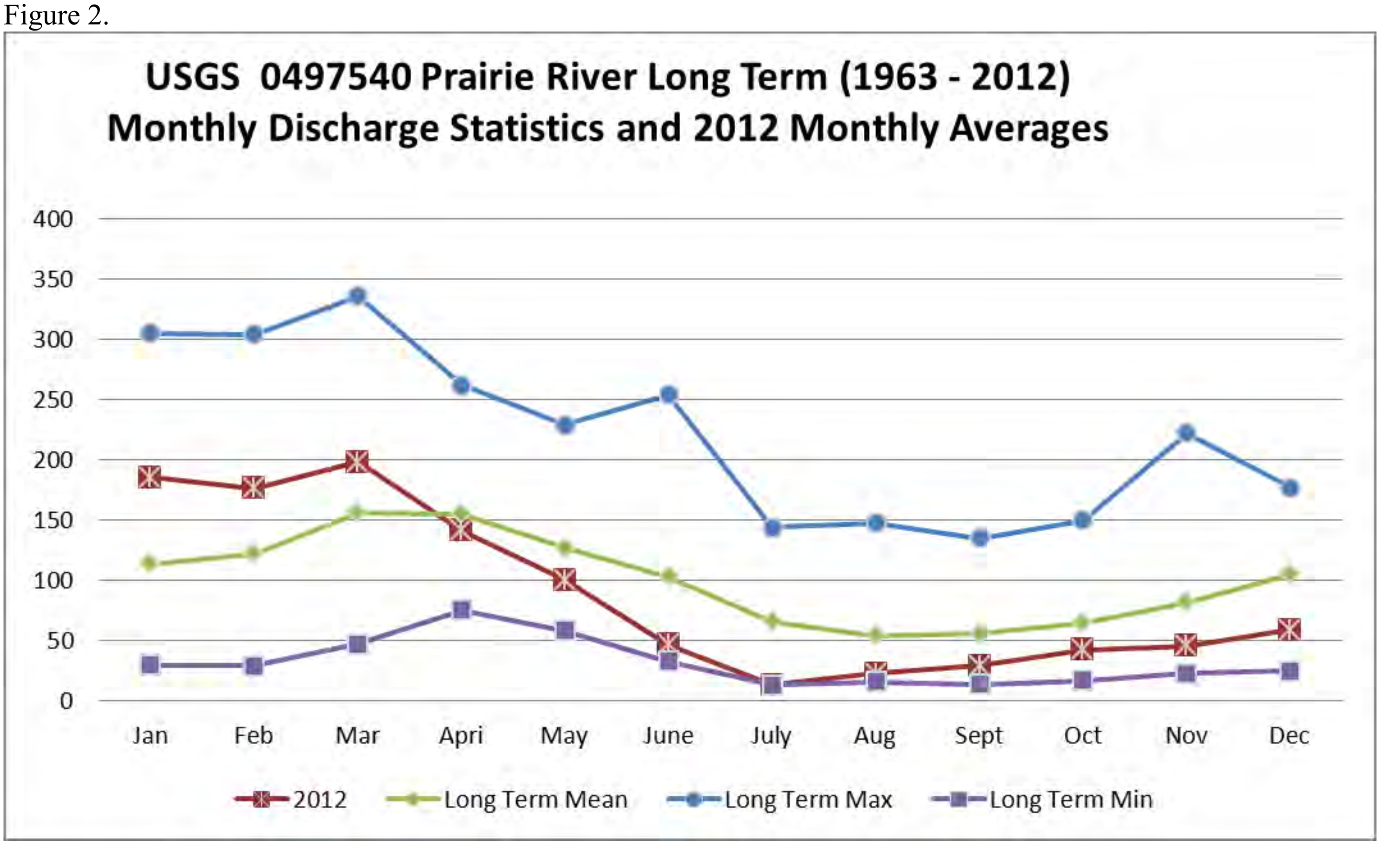


Figure 3 is the daily mean discharge from May through August 2012 and the long term median daily statistic while Figure 4 details discharge during the July 2012 extreme low flow event.

Figure 3.

