Nonpoint Source Implementation Plan for the Upper East River Watershed



Prepared by:

Outagamie County and Brown County Land Conservation Departments

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Upper East River Watershed Implementation Plan

Executive Summary

The East River Watershed is a subwatershed of the Lower Fox River Watershed and is located in east central Wisconsin in Brown, Calumet, and Manitowoc counties. The East River stretches from Wrightstown and empties into the Fox River in the City of Green Bay. The East River watershed is further divided into two subwatersheds the Upper and Lower East River Watersheds. The Upper East River Watershed drains approximately 22,992 acres.

Historically, the land in this area was forested with many wetlands. The Lower Fox River Basin was home to many Native American cultures before Europeans began to settle in the area in the early 1800's. The farming and paper industry in the area has led to clearing of forests and natural areas and draining of wetlands in the Lower Fox River Basin. Farming, industry, and urban development in the Lower Fox River Basin has led to poor water quality in the Fox River and Bay of Green Bay.

Excessive sediment loads and increased algal blooms in the Lower Fox River and Bay of Green Bay prompted the need for action to be taken in the Lower Fox River Basin. A Total Maximum Daily Load was approved for the Lower Fox River and its tributaries in 2012. The development of implementation plans for the subwatersheds of the Lower Fox River Basin are necessary to meet the assigned daily loads of the TMDL.

Agriculture is the dominant land use in the Upper East River watershed and is the main contributor to poor water quality. There are 5 large concentrated animal feeding operations (CAFO) located in just the Upper East River watershed with another farm near CAFO size. This area has some of the highest dairy farm and CAFO concentrations in the state.

The Upper East River was previously part of the East River Priority Watershed Program from 1991-2003. Despite this water quality is still poor in the East River and is a major contributor of phosphorus and suspended solids to the Lower Fox River.

The Upper East River Watershed plan provides a framework to accomplish the following goals:

Goal #1: Improve surface water quality to meet the TMDL limits for total phosphorus and sediment.

Goal #2: Increase citizens' awareness of water quality issues and active participation in stewardship of the watershed.

Goal #3: Reduce flood levels during peak storm events.

Goal #4: Improve streambank stability and reduce amount of streambank degradation.

Challenges and sources in the watershed:

The dominant land use in the watershed is agriculture and is responsible for 83 % of the sediment and 94% of the phosphorus loading in the watershed. The land in this watershed is largely owned and operated by large CAFO's. Even though the majority of the land (≈90%) is covered under nutrient management plans and the watershed was previously part of a priority watershed project, it is still one of the highest contributing subwatersheds of phosphorus and sediment to the Lower Fox River and Bay of Green Bay. Increased drainage and flooding in the watershed has led to moderate to severe erosion of streambanks of the Upper East River. Over application of nutrients, erosion, and lack of enough land to adequately distribute manure is likely the main contributor to nutrient and sediment loading in the watershed.

Watershed Implementation Plan:

In order to meet the goals for the watershed a 10 year implementation plan was developed. The action plan recommends best management practices, information and education activities, and needed restoration to achieve the goals of the watershed project. The plan includes estimated cost, potential funding sources, agencies responsible for implementation, and a measure of success.

Recommended Management Practices:

- Reduced Tillage Methods (Strip/Zone till, No till, Mulch till)
- Cover Crops
- Vegetated Buffers
- Wetland Restoration
- Grassed Waterways
- Improved Nutrient Management
- Vertical Manure Injection
- Streambank Stabilization

- Exploring new technologies/practices (anaerobic digester, gypsum applications, water control structures for tile outlets, etc)

Education and Information Recommendations:

- Provide educational workshops and tours on how to implement best management practices.
- Engage landowners in planning and implementing conservation on their land and ensuring they know what technical tools and financial support is available to them.
- Provide information on water quality and conservation practices to landowners in the watershed area.
- Newsletters and/or webpage with watershed project updates and other pertinent conservation related information.

<u>Conclusion</u>

Meeting the goals for the Upper East River watershed will be challenging. Watershed planning and implementation is primarily a voluntary effort with limited enforcement for “non-compliant” sites that will need to be supported by focused technical and financial assistance. It will require widespread cooperation and commitment of the watershed community to improve the water quality and condition of the watershed. This plan needs to be adaptable to the many challenges, changes, and lessons that will be found in this watershed area.

List of Acronyms

AM- Adaptive Management

BMP- Best Management Practice

CAFO- Concentrated Animal Feeding Operation

CLU- Common Land Unit

GBMSD- Green Bay Metropolitan Sewerage District (NEW Water)

GLRI- Great Lakes Restoration Initiative

GIS- Geographic Information System

HSG-Hydrologic Soil Group

IBI- Index of Biotic Integrity

LWCD/LCD- Land and Water Conservation Department/ Land Conservation Department

MS4- Municipal Separate Storm Sewer System

NRCS-Natural Resource Conservation Service

PI- Phosphorus Index

USEPA- United States Environmental Protection Agency

UWEX- University of Wisconsin Extension

USDA- United States Department of Agriculture

USGS-United States Geologic Service

UWGB-University of Wisconsin-Green Bay

WDNR-Wisconsin Department of Natural Resources

WPDES- Wisconsin Pollutant Discharge Elimination System

WWTF- Waste Water Treatment Facility

TMDL-Total Maximum Daily Load

TP- Total Phosphorus

TSS- Total Suspended Solids

WQT- Water Quality Trading

Note**: Lower Fox River TMDL plan-** Refers to the report "*Total Maximum Daily Load and Watershed Management Plan for Total Phosphorus and Total Suspended Solids in the Lower Fox River Basin and Lower Green Bay"* prepared by the Cadmus Group that was approved in 2012 by WDNR and EPA

1.0 Introduction

1.1 Upper East River Watershed Setting

The Upper East River Watershed is a sub watershed of the Lower Fox River Basin in Wisconsin. The watershed is located in Brown County with the southern portion of the watershed dipping into Calumet and Manitowoc County. The watershed drains a total area of 22,997 acres. The watershed is located Northeast of Lake Winnebago and South of the Bay of Green Bay. The East River flows into the Fox River in the City of Green Bay northeast of the Hwy 141 Bridge over the Fox River. The watershed is predominately agricultural land. The Fox River Trail runs through the watershed parallel to HWY 57, and the Holland Wildlife Area is also located in the eastern portion of the watershed. The watershed includes portions of the Towns of Brillion, Wrightstown, Maple Grove, and Holland. The unincorporated communities of Greenleaf and Askeaton also lie within the watershed.

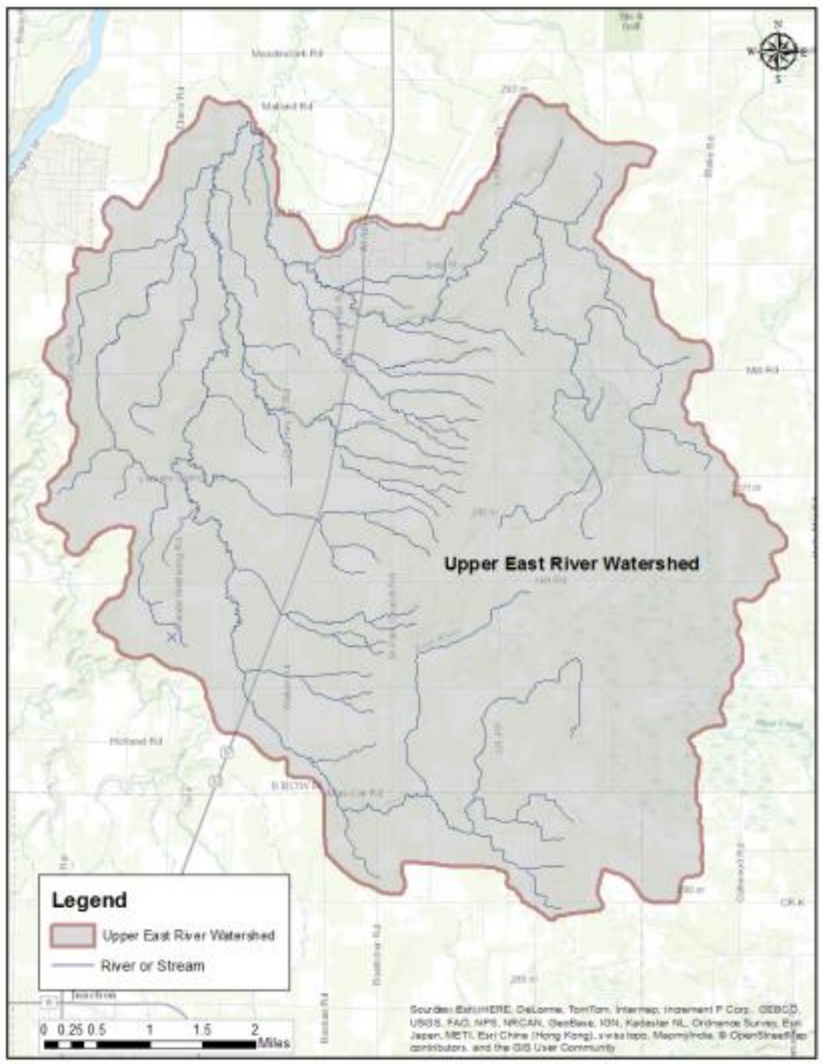

Figure 1. Upper East River Watershed.

1.2 Purpose

Excessive sediment and nutrient loading to the Lower Fox River and Bay of Green Bay has led to increased algal blooms, oxygen depletion, water clarity issues, and degraded habitat. Algal blooms can be toxic to humans and costly to a local economy. Estimated annual economic losses due to eutrophication in the United States are as follows: recreation ($1 billion), waterfront property value ($0.3-2.8 million), recovery of threatened and endangered species ($44 million) and drinking water ($813 million) (Dodds, et al 2009). Due to the impairments of the Lower Fox River Basin, a TMDL (Total Maximum Daily Load) was developed for the Lower Fox River basin and its tributaries that was approved in 2012. The purpose of this project is to develop an implementation plan for the Upper East River subwatershed to meet the requirements of the TMDL. The Lower Fox River TMDL requires that any tributaries to the Lower Fox River meet a median summer total phosphorus limit of 0.075 mg/l or less. A median total suspended solids limit has not been determined for tributaries but is set at 18 mg/l for the outlet of the Fox River. The TMDL calls for a 70.1% reduction in phosphorus and 63.5% reduction in TSS from the East River.

Figure 2. East River emptying into Fox River in City of Green Bay. Photo Credit: Steve Ryan (Ryan Photography)

1.3 US EPA Watershed Plan Requirements

In 1987, Congress enacted the Section 319 of the Clean Water Act which established a national program to control nonpoint sources of water pollution. Section 319 grant funding is available to states, tribes, and territories for the restoration of impaired waters and to protect unimpaired/high quality waters. Watershed plans funded by Clean Water Act section 319 funds must address nine key elements that the EPA has identified as critical for achieving improvements in water quality (USEPA 2008). The nine elements from the USEPA Nonpoint Source Program and Grants Guidelines for States and Territories are as follows:

1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified at the significant subcategory level along with estimates of the extent to which they are present in the watershed

2. An estimate of the load reductions expected from management measures.

3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in element 2, and a description of the critical areas in which those measures will be needed to implement this plan.

4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

5. An information and education component used to enhance public understanding of the plan and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element 8.

1.4 Prior Studies, Projects, and Existing Resource Management and Comprehensive Plans

Various studies have been completed in the Lower Fox River Basin and Lake Michigan Basin describing and analyzing conditions in the area. Management and Comprehensive plans as well as monitoring programs have already been developed for the Lower Fox River Basin and Lake Michigan Basin. A list of known studies, plans, and monitoring programs is listed below:

Total Maximum Daily Load & Watershed Plan for Total Phosphorus and Total Suspended Solids in the Lower Fox River Basin and Lower Green Bay -2012

The *TMDL & Watershed Plan for Total Phosphorus and Total Suspended Solids in the Lower Fox River Basin and Lower Green Bay* was prepared by the Cadmus Group for the EPA and WDNR and was approved in 2012. This plan set a TMDL for the Lower Fox River and its tributaries as well as estimated current pollutant loading and loading reductions needed to meet the TMDL for each subwatershed in the Lower Fox River Basin. The Lower Fox River TMDL modeling has shown that the East River is among the highest phosphorus and sediment loading subwatersheds in the Lower Fox River Basin.

Lower Fox River Watershed Monitoring Program

The Lower Fox River Watershed Monitoring Program is a watershed education and stream monitoring program that involves coordination from university students and researchers from University of Wisconsin-Green Bay, University of Wisconsin-Milwaukee, Green Bay Metropolitan Sewerage District (GBMSD/New Water), Cofrin Center for Biological Diversity, and the United States Geological Survey. The program also involves area high school teachers and students.

Lake Michigan Lakewide Management Plan-2008

Plan developed by the Lake Michigan Technical Committee with assistance from the Lake Michigan Forum and other agencies and organizations. The plan focuses on improving water quality and habitat in the Lake Michigan basin including reducing pollutant loads from its tributaries.

Lower Green Bay Remedial Action Plan-1993

The Lower Green Bay Remedial Action Plan is a long term strategy for restoring water quality to the Lower Green Bay and Fox River. Two of the top five priorities for the Remedial Action Plan are to reduce suspended sediments and phosphorus.

Hydrology, Phosphorus, and Suspended Solids in Five Agricultural Streams in the Lower Fox River and Green Bay Watersheds, Wisconsin, Water Years 2004-2006

A 3-year study done by the U.S. Geological Survey and University of Wisconsin-Green Bay to characterize water quality in agricultural streams in the Fox/Wolf watershed and provided information to assist in the calibration of a watershed model for the area.

Nonpoint Source Control Plan for the East River Priority Watershed Project Publication WR-274-93

Nonpoint watershed plan developed for the East River Watershed that focused on phosphorus and sediment reduction. The Wisconsin Nonpoint Source Water Pollution Abatement Program provided cost sharing to landowners who voluntarily implemented best management practices in priority watershed areas. Plan implementation began in 1991 and ended in 2003.

Effects of Best Management Practices in Bower Creek in the East River Priority Watershed, Wisconsin, 1991-2009

In 1989 the USGS and WDNR developed and began an evaluation monitoring program to assess the effectiveness of the Wisconsin Nonpoint Source Program. This report presents results from Bower Creek Watershed which is a subwatershed of the East River. Data from this project indicated that water quality did not generally improve in this watershed. The level of BMP implementation was high for all types of targeted areas except upland management and barnyard-runoff control. Study concluded that additional upland management could potentially reduce pollutant loads substantially more.

1.5 Wisconsin Ecoregion

Ecoregions are based on biotic and abiotic factors such as climate, geology, vegetation, wildlife, and hydrology. The mapping of ecoregions is beneficial in the management of ecosystems and has been derived from the work of James M. Omerik of the USGS. The Upper East River watershed is located in the Southeastern Wisconsin Till Plains ecoregion and in the Lake Michigan Lacustrine clay sub ecoregion. The Southeastern Wisconsin Till Plains supports a variety of vegetations types from hardwood forests to tall grass prairies. Land used in this region is mostly used for cropland and has a higher plant hardiness value than in ecoregions to the north and west.

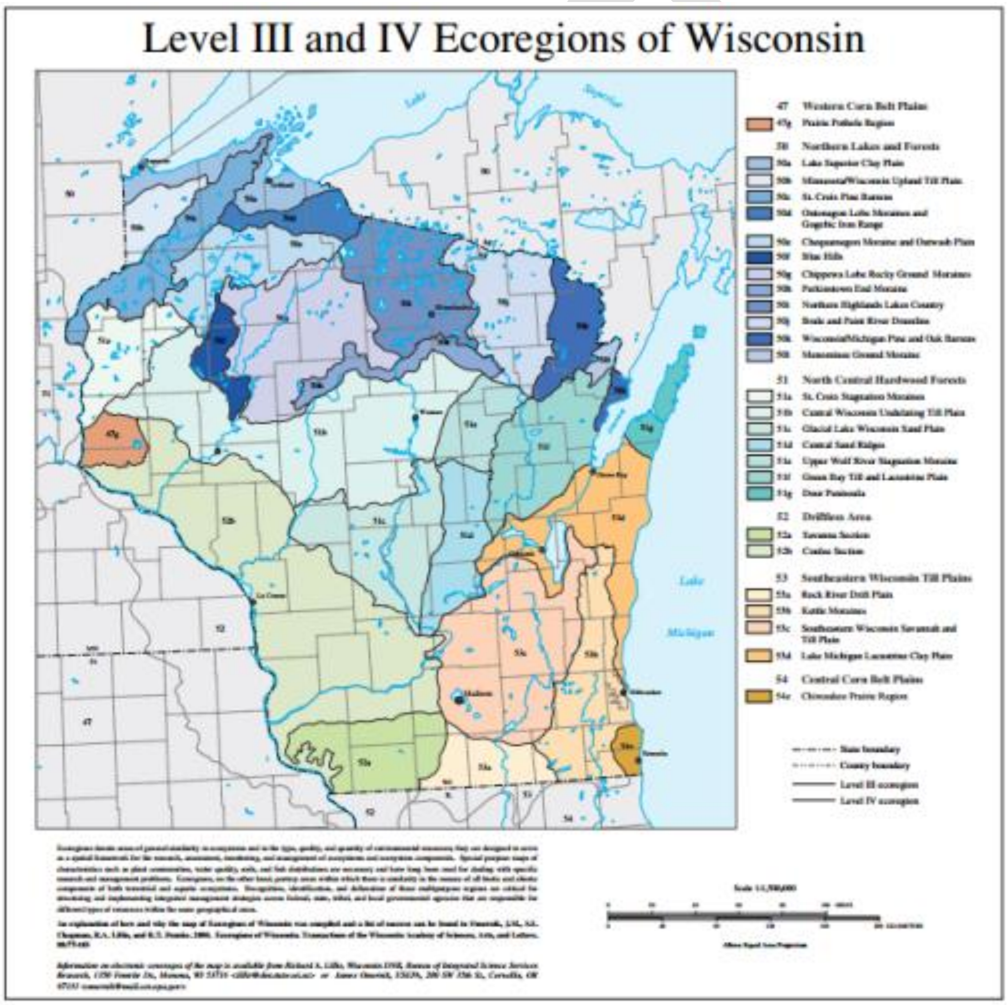

Figure 3. Map of Ecoregions of Wisconsin. Source: Omerik, et al 2000.

1.7 Climate

Wisconsin has a continental climate that is affected by Lake Michigan and Superior. Wisconsin typically has cold, snowy winters and warm summers. The average annual temperature ranges from 39°F in the north to about 50°F in the south. Temperatures can reach minus 30°F or colder in the winter and above 90°F in the summer. Average annual precipitation is about 30 inches a year in the watershed area. The climate in central and southern Wisconsin is favorable for dairy farming, where corn, small grains, hay, and vegetables are the primary crops.

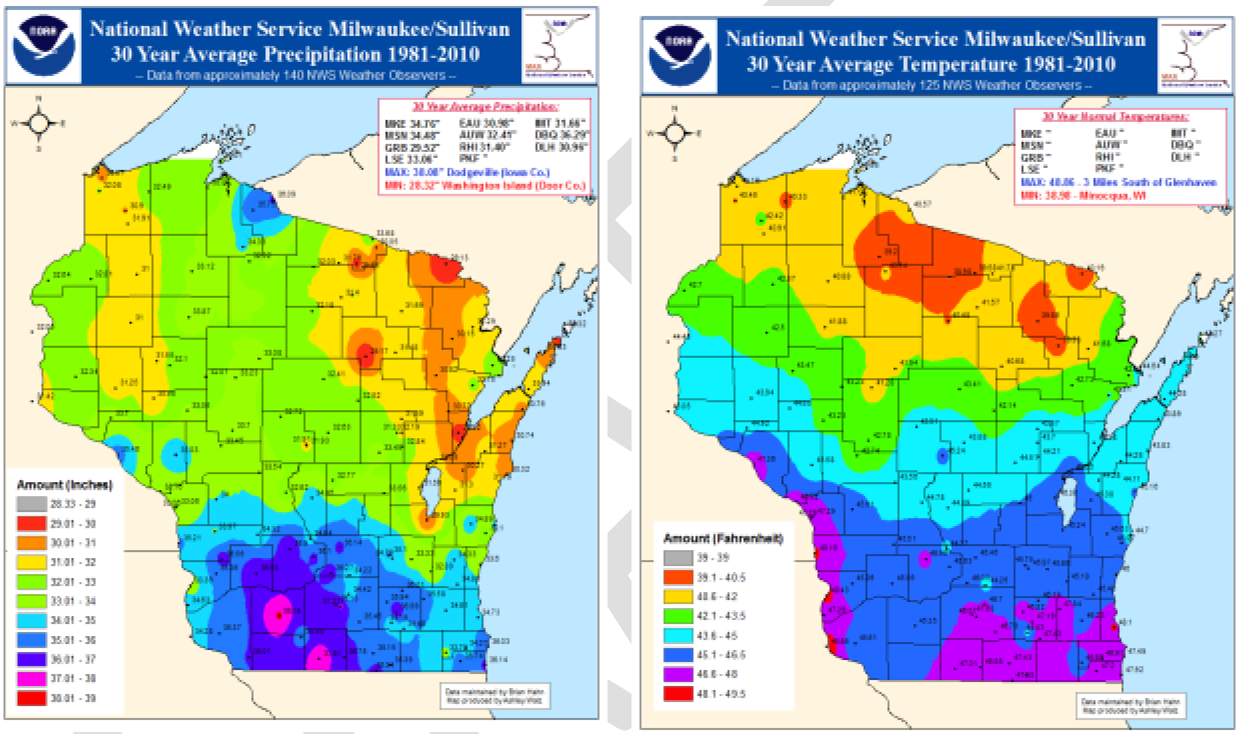

Figure 4. Climate data for Wisconsin. Source: NOAA National Weather Service Forecast Office Milwaukee/Sullivan 2010 & 2010b.

1.6 Topology and geology

The Upper East River watershed lies in the Eastern Ridges and Lowlands geographical province of Wisconsin. The Upper East River watershed area was part of the glaciated portion of Wisconsin. During the last Ice Age the Laurentide Ice Sheet began to advance into Wisconsin where it expanded for 10,000 years before it began to melt back after another 6,500 years. Glaciers have greatly impacted the geology of the area. The dolomite Niagara Escarpment is the major bedrock feature that runs along the eastern edge of Lake Winnebago and extends to the Niagara Falls. The topography is generally smooth and gently sloping with some slopes steepened by post glacial stream erosion. The main glacial landforms are ground moraine, outwash, and lake plain. The highest point in the watershed area is 1,020 ft above sea level in the South East corner and the lowest point in the watershed is 640 feet above sea level in the North West corner (Figure 6). There is 380 foot change in elevation from highest and lowest point in the watershed.

Figure 5. Ice Age Geology of Wisconsin. ©Mountain Press, 2004

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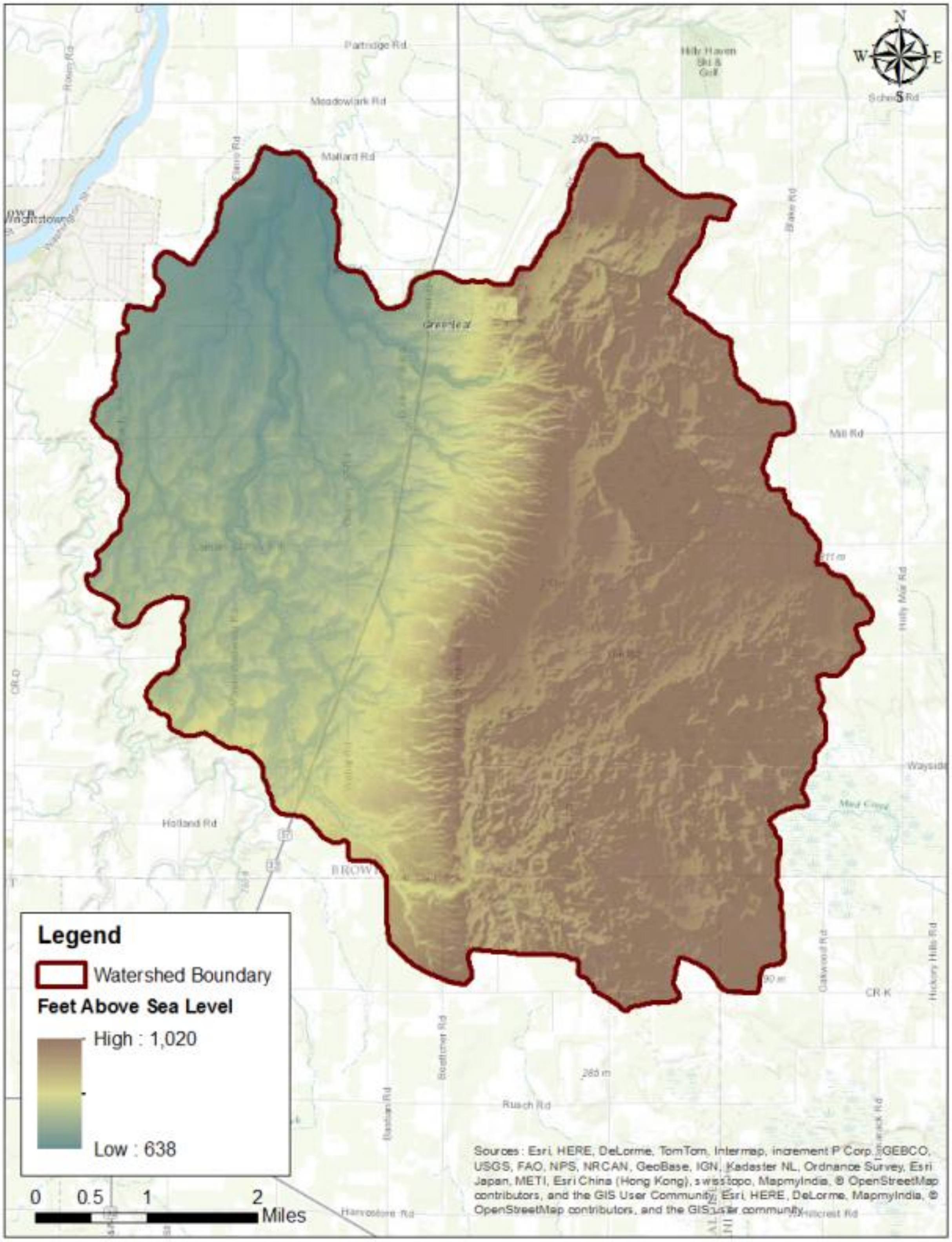


Figure 6. Digital Elevation Model.

1.8 Soil Characteristics

Soil data for the watershed was obtained from the Natural Resources Conservation Service (SSURGO) database. The type of soil and its characteristics are important for planning management practices in a watershed. Factors such as erodibility, hydric group, slope, and hydric rating are important in estimating erosion and runoff in a watershed.

The dominant soil types in the watershed are Kewaunee silt loam (16.6%), Oshkosh silt loam (13.0 %), and Waymor silt loam (10.2 %).

Hydrologic Soil Group

Soils are classified into hydrologic soil groups based on soil infiltration and transmission rate (permeability). Hydrologic soil group along with land use, management practices, and hydrologic condition determine a soil's runoff curve number. Runoff curve numbers are used to estimate direct runoff from rainfall. There are four hydrologic soil groups: A, B, C, and D. Descriptions of Runoff Potential, Infiltration Rate, and Transmission rate of each group are shown in Table 2. Some soils fall into a dual hydrologic soil group (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and water table depth when drained. The first letter applies to the drained condition and the second letter applies to the undrained condition. Table 1 summarizes the acreage and percent of each group present in the watershed and Figure 7 shows the location of each hydrologic soil group. The dominant hydrologic soil groups in the watershed are Group C (41.13 %) and Group D (37.06 %). Group D soils have the highest runoff potential followed by group C. Soils with high runoff potentials account for 78.19% of the soils in the watershed.

Table 1. Soil Hydrologic Groups.

Hydrologic Soil Group	Acres	Percent
A	176.59	0.78
A/D	910.31	4.03
B	622.68	2.76
B/D	2,318.35	10.27
C	9,288.00	41.13
C/D	899.27	3.98
D	8,369.10	37.06

Table 2. Description of Hydrologic Soil Groups.