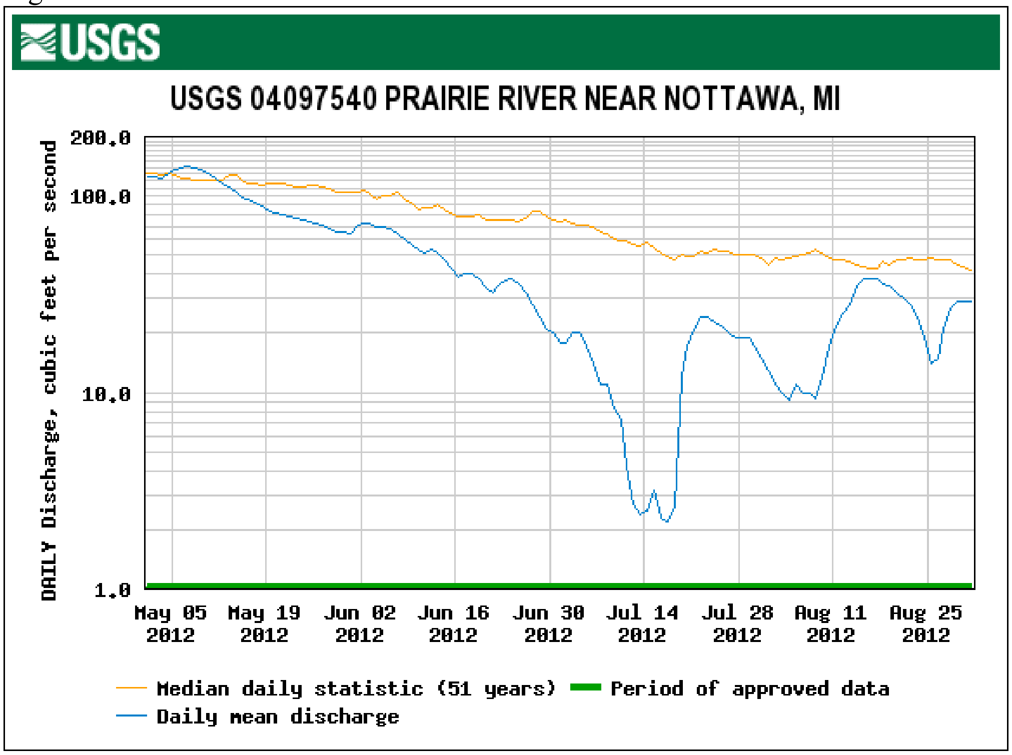
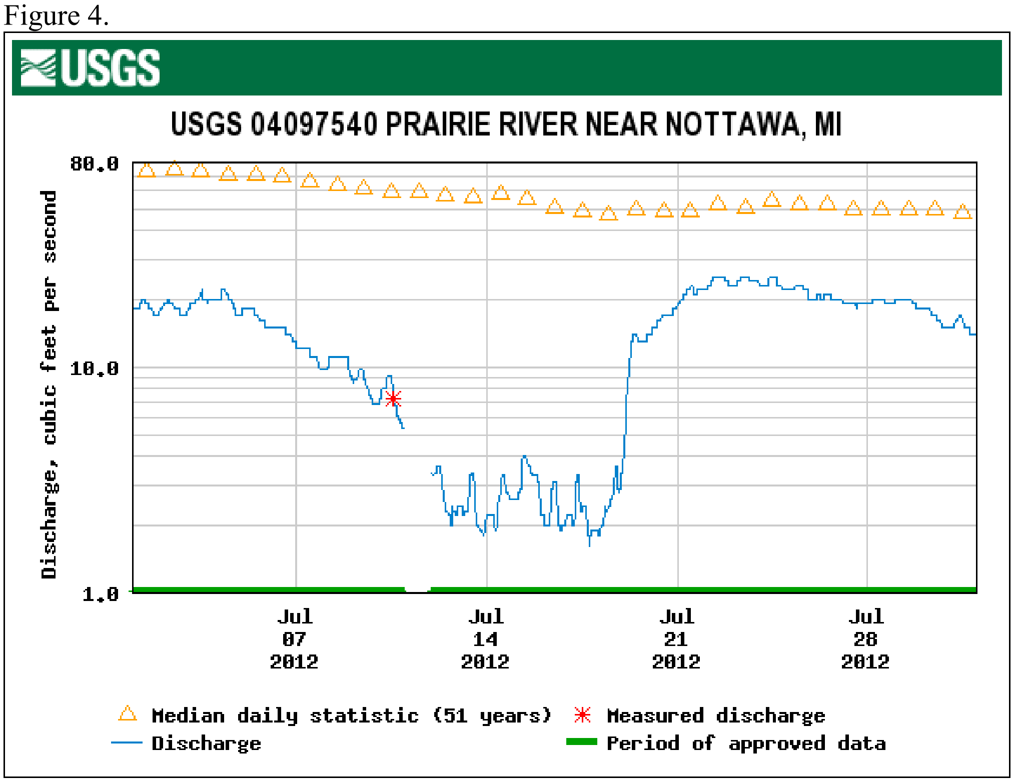
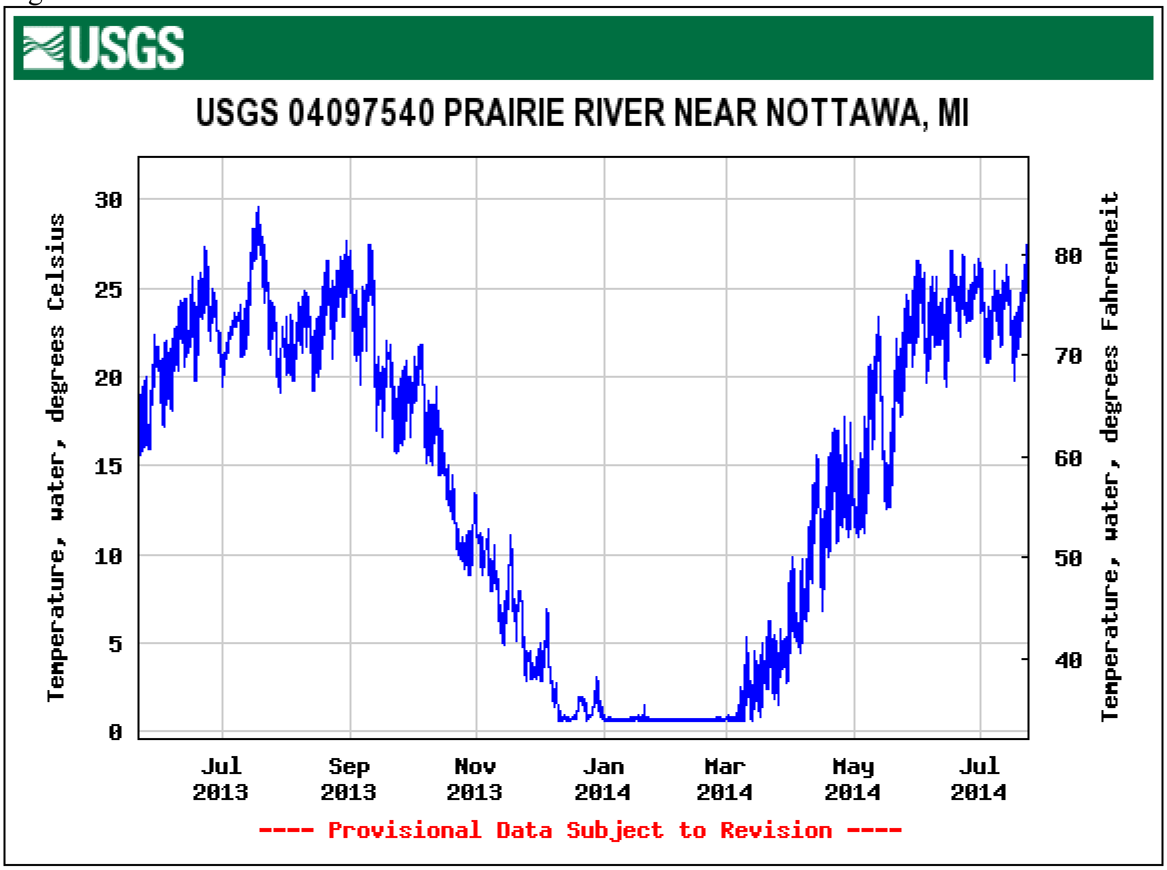


Figure 4.