HSG	Runoff Potential	Infiltration Rate	Transmission Rate
A	Low	High	High
B	Moderately Low	Moderate	Moderate
C	Moderately High	Low	Low
D	High	Very Low	Very Low

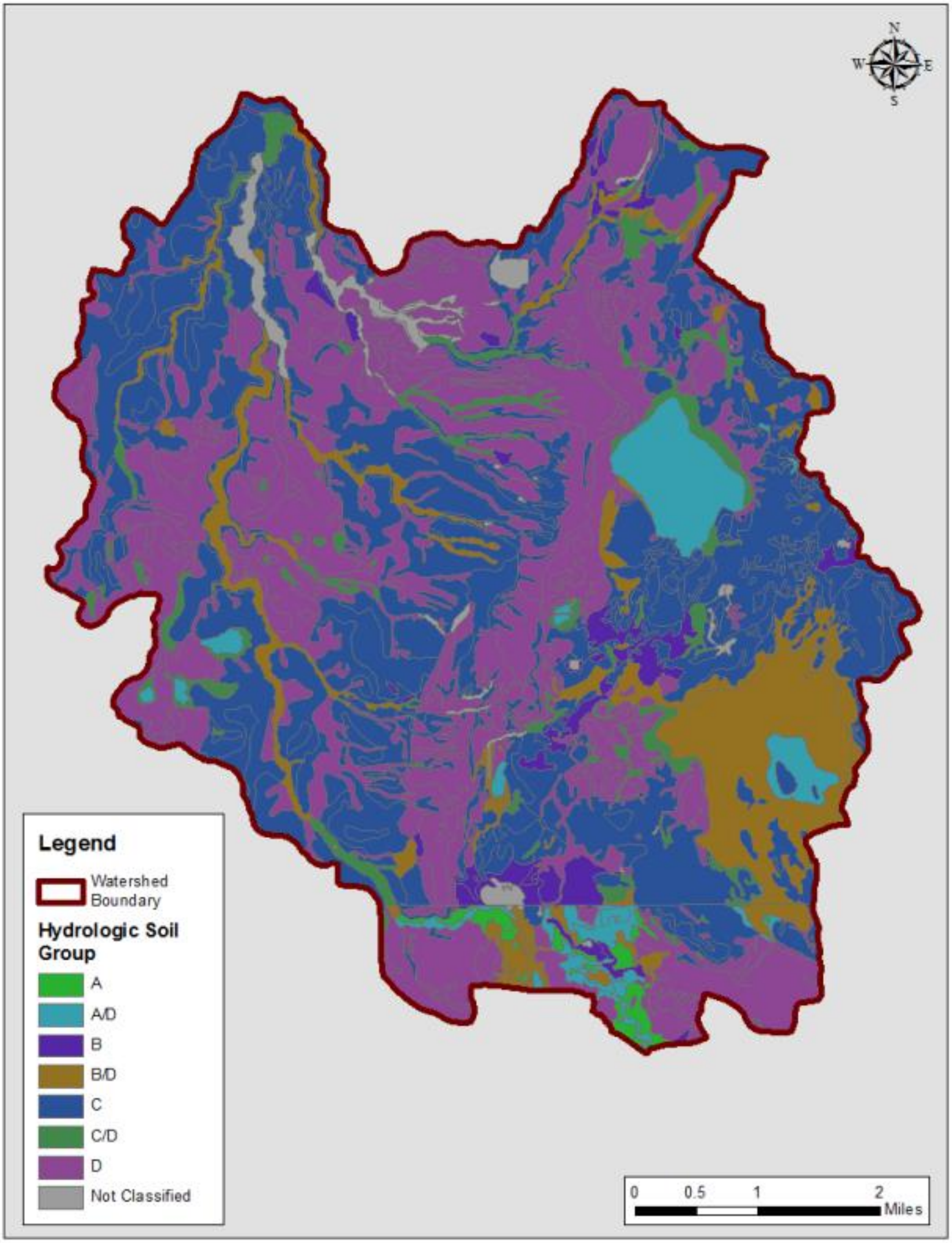


Figure 7. Soil Hydrologic Groups.

Soil Erodibility

The susceptibility of a soil to wind and water erosion depends on soil type and slope. Course textured soils such as sand or more susceptible to erosion than fine textured soils such as clay. The soil erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. It is one of the six factors used in the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons/acre/year. Values of K range from 0.02 to 0.69. The majority of the soils in the Upper East River watershed have moderate to high values for erodibility (K) (Figure 8).

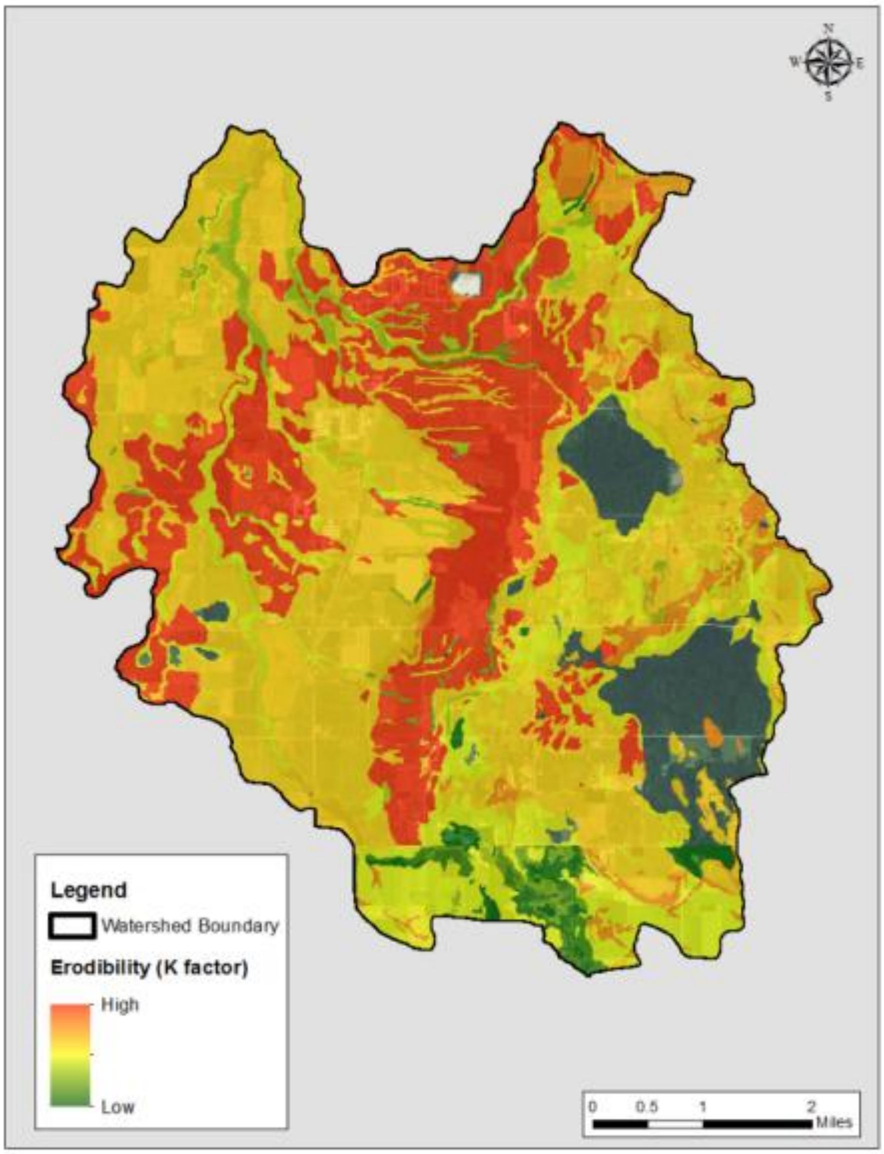


Figure 8. Soil Erodibility.

2.0 Watershed Jurisdictions, Demographics, and Transportation Network

2.1 Watershed Jurisdictions

The majority of the Upper East River watershed is located in Brown County (91.34 %) with small portions in Calumet (7.20%) and Manitowoc (1.46%) counties (Table 3). The Town of Wrightstown, Town of Holland, Town of Brillion, and the Town of Maple Grove are located in the watershed area with the Town of Holland occupying the most area.

Holland Town Hall (Royalbroil - Licensed under CC BY-SA 3.0 via Wikimedia Commons)

Table 3. Watershed Jurisdictions

Jurisdiction	Acres	Percent
County		
Brown	21,004.50	91.34
Calumet	1,656.00	7.20
Manitowoc	336.00	1.46
Municipality		
Town of Brillion	1,656.00	7.20
Village of Wrightstown	0.50	0.00
Town of Wrightstown	6,565.00	28.55
Town of Holland	14,439.00	62.79
Town of Maple Grove	336.00	1.46

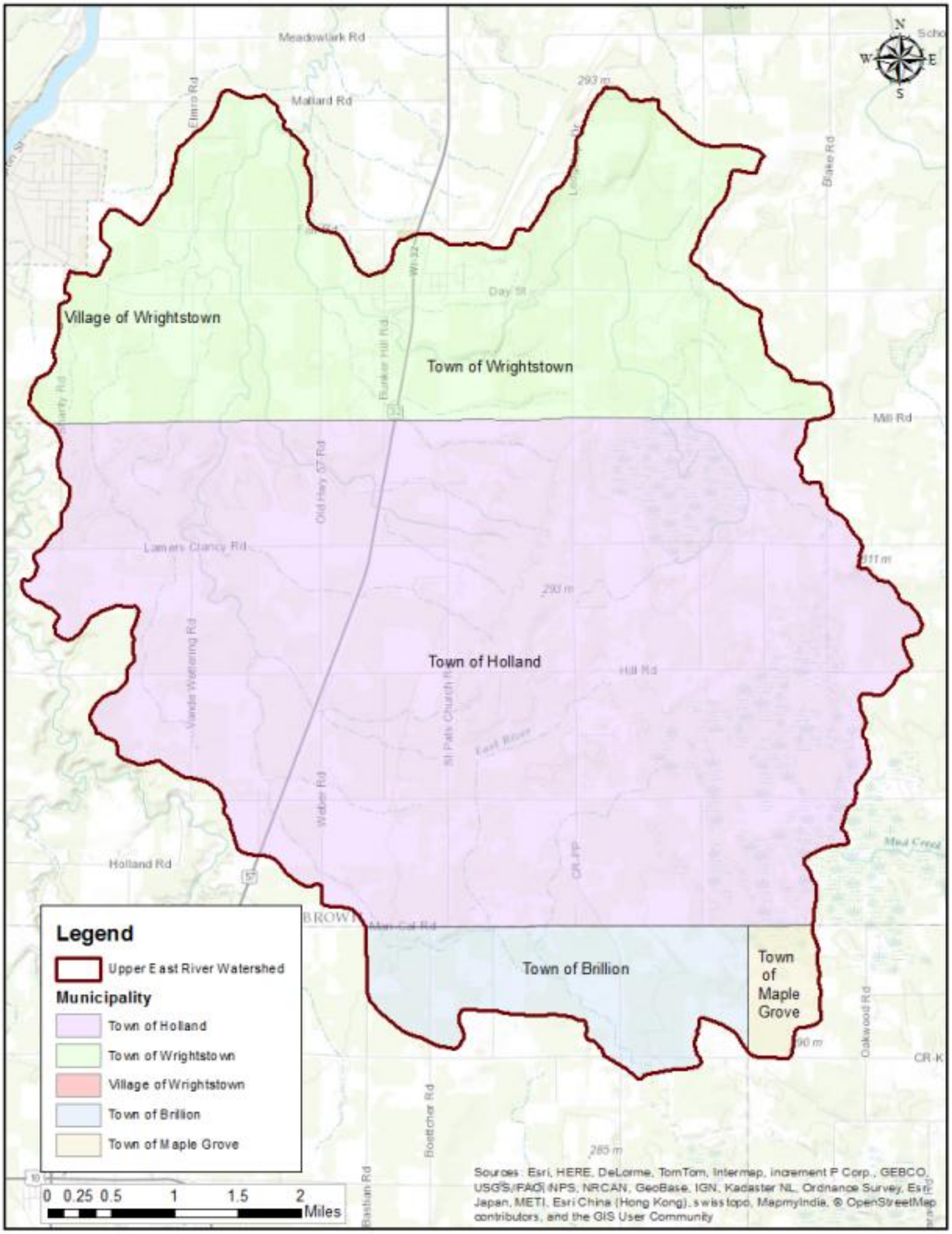


Figure 9. Watershed Jurisdictions

2.2 Jurisdictional Roles and Responsibilities

Natural resources in the United States are protected to some extent under federal, state, and local law. The Clean Water Act is the strongest regulating tool at the national level. In Wisconsin, the Wisconsin Department of Natural Resources has the authority to administer the provisions of the Clean Water Act. The U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers work with the WDNR to protect natural areas, wetlands, and threatened and endangered species. The Safe Drinking Water Act also protects surface and groundwater resources.

Counties and other local municipalities in the watershed area have already established ordinances regulating land development and protecting surface waters. Brown, Calumet, and Manitowoc County have ordinances relating to Shoreland and Wetland Zoning, Animal Waste Management & Runoff management, Erosion Control, and Illicit Discharge. In addition Brown County has an Agriculture Shoreland Management ordinance requiring the installation of vegetated buffers on all blue lines found on USGS quadrangle maps.

In addition to County-level regulations, each municipality has their own regulations. Municipalities may or may not provide additional watershed protection above and beyond existing watershed ordinances under local municipal codes.

The Northeast Wisconsin Stormwater Consortium (NEWSC) is a private entity in the watershed area that provides a technical advisory role. In 2002, Fox Wolf Watershed Alliance began exploring the creation of an organization to assist local and county governments in cooperative efforts to address storm water management, which led to the creation of the Northeast Wisconsin Stormwater Consortium. Outagamie County, Brown County, Calumet County, and the City of Kaukauna have representatives in the organization. Northeast Wisconsin Stormwater Consortium facilitates efficient implementation of stormwater programs that meet DNR and EPA regulatory requirements and maximize the benefit of stormwater activities to the watershed by fostering partnerships, and by providing technical, administrative, and financial assistance to its members.

Other governmental and private entities with watershed jurisdictional or technical advisory roles include: Natural Resources Conservation Service, Calumet County Resource Management Department, Brown County Land and Water Conservation Department and Planning and Land Services Department, Department of Agriculture, Trade, and Consumer Protection, Bay-Lake Regional Planning Commission, Department of Transportation.

2.3 Transportation

The major roads that run through the Upper East River watershed include State Highways 96 and 32/57. Hwy 96 runs east-west across the northern portion of the watershed Hwy 57/32 runs north-south intersecting Hwy 96. County highways PP, K, IL and county roads Z, Wayside Rd., and Mill Rd. are major throughways in the watershed area. The Fox River Trail is a 25 mile long trail that can be used for biking and hiking as well as horseback riding in some sections that runs parallel to State Highway 32/57.

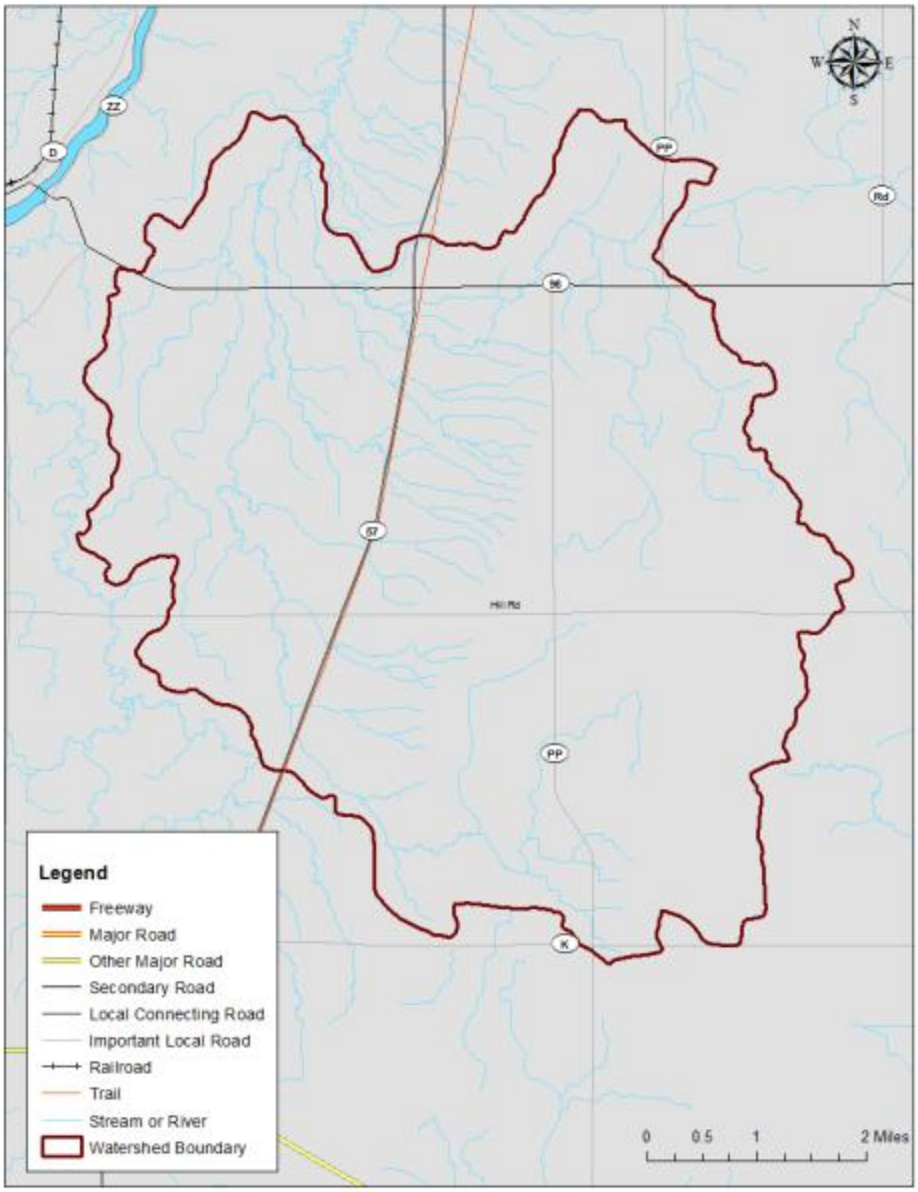


Figure 10. Transportation.

2.4 Population Demographics

The Upper East River Watershed is not a very densely populated area but is located fairly close to the Fox Valley and City of Green Bay. Wisconsin population projections were developed by the Wisconsin Department of Administration's Demographic Services Center. Projections were produced in 2013 and based on 2010 Census. Brown and Calumet County are in the top 5 predicted fastest growing populations in the projections (Eagan Robertson, 2013). Urban sprawl from the Fox Valley area and Green Bay area could further impact the amount of land available for agriculture in the area in the future.

Table 4. Population Projections. Source: Wisconsin Department of Administration Demographic Services Center (Eagan-Robertson 2013)

County Name	April 2010 Census	April 2020 Projection	April 2030 Projection	Total Change
Brown	248,007	270,720	299,540	51,533
Calumet	48,971	54,555	61,255	12,284
Manitowoc	81,442	81,400	82,230	788

Median annual income data was collected from 2008-2012 by the American Community Survey. Population data for municipalities and counties are from the 2010 US Census. Median annual income in the municipalities in the watershed is above the county averages for the area.

Table 5. Population and Median Income. Source: U.S. Census Bureau (US Census Bureau 2010 & US Census Bureau American Community Survey 2012)

Municipality	Population	Median Income
T. Brillion	1,486	68,021
T. Holland	1,519	65,750
T. Wrightstown	2,221	74,219
V. Wrightstown	2,827	71,522
T. Maple Grove	835	56,667
County		
Brown	248,007	53,419
Calumet	48,971	48,971
Manitowoc	81,442	50,091

3.0 Land Use/Land Cover

3.1 Existing Land Use/Land Cover

Land Cover and Land Use data for the watershed area was obtained from the National Land Cover Database 2011 (NLCD 2011). The land cover data was created by the Multi-resolution Land Characteristics (MRLC) Consortium. The NLCD 2011 has 16 land cover classifications and a spatial resolution of 30 meters. The classification of land use is based on 2011 Landsat satellite data. Land cover and land use for the watershed is shown in Figure 11 & Table 6.

The dominant land use in the watershed is agriculture at 75.76% including cultivated crops (41.53%) and pasture/hay (34.23%). Developed land accounts for just 5.78% of the land in the watershed. Natural areas such as wetlands, forest, and grassland make up the remaining 18.23 % of the watershed area.

Table 6. Land Use/Land Cover. Source: NLCD 2011.

Land Use	Acres	Percent
Open Water	6.97	0.03
Developed, Open Space	659.50	2.87
Developed, Low Intensity	628.62	2.73
Developed, Medium Intensity	35.13	0.15
Developed, High Intensity	6.86	0.03
Barren Land (Rock, Sand, Clay)	44.21	0.19
Deciduous Forest	1,495.52	6.50
Evergreen Forest	199.83	0.87
Mixed Forest	89.00	0.39
Grassland/Herbaceous	110.12	0.48
Pasture/Hay	7,873.50	34.23
Cultivated Crops	9,550.96	41.53
Woody Wetlands	2,182.42	9.49
Emergent Herbaceous Wetlands	116.51	0.51

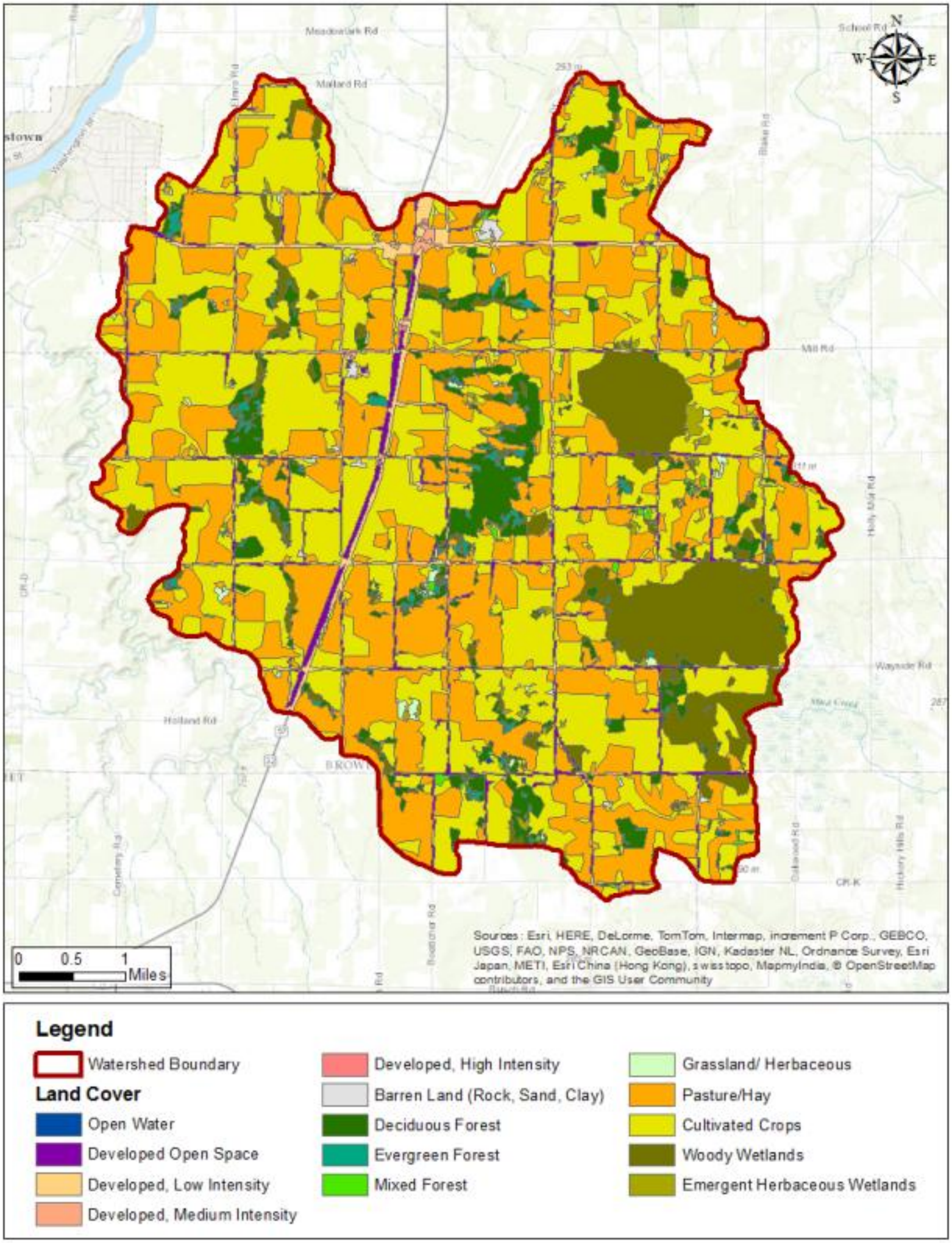


Figure 11. NLCD 2011 Land Use.

3.2 Crop Rotation

Cropland data was obtained from the USDA National Agriculture Statistics Service. NASS produced the Cropland Data Layer using satellite images at 30 meter observations, Resourcesat-1 Advanced Wide Field Sensor, and Landsat Thematic mapper. Data from 2009 to 2013 was analyzed to obtain a crop rotation. Crop rotations for the watershed are shown in Figure 12 and Table 7.

Dairy rotation is dominant in the watershed at 70.77% followed by Pasture/Hay/Grassland at 16.23% and Cash Grain at 9.24%. Different crop rotations can affect the amount of erosion and runoff that is likely to occur on a field. Corn is often grown in dairy rotations and harvested for corn silage; harvesting corn silage leaves very little residue left on the field making the field more susceptible to soil erosion and nutrient loss. Changing intensive row cropping rotations to a conservation crop rotation can decrease the amount of soil and nutrients lost from a field. Increasing the conservation level of crop rotation can be done by adding years of grass and/or legumes, add diversity of crops grown, or add annual crops with cover crops.

Table 7. Crop Rotation.