Information available for this gage site also includes limited water quality data such as temperature (Figure 5) and three samples screened for triazine (Atrazine) in 2001 and 2002. Atrazine was detected in one sample from May 2001 but not detected in samples from July 2001 and August 2002.

Figure 5.



Richards-Baker Flashiness Index – This section was largely excerpted from "Application of the Richards-Baker Flashiness Index to Gaged Michigan Rivers and Streams" - MI/DEQ/WRD-12/028

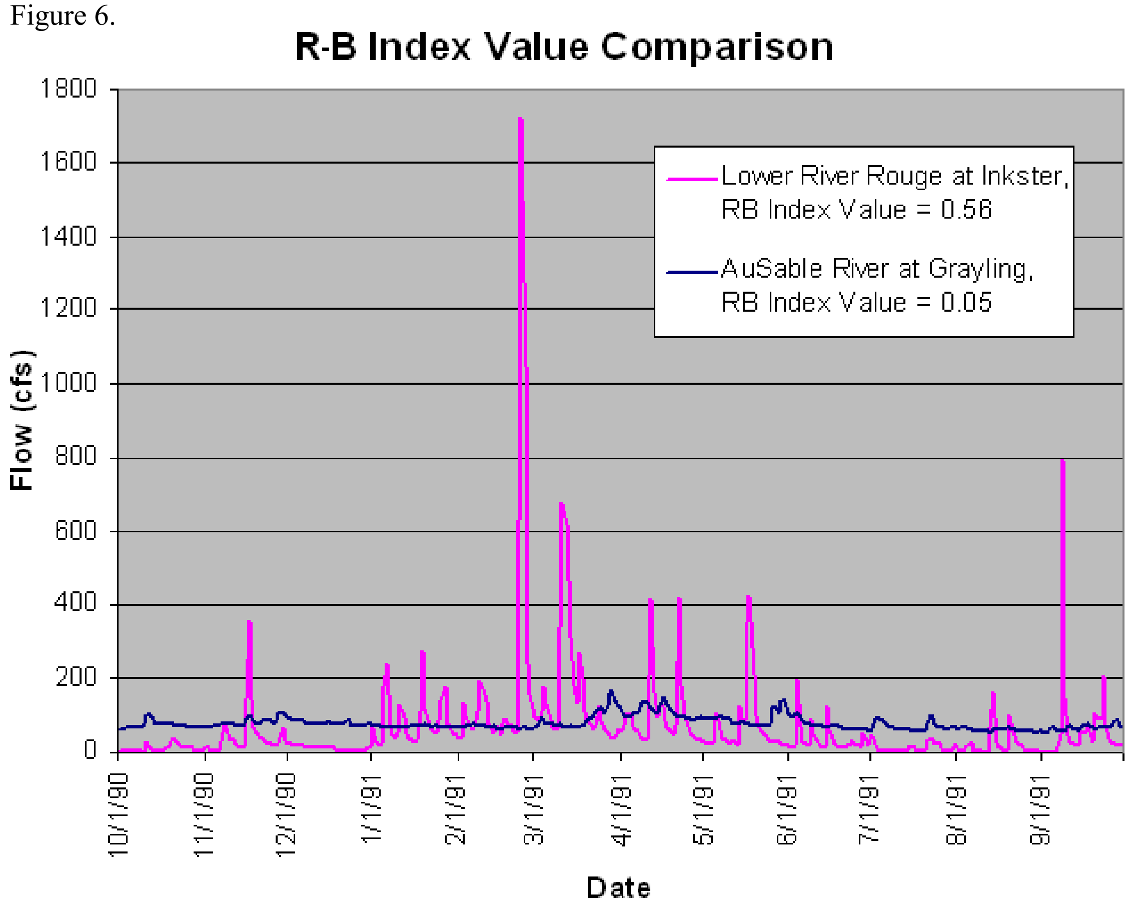
Stream flashiness is a stream flow response to storms. Streams that rise and fall quickly are considered flashier than those that maintain a steadier flow. An increase in flashiness, often due to changing land use, is a common cause of stream channel instability. The Richards-Baker Flashiness Index (R-B Index) uses data from United States Geological Survey (USGS) gaging stations to quantify the frequency and rapidity of short-term changes in stream flow. Values for the R-B Index are unitless and could theoretically range from zero to two. The R-B Index value would have a value of zero if the stream flow were absolutely constant. The R-B Index value increases as flashiness, increases.

The Michigan Department of Environmental Quality (MDEQ) Nonpoint Source (NPS) Program staff calculated R-B Index values and assessed trends for 308 USGS gages in Michigan watersheds. The characteristic R-B Index values for Michigan watersheds are unitless and range from 0.005 to 1.009. Fluctuations over time are apparent in a stream's R-B Index values. Some fluctuations in the R-B Index values are expected from year to year simply because of natural weather variations. Longer term trends result from hydrologic alterations within the watershed. Trends identified at gages in operation during the past 25 years should be influencing the streams' morphology today.

An example of R-B Index values for two Michigan streams with similar drainage areas is shown in Figure 6. The Au Sable River and Lower River Rouge gaged drainage areas are 97 and 84 square miles, respectively. For water year 1991, both gages recorded similar total flows; 900 and 790 billion cubic feet for the Au Sable River and

Lower Rouge River, respectively. Despite similar drainage areas and total discharges, the Lower Rouge River exhibited much flashier flows than the Au Sable River, with R-B Index values of 0.56 and 0.05, respectively. This is presumably due primarily to three factors: vegetation, soils, and imperviousness. The Au Sable River watershed has more vegetation and sandier, more permeable soils. The Lower Rouge River watershed has more impervious surface cover.