Rotation	Acres	Percent
Pasture/Hay/Grassland	2,547.08	16.23
Dairy Rotation	11,106.85	70.77
Cash Grain	1,450.77	9.24
Continuous Corn	578.59	3.69
Potato/Grain/Veggie Rotation	11.82	0.08
Total	**15,695.11**	**100.00**

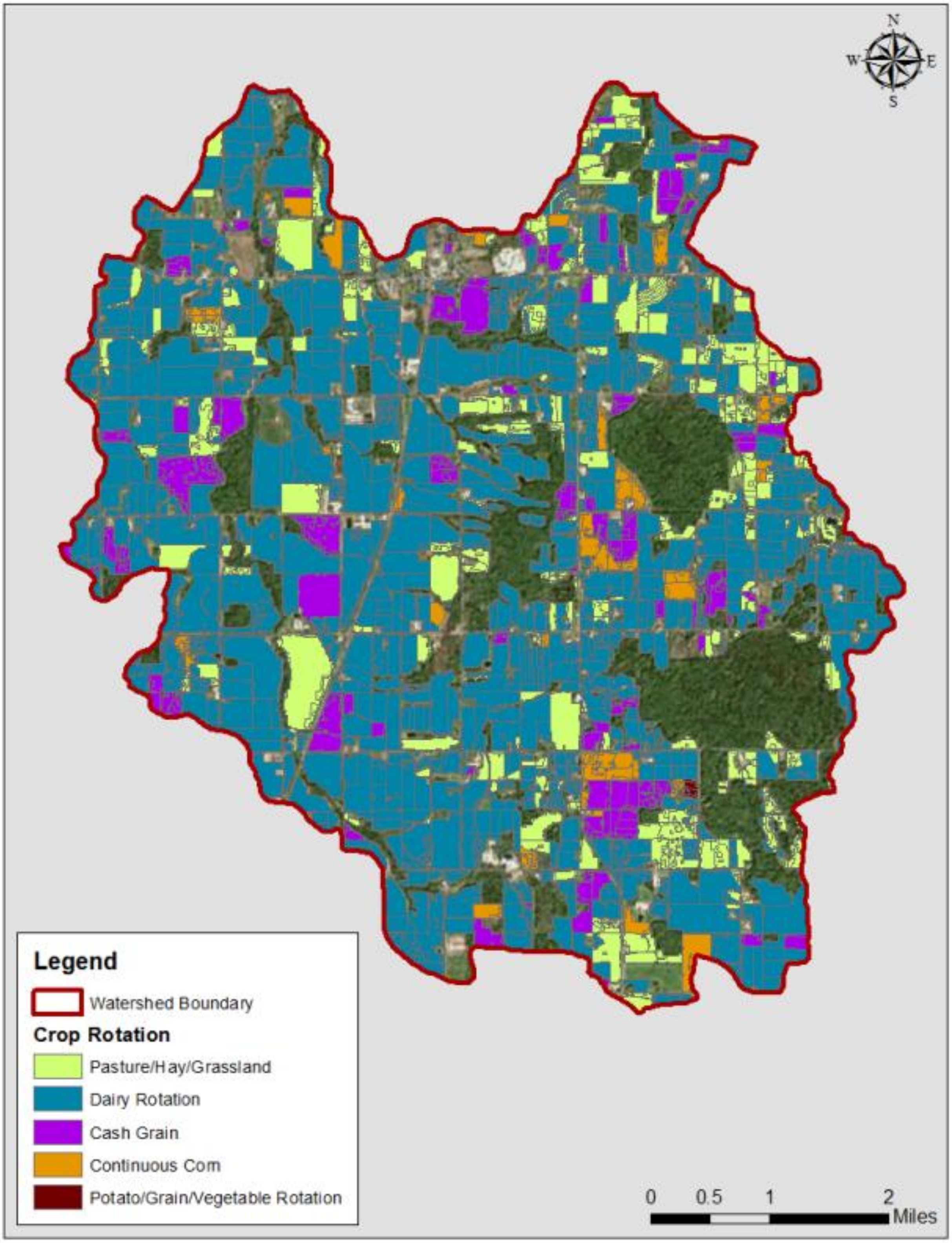
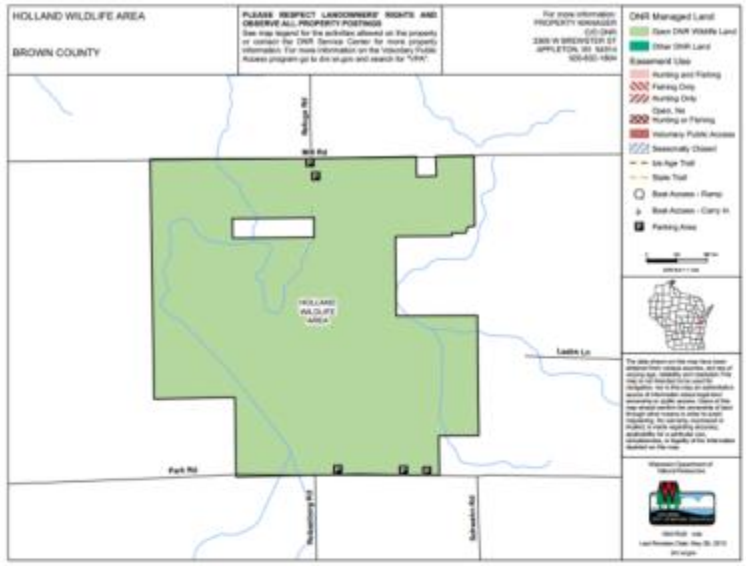


Figure 12. Crop rotations based on years 2009-2013.

3.3 Natural Areas & Recreational Areas

Holland Wildlife Area

The Holland Wildlife Area is located in the watershed east of Cth PP between Mill Rd and Park Rd. The wildlife area is a 536 acre property that consists of bottomland hardwood forest, open grassland, and small area of cedar forest. The wildlife area provides many recreational activities such as hiking, hunting, trapping, wildlife viewing, and cross country skiing.



Fox River Trail

The Fox River Trail is a 25 mile long trail that goes from Green Bay along the Fox River through Wrightstown and Holland. The permitted uses for the trail include bicycling, walking, rollerblading, and horseback riding (in designated rural areas). The trail runs parallel to HWY 57 in the Upper East River Watershed.

4.0 Water Quality

The federal Clean Water Act(CWA) requires states to adopt water quality criteria that the EPA publishes under 304 (a) of the Clean Water Act, modify 304 (a) criteria to reflect sit-specific conditions, or adopt criteria based on other scientifically defensible methods. Water quality standards require assigning a designated use to the water body.

4.1 Designated Use and Impairments

A 303 (d) list is comprised of waters impaired or threatened by a pollutant, and needing a TMDL. States submit a separate 303 (b) report on conditions of all waters. EPA recommends that the states combine the threatened and impaired waters list, 303 (d) report, with the 303(b) report to create an “integrated report”. The East River was first listed as an impaired waterway in 1998. The East River is impaired due to excess phosphorus, sediment loading and unspecified metals. The Lower Fox River TMDL only addresses phosphorus and sediment loading in the Lower Fox River tributaries. Figure 13 shows stream segments in the Upper East River watershed listed as impaired.

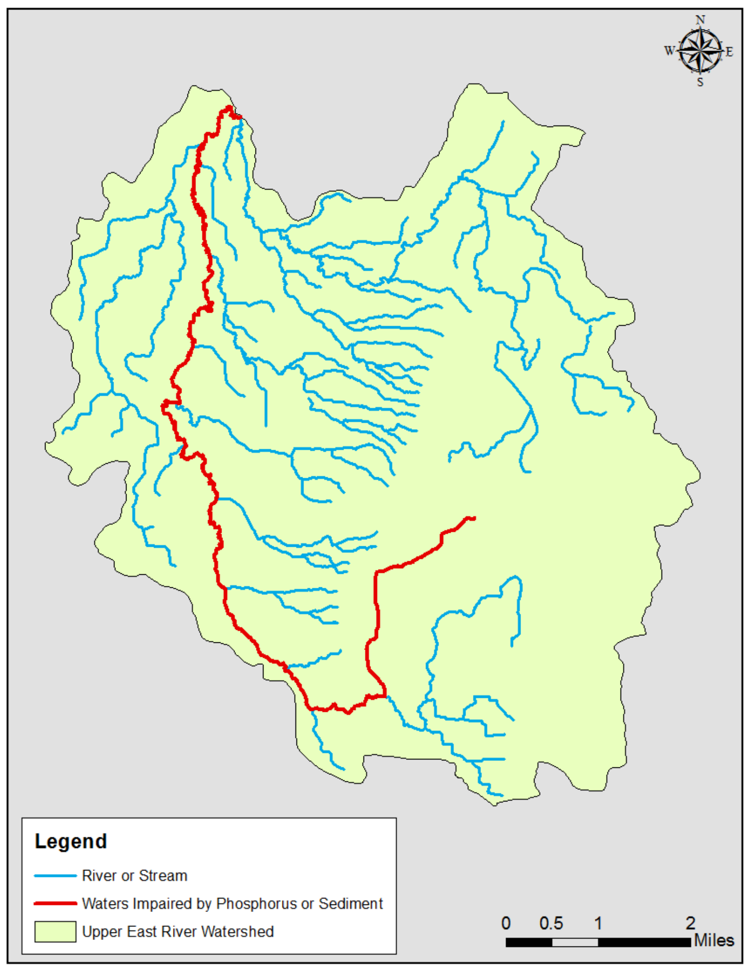


Figure 13. Impaired stream segments.

Streams and rivers in Wisconsin are assessed for the following use designations: Fish and Aquatic Life, Recreational Use, Fish Consumption (Public Health and Welfare), and General Uses. The East River is designated for Fish and Aquatic Life. The Fish and Aquatic Life (FAL) designations for streams and rivers are categorized into subcategories. The East River is designated to the Warmwater Forage Fish (WWFF) Community. Streams in this category are capable of supporting a warm water dependent forage fishery. Aquatic life communities in this category usually require cool or warm temperatures and concentrations of Dissolved Oxygen (DO) that do not drop below 5 mg/l. Streams and rivers are also being evaluated for placement in a revised aquatic life use classification system where the subclasses are referred to as Natural Communities. The East River is considered a Warm Headwater, Cool (Warm Transition) Headwater under the state's Natural Community Determinations.

4.2 Point Sources

Point sources of pollution are discharges that come from a pipe or point of discharge that can be attributed to a specific source. In Wisconsin, the Wisconsin Pollutant Discharge Elimination System (WPDES) regulates and enforces water pollution control measures. The WI DNR Bureau of Water Quality issues the permits with oversight of the US EPA. There are four types of WPDES permits: Individual, General, Storm water, and Agricultural permits.

Individual permits are issued to municipal and industrial waste water treatment facilities that discharge to surface and/or groundwater. WPDES permits include limits that are consistent with the approved TMDL Waste Load Allocations. There is only one WPDES permit holder, Wrightstown Sanitary District 1, in the Upper East River (Table 8). Facilities are required to report phosphorus and sediment loads to the DNR in Discharge Monitoring Reports (DMR).

Table 8. Point source load allocation. Source: WDNR 2012

Sources	Total Suspended Solids Load (lbs/yr)			Total Phosphorus Load (lbs/yr)		
	Baseline	Allocated	Reduction	Baseline	Allocated	Reduction
Wrightstown SD #1	472	472	-	690	170	520

To meet the requirements of the federal Clean Water Act, the DNR developed a state Storm Water Permits Program under Wisconsin Administrative Coded NR 216. A Municipal Separate Storm Sewer System (MS4) permit is required for a municipality that is either located within a federally designated urbanized area, has a population of 10,000 or more, or the DNR designates the municipality for permit coverage. Municipal permits require storm water management programs to reduce polluted storm water runoff. Brown and Calumet Counties have a general MS4 permit # WI-S050075-2. The general permit requires an MS4 holder to develop, maintain, and implement storm water management programs to prevent pollutants from the MS4 from entering state waters. Examples of stormwater best management practices used by municipalities to meet permits include: detention basins, street sweeping, filter strips, and rain gardens.

4.3 Nonpoint Sources

The majority of pollutants in the Upper East River watershed come from nonpoint sources. A nonpoint source cannot be traced back to a point of discharge. Runoff from agricultural and urban areas is an example of non point source. Agriculture is the dominant land use in the Upper East River watershed and accounts for over 90% of total phosphorus loading and 80% of total suspended sediment loading. Other nonpoint sources in the watershed include erosion from stream banks and runoff from lawns and impervious surfaces.

In 2010, new state regulations in Wisconsin went into effect that restricts the use, sale, and display of turf fertilizer that is labeled as containing phosphorus or available phosphorus (Wis.Stats.94.643) The law states that turf fertilizer that is labeled containing phosphorus or available phosphate cannot be applied to residential properties, golf courses, or publicly owned land that is planted in closely mowed or managed grass. The exceptions to the rule are as follows:

- Fertilizer that is labeled as containing phosphorus or available phosphate can be used for new lawns during the growing season in which the grass is established.
- Fertilizer that is labeled as containing phosphorus or available phosphate can be used if the soil is deficient in phosphorus, as shown by a soil test performed no more than 36 months before the fertilizer is applied. The soil test must be done by a soil testing laboratory.
- Fertilizer that is labeled as containing phosphorus or available phosphate can be applied to pastures, land used to grow grass for sod or any other land used for agricultural production.

Wisconsin also has state standards pertaining to agricultural runoff. Wisconsin State Standards, Chapter NR 151 subchapter II describes Agricultural Performance Standards and Prohibitions. This chapter describes regulations relating to phosphorus index, manure storage & management, nutrient management, soil erosion, tillage setback as well as implementation and enforcement procedures for the regulations.

4.4 Water Quality Monitoring

Visible signs of nutrient loading and suspended solids are often present in the East River during the summer months and during or after a peak storm or runoff event. The East River near the mouth of Green Bay is usually green with algae mid to late summer(Figure 14).

Figure 14. East River from Hwy 54/57 Bridge in Green Bay, WI July 2012. Credits: Google

The Lower Fox River TMDL set total phosphorus concentration limits for tributaries as well as phosphorus and suspended sediment loading rates for each subwatershed. The allowable summer median (May-October) phosphorus concentration for tributaries is 0.075 mg/l and allowable suspended sediment concentration for the mouth of the Fox River is 18 mg/l. The allocated TMDL loading rates are 39.95 lbs of P/day and 9.9 tons of sediment/day for the East River. Current water quality data shows that levels are currently much higher than where they need to be. Water quality monitoring data has been collected from several sites on the East River from the WDNR and USGS. USGS monitoring stations in the East River watershed are shown in Figure 15.

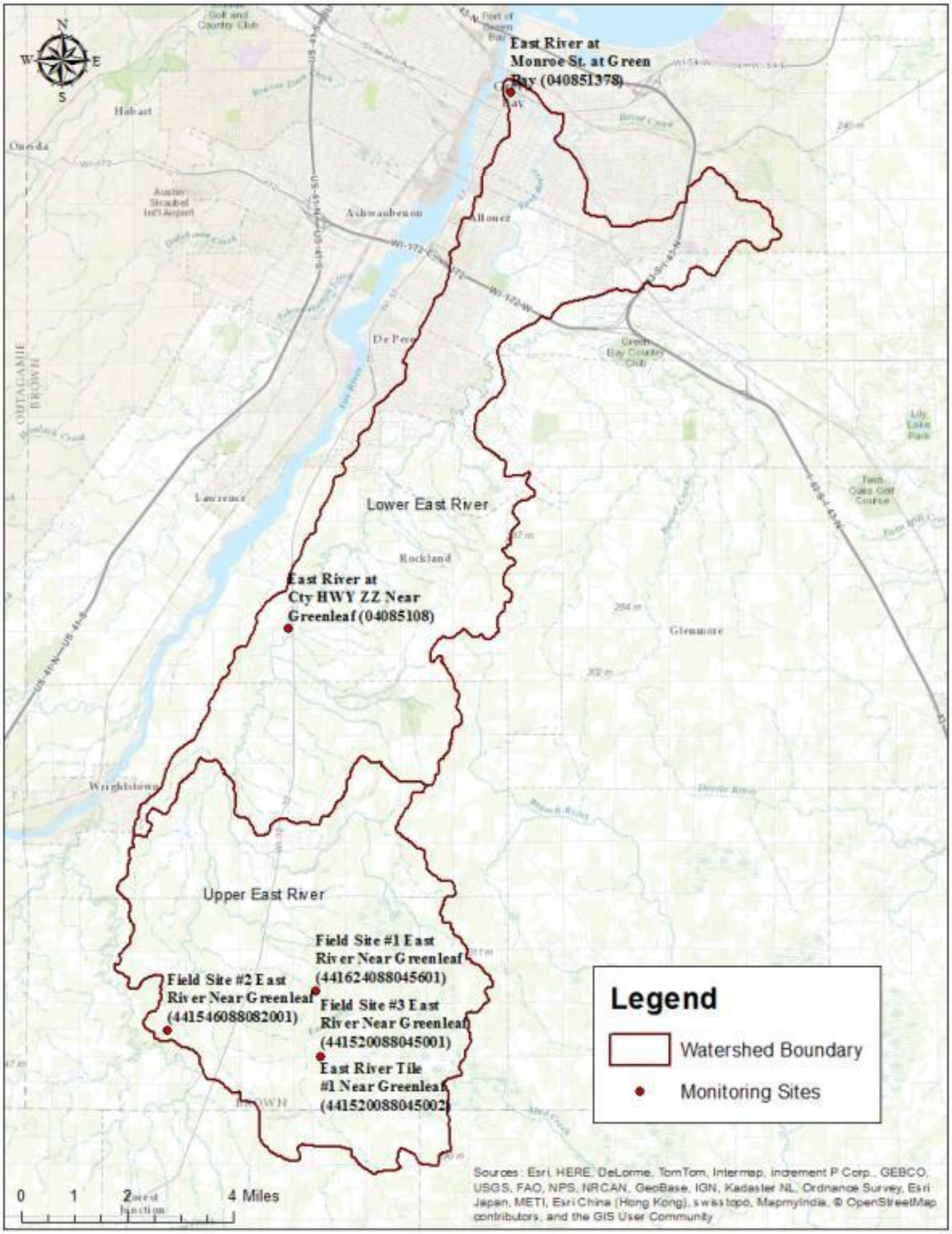


Figure 15. Current and past USGS East River Monitoring Sites.

Water quality data was collected from a USGS gauging station on the East River from 2003-2007 at Monroe Street in Green Bay. This station has been inactive since 2007. The data from this station was used to calibrate the SWAT model used for the Lower Fox River TMDL. The highest maximum suspended solids and total phosphorus discharge recorded during the period from 2003-2007 was 5,240 tons suspended sediment and 17,400 lbs phosphorus on June 1, 2004. Monthly loading amounts from 2004-2007 are shown in Figure 16 and annual loading amounts from 2005-2007 are shown in Table 9.

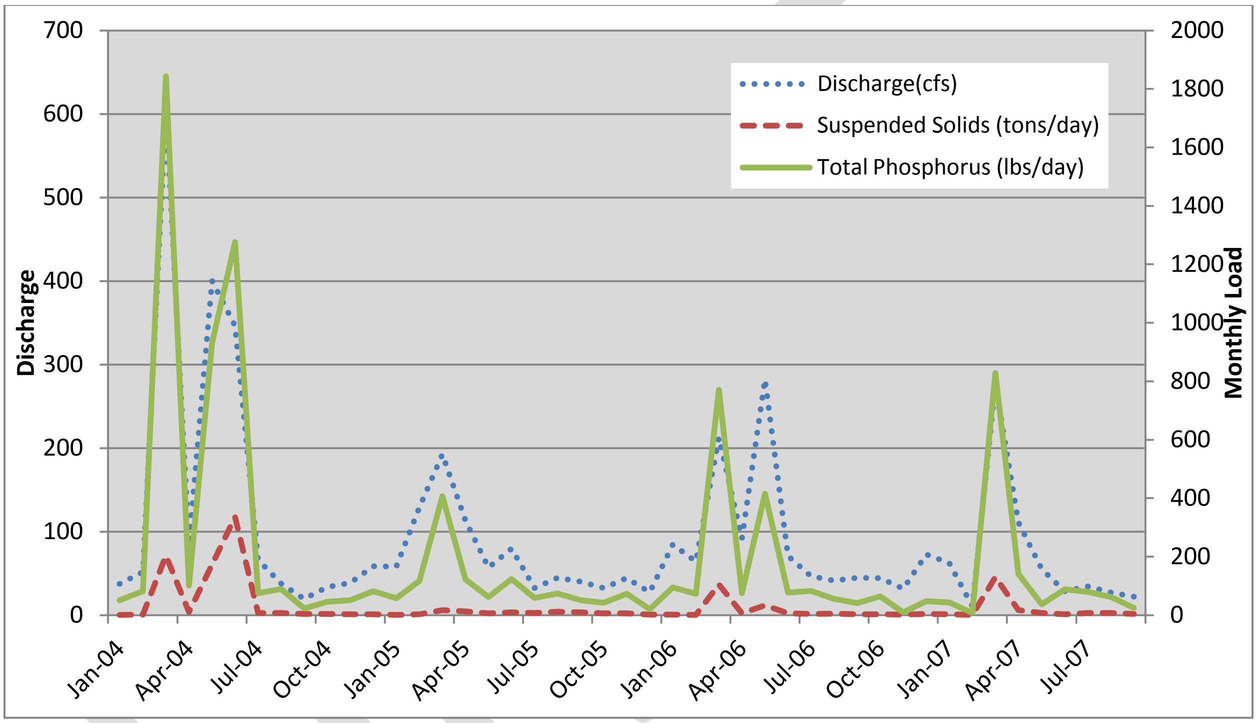


Figure 16. Monthly statistics from WY 2004-2007 at USGS Station at Monroe St., Green Bay, WI (USGS 040851378).

Table 9. Annual water quality statistics from WY 2005-2007 at USGS Station at Monroe St., Green Bay, WI (USGS 040851378).

Water Year	Discharge (cubic feet per second)	Suspended solids (tons per day)	Phosphorus (pounds per day)
2005	72.60	7.31	104.40
2006	87.40	15.21	153.40
2007	65.30	15.71	120.80

There is a USGS gauging station located on the East River near Cty Hwy ZZ that is currently active and collecting water quality data. This monitoring station records gage height, discharge, and precipitation daily. There is surface water quality data from this site for dissolved oxygen, temperature, pH, specific conductance, and turbidity collected from a YSI meter from May 1, 2014 to present. There is also phosphorus and suspended sediment water quality data from field samples at this site from 2012-present (Figure 17). Summer median phosphorus values for this site ranged from 0.58 mg/l to 0.67 mg/l and summer median suspended sediment concentrations ranged from 71 mg/l to 174 mg/l from 2012-2014 (Figure 18). This site is part of the next Action Plan for the EPA and the long term goal of the location is to potentially track a long term reduction in phosphorus due to increased agricultural conservation effort in the basin.

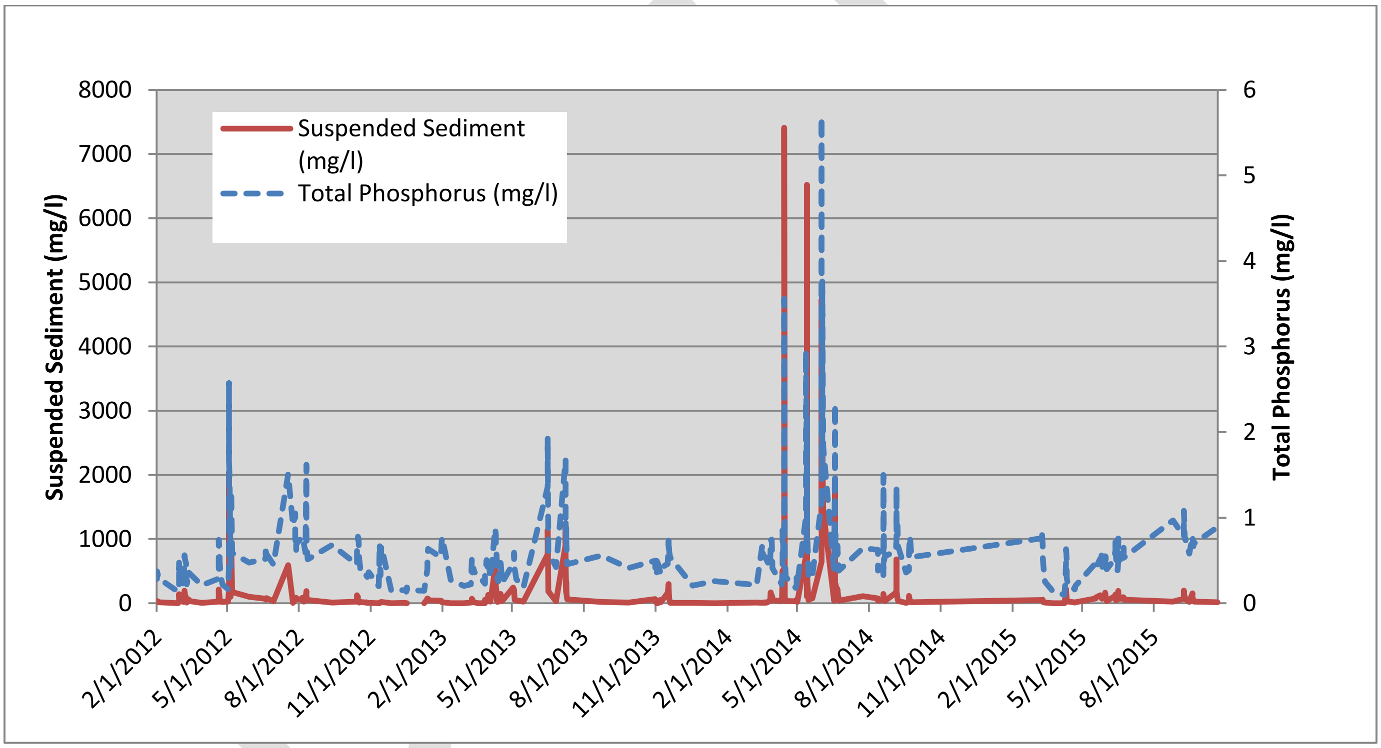


Figure 17. Suspended Sediment and Phosphorus Concentrations from 2012-2015 at USGS Station at Cty Hwy ZZ near Greanleaf, WI (USGS 04085108).

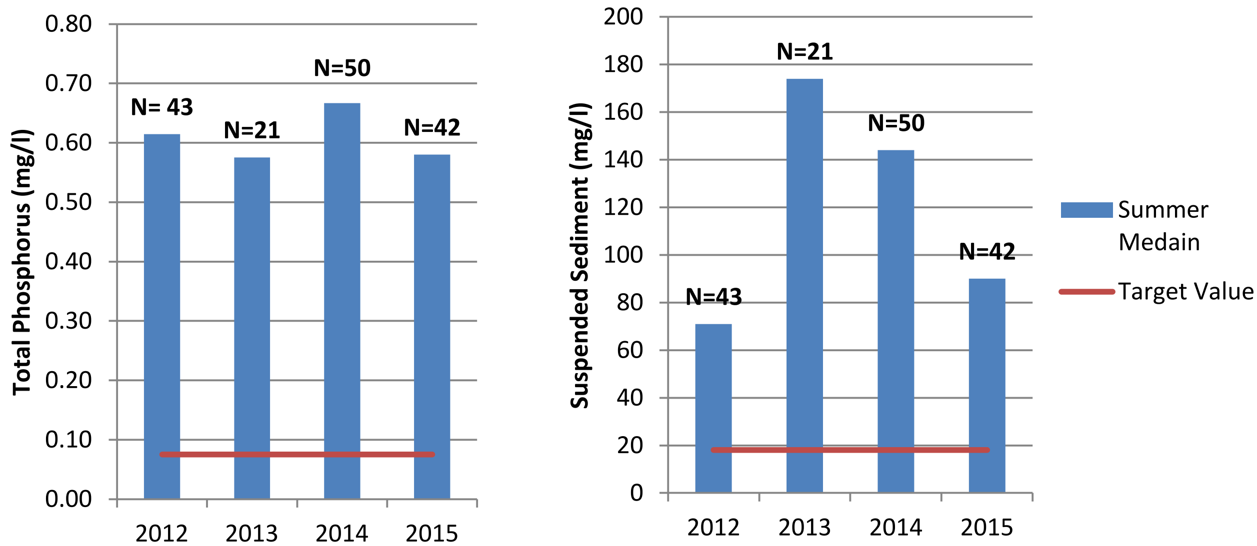


Figure 18. Median summer (May-October) Total Phosphorus and Suspended Sediment concentrations from 2012-2015 at USGS Station at Cty Hwy ZZ near Greenleaf, WI (USGS 04085108).

There are also four USGS field monitoring sites in the Upper East River watershed. These sites are set up to measure changes in water quality from planned conservation practices. Currently these sites are collecting baseline data. Planned practices at these sites include grassed waterways, cover crops, and reduced tillage methods. USGS field monitoring site locations are also shown in Figure 15. Baseline water quality data from the field sites are shown in Appendix C. The USGS gauging station located near Cty Hwy ZZ and the four field monitoring sites are part of the Lower Fox River Watershed Monitoring Program.

The WDNR monitors water quality of aquatic resources in the state through various monitoring programs. There is WDNR water quality data available for the East River dating back to 1986 from various monitoring programs. WDNR water quality data for the East River can be viewed at http://dnr.wi.gov/water/watershedsearch.aspx.

Macroinvertebrate analyses were conducted at various locations the East River by University of Wisconsin-Stevens Point and WDNR. The macroinvertebrate index of biotic integrity is a biological indicator for impairment classification. Different types of macroinvertebrates are more tolerant of poor water quality than others. The number and type of macroinvertebrates present in a stream can provide an indicator of water quality. Table 11 shows

Table 10. Macroinvertebrate Index of Biological Integrity (IBI). Source: WDNR 2012b

Macroinvertebrate IBI Rating	
7.5-10	Excellent
5.0-7.4	Good
2.6-4.9	Fair
0-2.5	Poor

macroinvertebrate IBI ratings from various sites on the East River from 1986-2013. The majority of sites in the East River watershed were rated poor to fair for macroinvertebrate IBI.

Table 11. Macroinvertebrate Index of Biological Integrity Survey Scores from 1986-2013 at WDNR survey sites.