Figure 6.



The R-B index value for the Prairie River is 0.056 (Figure 7) ranking it as one of the most stable, for its size within the larger St. Joseph River Basin and in the lowest quartile (most stable/least flashy) of Midwestern Rivers of similar size (Figure 8) (Note – Larger Rivers are inherently more stable).

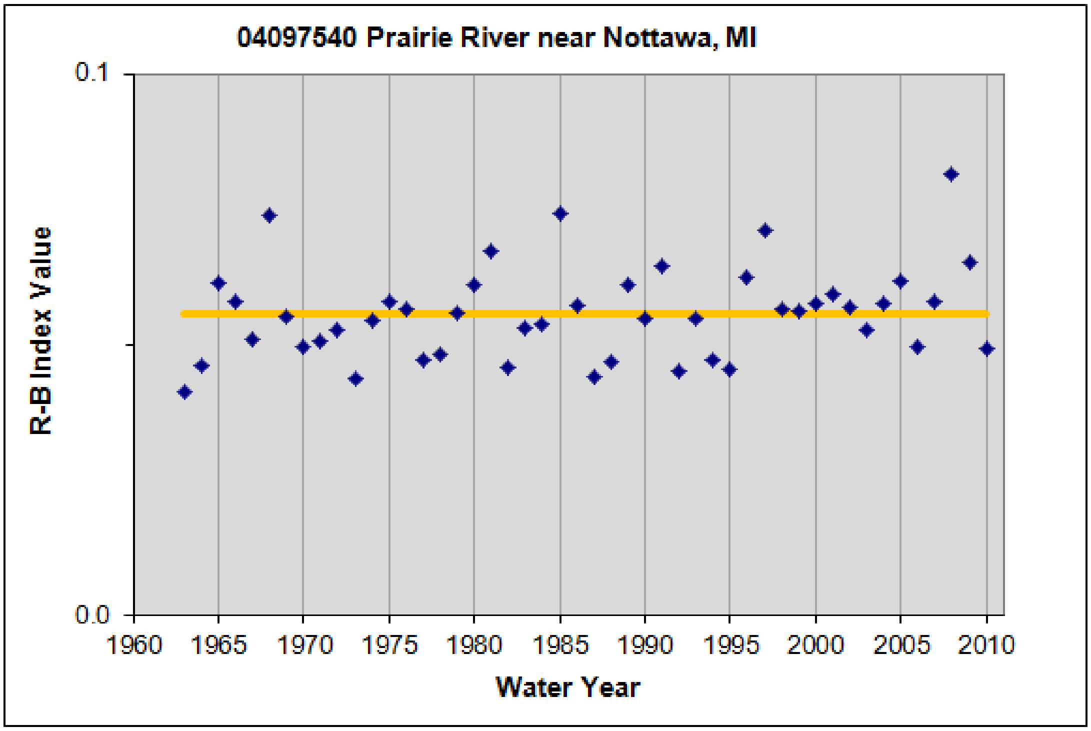
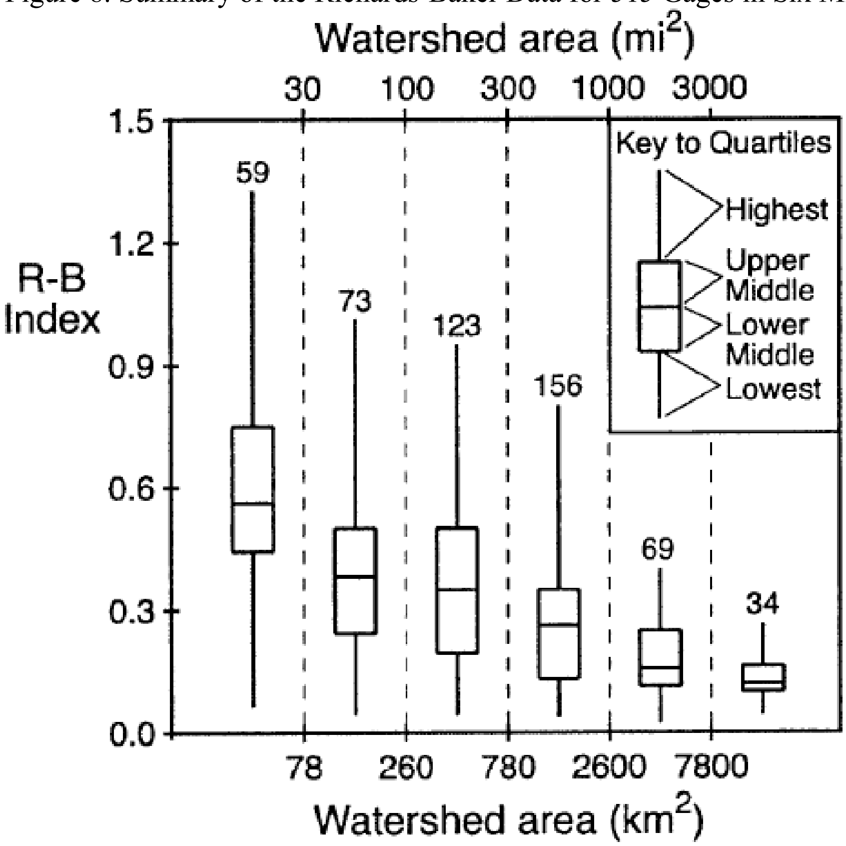


Figure 7. Richards-Baker Index for the Prairie River (USGS Gage 04097540)

Figure 8. Summary of the Richards-Baker Data for 515 Gages in Six Midwestern States, including Michigan.



Fluctuations over time are common in a stream's R-B Index values. Some fluctuations in the R-B Index values are expected from year to year simply because of natural weather variations. Longer-term trends result from hydrologic alterations, such as a change in land use or removal or change in operation of a dam. An increase in flashiness, due to higher peak flows or more frequent bankfull flows, can result in changes to the channel shape: width, depth, sinuosity, and slope. This is especially true for stream channels that are steep and composed of noncohesive materials (Rhoads and Miller, 1991). Changes in stream channel shape, in turn, can have significant impacts on aquatic organism populations (Richards et al., 1997; Van Steeter and Pitlick, 1998).

An increase in flashiness, due to higher or more frequent flows, results in changes to the channel shape: width, depth, sinuosity, and slope. These changes occur by erosion. Reducing excessive erosion is a component of many NPS projects. A frequent dilemma in selecting and siting NPS BMPs is assessing the scale of the stream channel stability problem versus the scale of the problem's cause. A bank erosion problem with a local, small-scale cause (e.g., cattle access) can be addressed by a local BMP (e.g., fencing), while a bank erosion problem with a large-scale cause (e.g., a watershed-wide increase in impervious area) can only be addressed with a similarly large-scale solution (e.g., regional storm water management practices).

The R-B Index is one tool for diagnosing the scale of a particular stream channel problem. If the R-B Index values are steady over time, channel erosion problems in the vicinity of the USGS gage may have local causes that can be addressed with a local BMP. Conversely, if an R-B Index trend indicates that flashiness is increasing over time, channel erosion problems in the vicinity of the gage station may have large-scale causes and will require a large-scale solution. Note that "in the vicinity of the gage" is not well defined. Streams that are increasingly flashy at one location may become stable downstream due to attenuation of flashy flows by tributary flows downstream of the gage. Similarly, flashy flows in a stream above the gage may be masked by the combined flows of other streams at the gage.

In general, flashiness changes result from hydrologic alterations. Some factors that can alter flashiness include:

- In-Stream Changes
    - Removal or change in operation of a dam
    - Expansion or straightening of the drainage network

- Watershed Land Use Changes
    - Urbanization
    - Forest regrowth
    - Soil compaction
    - Change in paved or other impervious areas
    - Use of low impact development techniques
    - Change in forestry practices
    - Change in agricultural practices
    - Change in runoff storage capacity

<u>Appendix 10</u>

Prairie River Watershed

Prioritization Model Synopsis

Prairie River Watershed Preservation Areas Criteria

Synopsis

The model is based on numerical ratings for different preservation related criteria in each quarter-quarter section (approximately 40 acre squares) of the Prairie River Watershed. Adding the numeric values of the criteria for each quarter quarter section allowed for a ranking of priority areas for preservation. The criteria are discussed below and the numeric weighting is further detailed in Table 1. The classification and distribution of the resulting scores are illustrated in Figure 1 and Table 2.

The following criteria were considered when computing preservation values:

Land Cover Acres

- Natural land cover was characterized using 2006 Coastal Change Analysis Program (CCAP). The amount of natural land was calculated for each quarter-quarter (QQ) *(2 points per acre).*

Hydrology

- Hydrology values were given based on the presence of **1)** any water feature *(5 points if present in QQ)*, **2)** natural acres in a QQ that are within a 200 meter buffer *(1 points per acre),* 3**)** high quality fisheries *(15 points if present in QQ)*. Michigan DNR Fisheries Division assisted in determining which portions of stream/lake qualified as high quality fisheries.

Wetlands

- Existing wetlands were identified using the National Wetland Inventory *(.5 points per acre).*
- Utilizing the Landscape Level Wetland Functional Assessment data created by MDEQ, the steering committee ranked sediment retention and stream flow maintenance as the most important wetland functions. Wetland areas especially significant for those functions were given additional points *(.05 per acre for moderate significance and .1 points per acre for high significance).*

Recreation

- Lakes -- Protection of undeveloped areas on lakes over 25 acres were included. Recreation such as boating can result in shoreline erosion. When undeveloped sections are present, much of the erosive energy from recreation is shifted to the undeveloped areas, making them important for protection to limit erosion *(10 points if present in QQ).*
- Mainstem -- The mainstem of the Prairie River was given values base on the importance of protecting the social, economic and wildlife benefits of a connected natural corridor along a navigable waterway. Areas known for paddling were identified with the help of Liquid Therapy Livery in Three Rivers, MI. *(10 points if present in QQ).*

Table 1: Criteria Weighting for Preservation Priority Areas

Criteria	**Weight**	**Max Points**	**Target % of total**
LAND COVER			
Natural Land Cover Acres	2 points per acre in QQ *(up to 80 points)*	80	43.5%
HYDROLOGY			
Natural acres within 200M buffer water feature	1 point per acre	40	21%
Any water feature	5 points *(if present in QQ)*	5	2.5%
High Quality Fisheries	15 points *(if present in QQ)*	15	8%
WETLANDS			
Wetlands	.5 points per acre	20	10%
Stream Flow Maintenance/Sediment Retention Significance	.05 points per acre for moderate significance and .1 points per acre for high significance	8	5%
RECREATION			
Lakes>25 acres	10 *(if present in QQ)*	10	5%
Mainstem	10 *(if present in QQ)*	10	5%
Max Points:		**188** ***(possible)*** **157** ***(actual)***	
Total Percentage:			**100%**