Date	Project	Location	IBI	Rating
9/30/2013	NER NC Stream Stratified Sites 2013	East River 5m US Old Martin Road-ID 10040710	3.42	Fair
9/26/2007	NER_CWA_Baseline_2007	East River - Wrightstown Rd-ID 053509	0.24	Poor
9/30/2003	UW Stevens Point Macroinvertebrate Analyses	East River - East River-Mallard Rd - ID 10010753	3.00	Fair
9/30/2003	UW Stevens Point Macroinvertebrate Analyses	East River - East River-Weber Rd. Or Old 57 - ID 10010742	3.92	Fair
9/30/2003	UW Stevens Point Macroinvertebrate Analyses	East River - East River-Ryan Rd.-ID 10010745	2.01	Poor
11/14/1990	UW Stevens Point Macroinvertebrate Analyses	East River Upper at Fair Road-ID 53493	5.14	Good
4/23/1986	UW Stevens Point Macroinvertebrate Analyses	East River - East River-Mallard Rd - ID 10010753	0.81	Poor
4/23/1986	UW Stevens Point Macroinvertebrate Analyses	East River - Meadowlark Road- ID 53507	2.33	Fair

5.0 Pollutant Loading Model

The developers of the Lower Fox River TMDL plan ran the Soil and Water Assessment Tool (SWAT) for all subwatersheds in the Lower Fox River Basin. The SWAT model is able to predict the impact of land use management on the transport of nutrients, water, sediment, and pesticides. Actual cropping, tillage and nutrient management practices typical to Wisconsin were input into the model. Other data inputs into the model include: climate data, hydrography, soil types elevation, land use, contours, political/municipal boundaries, MS4 boundaries, vegetated buffer strips, wetlands, point source loads, and WDNR-Enhanced USGS 1:24K DRG topographic maps. The model was calibrated with water quality data taken at USGS sites from the East River, Duck Creek, Baird Creek, Ashwaubenon, and Apple Creek in the Lower Fox River Basin.

The SWAT model from the Lower Fox River TMDL was run on the entire East River Watershed (Figure 19). To characterize the loading in just the Upper East River subwatershed the STEPL model was used. STEPL[1] (Spreadsheet Tool for Estimating Pollutant Load) is another watershed model that calculates nutrient loads based on land use, soil type, and agricultural animal concentrations. The SWAT model analysis for the entire East River Watershed can be seen in Appendix B. .

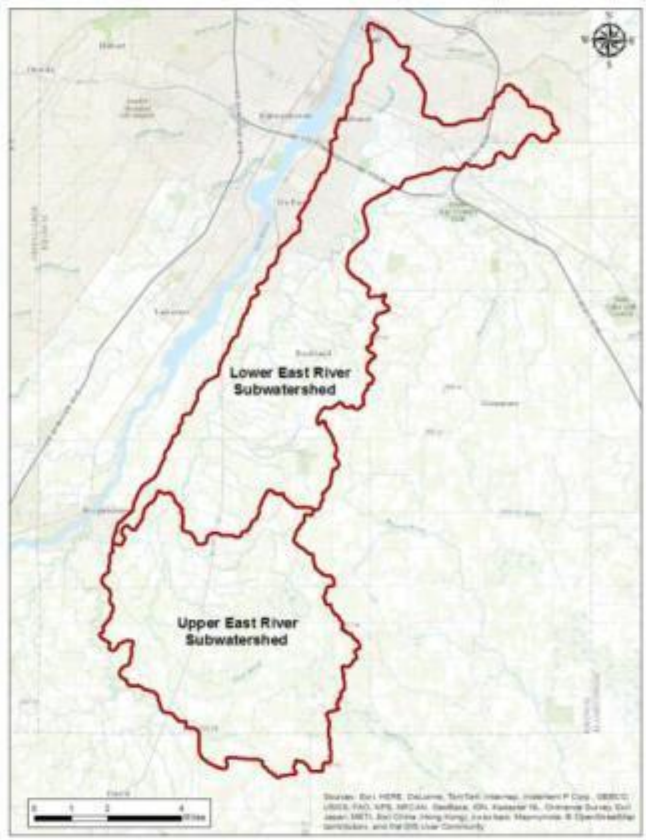


Figure 19. East River Watershed.

Both loading models indicate that agriculture is the main contributor of phosphorus and sediment in the watershed. According to the STEPL model the Upper East River Watershed contributes an estimated 27,193 lbs of phosphorus and 6,348 tons of sediment to the East River per year. The SWAT model estimated 48,748 lbs of phosphorus and 9,898 tons of sediment per year for the entire East River watershed. Therefore the Upper East Rivers is contributing approximately 55% of the Total Phosphorus and 64% of the sediment load from the entire East River basin.

[1] Additional information on STEPL can be found at http://it.tetratech-ffx.com/steplweb/default.htm.

STEPL pollutant loading results are shown in Table 12. STEPL modeling estimates agriculture including pasture land, gullies, and feedlots contributes 93.7% of the phosphorus loading in the Upper East River Watershed. Agriculture including pastures and gullies contributes 83.2 % of the sediment loading in the Upper East River Watershed. Streambank erosion also contributes a significant amount of sediment (14.3%) to the East River.

Table 12. STEPL model TP & TSS baseline loading results.

Sources	Phosphorus Load (lb/yr)	Sediment Load (tons/yr)
Urban	967.8	141.9
Cropland	23,214.4	3,812.7
Pastureland	978.3	13.5
Forest	183.9	8.8
Feedlots	387.8	0.0
Gully	914.8	1,485.1
Streambank	546.2	886.6
Total	**27,193.2**	**6,348.5**

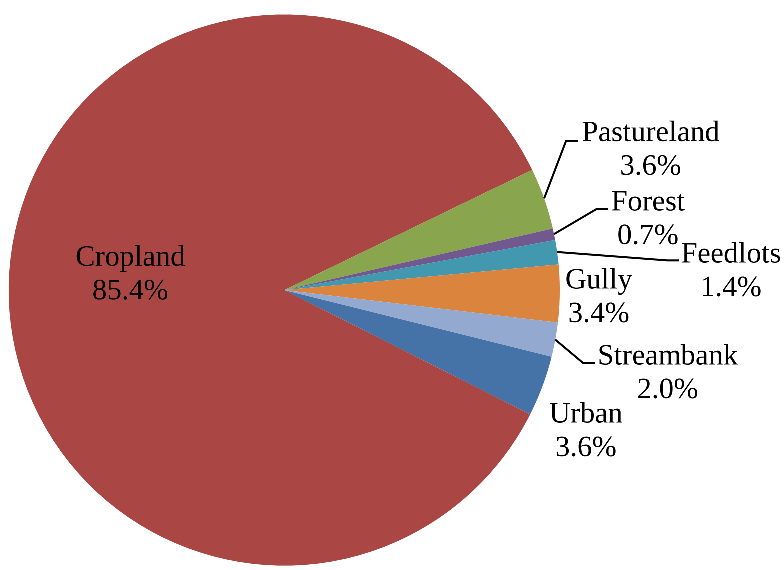


Figure 20. STEPL model baseline TP loading in Upper East River Watershed.

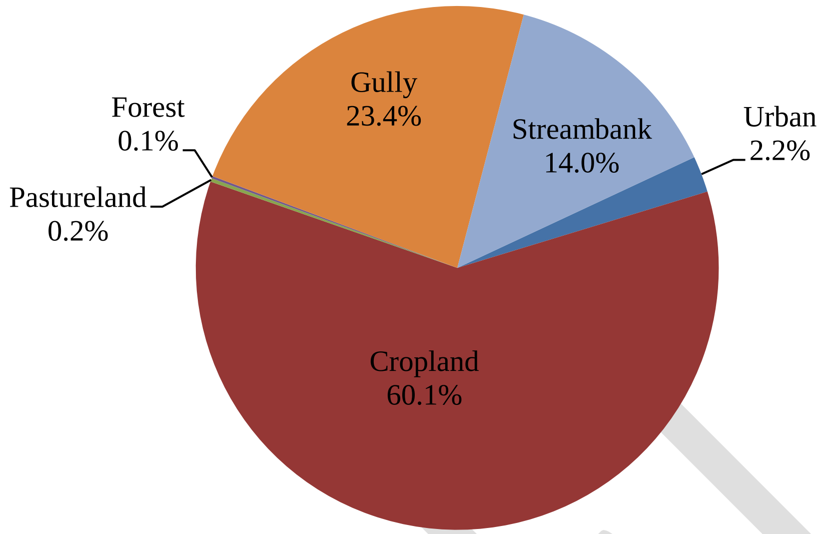


Figure 21. STEPL model baseline TSS loading in the Upper East River Watershed.

6.0 Watershed Inventory

6.1 Barnyard Inventory Results

Location and data on current livestock operations was compiled through existing Land Conservation Department data, air photo interpretation, and windshield surveys. Additional barnyard data was collected by meetings with farm owners. There are a total of 46 active livestock operations with an estimated 21,398 cattle including dairy, beef, and veal farms. In addition there is also one farm in the watershed with about 75 swine. Five of these farm sites are permitted CAFO's with one farm site in the process of obtaining a CAFO permit. All CAFO's were assumed to have zero discharge from their production area. A large majority of the land in this watershed is owned and operated by CAFO's. There are an estimated 15,657 animal units attributed just to the CAFO operations in this watershed. Locations of livestock operations in the watershed are shown in Figure 22.

Barnyard data was entered in to the NRCS BARNY spreadsheet tool to estimate phosphorus loading. According to the BARNY calculations an estimated 310 lbs of phosphorus per year can be attributed to barnyard runoff. STEPL model loading estimates barnyard phosphorus loading slightly higher at 388 lbs of phosphorus. Barnyard runoff accounts for approximately 1% of the total phosphorus loading from agriculture.

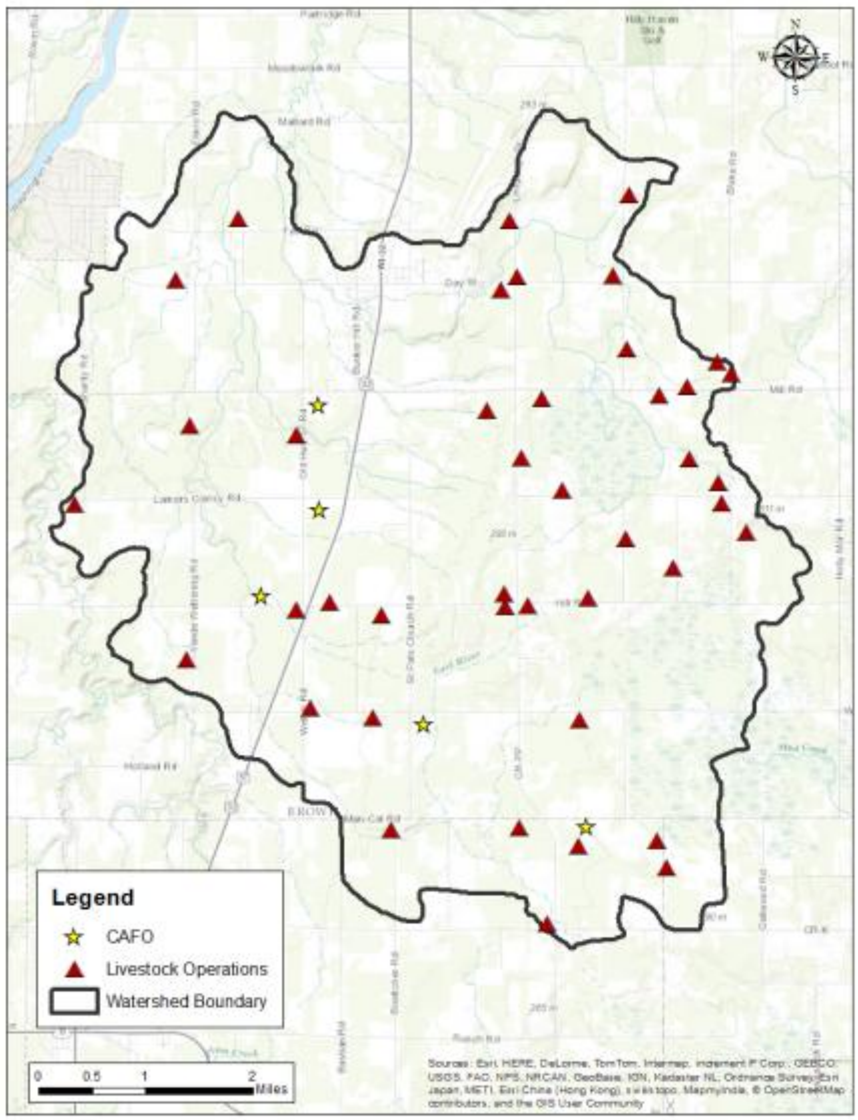


Figure 22. Location of livestock operations.

The majority of the farm sites have already had runoff management measures and waste storage installed during the East River Priority Watershed Project that ended in 2003. Barnyard runoff is not a significant source of phosphorus in this watershed. Barnyards that exceed the annual phosphorus discharge limit of 15 lbs/year will be eligible for cost share assistance to obtain necessary reductions in phosphorus loading. There are only 6 farm sites with phosphorus discharges of 15 lbs/year or more according to the BARNY model. A few of the farm sites may need to expand current manure storage and some sites will need to repair and perform maintenance on already installed practices. Most of these sites can reduce their annual load with low cost practices such as roof gutters, filter strips, and fencing.

Table 13. Farm sites with 15 lbs/yr P discharge or greater.

FARM #	P (lbs/yr)
4021	64.00
4027	63.90
4104	32.60
4122	18.80
4076	18.00
4024	16.00

6.2 Streambank Inventory Results

The Wisconsin DNR 24K Hydrography data set was used to determine the location of perennial and intermittent streams in the watershed area. There are approximately 98 miles of perennial and intermittent streams in the Upper East River watershed including its tributaries. Streambank erosion was inventoried by walking the streams with an Ipad using the ArcCollector application. Information on lateral recession, soil type, height, and length were collected with the app as well as GPS located photos. Twelve miles of perennial and intermittent stream were inventoried. Of the 12 miles inventoried a little over 8 miles was actively eroding. Inventoried streambank erosion is shown in Figure 23.

Sediment loss was calculated for the 12 miles of blue line perennial and intermittent streams using the NRCS Direct Volume Method:

$$[(eroding\ area)(lateral\ recession\ rate)(density)] \div \left(2000\,\frac{lbs}{ton}\right) = erosion\ in\ tons/year$$

Lateral recession rate was determined by Table 14 and density was determined by soil type using Table 15. The lowest value for lateral recession rate was used for all calculations; therefore streambank erosion estimates are on the conservative side. Sediment loss calculations for inventoried sites are shown in Table 16. The amount of sediment loss for the remaining 86 miles of intermittent and perennial stream that was not inventoried was extrapolated. The estimated amount of annual gross sediment loss due to stream bank erosion in Upper East River is approximately 1,154 tons/year. Adjacent gullies and eroding ravines entering into the stream were also inventoried. The following NRCS equation was used to estimate sediment coming from the adjacent gullies and eroding ravines:

$$[(volume)(soil\ density\ (pcf))/2000)(number\ of\ years\ gully\ has\ been\ active) = soil\ loss\ (tons/year)]$$

The adjacent gullies/ravines inventoried had an estimated 38 tons/year sediment loss.

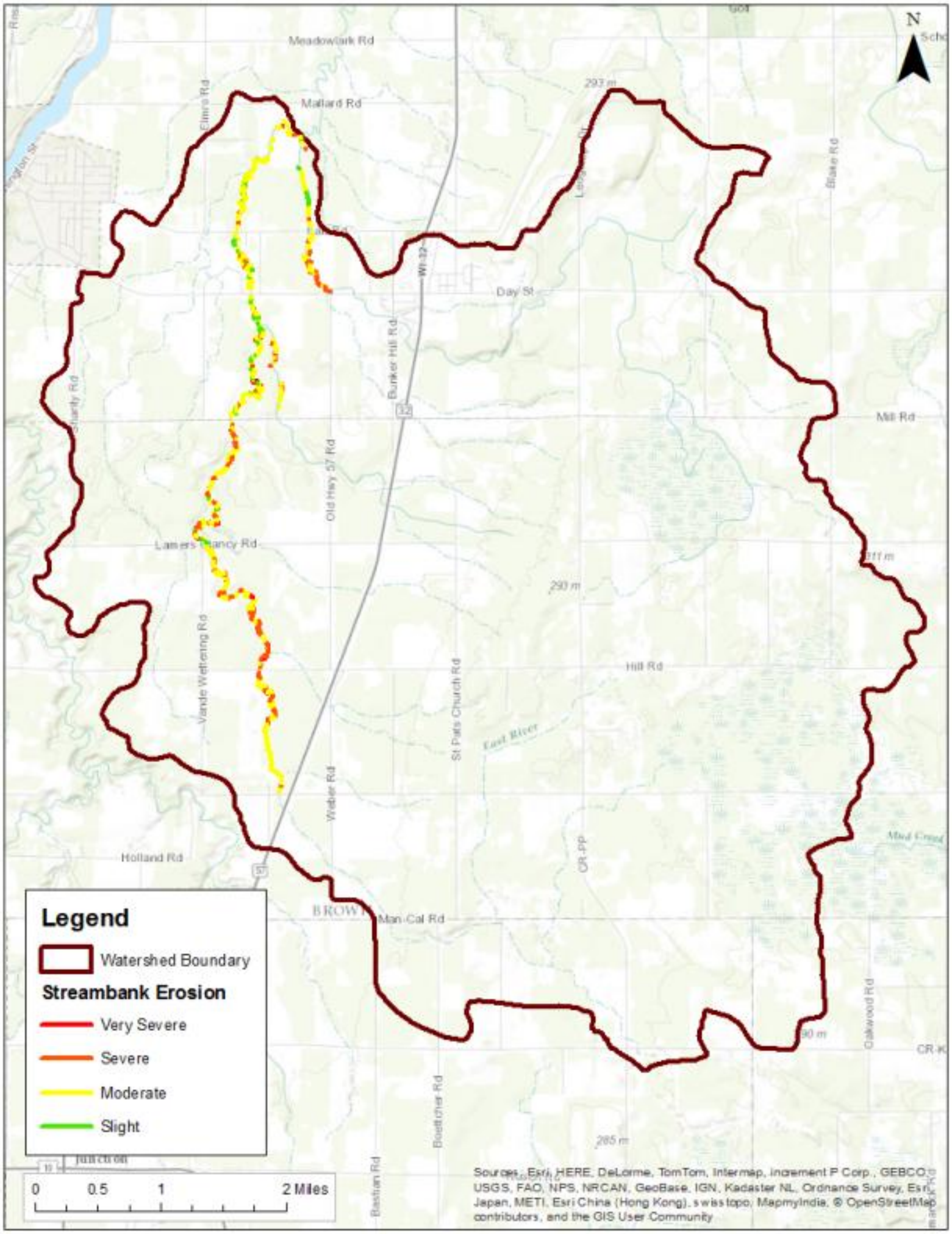


Figure 23. Inventoried Streambank Erosion.

Table 14. Description of Lateral Recession Rates**.** Source: NRCS 2003

Lateral Recession Rate (ft/yr)	Category	Description
0.01-0.05	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
0.06-0.2	Moderate	Bank is predominantly bare with some rills and vegetative overhang. Some exposed tree roots but no slumps or slips.
0.3-0.5	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross section becomes U-shaped as opposed to V-shaped.
0.5+	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross section is U-shaped and stream course may be meandering.

Table 15. Soil density. Source: NRCS 2003

Soil Texture	Volume-Weight (pcf)
Clay	60-70 pcf
Silt	75-90
Sand	90-110
Gravel	110-120
Loam	80-100
Sandy loam	90-110
Gravelly loam	110-120

Table 16. Amount of erosion inventoried in the Upper East River.

Upper East River	Lateral Recession			
	Very Severe	Severe	Moderate	Slight
length (ft)	765	10,952	28,417	3,722
sediment (tons/yr)	78	517	250	4.8

The amount of sediment actually delivered to the Fox River depends on factors such as channelization, straightening, modification, and amount of disturbed channels. By using the NRCS Field Office Technical Guide for Erosion and Sediment Delivery, a sediment delivery ratio of 80% was assumed (Table 17). Using the 80% sediment delivery ratio, the amount of sediment that is actually delivered to the Fox River from streambank erosion is estimated to be about 923 tons/year which is 15% of the STEPL modeled baseline load. There is an estimated 572 lbs of P loading attributed to stream bank erosion which is 2.0 % of the total phosphorus loading from agriculture. Adjacent gullies and ravines add another 30 tons sediment/year and approximately 19 lbs of phosphorus/year. Inventory data indicates that stream bank erosion is a significant source of sediment in this subwatershed. Pictures and locations of a few of the severe erosion sites inventoried are shown in Figure 24.

Table 17. Sediment Delivery Rations. Source: NRCS 1998

Erosion Type	Integrated drainage, Incised Channel (%)	Nonintegrated drainage, Nonincised channel (%)
Ephemeral Gully	50-90	20-50
Classic Gully	80-100	60-80
Streambank	80-100	60-80

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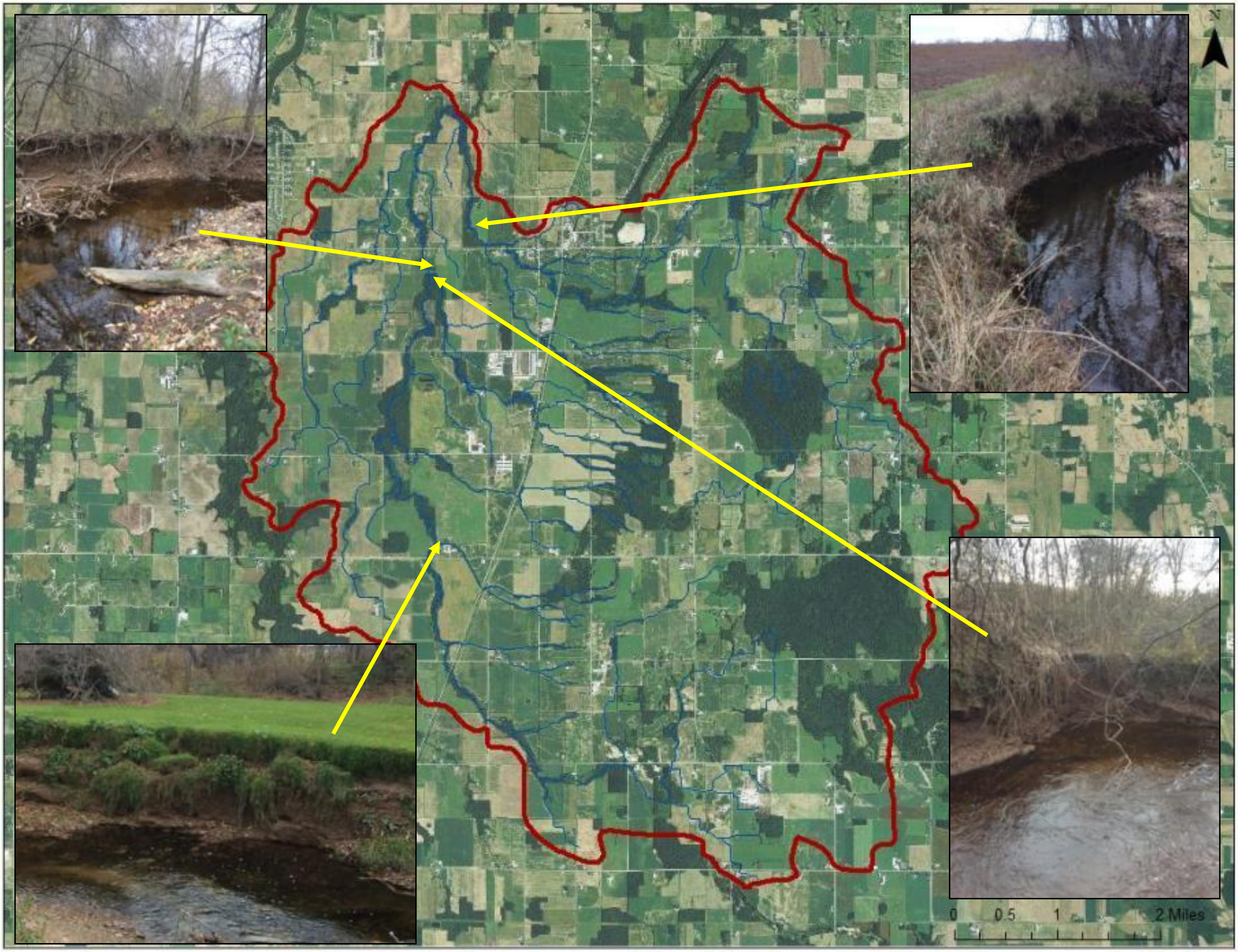

Figure 24. Streambank erosion sites on Upper East River.

Excess runoff to the streams and flooding is likely the cause of the majority of the stream erosion. Regular severe flooding of the Upper East River is common and affects many landowners in the area. Flooding of the stream in one resident's backyard is shown in Figure 25. Streambank degradation due to livestock access is not a significant issue in this watershed. There are only 3 farms sites where livestock have free access to a stream or tributary.

Figure 25. Flooding of Upper East River (photo credit: James Wochos)

Stabilizing eroding streambanks will help decrease the amount of sediment loading coming from the watershed. Due to the terrain and thick vegetation, many sites of streambank erosion are not easily accessible and therefore not feasible for restoration. Sites were assessed to be feasible for restoration if they had moderate to very severe lateral recession and were easily accessible. There are 63 sites where streambank restoration would be feasible (Table 18). Sites with 3 tons of sediment loss per year or greater will be considered high priority sites for stabilization. Gullies emptying into the stream were also analyzed for stabilization feasibility. There are 8 gullies that are feasible for stabilization. Practices that slow the flow of water to the stream and its tributaries as well as store water will be necessary to prevent further streambank degradation. These practices would consist of wetland restoration, buffers, grassed waterways, water and sediment control basins, and cover crops.

Table 18. Streambank Restoration Feasible sites.

Site ID	Erosion Type	Lateral Recession	Length	Sediment Loss (tons/year)	Feasibility
848	undercutting	Very Severe	264.51	16.86	Feasible
2278	undercutting	Severe	217.97	11.12	Feasible
2332	undercutting	Severe	178.59	9.11	Feasible
1844	undercutting	Severe	172.06	7.68	Feasible
2259	undercutting	Severe	109.70	5.59	Feasible
2565	undercutting	Severe	100.45	5.12	Feasible
1902	undercutting	Severe	133.03	5.09	Feasible
2572	undercutting	Severe	98.71	5.03	Feasible
2277	undercutting	Severe	96.75	4.32	Feasible
2569	undercutting	Severe	77.63	3.96	Feasible
2280	undercutting	Severe	86.61	3.86	Feasible
2236	undercutting	Severe	100.41	3.84	Feasible
2598	vertical bank	Severe	54.88	3.50	Feasible
1885	undercutting	Severe	82.46	3.15	Feasible
1891	undercutting	Severe	57.26	2.92	Feasible
2625	vertical bank	Moderate	156.99	2.80	Feasible
866	undercutting	Severe	52.74	2.69	Feasible
4950	undercutting	Severe	67.69	2.59	Feasible
829	undercutting	Moderate	389.14	2.48	Feasible
2286	undercutting	Severe	64.76	2.48	Feasible
1900	undercutting	Severe	48.21	2.46	Feasible
916	undercutting	Moderate	233.04	2.38	Feasible
1916	undercutting	Severe	55.73	2.13	Feasible
907	slumping	Severe	39.66	2.02	Feasible
2295	undercutting	Moderate	192.22	1.96	Feasible
1878	undercutting	Severe	28.09	1.79	Feasible
2617	vertical bank	Moderate	174.99	1.78	Feasible
2315	undercutting	Severe	33.70	1.72	Feasible
2574	undercutting	Severe	31.98	1.63	Feasible
809	undercutting	Moderate	157.51	1.61	Feasible
2324	undercutting	Moderate	206.94	1.58	Feasible
2242	undercutting	Moderate	203.18	1.55	Feasible
864	undercutting	Moderate	69.20	1.41	Feasible
835	undercutting	Severe	27.26	1.39	Feasible
2582	vertical bank	Moderate	133.55	1.36	Feasible

Site ID	Erosion Type	Lateral Recession	Length	Sediment Loss (tons/year)	Feasibility
807	slumping	Severe	23.11	1.33	Feasible
2633	vertical bank	Moderate	84.19	1.29	Feasible
2568	undercutting	Moderate	124.36	1.27	Feasible
2590	vertical bank	Moderate	146.31	1.12	Feasible
2275	undercutting	Severe	28.12	1.08	Feasible
936	undercutting	Moderate	100.10	1.02	Feasible
2610	undercutting	Moderate	100.03	1.02	Feasible
858	slumping	Moderate	60.94	0.93	Feasible
2604	undercutting	Moderate	81.76	0.83	Feasible
812	undercutting	Moderate	79.56	0.81	Feasible
2562	vertical bank	Moderate	79.45	0.81	Feasible
2311	undercutting	Moderate	102.36	0.78	Feasible
2627	undercutting	Moderate	144.66	0.74	Feasible
2609	vertical bank	Moderate	67.50	0.69	Feasible
2581	vertical bank	Moderate	73.11	0.65	Feasible
921	undercutting	Moderate	83.24	0.64	Feasible
2297	undercutting	Moderate	90.83	0.58	Feasible
951	undercutting	Moderate	74.34	0.57	Feasible
994	undercutting	Moderate	54.73	0.56	Feasible
817	undercutting	Moderate	68.69	0.53	Feasible
2246	undercutting	Moderate	66.87	0.51	Feasible
2612	undercutting	Moderate	48.34	0.49	Feasible
806	undercutting	Moderate	49.83	0.44	Feasible
2618	undercutting	Moderate	51.72	0.40	Feasible
2252	undercutting	Moderate	47.06	0.36	Feasible
865	undercutting	Moderate	41.23	0.32	Feasible
2263	undercutting	Moderate	40.44	0.31	Feasible
4951	undercutting	Moderate	39.11	0.30	Feasible

Table 19. Feasible gully/ravine stabilization sites.

Site ID	Erosion Type	Length	Sediment Loss (tons/year)	Feasibility
4944	gully	49.11	4.68	Feasible
2594	gully	73.92	4.04	Feasible
2271	gully	49.89	3.34	Feasible
1919	gully	59.41	3.13	Feasible
4947	gully	16.62	2.17	Feasible
1873	gully	17.21	1.16	Feasible
1892	gully	30.20	0.80	Feasible
4948	gully	14.53	0.50	Feasible

6.3 Upland Inventory

Agricultural uplands were inventoried by windshield survey, use of GIS data and tools, and with aerial photography. The use of a tool developed by the WDNR called EVAAL (Erosion Vulnerability Assessment for Agricultural Lands) and its data sets were used to determine priority areas for best management practices in the watershed. The tool estimates the vulnerability of a field to erosion and can be used to determine internally draining areas, potential for gully erosion, and potential for sheet and rill erosion. Other GIS methods also used to determine priority areas include the Compound Topographic Wetness Index and Normalized Difference Tillage Index.

Tillage Practices and Residue Management

Data was analyzed from the Conservation Technology Information Center (CTIC) Conservation Tillage Reports (Transect Surveys) from Brown, Outagamie, Calumet, and Winnebago Counties to determine primary tillage practices for the SWAT model input for the Lower Fox River TMDL. Baseline tillage conditions were based on data averages from 1999, 2000, and 2002. The baseline tillage conditions for a dairy rotation were determined to be 83.1% Conventional Tillage, 15.2 % Mulch Till, and 1.7% No till and 75.9 % Conventional Tillage, 20.2 % Mulch Till, and 3.9% No till for Cash Crop Rotation (WDNR 2012).

Figure 26. Field in watershed being intensively tilled leaving little crop residue (10/9/2014).

Crop residue levels and tillage intensity can be analyzed from readily available satellite imagery. Since tillage takes place at different times a series of photos were chosen for analysis. Satellite photos from 3/20/2010, 4/5/2010, and 5/23/2010 were used to calculate a minimum Normalized Difference Tillage Index (NDTI). The NDTI estimates crop residue levels based on shortwave infrared wavelengths. The mean minNDTI values per agricultural field for the spring of 2010 are shown in Figure 27. It is also important to note that the majority of Green Vegetation areas shown in Figure 27 are in the alfalfa/hay years of a dairy crop rotation and are not permanent grassland. This analysis of imagery can be used to identify areas needing BMP’s as well as a way to track implementation of practices since satellites regularly circle the earth. Correlations between NDTI values and percent crop residues can be more accurately estimated by doing field verifications in the watershed.

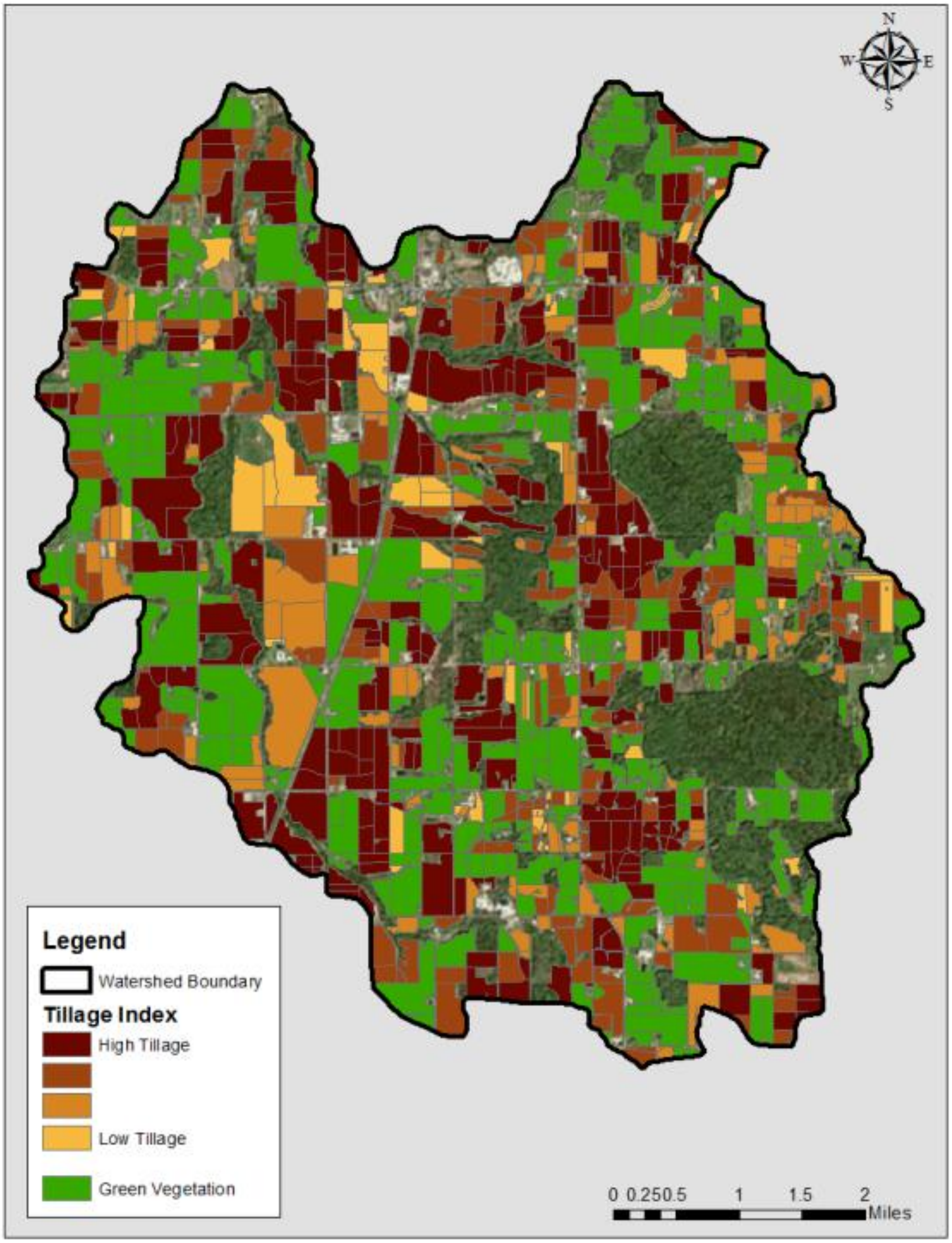

Figure 27. Spring 2010 Mean minNDTI (Normalized Difference Tillage Index) values.

Erosion Vulnerability

The EVAAL[2] (Erosion Vulnerability Analysis for Agricultural Lands) tool was used to determine areas in the watershed that are more prone to sheet, rill, and gully erosion. The tool analyzes the watershed based on precipitation, land cover, and elevation data. The resulting outputs of the tool are an Erosion Score, Stream Power Index, and Soil Loss Index. Figure 28 shows the EVAAL erosion score indicating which fields are more susceptible to erosion based on USLE[3], SPI, and internally draining areas. By running the EVAAL tool twice for the USLE and using the high C-factor for "worst case" and low C-factor for "best case" scenarios, the worst case can be subtracted from the best case which indicates areas with the greatest potential for improvement (Figure 29). These maps are an important tool in indicating which fields are contributing the most sediment and phosphorus in comparison to other fields in the watershed, therefore indicating where best management practices are going to benefit the most in the watershed.

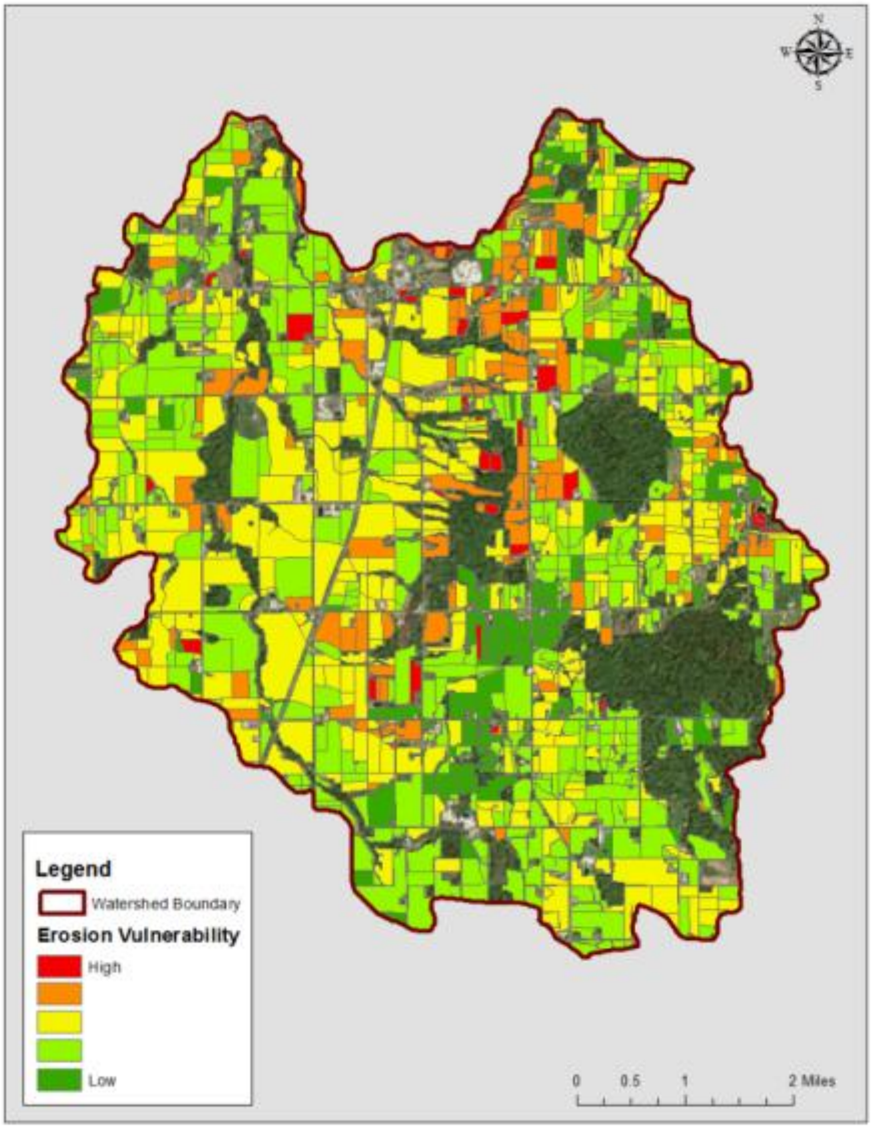

Figure 28. Erosion vulnerability.

[2] Additional information on EVAAL can be found at http://dnr.wi.gov/topic/nonpoint/evaal.html.
[3] USLE refers to the Universal Soil Loss Equation that estimates average annual soil loss caused by sheet and rill erosion base on the following factors: rainfall and runoff (A), soil erodibility factor (K), slope factor (LS), crop and cover management factor (C), and conservation practice factor (P).

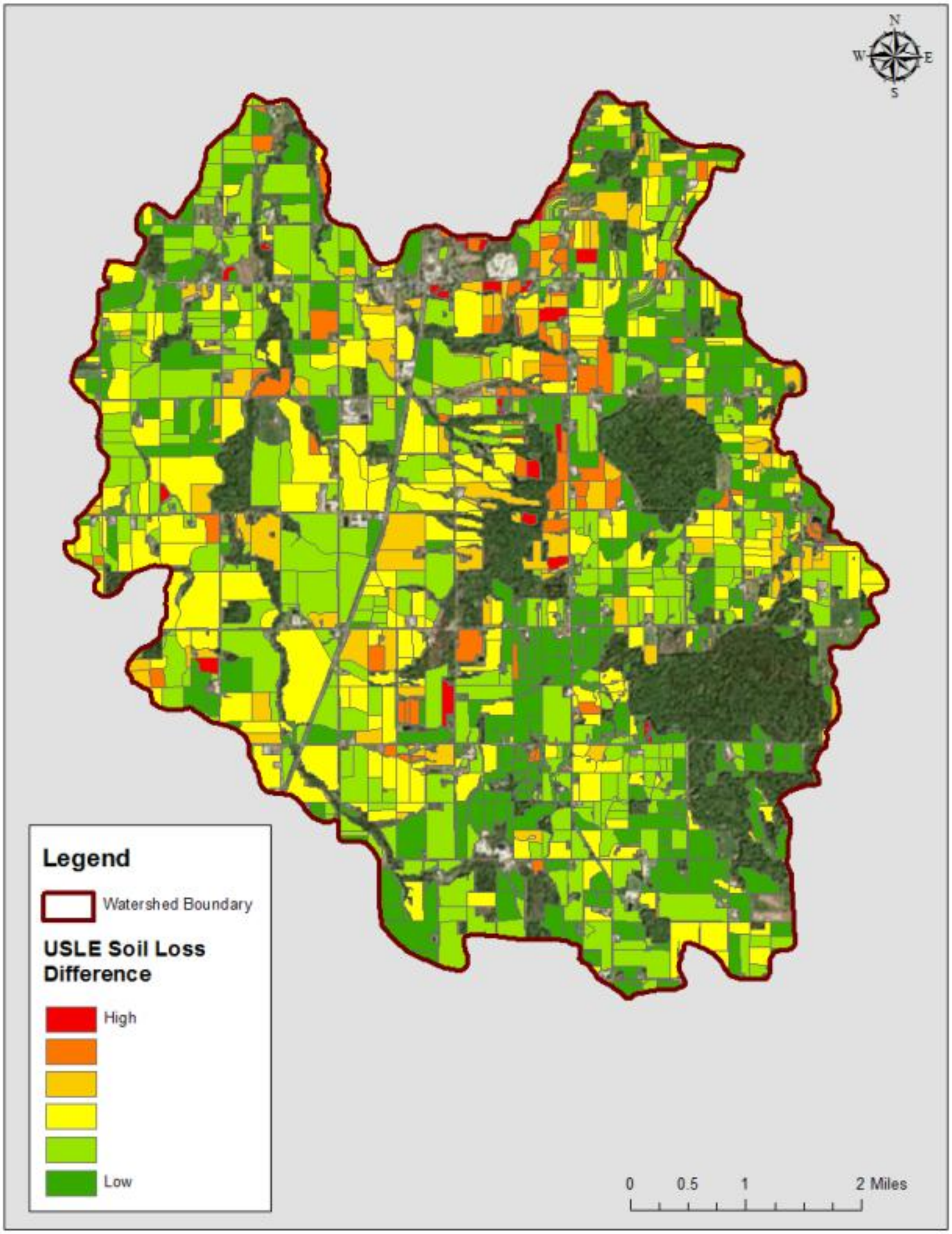

Figure 29. USLE (high cover – low cover) Soil Loss Difference.

Nutrient Management Planning

Nutrient management plans are conservation plans specific to anyone who applies manure or commercial fertilizer. Nutrient management plans address concerns related to soil erosion, manure management, and nutrient applications. Nutrient management plans must meet the standards of the Wisconsin NRCS 590 standard.

The majority of land in the Upper East River is covered under a nutrient management plan. Nutrient management coverage is shown by parcel in Figure 30. There are approximately 16,782 acres covered by NMP and 1,236 acres not covered in the watershed. This watershed has high nutrient management cover due to the amount of CAFO owned and operated land and the East River Priority Watershed Project that ended in 2003. Even though the majority of land in this watershed is covered by nutrient management plans water quality still remains poor. This indicates that the current use of nutrient management planning is not adequate enough to improve water quality. This can likely be attributed to plans not being followed correctly and also that a P Index of less than 6 may be needed to attain water quality goals in this watershed.

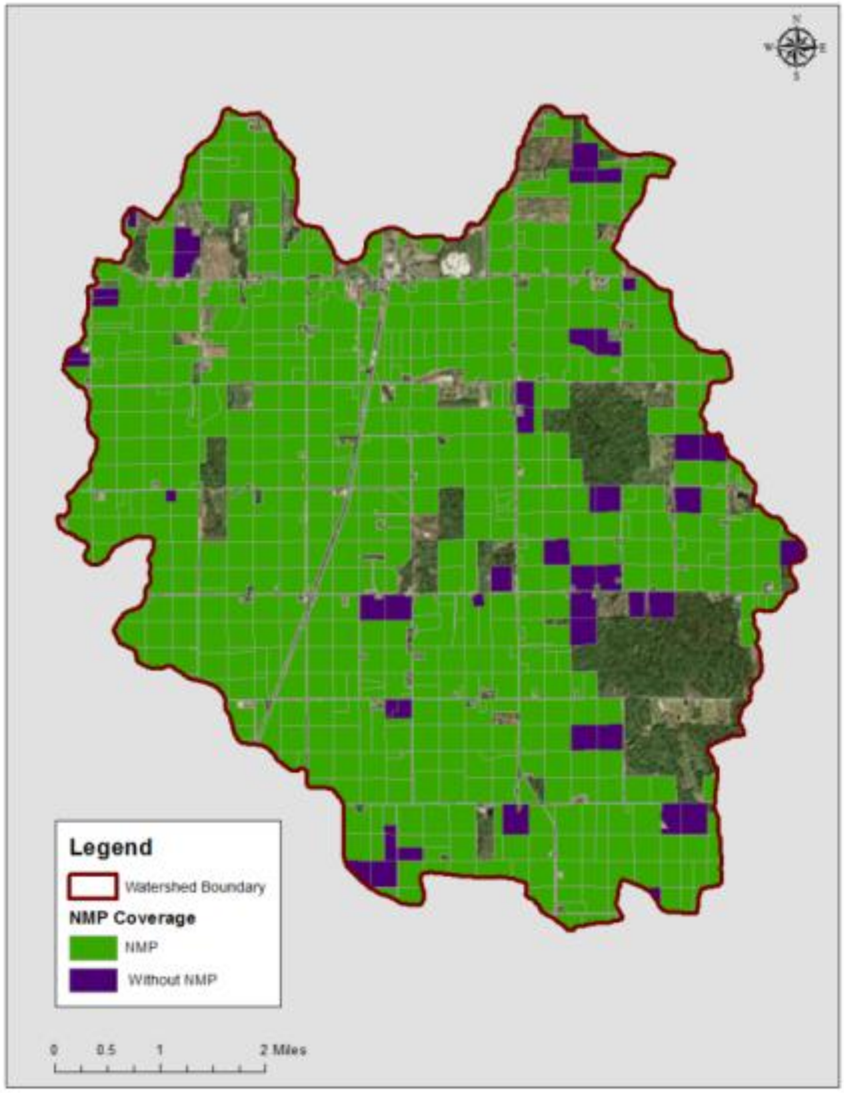

Figure 30. Nutrient Management Plan coverage.

The amount of livestock in this area has been increasing while the amount of farm land has decreased. The widespread use of liquid manure to fertilize crops and more crops grown for forage leaving little crop residue to prevent soil erosion is likely a significant contributor to phosphorus loading. There is an estimated 15,695 acres of agricultural land in the watershed, and an estimated 21,398 animal units. This adds up to less than 1 acre of agricultural land per animal unit in the watershed area.

According to a study done by Saam et al. (2005) having less than 1 acre of cropland per animal unit is likely to result in excess nitrogen and phosphorus (Table 20).

Table 20. Calculated animal: cropland ratio threshold levels for Wisconsin dairy farms. (Saam et al, 2005)

Animal density category	Animal: Cropland Ratio (AU-acre-1)	acres/cow	Implication for nutrient management
Low	<0.75	2	Crop P requirements met by manure, N deficit
Medium	0.75 to 1.5	1-2	P surplus, crop N requirements met by manure
High	>1.5	less than 1	P and N surplus

Figure 31. Manure runoff from field in Upper East River Watershed (11/5/2014).

Alternative ways of handling manure in this watershed will likely need to be implemented to meet TMDL reductions in phosphorus. Vertical manure injection is a newer method of applying manure to fields that is recommended for this watershed area. Vertical manure injection allows manure to be incorporated into the soil with minimal disturbance to the soil surface and is compatible with reduced tillage methods and cover crops. Manure injection equipment can be equipped to also allow farmers to side dress manure into growing crops such as corn and soybeans. Manure injection increases the availability of nutrients and decreases the amount of potential manure runoff. Another option is to explore the use nutrient capturing technologies in this watershed. Current nutrient capturing technologies being researched and tested are designed to capture and store nutrients from manure, separate solids, and generate energy. Nutrient rich fertilizers, animal bedding, and energy are all beneficial by products of these technologies. Liquid-solid separation technologies also allow for reuse of water and can decreased transportation costs associated with hauling liquid manure.

Phosphorus Index and Soil Test Phosphorus

Phosphorus Index and phosphorus concentrations for fields under Nutrient Management plans have been tracked by Brown County. Soil test phosphorus values and soil test phosphorus concentrations in Brown County fields are shown in Figure 32 . The majority of the fields in the watershed meet the PI index of 6. Tracking of soil test phosphorus concentrations and P index in the watershed will be useful in prioritizing fields for improved management practices.

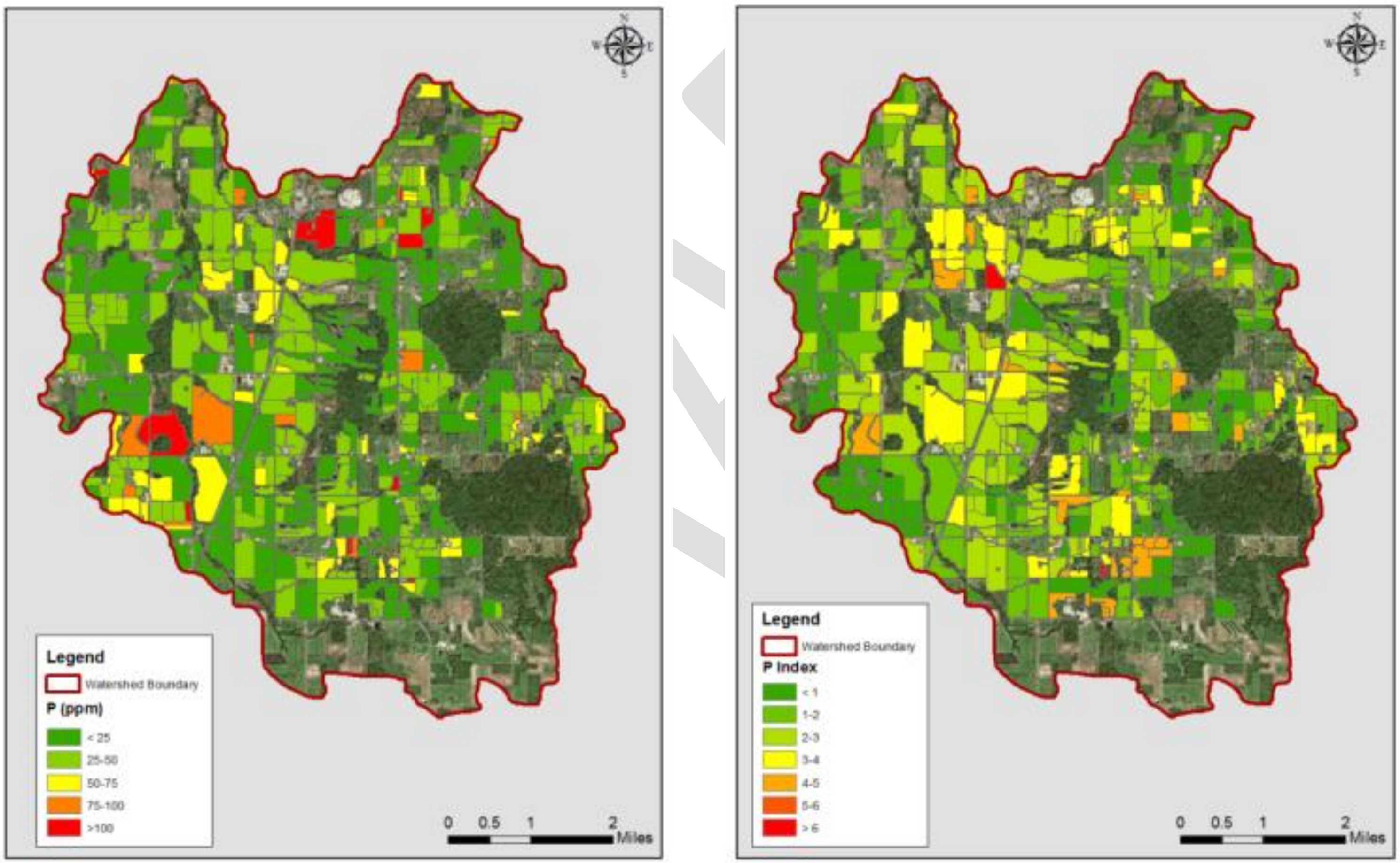

Figure 32. Soil test phosphorus concentration (left) and soil Phosphorus Index (right).

Grazing/Pastureland Management

By doing one on one inventory with farms in the area we were able to determine how many farms grazed or pastured their livestock. Approximately 100 acres in the watershed area is currently being used as pasture for livestock. Most of the farmers that do pasture their livestock in the watershed do it for exercise and not as a means of forage with the exception of a few smaller hobby farms with horses and beef cattle.

According to the EVAAL analysis of crop rotations from satellite imagery in the watershed there are 2,547 acres of land in the category of pasture/hay/grassland. Based on our farm site visits and air photo analysis the majority of the land in the pasture/hay/grassland is not pasture but mostly hay fields and grassland. The STEPL model estimated 978 lbs of phosphorus/year and 13 tons of sediment per year can be attributed to the pasture/hay/grass land use category. Since the majority of land in this watershed is owned and operated by large CAFO's, grazing is not viable option for most of the area. Encouraging smaller farms to convert cropland or land used for hay to managed grazing land could result in pollutant reductions but reductions are not likely to be significant. Grazing can also benefit farmers financially by saving them money on fuel costs associated with harvesting, planting, and transportation. Better management of current pastureland can reduce pollutant loading as well.

Wetland Restoration Analysis

Wetlands are an important feature of a watershed. Wetlands provide a number of benefits such as water quality improvement, wildlife habitat, and flood control. According to the USEPA a typical one acre wetland can store about 1 million gallons of water (USEPA 2006). Restoring wetlands and constructing designed wetlands in the watershed area will provide water storage and reduce sediment and phosphorus loading. Constructed treatment wetlands can be used to treat water from tile drains, barnyards, upland runoff, and waste water.

Existing wetland and potentially restorable wetland GIS data was obtained from the Wisconsin Department of Natural Resources (WDNR). A restorable wetland is any wetland that was historically a wetland but has since been drained due to tiling and ditching or has been filled in. The WDNR considers an area a potentially restorable wetland (PRW) if it meets hydric soil criteria and is not in an urban area. There are 2,996 acres of existing wetlands and 964 acres of potentially restorable wetlands in the Upper East River watershed according to the WDNR wetlands and potentially restorable wetlands GIS data(Figure 33).