Figure 1: Prairie River Watershed Preservation Areas

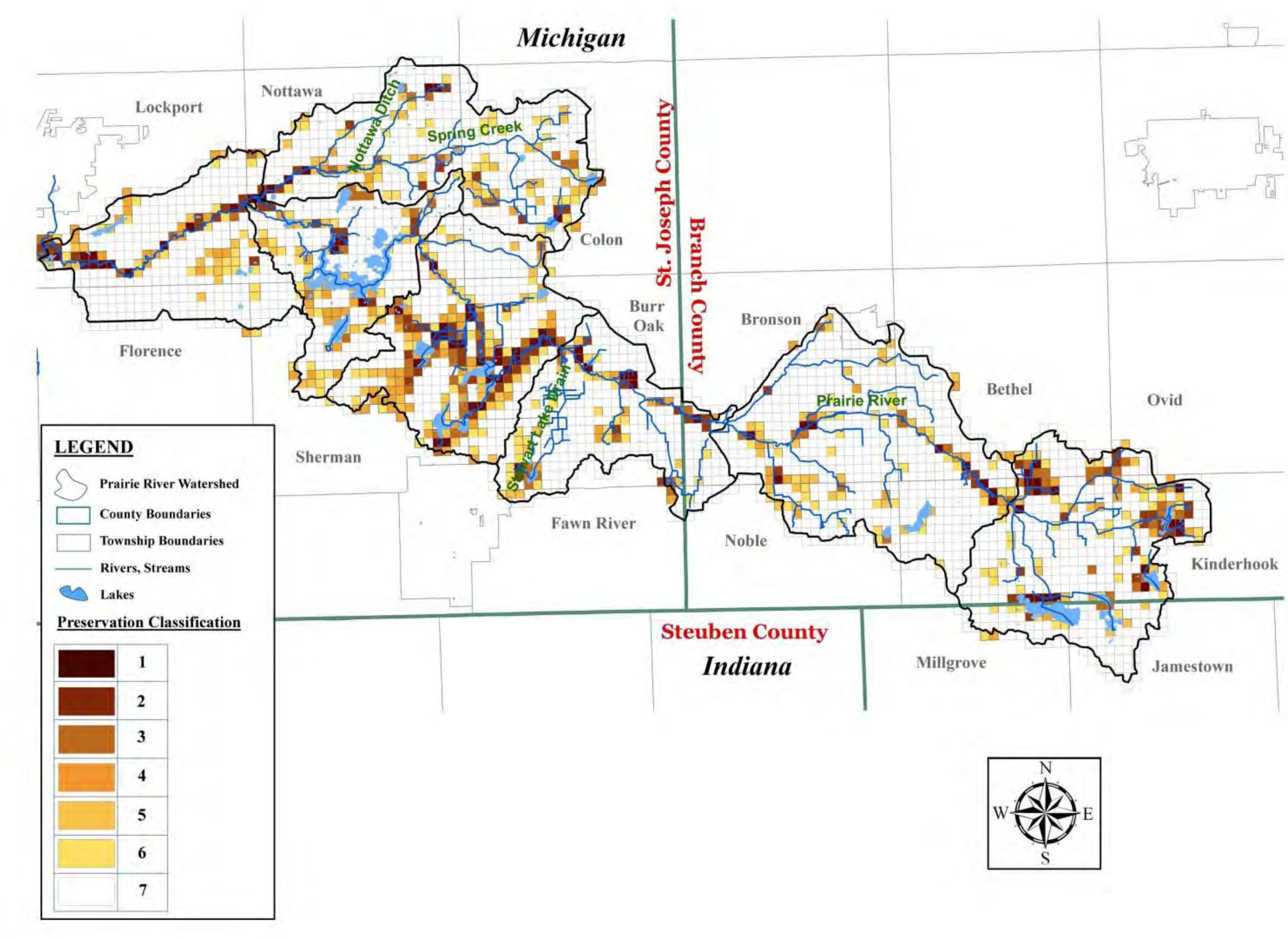


Table 2: Classification and Distribution of QQ's for Preservation Areas Ranking.

Rank	Preservation Class*	Value Range	Number of QQ's	% of QQ's
Priority	1	116-157	83	2.6%
	2	97-115	93	2.9%
	3	83-96	99	3.1%
High	4	73-82	128	4.0%
	5	60-72	158	5.0%
	6	45-59	247	8.0%
Medium and Less	7	0-44	2365	74.5%

*A manual breaks classification system was used to create 6 classes which contain an increasing number of QQ's in each class and a 7th class containing the remainder of the QQ's. Classes 1-6 (25.5%) contain the most significant QQ's and class 7 (74.5%) contains the remainder.

Prairie River Watershed Agricultural Management Areas Criteria

Synopsis

The model is based on numerical ratings for different agricultural related criteria in each quarter-quarter section (approximately 40 acre squares) of the Prairie River Watershed. Adding the numeric values of the criteria for each quarter quarter section allowed for a ranking on the basis of potential agricultural impact to water quality and mitigation potential. The criteria are discussed below and the numeric weighting is further detailed in Table 3. The classification and distribution of the resulting scores are illustrated in Figure 2 and Table 4.

The following criteria were considered when computing agricultural impact values:

Land Cover

- Agricultural land cover was characterized using 2006 Coastal Change Analysis Program (CCAP) data. The amount of agricultural land was calculated for each quarter-quarter (QQ) *(2 points per acre).*

Hydrology

- Hydrology values were given based on the presence of **1)** any water feature *(5 points if present in QQ)*, **2)** agricultural acres in a QQ that are within a 200 meter buffer of a water feature *(1 point per acre),* **3)** high quality fisheries *(10 points if present in QQ*). Michigan DNR Fisheries Division assisted in determining which lakes and stream portions qualified as high quality fisheries.

Wetlands

- Wetland restoration areas were identified using NRCS hydric soil data. Hydric soil areas not included in the National Wetland Inventory were determined to be potential restoration areas *(.5 points per acre).*
- Utilizing the Landscape Level Wetland Functional Assessment data created by MDEQ, the steering committee ranked sediment retention and streamflow maintenance as the most important wetland functions. Wetland restoration areas especially significant for those functions were given additional points *(.05 points per acre for moderate significance and .1 points per acre for high significance).*

Sediment Loading

- Using Michigan State University's High Impact Targeting (HIT) Model data, the number of tons of sediment delivered to the nearest waterbody per year was calculated for each QQ *(2 points per ton up to 50 points).*

Table 3: Criteria Weighting for Agricultural Management Priority Areas.

Criteria	**Weight**	**Max Points**	
LAND COVER			
Agricultural Land Cover Acres	2 points per acre in QQ *(up to 80 points)*	80	37.5%
HYDROLOGY			
Any water feature	5 points *(if present in QQ)*	5	3%
Agricultural acres within 200M water feature buffer	1 points per acre	40	12.5%
High Quality Fisheries	10 points *(if present in QQ)*	10	7%
WETLANDS			
Restorable Wetland Acres	.5 points per acre	20	10%
Stream Flow Maintenance/Sediment Retention Significance	.05 points per acre for moderate significance and .1 points per acre for high significance	8	5%
SEDIMENT LOADING			
High Impact Targeting	2 points per ton *(up to 50 points)*	50	25%
Max Points:		**213** ***(possible)*** **180** ***(actual)***	
Total Percentage:			**100%**

Figure 2: Prairie River Watershed Agricultural Management Areas

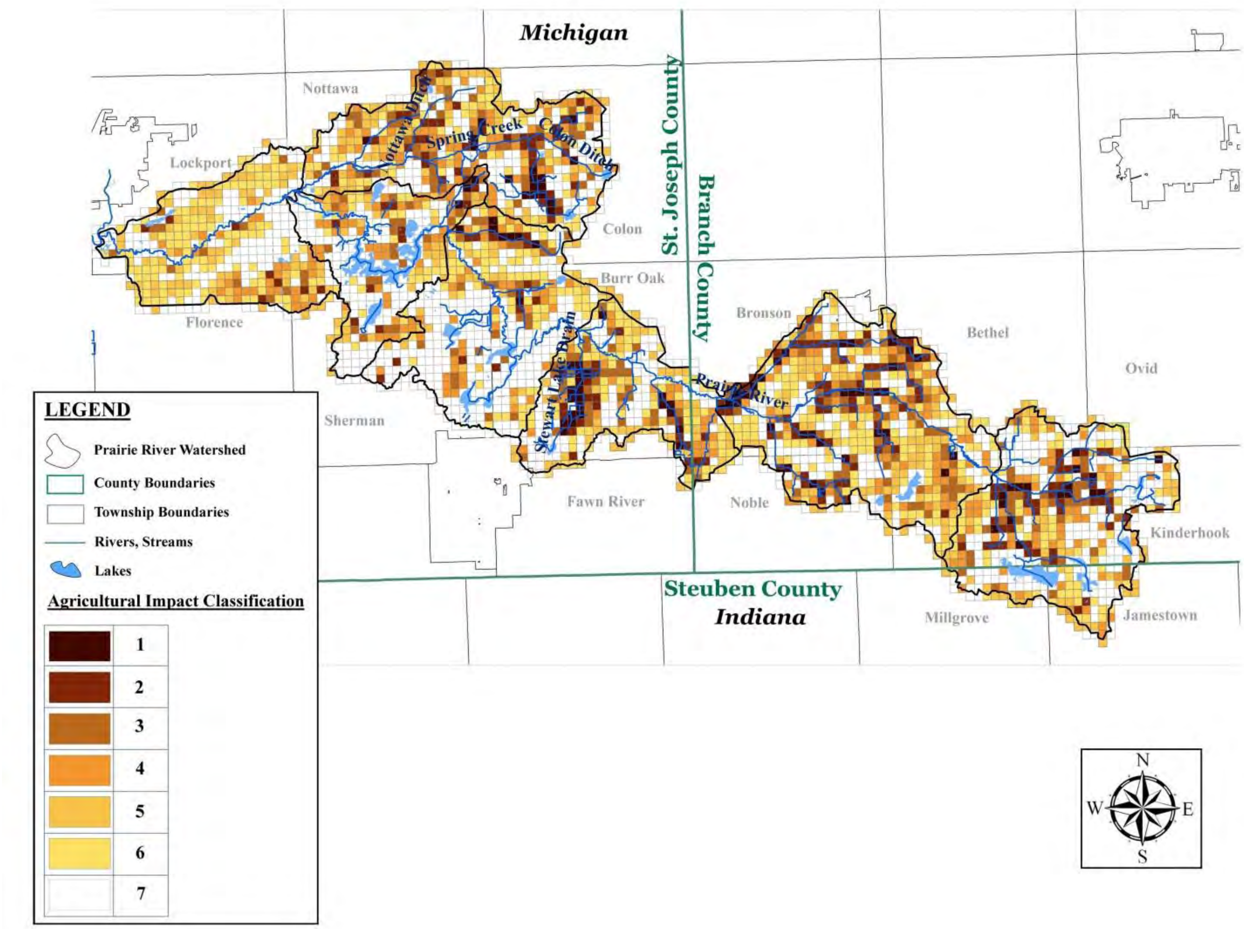


Table 4: Classification and Distribution of QQ's for Agricultural Areas Ranking

Rank	Agricultural Impact Class*	Value Range	Number of QQ's	% of QQ's
Critical	1	129-180	98	3.1%
	2	107-128	193	6.1%
	3	94-106	260	8.2%
High	4	84-93	358	11.3%
	5	80-83	412	13%
	6	70-79	579	18.2%
Medium and Less	7	0-69	1273	40.1%

*A manual classification system was used to create 6 classes which contain an increasing number of QQ's in each class and a 7th class containing the remainder of the QQ's. Classes 1-6 (59.9%) contain the most significant QQ's and class 7 (40.1%) contains the remainder.

<u>**Prairie River Watershed Urban Management Area Criteria**</u>

Synopsis

The model is based on numerical ratings for different urban related criteria in each quarter-quarter section (approximately 40 acre squares) of the Prairie River Watershed. Adding the numeric values of the criteria for each quarter quarter section allowed for a ranking on the basis of potential urban impact to water quality and mitigation potential. The criteria are discussed below and the numeric weighting is further detailed in Table 5. The classification and distribution of the resulting scores are illustrated in Figure 3 and Table 6.

The following criteria were considered when computing urban impact values:

Land Cover Acres

- Urban land cover was characterized using 2006 Coastal Change Analysis Program (CCAP). The amount of urban land acres were calculated for each quarter-quart (QQ). *(2 points per acre)*

Hydrology

- Hydrology values were given based on the presence of **1)** any water feature *(5 points if present in QQ)*, **2)** QQ with any water feature that within a 200 meter buffer *(1 point per acre),* 3**)** high quality fisheries *(10 points if present in QQ)*. Michigan DNR Fisheries Division assisted in determining which portions of stream qualified as high quality fisheries.