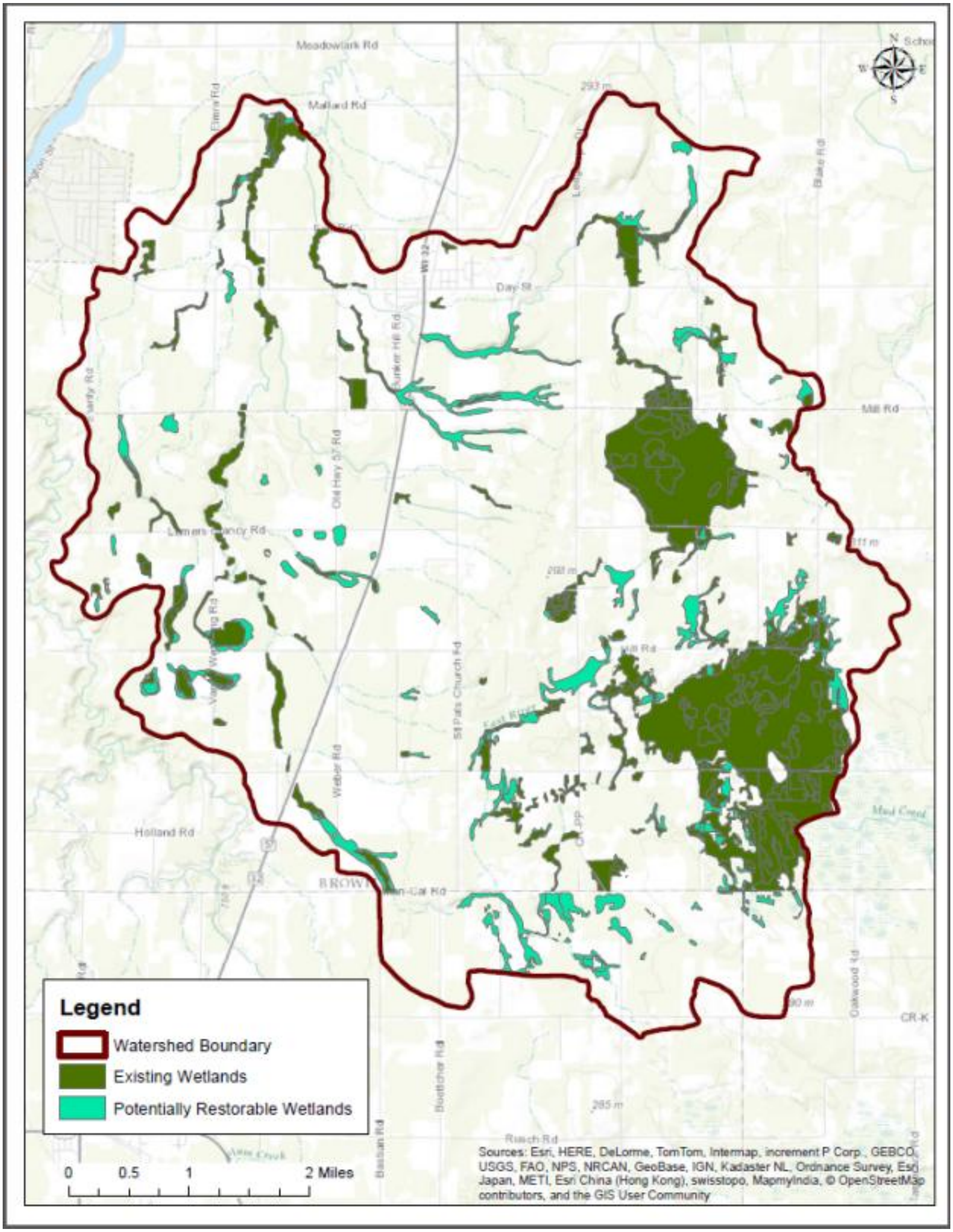

Figure 33. WDNR Existing Wetlands and Potentially Restorable Wetlands.

In addition to the WDNR PRW layer the Compound Topographic Wetness Index was also used to identify potential wetland restoration sites. A high topographic wetness index indicates areas that are likely to be wet and have ponding water. The compound topographic wetness index may indicate potential wetland conditions not indicated by the WDNR Potentially Restorable Wetland Layer as well as confirm sites identified by hydric soils criteria. A CTI value 10 or greater was used to determine high probability of a restorable wetland (Figure 34).

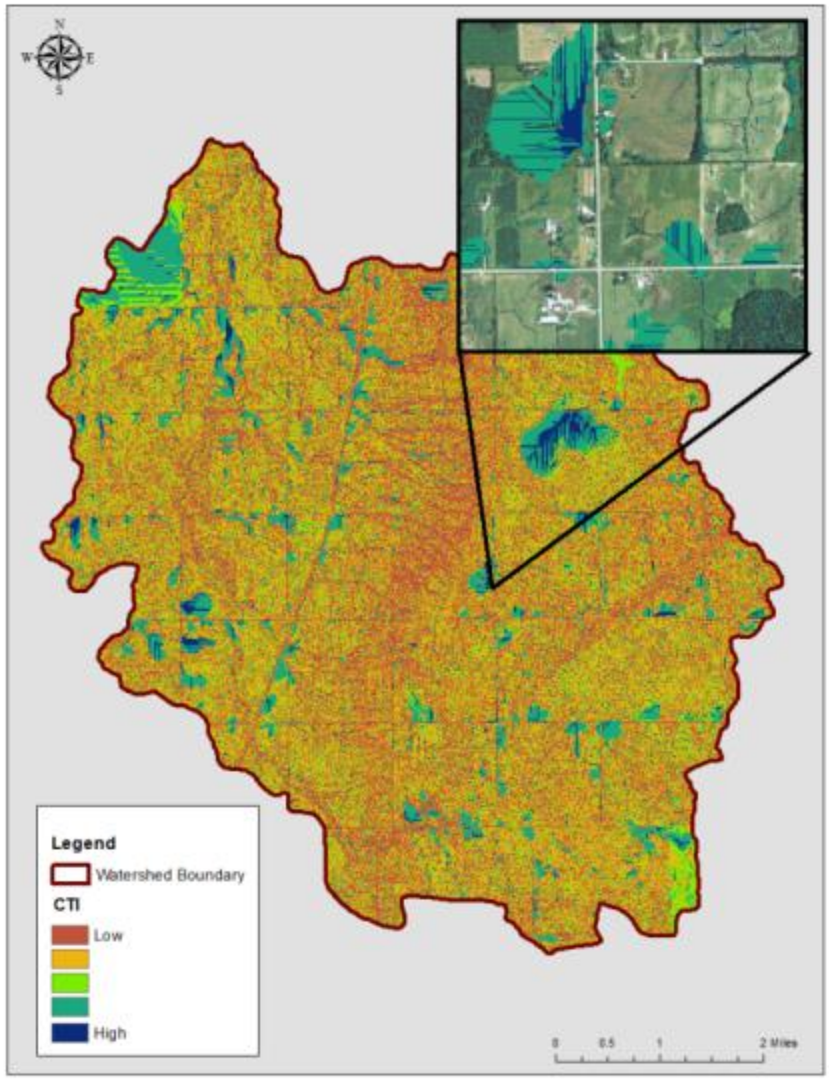

Figure 34. Compound Topographic Wetness Index.

Potential wetland restoration sites identified by the WDNR PRW layer and CTI were further analyzed for feasibility based on size, location, and number of landowners. There were 17 potentially restorable wetland sites determined to be feasible sites totaling 73 acres. Each potentially restorable wetland site was then ranked based on flood water storage, nutrient retention, and sediment retention based on the following features: landform class, landscape position class, water flow path class, and water regime. Table 21 shows the feasible potentially restorable wetlands identified by CTI and/or the WDNR PRW layer and their rank based on flood water storage, nutrient retention, and sediment retention. Any potential wetland restoration will have to be further evaluated prior to any planning and implementation.

Table 21. Potentially Restorable Wetland sites in the Upper East River Watershed.

Site ID	Wetland Identifier	Acres	Priority
1	CTI & PRW	7.43	High
2	CTI & PRW	5.90	High
3	CTI & PRW	8.95	High
4	CTI & PRW	3.02	Low
5	CTI & PRW	2.30	Medium
6	PRW	1.61	Low
7	CTI & PRW	0.89	Low
8	PRW	5.67	High
10	CTI & PRW	4.21	Low
12	CTI & PRW	5.27	High
13	CTI & PRW	3.14	High
14	CTI	7.09	High
15	CTI	1.82	High
16	CTI	4.85	Medium
17	CTI & PRW	6.59	High
18	CTI	0.92	Low
19	CTI & PRW	3.63	High

* CTI refers to Compound Topographic Index and PRW refers to the WDNR's Potentially Restorable Wetlands Layer based on hydric soils.

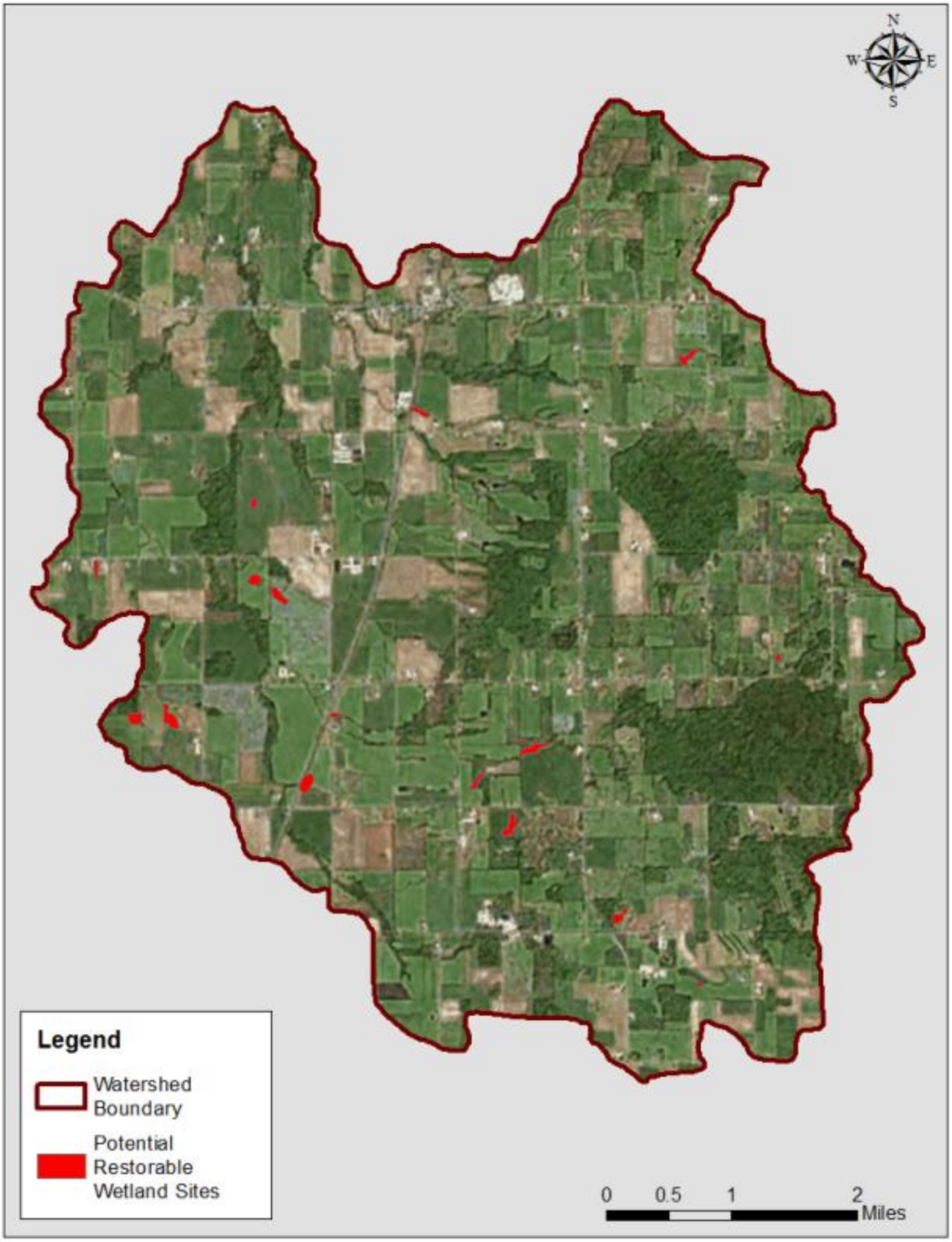

Figure 35. Feasible Potentially Restorable Wetland Sites.

Tile Drainage

Fields with tile drainage were inventoried by using aerial photographs and then mapped using ArcGIS. There were 3,536 acres of fields that had visible signs of tile drainage in the watershed area (Figure 37). Tile drains in fields can act as a conduit for nutrient transport to streams if not managed properly. An average of 0.9 lbs P/acre/yr and 240 lbs sediment/acre/yr was found to be leaving via tile drainage on a UW Discovery Farm study in Kewaunee County, Wisconsin (Cooley et al, 2010). Treating tile drainage at the outlet and better management of nutrient/manure applications on fields can reduce the amount of phosphorus reaching the East River. Some options for treating tile drainage at the outlet include constructing a treatment wetland, biofilters at the outlets, and installation of water control structures to stop the flow of drainage water during poor conditions. Visible tile drain outlets were also noted while doing the stream bank inventory. Eight tile outlets were found during the inventory, four of them causing scouring/erosion as seen in Figure 36. Tile outlets that are causing scouring of the land should be stabilized with rip rap or extended to prevent further erosion and contribution of sediment to the stream or be considered for a treatment wetland.

Figure 36. Tile drainage outlets causing erosion in Upper East River Watershed.

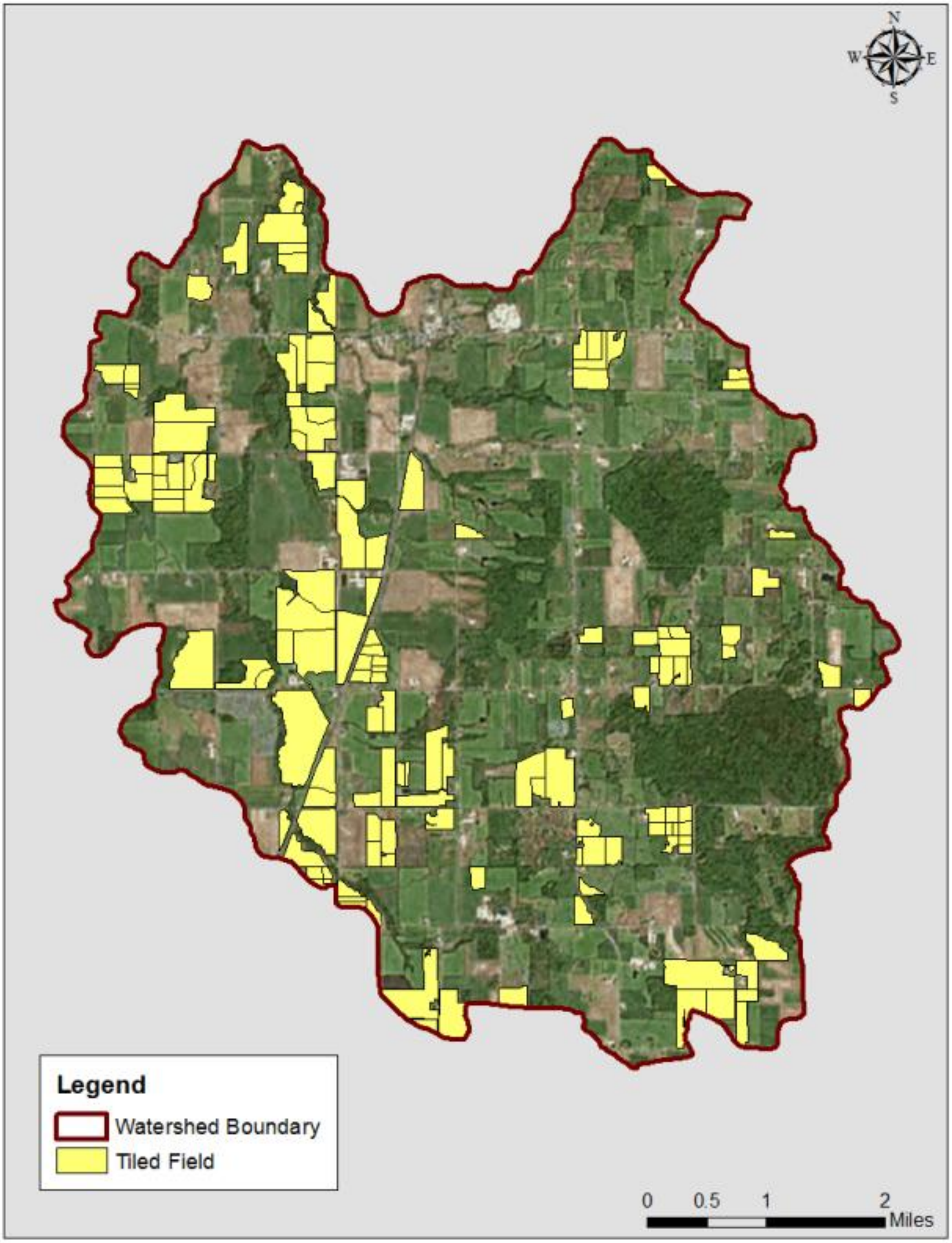

Figure 37. Tiled fields in Upper East River Watershed.

Vegetative Buffer Strips

Riparian Buffers

Riparian buffers filter out sediment and nutrients from water before reaching a stream channel. Buffers also reduce amount of runoff volume, provide wildlife habitat, and help regulate stream temperature. Brown County has an agricultural shoreland management ordinance that prohibits row cropping and tillage practices from land extending 20 feet from the top of the bank on each side of a perennial stream or river, the centerline of an intermittent stream, or the ordinary high-water mark of any lake or pond shown on a United States Geological Survey quadrangle map with a scale of 1:24,000. A minimum 35 ft riparian buffer for any intermittent or perennial stream is recommended for this watershed. In addition to meeting the minimum 35 ft buffer some priority area buffers may need to be extended to 50 ft to provide necessary reductions in pollutant loads. Priority riparian buffer areas were determined using aerial photography, the DNR 24K Hydrography data set, and USGS topography maps. There may be additional streams, drainage ditches, and channels not delineated that could also have vegetated buffer strips installed to improve water quality and riparian habitat. Areas along perennial and intermittent streams needing riparian buffers are shown in Figure 38.

Figure 38. Priority riparian buffer restoration sites.

Tillage Setback and Field Borders

During windshield surveys of the watershed area there were many fields noted that did not have any tillage setback from drainage ditches. The NR 151.03 tillage setback performance standard states that no tillage operation may be conducted within 5 ft from the top of the channel of surface waters, and tillage setbacks greater than 5 ft but no more than 20 feet may be required to meet this standard. Enforcement of NR 151.03 tillage setback standards will be necessary in the watershed. In addition to the mandated tillage setback requirements, some fields may need additional buffer area to protect surface water in road and other drainage ditches. An additional 20 ft field border may be necessary in fields where there are resource protection concerns. Locations that may be ideal for field borders can be identified by using the compound topographic wetness index and stream power index. Figure 39 shows a field with high Compound Topographic Index and Stream Power Index values indicating runoff and water accumulation at the edge of field. From GIS analysis there is an estimated 20 fields that may need a field border along a drainage ditch.

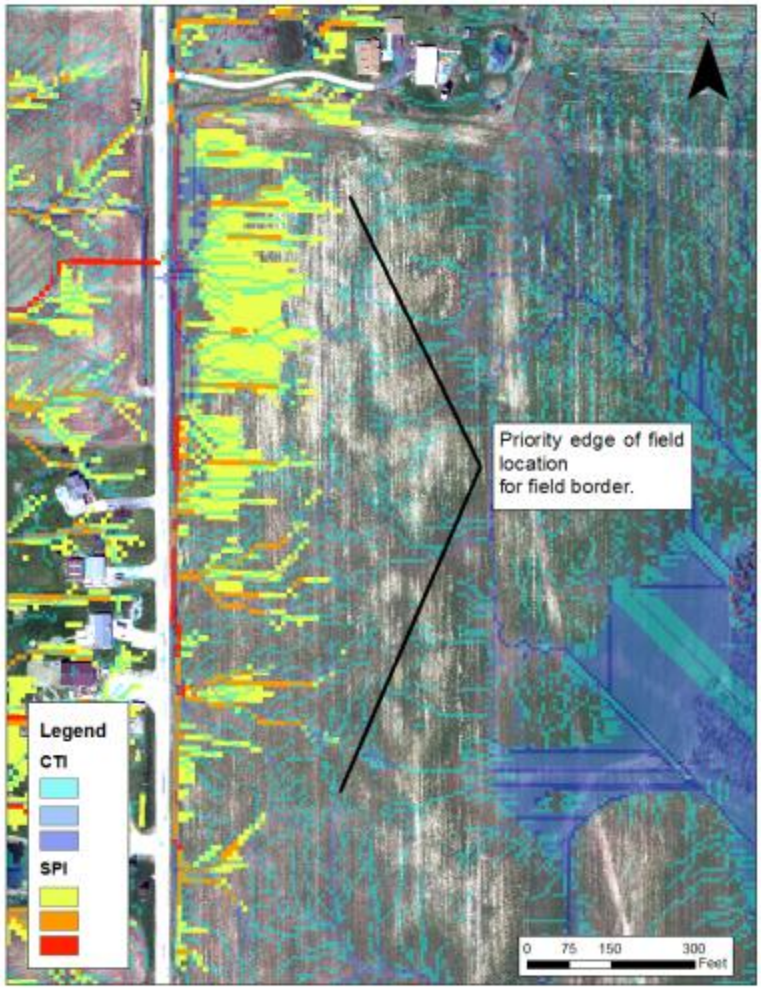

Figure 39. High Compound Topographic Index and Stream Power Index values indicating areas needing vegetated buffers.

Gully and Concentrated Flow Stabilization

Gullies and concentrated flow areas were determined by GIS analysis and by walking fields. Staff from Brown County Land Conservation Department walked several fields in the watershed for Farmland Preservation compliance inventories. Elevation and flow direction data is used to develop a stream power index (SPI) that can indicate areas of concentrated flows that might be gullies. High stream power index values are shown in Figure 40. Stream power index data for the watershed can be found in Appendix D. A high stream power index was used to determine where grassed waterways may be necessary in the watershed. Priority areas for grassed waterways determined by GIS methods and field walks are shown in Figure 41. Concentrated flow areas that have less severe erosion should also be stabilized but do not necessarily require a grassed waterway. To stabilize these less severe concentrated flow areas while still promoting productive agricultural practices, these areas should be seeded with permanent cover. Unlike a grassed waterway, crops can still be planted in the concentrated flow area seeding but the area cannot be tilled. In addition to using grassed waterways and concentrated flow area planting, water and sediment control basins will also be necessary in some locations with gully erosion. Water and sediment control basins usually consist of an earth embankment or a combination ridge and channel generally constructed across the slope and minor water courses to form a sediment trap and water detention basin.

Figure 40. High stream power index indicating potential gully erosion.

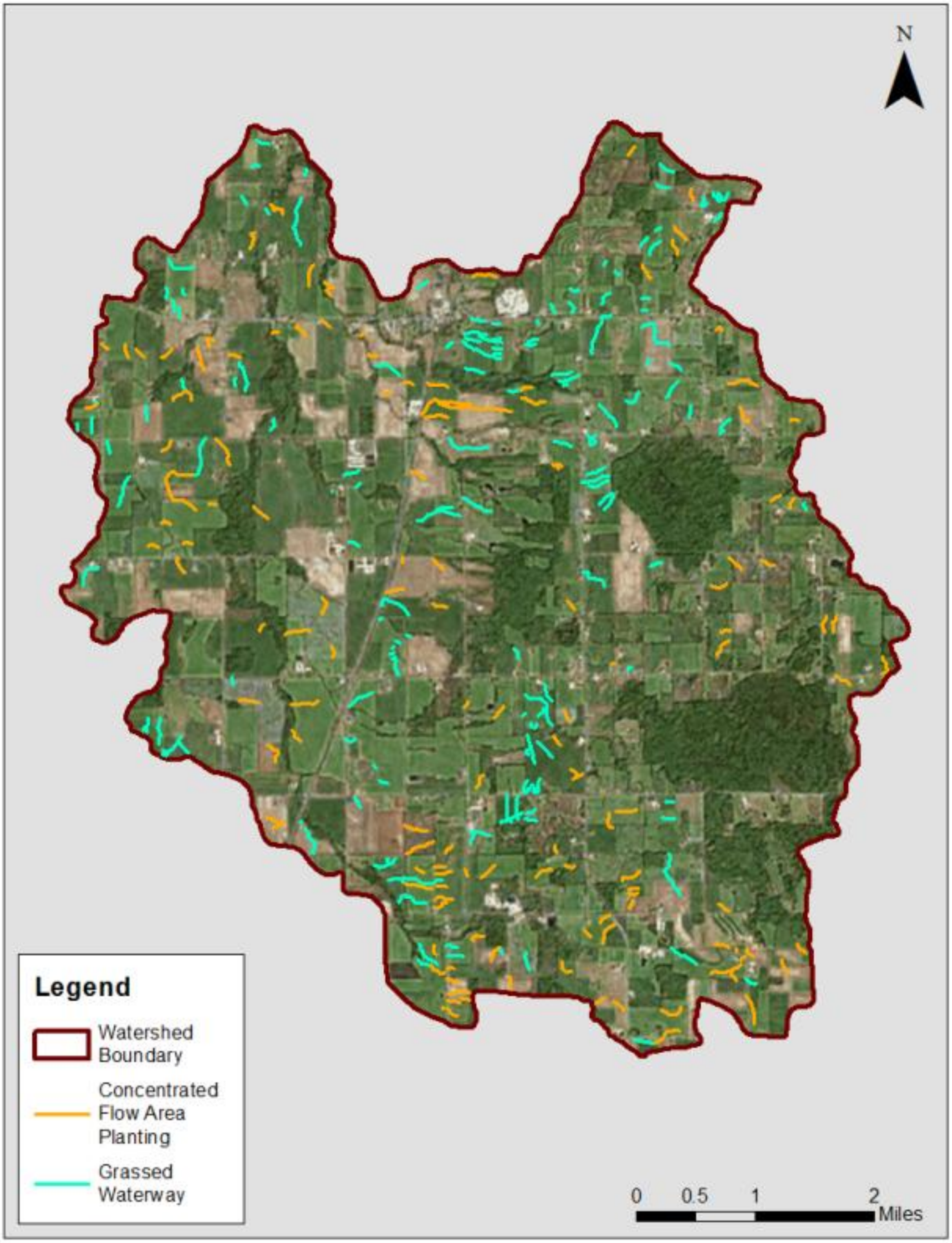

Figure 41. Priority locations for grassed waterways and concentrated flow area planting.

Current Management Practices/Projects

There have been a number of conservation projects installed within the Upper East River Watershed over the last several years. These projects include barnyard runoff control systems, grade stabilization, waste storage facilities, buffers, and nutrient management planning. Manure storage facilities have already been installed at 41 of the production sites in the watershed area. Nutrient management coverage in the watershed is shown in Figure 30 in Chapter 6.3.

In addition, the Brown County Land Conservation Department has installed 60 acres of buffers in the Upper East River through implementation of the East River Priority Watershed Project and the Agricultural Shoreland Management Ordinance.