Lost Wetlands

- Utilizing the Landscape Level Wetland Functional Assessment data, lost wetland functions that impact urban areas were determined as floodwater storage and shoreline stabilization. Wetlands significant for those functions were given points. *(.05 points per acre for moderate significance and .1 points per acre for high significance)*

Recreation Lakes

- Values were given to lakes over 25 acres as they are likely to see a higher potential for development due to the desire to have recreational lake access *(20 points if present in QQ).*

Mainstem

- The mainstem of the Prairie River was given values base on the likelihood of higher development pressure for those who desire waterfront property. *(15 points if present in QQ).*

Primary Roads

- Major road corridors were identified as development pressure in these areas is likely to be higher particularly for commercial growth *(10 points if present in QQ).*

Table 5: Criteria Weighting for Urban Management Priority Areas

Criteria	**Weight**	**Max Possible**	**Target % of total**
Urban Land Cover Acres	2 points per acre in QQ	80	44%
Hydrology			
QQ with 200M buffer water feature	1 point per acre	33	18%
Any water feature	5 points *(if present in QQ)*	5	3%
High Quality Fisheries	10 points *(if present in QQ)*	10	6%
Wetlands			
Lost Shoreline Stabilization and Floodwater Storage Function	05 points per acre for moderate significance and .1 points per acre for high significance	8	4%
Development Pressure			
Lakes > 25 acres	20 points *(if present in QQ)*	20	11%
Mainstem	15 points *(if present in QQ)*	15	8%
Primary Roads	10 *(if present in QQ)*	10	6%
Max Points:		181 *(possible)* 135 *(actual)*	
Total Percentage:			**100%**

Figure 3: Prairie River Watershed Urban Management Areas

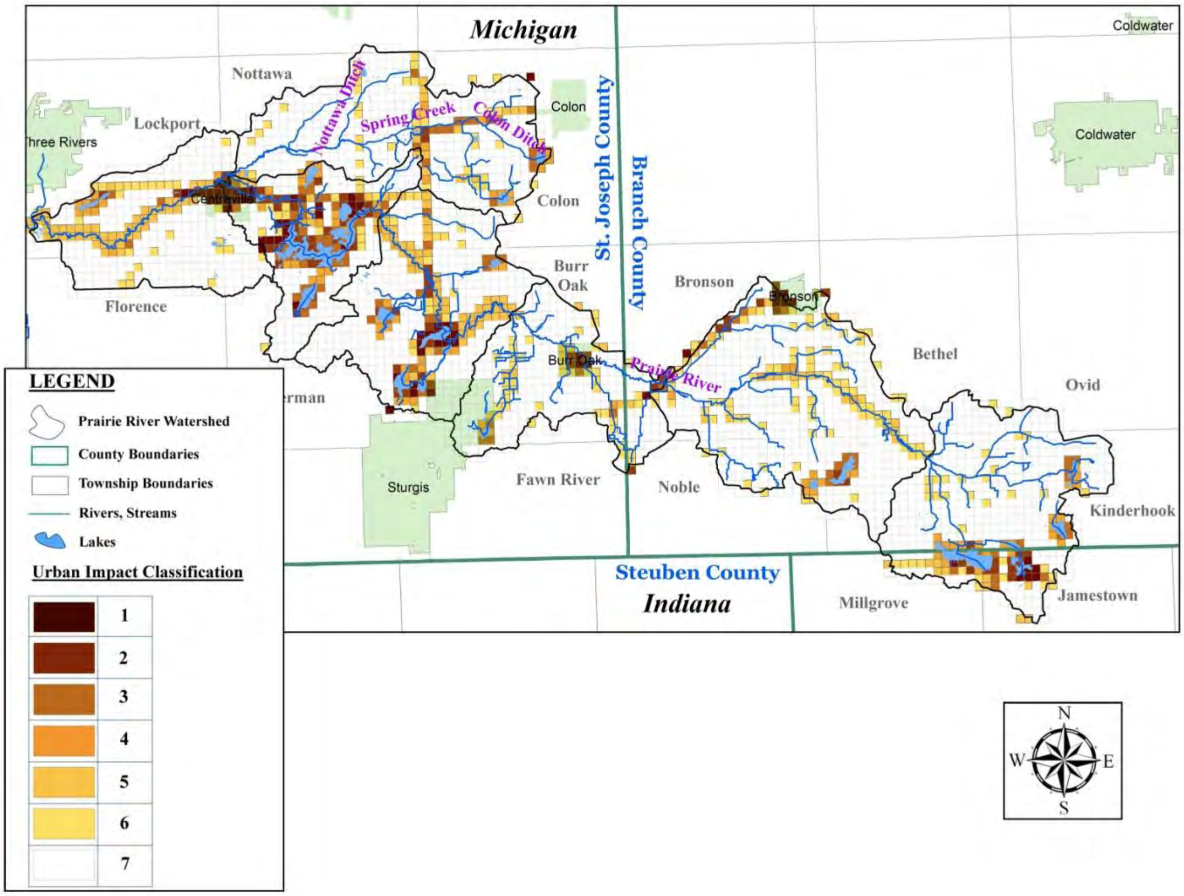


Table 6: Classification and Distribution of QQ's for Urban Areas Ranking

Rank	Urban Impact Class*	Value Range	Number of QQ's	% of QQ's
Critical	1	45-136	71	2.24%
	2	33-44	86	2.71%
	3	37-32	109	3.43%
High	4	25-26	113	3.56%
	5	20-24	172	5.42%
	6	12-19	252	7.94%
Medium and Less	7	0-11	2371	74.7%

* A manual breaks classification system was used to create 6 classes which contain an increasing number of QQ's in each class and a 7th class containing the remainder of the QQ's. Classes 1-6 (25.3%) contain the most significant QQ's and class 7 (74.7%) contains the remainder.