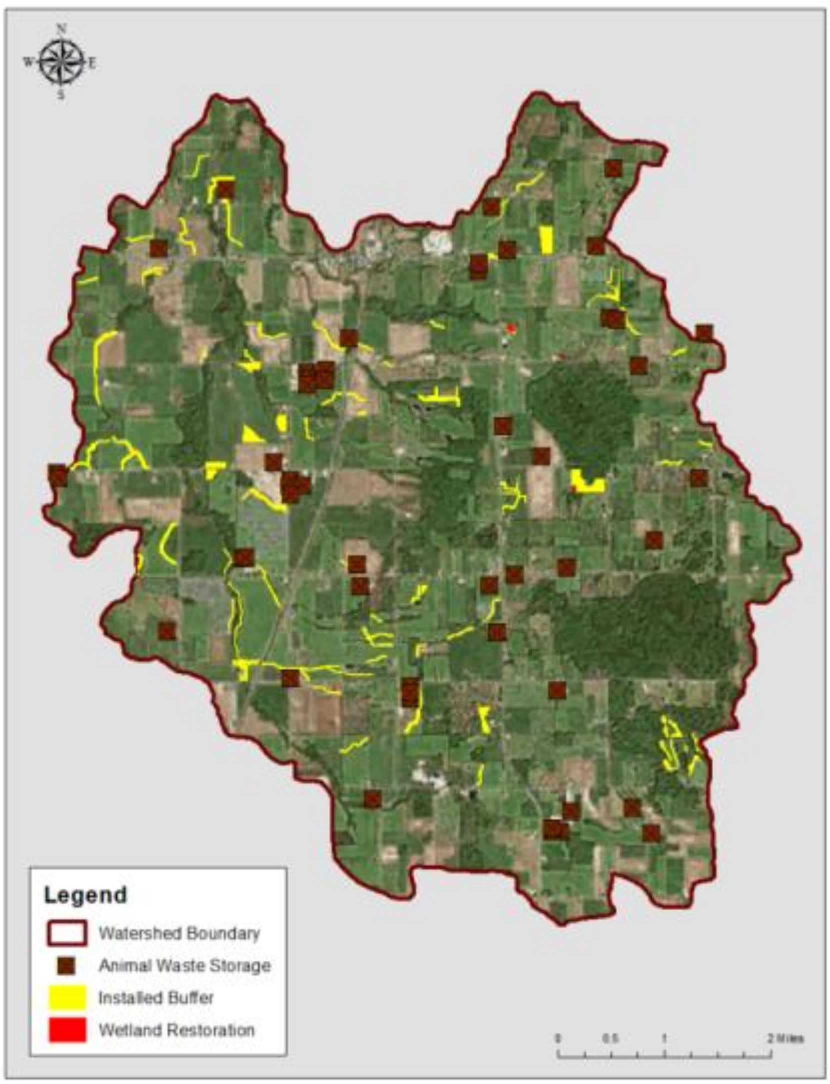

Figure 42. Previous conservation practices installed in the Upper East River.

7.0 Watershed Goals and Management Objectives

The main focus of the watershed project is to meet the limits set by the Lower Fox River TMDL. Additional goals were set that address critical issues in the watershed area based on watershed inventory results. Management objectives address the sources that need to be addressed in order to meet the watershed goals.

Table 22. Watershed Goals and Management Objectives.

Goal	Indicators	Cause or Source of Impact	Management Objective
Improve surface water quality to achieve DNR/EPA water quality standards.	Total Phosphorus, Total Suspended Sediment	High phosphorus levels causing algal growth and decreased dissolved oxygen. Cropland and barnyard runoff.	Reduce the amount of sediment and phosphorus loads from cropland. Reduce the amount of phosphorus runoff from livestock facilities.
Citizens of the watershed area are aware of water quality issues and are involved in the stewardship of the watersheds.	Interview/Questionnaire results	Lack of awareness of environmental issues and their impact.	Increase public awareness of water quality issues and increase participation in watershed conservation activities.
Reduce the flood levels during peak storm events.	Peak flow discharges and flash flooding of the creeks and their tributaries occurring during heavy precipitation events.	Increased impervious area, tile drainage, and ditching. Inadequate storm water practices. Poor soil health.	Reduce the flow of runoff from upland areas to streams. Increase soil infiltration.
Improve streambank stability and reduce amount of streambank degradation.	Moderate to severe erosion characterized by undercutting, vertical banks, and slumping. Meandering and redirection of flow.	High peak flows to stream, flooding, and inadequate riparian vegetation.	Restore and stabilize degraded streambanks.

8.0 Management Measures Implementation

The Upper East River Watershed plan presents the following recommended plan of actions needed over the next 10 years in order to achieve water quality targets and watershed goals. The plan implementation matrix (Table 23) provides a guideline to what kinds of practices are needed in the watershed and to what extent they are needed to achieve the watershed goals. The plan provides a timeline for which practices should be completed, possible funding sources, and agencies responsible for implementation.

Existing runoff management standards have been established by the State of Wisconsin. Chapter NR 151 provides runoff management standards and prohibitions for agriculture. This plan recommends enforcement of the state runoff standards when implementing the plan. NR 151.005 (Performance standard for total maximum daily loads) states that a crop producer or livestock producer subject to this chapter shall reduce discharges of pollutants from a livestock facility or cropland to surface waters if necessary to meet a load allocation in a US EPA and state approved TMDL. Local ordinances and regulations will also be used to implement conservation practices and compliance. County Land Conservation and NRCS departments will work with landowners to implement conservation practices. Landowners will be educated on programs and funding available to them as well as current state and local agricultural regulations.

Many alternative and new conservation technologies and methods are currently being developed and evaluated. Incorporation of new and alternative technologies and management methods into the implementation plan will be necessary to achieve desired water quality targets. Newer practices will need to be evaluated for effectiveness and feasibility before incorporation into the plan. Examples of new technologies and methods include:

- Gypsum application to fields: Studies show that gypsum application can improve soil health properties that promote nutrient uptake, increase infiltration, and decrease surface runoff.
- Biofilters at outlets of drain tiles: Installing biofilters at outlets of drain tiles can reduce nutrient loading.
- ROWBOT: Small robot that can travel between corn rows that can apply fertilizer in sync with corn needs, inter-seed cover crops into corn at the V4-V8 corn stage, and collect data.
- Aerial seeding of cover crops.
- Saturated Buffer: Diversion of tile drainage to riparian buffer area reducing nutrient loading.
- Manure Digester: Collects manure and converts the energy stored in the organic matter into methane, which is used to produce energy that can be used for on or off farm use. Manure digesters can be equipped with back end nutrient capture and partitioning technology.

- Emerging manure application methods such as manure injection and side dressing liquid manure that can be applied to crops during the growing season.

Table 23. 10 Year Management Measures Implementation Plan Matrix.

10 Year Management Measures Plan Matrix							
Recommendations	*Indicators*	*Milestones*			*Timeline*	*Funding Sources*	*Implementation*
		0-3 years	*3-7 years*	*7-10 years*			
1) Management Objective: Reduce the amount of sediment and phosphorus loading from agricultural fields and uplands.							
a) Application of conservation practices to cropland. These practices include: • Encourage adaptation of less erosive crop rotations. • Utilization of strip cropping and/or contour cropping practices on fields. • Increase acreage of conservation tillage in watershed area. Fields must meet 30% residue. • Implement use of cover crops. • Installation of field borders. • Enforcement of NR151.03 standard for tillage setback from surface waters where necessary. • Use of vertical manure injection methods on fields with cover crops & reduced tillage.	# acres cropland with conservation practices applied	2,960	3,950	2,950	0-10 years	EQIP, TRM, GLRI, CSP, AM, WQT	NRCS, LWCD

10 Year Management Measures Plan Matrix							
Recommendations	*Indicators*	*Milestones*			*Timeline*	*Funding Sources*	*Implementation*
		0-3 years	*3-7 years*	*7-10 years*			
b) Installation of grassed waterways in priority areas.	# of linear feet of grassed waterways installed	28,500	38,000	28,445	0-10 years	EQIP, CREP, AM, WQT	NRCS, LWCD
c) Concentrated flow path seedings of cover that can be planted through.	# acres of concentrated flow area seedings	30	40	30	0-10 years	GLRI	NRCS, LWCD
d) Installation of riparian buffers.	# acres of riparian buffers installed	10	14	10	0-10 years	CREP/CRP, EQIP, GLRI, AM, WQT	NRCS, LWCD
e) Nutrient Management: Sign up remaining landowners for nutrient management.	# of landowners signed up for nutrient management plans	3	2	0	0-10 years	EQIP, TRM, SEG, AM, WQT	NRCS, LWCD
f) Checks to make sure installed practices and management plans are being maintained and properly followed.	# of farms checked	15	20	15	0-10 years	N/A	LWCD
h) Enforcement of NR 151.03 standard for tillage setback from surface waters where necessary.	% of fields meeting standard tillage setback	25%	50%	75%	0-10 years	N/A	LWCD
j) Construct treatment wetlands to treat and store water from agriculture runoff and tile drainage.	# of treatment wetlands installed	–	2	1	0-10 years	GLRI, AM, WQT	Nature Conservancy, NRCS, LWCD

10 Year Management Measures Plan Matrix							
Recommendations	*Indicators*	*Milestones*			*Timeline*	*Funding Sources*	*Implementation*
		0-3 years	*3-7 years*	*7-10 years*			
k) Assess feasibility of alternative nutrient capturing technologies.	Completed feasibility assessment	1	–	–	0-10 years	Federal/State/Private funding	LWCD, Consulting Firm, Private Company
i) Use of new technologies such as biofilters, water control structures for tile outlets, gypsum applications, ROWBOT, cover crop interseeding into V4-V8 corn, etc.	# sites where new technologies have been used and assessed for effectiveness	3	2	–	0-10 years	GLRI, Other Federal/State/Private funding	LWCD,NRCS
2) Management Objective: Slow the flow of runoff from upland areas to watershed streams							
a) Increase water storage by restoring wetlands.	# of acres of wetlands restored	15	20	20	0-10 years	EQIP, CREP/CRP, WQT, AM	NRCS, LWCD
b) Install Water and Sediment Control basins to store and slow flow of runoff.	# of WASCOBS installed	3	4	3	0-10 years	EQIP, AM, WQT	NRCS, LWCD
c) Increase soil infiltration and improve soil health by implementing practices (a-j &i) under Management Objective 1.	–	–	–	–	–	–	–

10 Year Management Measures Plan Matrix							
Recommendations	*Indicators*	*Milestones*			*Timeline*	*Funding Sources*	*Implementation*
		0-3 years	*3-7 years*	*7-10 years*			
3) Management Objective: Reduce phosphorus runoff from barnyards							
a) Retrofit barnyard sites with necessary runoff control structures (gutters, filter strips, settling basins, clean water diversions)	# of barnyard sites addressed and retrofitted with necessary runoff control measures	3	3	_	0-7 years	EQIP, AM, WQT	NRCS, LWCD
b) Manure management on livestock operation sites.	# of new or updated manure storage facilities	1	2	_	0-7 years	EQIP, AM, WQT	NRCS, LWCD
4) Management Objective: Restore and stabilize degraded streambanks.							
a) Restore eroded stream banks by use of rip rap and/or biostabilization	# of linear feet of streambank stabilized	1,775	2,700	1,775	0-10 years	EQIP, GLRI, WQT	NRCS, LWCD, WDNR
b) Install streambank crossings to prevent further degradation	# of stream crossings installed	1	_	_	0-7 years	EQIP	NRCS, LWCD, WDNR
c) Removal of debris that is deflecting water and causing erosion issues	# of stream sites where debris is removed	_	2	_	0-7 years	EQIP	NRCS, LWCD
d) Stabilization of critical gullies/ravines that are located adjacent to the stream	# of gullies and ravines stabilized	3	3	_	0-10 years	EQIP	NRCS, LWCD

10 Year Management Measures Plan Matrix							
Recommendations	*Indicators*	*Milestones*			*Timeline*	*Funding Sources*	*Implementation*
		0-3 years	*3-7 years*	*7-10 years*			
e) Limit livestock access where stream degradation is occurring.	# of sites where fencing is installed	2	–	–	0-5 yeas	EQIP	NRCS, LWCD

9.0 Load Reductions

Load reductions for upland best management practices were estimated using STEPL (Spreadsheet Tool for Estimating Pollutant Loading) and load reductions from barnyards were estimated using the BARNY model. Percent reduction was based on the STEPL model agricultural baseline loading of 26,042 lbs TP/yr and 6,198 tons TSS/year. The Lower Fox River TMDL calls for 70.6 % reduction of TSS and 83.9% reduction of TP from agriculture in the East River Watershed. An estimated 62.5% reduction in TP and 67.6% reduction in TSS are expected for planned management measures in the Upper East River subwatershed. Expected load reductions from planned activities are shown in Table 24. These estimated reductions show that the TMDL suspended sediment reduction goal is likely to be achieved but phosphorus reductions fall short of the TMDL goal. Using new management methods and technologies may help to achieve the additional phosphorus reduction needed. See Appendix F for strategy to achieve the phosphorus reduction amount required by the TMDL. In addition, decrease in streambank erosion and resulting decrease in sediment and phosphorus loads from implementation of management practices that decrease flow of water to the stream and flood levels is not quantifiable.

Watershed inventory data and modeling indicate that reaching the necessary 83.9% reduction for phosphorus from agriculture will be very difficult to achieve in this watershed with conservation controls alone due to the high amount of land used for agriculture and animal density in the watershed. Another challenge that presents itself is legacy phosphorus in the soil and in stream. In recent years scientists and watershed managers are finding that water quality is not responding as well as expected to implemented conservation practices (Sharpley et al 2013). They are attributing this slower and smaller response to legacy phosphorus. Legacy phosphorus is used to describe the accumulated phosphorus that can serve as a long- term source of P to surface waters. Legacy phosphorus in a soil occurs when phosphorus in soils builds up much more rapidly than the decline due to crop uptake. In stream channels, legacy phosphorus can result from sediment deposition of particulate phosphorus, sorption of dissolved phosphorus onto riverbed sediments or suspended sediments, or by incorporation into the water column (Sharpley et al 2013). Therefore, water quality may not respond to implementation of conservation practices in a watershed as quickly as expected due to remobilization of legacy phosphorus hot spots. Land use changes in the future could also further exacerbate phosphorus loading in the watershed. In a study done by Duan et al (2013) significantly higher particulate phosphorus loads were found in watershed effluent following residential development of agricultural land.

Significant reduction in phosphorus loading can be achieved in this watershed, but meeting the phosphorus limit set by the TMDL with current technologies, funding sources, land prices, and attitudes in the watershed area will be a challenge without the adoption of nutrient capture technologies.

Table 24. Estimated load reductions for the Upper East River Watershed.

Management Measure Category	Total Units (size/length)	Total Cost ($)	Estimated Load Reduction			
			TP (lbs/yr)	Percent	TSS (t/yr)	Percent
Streambank Restoration		329,776.25				
Bank Stabilization (Feasible)	6,250 ft		71.0	0.3	113.0	1.6
Adjacent Gully/Ravine Stabilization	310 ft		9.3	0.0	15.0	0.2
Riparian Buffers	34 acres	136,000.00	931.8	3.4	136.3	2.0
Agricultural BMP's		3,165,314.74				
Barnyard Retrofits (filter strips, waste storage, clean water diversions, etc) & Maintenance/repair of existing practices	6 sites		95.0	0.3	N/A	N/A
Upland Practices applied to Cropland (Conservation Tillage, Field Borders, Cover Crops, Nutrient Management, Contour Cropping, Strip Cropping, Conservation Crop Rotation, Tillage Setback, Vertical Manure Injection) [1]	9,861 acres		13,377.2	48.5	2,516.4	36.1
Grassed Waterways/WASCOB	96,166 ft 10 WASCOBs		628.0	2.3	1,019.0	14.6
Concentrated Flow Area Seeding	84,912 ft		111.0	0.4	180.0	2.6
Use of new technologies/management measures (gypsum applications, water controls structures for tile outlets, nutrient capturing technologies, interseeding cover crops, etc) [2]	N/A	N/A	N/A	N/A	N/A	N/A
Wetlands		634,000.00				
Treatment wetlands for tile drainage	3 sites		132.3	0.5	30.1	0.4
Wetland Restoration	55.00		926.8	3.4	181.1	2.6
Totals		**4,265,090.99**	**16,282.4**	**62.5**	**4,190.9**	**67.6**

1. *This category* <u>*does not*</u> *indicate that all these practices will be applied to all 9,861 acres of cropland. A combination of conservation practices applied to a majority of the cropland in the watershed is necessary to get the desired pollutant load reductions suggested by the TMDL. It is also important to note that not all fields will need to apply more than one practice to meet desired reduction goals. The BMP Efficiency Calculator was used to determined efficiencies of different combinations of practices such as Reduced Tillage & Cover Crops or the use of a Field Border and Reduced Tillage. An average pollutant reduction efficiency was determined for this category. See Appendix D.*
2. *The amount of new technologies and management measures needed has not been determined as well as expected load reductions. In order to meet reductions required by the TMDL use of new technologies will be needed and are included in the plan as alternative options. These new technologies will need to be assessed for feasibility and tested for effectiveness of reducing sediment and phosphorus pollution in the watershed. It is estimated that there will be another $10-$20 million in technology costs for the cattle numbers in this watershed. If new management measures/technologies prove effective and feasible they will be incorporated into the plan with more accurate load reductions, cost, and amount needed.*

10.0 Information and Education

This information and education plan is designed to increase participation in conservation programs and implementation of conservation practices by informing the landowners of assistance and tools available to them and providing information on linkages between land management and downstream effects on water quality.

10.1 Alliance for the Great Lakes Survey

The Alliance for the Great Lakes developed an interview and questionnaire that was given to landowners in the Lower Fox River Watershed area by County Land and Water Conservation Departments and local agronomists. Data from the questionnaires and interviews was analyzed by subwatershed. The survey and questionnaire gathered information on the knowledge of conservation and water quality issues, willingness to participate in conservation programs, and where landowners obtain their information. Moreover, many landowners of all farm sizes did not recognize the severity of water quality issues impacting the Lower Fox River Basin and the extent to which agricultural sources contribute to nutrient and sediment loadings to the River and the Bay of Green Bay. Providing information on available conservation programs, technical assistance, and education will be a very critical component of implementing the management plan.

<u>Selected Results from Survey</u>

Knowledge and Thoughts on Current Conservation Programs:

One of the interview questions asked respondents to reflect on the conservation programs currently being offered. The responses were organized by themes and further by subwatersheds to gain a better understanding of what landowners think about conservation programs and whether responses differ across different areas of the Lower Fox River watershed. A total of 28 themes were identified (ranging from “Willing to try them” to “More exist than necessary”) with the most frequently mentioned theme being “Not familiar with programs” as shown in Figure 43 below. This is in contrast to the most frequently mentioned themes by the other subwatersheds. For comparison, among respondents in Duck/Trout Creeks subwatershed most frequently mentioned theme was “involved in them”, in Apple/Ashwaubenon/Dutchman Creeks, it was “going well-good programs”, and in East River/Baird/Bower Creeks, both “involved in them” and going well-good programs” were both at the top of the list.

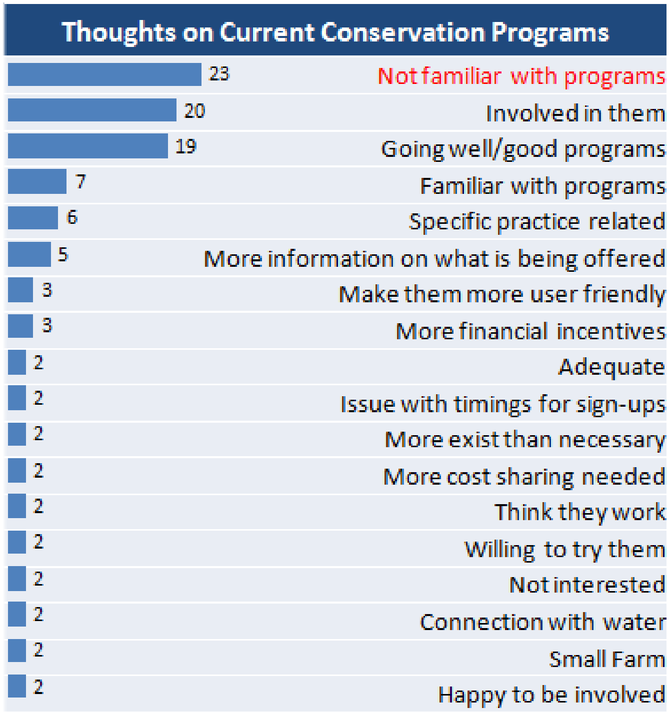

Figure 43. Survey results on Thoughts on Current Conservation Programs in all subwatersheds.

Information/Communication:

A number of the questions in the interview and questionnaire were designed to get a better understanding regarding what organizations or entities landowners go to for information and how they prefer to receive/exchange information. The results listed below reflect some of the responses most relevant to this plan:

1. Many respondents want to see the County Land and Water Conservation Departments conduct more education and provide information on practices.
2. 63% Moderately to very interested in demonstration farms as information sources in the East River subwatershed.
3. 57% Moderately to very interested in sharing information in a group setting in the East River/Baird/Bower subwatershed.
4. The preferred methods of communication were: newsletters, on farm demonstrations/field days, one on one hands on demonstrations, and magazines (based on responses from the entire Lower Fox River watershed).
5. Landowners go to similar organizations for both farming advice and water quality information (% indicates the percentage of respondents who named this organization as important).

a. For agronomic information in East River/Baird/Bower Creeks, these include: Local Farm Cooperatives/Crop Consultants (74%); Farmers (68%); Farm Service Agency (42%)
b. For water quality information in East River/Baird/Bower Creeks, these include; Local Farm Cooperatives/Crop Consultants (88%); County Land and Water Conservation Department (69%); NRCS (63%)

Severity of sources of pollution in your area:

The survey asked several questions related to water quality in the Lower Fox River watershed and Green Bay, specifically on impacts, particular pollutants, and sources of the pollutants. Overall, consequences of poor water quality in the area were mostly rated as slight to moderate problems. Similarly, among the sources listed, most were perceived to be slightly or moderately problematic. Notably:

- Respondents perceived the most serious source of water pollution coming from non-agricultural sources.
    - 65 % identified “excessive use of lawn fertilizers and pesticides” as a moderate to severe problem
    - Next three most problematic pollutant sources were stormwater runoff from urban areas, discharges from sewage treatment plants, and discharges from industry.
- Of the six agricultural pollution sources, the one perceived as most severe was “soil erosion from fields” with 37% followed by “land application of animal waste” with 19%. By comparison, 31% identified waterfowl droppings as a moderate to severe problem.

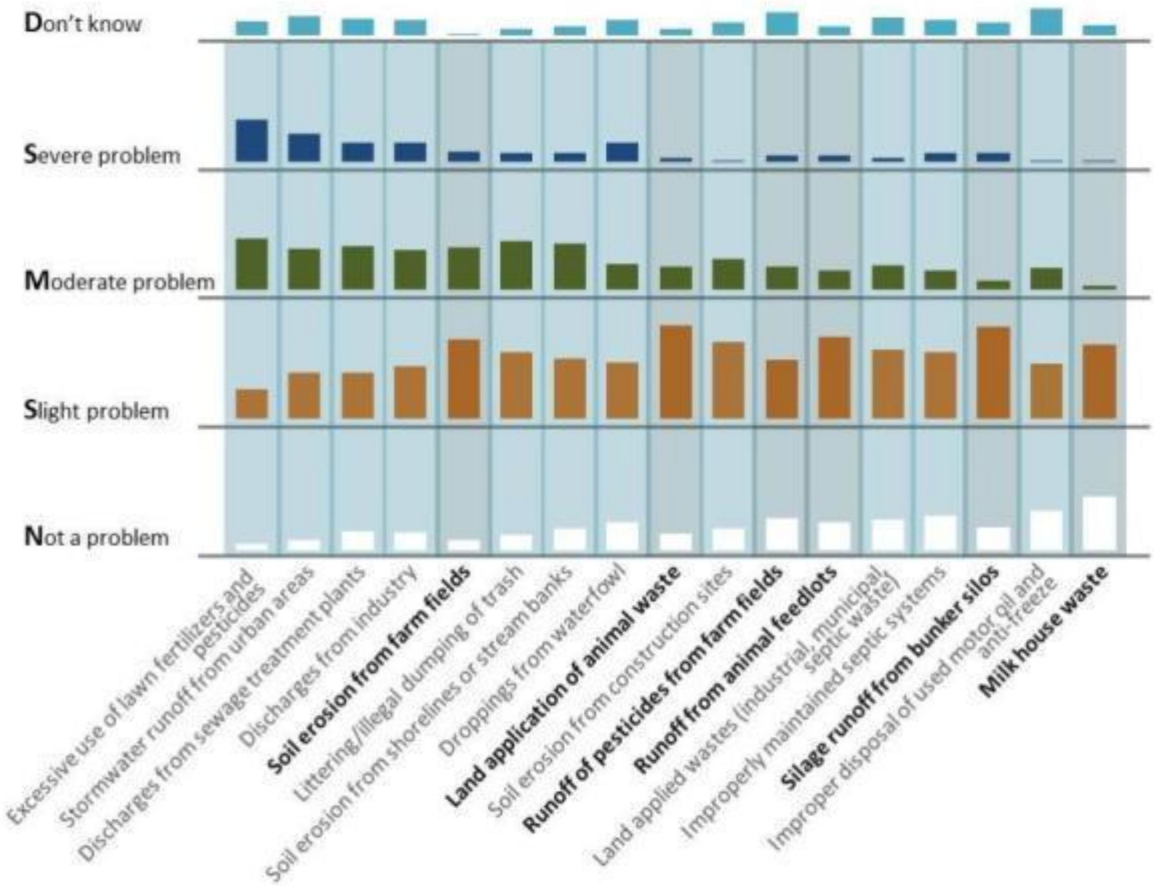

Figure 44. Survey responses to severity of sources of pollution in the Lower Fox River and Bay of Green Bay.

10.2 Recommended Information and Education Campaigns

Goals for the Information and education plan and recommended actions were based on the results from the survey. An effective Information and Education Plan includes the following components as referenced in USEPA's "*Handbook for Developing Watershed Plans to Restore and Protect our Waters*" (USEPA 2008):

- Define I&E goals and objectives
- Identify and analyze the target audiences
- Create the messages for each audience
- Package the message to various audiences
- Distribute the message
- Evaluate the I&E program

<u>Goals of the information and education plan</u>: Create public awareness of water quality issues in the watershed, increase public involvement in watershed stewardship, and increase communication and coordination among municipal officials, businesses, and agricultural community.

Objectives

- Educate local officials about the watershed plan. Encourage amendments to municipal comprehensive plans, codes, and ordinances.
- Develop targeted educational materials to appropriate audience in the watershed.
- Host workshops, meetings, and events that landowners can attend to learn about conservation practices.
- Increase landowners' adoption of conservation practices.
- Inform public of current water quality issues in the Lower Fox River Watershed basin and how the Upper East River watershed contributes.
- Get local high schools and colleges involved in watershed activities.

Target Audience

There are multiple target audiences that will need to be addressed in this watershed. Target audiences in this watershed will be agricultural land owners and operators, local government officials, private land owners along stream channels, urban home owners, local agricultural organizations/businesses, and schools. Focused attention will be on agricultural land owners and operators since the main source of pollutant loading in the watershed is from agricultural land. Non-operator agricultural landowners are an important subset of this group as they are usually not focused on and are less likely to participate in conservation programs. The 1999 Agricultural Economics and Land Ownership survey showed that 34 % of farmland in Wisconsin was owned by non-operator landlords (USDA 1999). Studies have shown that non-operators tend to be older, less likely to live on the farm, and less likely to participate in conservation programs (Nickerson, et al 2012). Non-operator land owners in the watershed area need to be addressed as they control a significant amount of agricultural land but tend to leave the management of the land up to the tenant.

Existing Education Campaigns:

Fox- Wolf Watershed Alliance: A nonprofit organization that identifies issues and advocates effective policies and actions to protect and restore the water resources of Wisconsin's Fox-Wolf River watershed. They hold events such as river clean-ups, workshops, presentations at Annual Watershed Conferences, and meetings with other organizations to outreach to the public.

Northeast Wisconsin Stormwater Consortium: A subsidiary of the Fox-Wolf Watershed Alliance composed of municipal members and business partners working to address stormwater issues and to educate residents on best management practices, ordinances and other storm water concerns and programs.

Demonstration Farm Project: Currently there is a demonstration farm project to establish 4 demonstration farms in the Lower Fox River Watershed. One of these farms is located in the Upper East River subwatershed. The goal of the demonstration project is to test new conservation methods and to educate other farmers.

Lower Fox TMDL Outreach Committee- A group of stakeholders working to develop an overarching Education and Outreach plan for the Lower Fox River Basin TMDL. This education plan will be integrated in to the full Lower Fox River TMDL Implementation Plan once complete. The purpose of the Education and Outreach Plan is to assist in the communication, coordination, and implementation efforts of the Lower Fox River TMDL. The plan will be evaluated annually and updated by the Lower Fox TMDL Outreach Committee.

I&E Plan Recommended Actions

An Information and Education Plan matrix (Table 25) was developed as a tool to help implement the I&E plan. The matrix includes recommended action campaigns, target audience, package for delivery of message, schedule, outcomes, estimated costs, and supporting organizations.

Evaluation

The I&E plan should be evaluated regularly to provide feedback regarding the effectiveness of the outreach campaigns. Section 13.3 describes milestones related to watershed education activities that can be used to evaluate I&E plan implementation efforts.

Table 25. Information and Education Plan Implementation Matrix.

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Inform the public on watershed project.	General Public	• Public notice in local newspaper upon completion of watershed plan. • Present plan to public at a public meeting. • Create a web page (Facebook, page on County website) for watershed project. • Develop exhibits for use at libraries, government offices, and local events (County Fairs and Farm Shows).	0-3 years	General public is aware of watershed implementation plan and has better understanding of how they can impact water quality.	$1,200	LWCD
Educate landowners on watershed project and progress.	Private landowners, agricultural landowners/operators	Bi-annual/annual newsletter including watershed updates as well as information on new practices and programs.	0-10 years	Landowners are informed on project and progress. Landowners can stay up to date on new practices and strategies available.	$7,000	LWCD, FWWA

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Educate agricultural landowners and operators about the plan, its recommendation actions, and technical assistance and funding available.	Agricultural landowners/operators	• Distribute educational materials on conservation practices and programs. • One on one contact with individual landowners to provide tools and resources. • Orchestrate group meetings with agricultural landowners in watershed to share knowledge and foster community connections for long term solutions. • Offer workshops to agricultural landowners to educate them on conservation practices that should be used to preserve the land and protect water resources. • Tour local demonstration farm and other sites that have implemented conservation practices.	0-7 years	• Agricultural landowners are informed about conservation practices, cost share programs, and technical assistance available to them. • Increase in interest in utilizing and installing conservation practices. • Improved communication between agricultural landowners, willingness to share ideas, and learn from other agricultural landowners. • Agricultural landowners recognize the benefit of conservation farming practices and how it improves water quality. • Agricultural landowners see success of conservation practices as well as problems that can be expected.	$15,000	LWCD,NRCS,UWEX

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Reach out to non-operator land owners.	Non-operator agricultural landowners	• Distribute educational materials targeted to non-operator agricultural landowners. • One on one contact and group meetings with non-operator agricultural land owners to share knowledge and foster community connections for long term solutions. • Hold workshop for non-operator female land owners based on Women Caring for the Land Handbook (WFAN, 2012).	0-7 years	Non-operator landowners are informed on conservation practices. Increased participation rates in conservation activities from non-operator land owners.	$3,500	LWCD, NRCS, UWEX

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Educate local officials about the completed plan. Encourage amendments of municipal comprehensive plans, codes, and ordinances to include watershed plan goals and objectives.	Elected officials in Calumet County, Outagamie County, Brown County, Town of Woodville, Town of Brillion, Village of Harrison, Town of Wrightstown, Town of Holland, Village of Sherwood, Town of Buchanan.	Present project plan to officials and conduct meetings with government officials.	0-7 years	Local municipalities adopt plan and amend ordinances, codes, and plans to include watershed plan goals and objectives.	No cost using existing resources.	LWCD
Provide local schools information about the watershed project to use as a tool in environmental education.	Teachers/Students at local schools	• Provide local schools with watershed project information. • Offer presentations to teachers and student groups. • Get local schools involved in water quality monitoring.	0-7 years	• Schools will use watershed project in environmental/water education programs. • Use watershed area as a site for field trips. • Student participation in watershed monitoring.	$3,000	Wrightstown High School, Fox Valley Technical College, UWGB

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Educate riparian landowners on best management practices for stream banks.	Private riparian landowners	• One on one contact with landowners with priority streambank restoration sites on their land. • Distribute educational materials on riparian buffers, bank stabilization techniques, fencing of livestock, and proper stream crossings.	0-5 years	Increased interest and participation in restoring degraded streambanks and riparian habitat.	$1,500	LWCD, UWEX
Educate local agricultural businesses and organizations on objectives of watershed project.	Agronomists, Co-ops, Seed dealers	Meetings with local agricultural organizations to share goals of project and planned conservation practices and outreach needed.	0-3 years	Local agricultural organizations are aware of watershed project and can assist landowners with conservation needs as well as help deliver common message to protect water quality in watershed area.	$1,500	UWEX, LWCD
Educate homeowners on actions they can take to reduce polluted runoff from their yards.	Homeowners	Distribute educational materials to homeowners on how to reduce polluted stormwater runoff from their yards.	0-3 years	Homeowners are aware of the impact they can have on water quality and actions they can take to reduce pollutions from their yards.	$1,000	UWEX, LWCD

Information and Education Plan Implementation Matrix						
Information and Education Action	**Target Audience**	**Recommendations**	**Schedule**	**Outcomes**	**Cost**	**Implementation**
Outcome of information and education plan.	Agricultural landowners/operators	Survey agricultural landowners on water quality awareness, knowledge of conservation practices, and participation on conservation practices.	7-10 years	Increased awareness of water quality and conservation practices in the watershed area in comparison to 2014 survey.	$2,000	LWCD, UWEX

11.0 Cost Analysis

Cost estimates were based on current cost-share rates, incentives payments to get necessary participation, and current conservation project installation rates. Current conservation project installation rates were obtained through conversations with county conservation technicians. Landowners will be responsible for maintenance costs associated with installed practices. The total cost to implement the watershed plan is estimated to be $6,311,160-$6,511,160 with an estimated additional $10-20 million in technology costs.

Summary of Cost Analysis:

- $4,274,991 to implement best management practices.
- $1,909,220 needed for technical assistance
- $125,449 needed for Information and Education
- $13,000-20,000/yr needed for Water Quality Monitoring if current funding source is discontinued.
- It is estimated that there will be another $10-20 million in technology costs for the cattle numbers in this watershed.

Table 26. Cost estimates for implementation of best management practices.

BMP	Quantity	Cost /Unit $	Total Cost
Upland Control			
Conservation Crop Rotation (ac)	750	1.75	1,312.50
Conservation Tillage[1] (ac)	8,245	18.50	457,597.50
Cover Crops[1] (ac)	6,000	70.00	1,260,000.00
Grass Waterways (ln ft)	94,994	4.21	399,924.74
Concentrated Flow Area Seeding (ac)	100	220.00	22,000.00
Veg. Riparian Buffers (ac)	34	4,000.00	136,000.00
Nutrient Mgmt[1] (ac)	500	28.00	42,000.00
Wetland Restoration (ac)	55	10,000.00	550,000.00

BMP	Quantity	Cost /Unit $	Total Cost
Treatment Wetlands (sites)	3	28,000.00	84,000.00
Water and Sediment Control Basin (ea)	10	7,000.00	70,000.00
Field Borders (ac)	10	4,000.00	40,000.00
Contour Farming[1] (ac)	2,000	7.62	45,720.00
Strip Cropping[1] (ac)	2,000	10.28	61,680.00
Manure Injection (ac)	3,500	58.00	203,000.00
Barnyard Runoff Control			
Filter Strip/ Wall (ea)	6	25,000.00	275,000.00
Roof Gutters (ln ft)	400	10.00	53,500.00
Waste Storage (ea)	3	70,000.00	210,000.00
Milkhouse Waste Treatment (ea)	3	4,860.00	14,580.00
Streambank Erosion Control			
Fencing (ln ft)	1,485	1.25	1,856.25
Bank Stabilization (ln ft)	6,250	50.00	312,500.00
Crossing (ea)	1	5,000.00	5,000.00
Obstruction Removal (ea)	3	1,200.00	3,600.00
Adjacent gully/ravine stabilization (ln ft)	310	22.00	6,820.00
Technical Assistance			
Conservation/Project Technician[2]	1	95,461.00	954,610.00
Agronomist[2]	1	95,461.00	954,610.00

1. *Cost based on cost sharing for 3 year time period.*
2. *Cost based on employment for 10 years.*

Information and Education Costs:

Table 27. Information and Education Costs.

Information and Education	Cost
Staff hours (2,600 hours of staff time for 5 years)	$ 91,249
Materials (Postage, printing costs, paper costs, and other presentation materials)	$ 35,700

Water Quality Monitoring Costs:

The current USGS monitoring sites that are set up in the watershed are currently being operated solely by the USGS and funded by GLRI (Great Lakes Restoration Initiative). The USGS gauging station at Cty Hwy ZZ is currently funded on a year to year basis. Additional funding and cooperation may be needed to extend the duration of monitoring for the East River site on Cty Hwy ZZ depending on availability of GLRI funds for this site. The WDNR surface water monitoring program depends on volunteers and is funded by the state.

Cost of operating the East River station depends on collaboration with other entities. If the USGS is solely responsible for operation it costs approximately $20,000/yr for collecting phosphorus and sediment data. If a local organization such as UWGB or Land Conservation Department is willing to collaborate with the USGS and assist with sample collection it can bring the cost down to $13,000/yr.

Estimated Costs of new/alternative practices:

Cost of new technologies/management methods was not included in this estimate since the quantity of these technologies that may be needed is not yet known. Approximate costs for new technologies are as follows:

- $10-15/acre for ROWBOT when used as a service
- $25-45/ton gypsum
- $4,000-12,000 for various types of biofilters for treating tile drainage
- Anaerobic digester with nutrient capture technology: $1,800/Cow
- Drainage water management structure for tile drains: $500-$2,000 ea or $20-$110/acre.

Operation & Maintenance

This plan will require a land owner to agree to a 10 year maintenance period for practices such as vegetated buffers, grassed waterways, water and sediment control basins, treatment wetlands, wetland restoration, barnyard runoff control, manure storage, streambank stabilization including crossings and fencing, and concentrated flow area seedings. A 10 year maintenance period is also required for implementation of strip cropping and prescribed grazing. For practices such as conservation tillage, cover crops, nutrient management, and prescribed grazing landowners are required to maintain the practice for each period that cost sharing is available. Upon completion of the operation and maintenance period, point sources may be able to work with operators and landowners to continue implementation of the BMP's under a pollutant trading agreement (non EPA 319 monies).

12.0 Funding Sources

There are many state and federal programs that currently provide funding sources for conservation practices. Recently the option of adaptive management, water quality trading, and phosphorus variance has become another option for funding of practices.

12.1 Federal and State Funding Sources

A brief description of current funding programs available and their acronyms are listed below:

Environmental Quality Incentives Program (EQIP) - Program provides financial and technical assistance to implement conservation practices that address resource concerns. Farmers receive flat rate payments for installing and implementing runoff management practices.

Conservation Reserve Program (CRP) - A land conservation program administered by the Farm Service Agency. Farmers enrolled in the program receive a yearly rental payment for environmentally sensitive land that they agree to remove from production. Contracts are 10-15 years in length. Eligible practices include buffers for wildlife habitat, wetlands buffer, riparian buffer, wetland restoration, filter strips, grass waterways, shelter belts, living snow fences, contour grass strips, and shallow water areas for wildlife.

Conservation Reserve Enhancement Program (CREP) - Program provides funding for the installation, rental payments, and an installation incentive. A 15 year contract or perpetual contract conservation easement can be entered into. Eligible practices include filter strips, buffer strips, wetland restoration, tall grass prairie and oak savanna restoration, grassed waterway, and permanent native grasses.

Agricultural Conservation Easement Program (ACEP) - New program that consolidates three former programs (Wetlands Reserve Program, Grassland Reserve Program, and Farm and Ranchlands Protection Program). Under this program NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agriculture use and conservation values of eligible land.

Targeted Runoff Management Grant Program (TRM) - Program offers competitive grants for local governments for controlling nonpoint source pollution. Grants reimburse costs for agriculture or urban runoff management practices in critical areas with surface or groundwater quality concerns. The cost-share rate for TRM projects is up to 70% of eligible costs.

Conservation Stewardship Program (CSP) – Program offers funding for participants that take additional steps to improve resource condition. Program provides two types of funding through 5 year contracts; annual payments for installing new practices and maintaining existing practices as well as supplemental payments for adopting a resource conserving crop rotation.

Great Lakes Restoration Initiative (GLRI) - Program is the largest funding program investing in the Great Lakes. Currently the Lower Fox River watershed is one of three priority watersheds in the Great Lakes Restoration Initiative Action Plan. Under the initiative nonfederal governmental entities (state agencies, interstate agencies, local governments, non- profits, universities, and federally recognized Indian tribes) can apply for funding for projects related to restoring the Great Lakes.

Farmable Wetlands Program (FWP) - Program designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. The Farm Service Agency runs the program through the Conservation Reserve Program with assistance from other government agencies and local conservation groups.

Land Trusts- Landowners also have the option of working with a land trust to preserve land. Land trusts preserve private land through conservation easements, purchase land from owners, and accept donated land.

12.2 Adaptive Management and Water Quality Trading

Adaptive management and water quality trading are potential sources of funding in this watershed if there are interested point sources. Adaptive management and water quality trading can be easily confused. Adaptive management and water quality trading can provide a more economically feasible option for point source dischargers to meet their waste load allocation limits. Point sources provide funding for best management practices to be applied in a watershed and receive credit for the reduction from that practice. Adaptive management focuses on compliance with phosphorus criteria while water quality trading focuses on compliance with a discharge limit.

Table 28. Comparison of Adaptive Management and Water Quality Trading.

Adaptive Management	Water Quality Trading
Receiving water is exceeding phosphorous loading criteria.	The end of pipe discharge is exceeding the allowable limit.
More flexible and adaptive to allow cropland practices to show reductions over extended time period.	Not as flexible, needs to show stable reductions year to year.
Does not use "trade ratios" as modeling factor.	Uses "trade ratios" as margin of error factor.
Uses stream monitoring to show compliance.	Uses models such as SNAP+ or BARNY to show compliance with reduction in loading.
Typically used for phosphorus compliance only.	Can be used for a variety of pollutants, not just phosphorus.

Can be used to quantify phosphorus reductions for up to 15 years.	Can be used to demonstrate compliance indefinitely as long as credits are generated.

12.3 Phosphorus Multi- Discharger Variance (Wisconsin Act 378)

In April of 2014, Act 378 was enacted; this act required the Wisconsin Department of Administration in consultation with the Department of Natural Resources to determine if applying with phosphorus causes Wisconsin substantial and economic hardship. If so, DNR will work with the EPA to implement a phosphorus Multi-discharger Phosphorus Variance to help point sources comply with phosphorus standards in a more economically viable way. A multi-discharger variance extends the timeline for complying with low level phosphorus limits. In exchange, point sources agree to step wise reduction of phosphorus within their effluent as well as helping to address nonpoint source of phosphorus from farm fields, cities or natural areas by paying $50 per pound to implement projects designed to improve water quality. A permittee that chooses to make payments for phosphorus reduction will make payments to each county that is participating in the program and has territory within the basin in which the point source is located in proportion to the amount of territory each county has within the basin. A county will then use the payments to provide cost sharing for projects to reduce the amount of phosphorus entering the waters of the state, for staff to implement phosphorus reduction projects, and/or for modeling or monitoring to evaluate the amount of phosphorus in the waters of the state for planning purposes.

13.0 Measuring Plan Progress and Success

Monitoring of plan progress will be an essential component of achieving the desired water quality goals. Plan progress and success will be tracked by water quality improvement, progress of best management practice implementation, and by participation rates in public awareness and education efforts.

13.1 Water Quality Monitoring

In order to measure the progress and effectiveness of the watershed plan, water quality monitoring will need to be conducted throughout the plan term. Physical, chemical, and biological data will need to be collected to see if the water quality is meeting TMDL standards and designated use standards. This plan calls for the continuation of current monitoring programs with additional monitoring recommendations.

Stream Water Quality Monitoring

Surface water samples will be collected on a monthly basis from the East River from May through October starting in 2015 as part of the Lower Fox River Monitoring program. On each sampling date, volunteers will collect and ship surface water samples to the Wisconsin State Laboratory of Hygiene for the analysis of TP, TSS, and dissolved reactive phosphorus (DRP). Volunteers will also utilize transparency tubes to assess and document the transparency of each stream on each date. Macroinvertebrate sampling will also be performed by volunteers on the East River during September or October and will be delivered to UW-Superior for identification to lowest taxonomic level on a periodic basis, currently proposed to be every 3-5 years. All sampling will be conducted in accordance with WDNR protocol. A summary of the Lower Fox River Monitoring Strategy is shown in Appendix F.

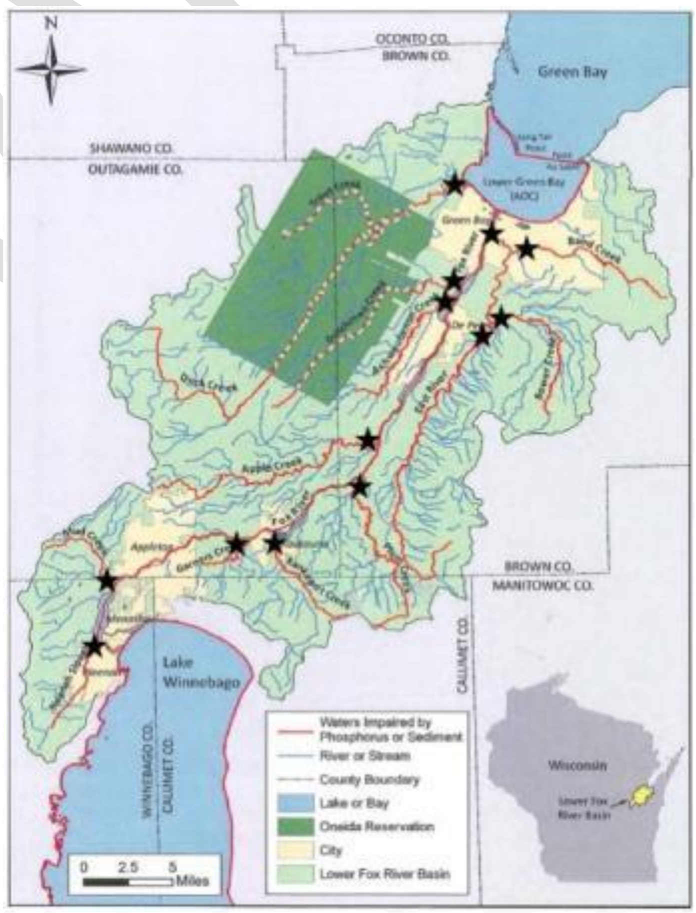

Figure 45. Approximate sample locations for the Lower Fox River Volunteer Monitoring.

As mentioned previously, there is also a USGS gauging station located on the Upper East River on Cty Hwy ZZ. This station currently collects data on turbidity, specific conductance, DO, temperature, and discharge. Field/lab samples for phosphorus and suspended sediment analysis are also collected at this site. The site is currently funded by the GLRI on a year to year basis and operated solely by the USGS. The long term goal of this site is to track phosphorus and sediment trends due to increased agricultural conservation efforts in the watershed.

Streambank Erosion Monitoring

Land Conservation Department staff will track rates of lateral recession in the Upper East River. Lateral recession rates will be tracked by using erosion pins. Erosion pins are metal rods that are inserted into the bank perpendicular (Figure 46). Pins will be measured at least 3 times a year to determine trends in erosion. An initial survey of the streambank of selected sites will also be conducted to serve as benchmark. A minimum of 2 sites should be surveyed. Streambank erosion monitoring will begin following approval of the plan. A decrease in observed lateral recession rate over the 10 year time period will demonstrate plan progress. If lateral recession rates are observed to be increasing or remaining the same after several years of implementation of plan and practices it may indicate that the plan may need to be reevaluated for effectiveness.

Figure 46. Erosion pins in a streambank. Photo Credit: Allamakee Soil and Water Conservation District, Iowa.

Edge of Field Monitoring Sites

There are several field sites already set up in the watershed to measure reductions from planned conservation practices (Figure 48). Results from edge of field monitoring will help determine the efficiency of practices at reducing phosphorus and sediment leaving a field. Descriptions of each field site and site ID are listed below. Baseline data collection has begun for all listed sites.

USGS ID# 441624088045601:
Baseline data is currently being measured at this site at the outlet of a waterway in a crop field that is planted and tilled through. Data collection for this site began January 2012. A grassed waterway meeting NRCS design standards will be installed at this site.

USGS ID # 441546099082001:
Baseline data is currently being measured at this site at the outlet of a waterway in a crop field since January 2013. At this site the farmer leaves the waterway vegetated and does not till or crop through it. A grassed waterway meeting NRCS design standards will be installed at this site.

USGS ID # 441520088045001 & 441520088045002:

Baseline data is currently being measured at this site at a tile outlet and waterway outlet. This site is part of the demonstration farm project. This site will be monitoring implementation of practices such as no till and cover crops.

Figure 47. USGS edge of field site ID# 44152008045001 & 441520088045002.

These sites are currently set up to measure discharge, precipitation, gage height, phosphorus, suspended sediment, chloride, and nitrogen. Baseline data from these sites is shown in Appendix C. There is also a second edge of field monitoring site planned for the demonstration farm project that will be set up slightly differently. This site will be a paired basin test where 2 fields with similar characteristics (soil type, slope, etc) next to each other will be compared.

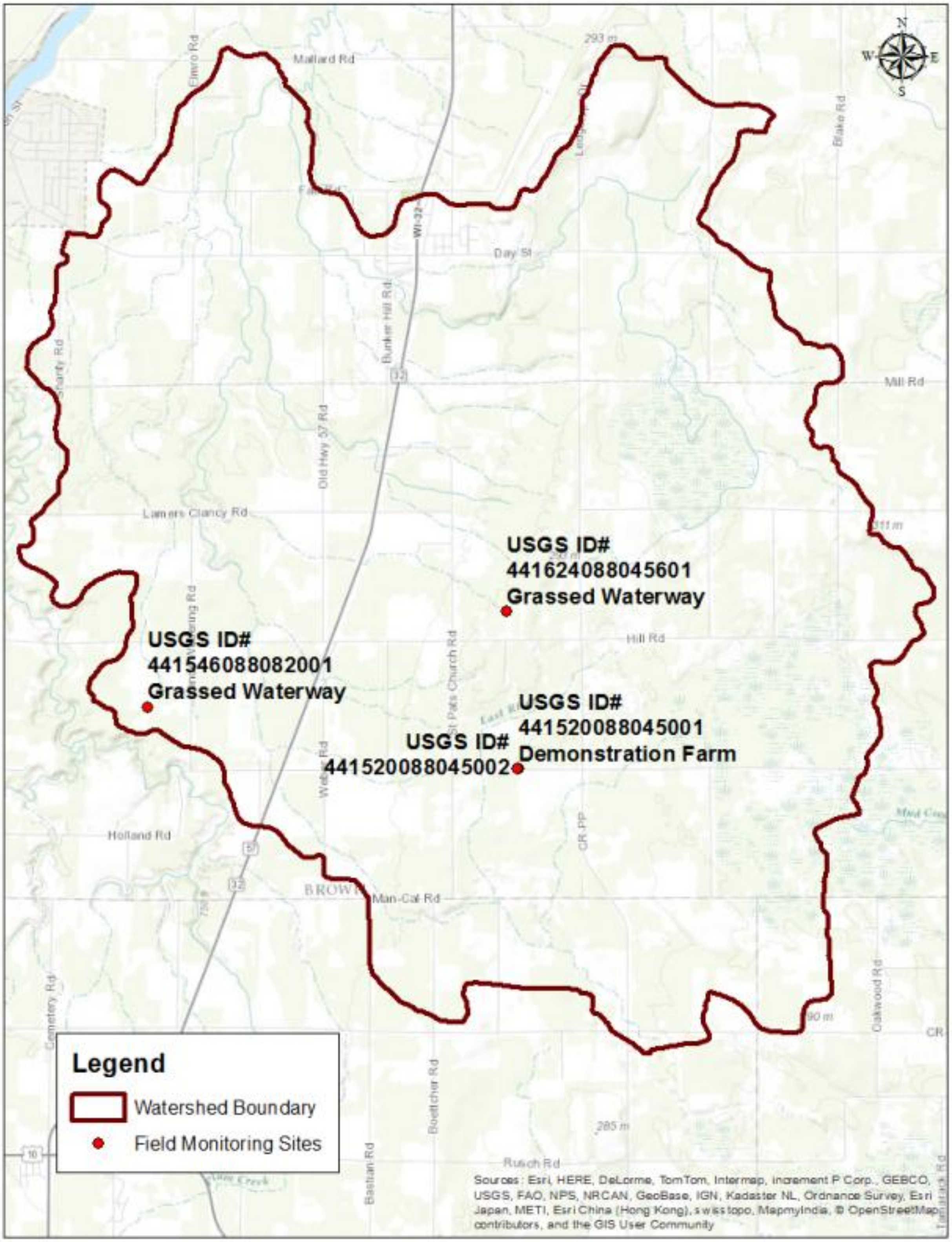

Figure 48. USGS edge of field monitoring sites.

Water Quality Indicators and Targets

Median summer phosphorus concentrations, annual phosphorus and suspended sediment loading rates, and macroinvertebrate index of biotic integrity values will be used to determine improvement in water quality and plan progress. Water quality milestones are based on available monitoring data, STEPL model estimates, and TMDL reduction goals. These water quality milestones support the adaptive management approach by providing ways to reevaluate the implementation process if adequate progress is not being made toward achieving water quality goals.

Table 29. Water quality monitoring indicators for success measured from USGS Station (#04085108) at the Cty Hwy ZZ site near Greenleaf, WI.

Monitoring Recommendation	Indicators	Current Values	Target Value or Goal	Milestones			Implementation	Funding
				Short Term (3 yrs)	Medium Term (7 yrs)	Long Term (10 yrs)		
Upper East River								
Lower Fox River Watershed Monitoring Program (USGS Monitoring Station (#04085108) at Cty Hwy ZZ near Greenleaf, WI)	median summer phosphorus concentration (mg/l)[1]	0.610	0.075	0.450	0.236	0.075	USGS	GLRI
	# lbs phosphorus/yr[2]	27,193	4,378	20,349	11,223	4,378	USGS	GLRI
	# tons total suspended sediment/yr[2]	6,198	1,822	4,885	3,135	1,822		

1. Median summer phosphorus concentration current values from USGS Station (#04085108) at Cty Hwy ZZ from May -October 2012- 2015.
2. Upper East River current load values estimated by STEPL and Target Values based on Lower Fox TMDL reduction needs.

Table 30. Water quality monitoring indicators for success measured from Lower Fox River Volunteer Monitoring sites on the East River (See **Figure 45**).

Monitoring Recommendation	Indicators	Current Values	Target Value or Goal for East River Watershed (Upper & Lower)	Milestones from Implementation in only Upper East River Subwatershed			Implementation	Funding
				Short Term (3 yrs)	Medium Term (7 yrs)	Long Term (10 yrs)		
East River								
Lower Fox River Volunteer Monitoring	# lbs phosphorus/yr[1]	48,748	14,592	41,904	32,778	25,933	WDNR	WDNR
	# tons total suspended sediment/yr[1]	9,898	3,616	8,585	6,835	5,522		
Lower Fox River Volunteer Monitoring	% of sites with a Fair to Good IBI rating[2]	Poor-Fair	Fair-Good	50%	75%	100%	WDNR	WDNR

1. Current loading values and target values from Lower Fox River TMDL plan.
2. Current values based on WDNR IBI data.

13.2 Tracking of Progress and Success of Plan

Progress and success of the Upper East River Watershed Project will be tracked by the following components:

1) Information and education activities and participation
2) Pollution reduction evaluation based on BMP's installed
3) Water quality monitoring
4) Administrative review

Brown County and Calumet County Land Conservation Departments will be responsible for tracking progress of the plan. Land Conservation departments will need to work with NRCS staff to track progress and implement projects. Reports will be completed annually, and a final report will be prepared at the end of the project.

1) Information and education reports will include:
   a) Number of landowners/operators in the watershed plan area.
   b) Number of eligible landowners/operators in the watershed plan area.
   c) Number of landowners/operators contacted.
   d) Number of cost-share agreements signed.
   e) Number and type of information and education activities held, who lead the activity, how many invited, how many attended, and any measurable results of I& E activities.
   f) Number of informational flyers/brochures distributed per given time period.
   g) Number of one on one contacts made with landowners in the watershed.
   h) Number of municipalities that adopt municipal comprehensive plans, codes, and ordinances supportive of watershed plan goals and objectives.
   i) Comments or suggestions for future activities.

2) Installed best management practices will be mapped using GIS. Pollution reductions from completed projects will be evaluated using models and spreadsheet tools such as STEPL and SNAP Plus[4] for upland practices and the BARNY model for barnyard practices. The annual report will include:
   a) Planned and completed BMP's.
   b) Pollutant load reductions and percent of goal planned and achieved.
   c) Cost-share funding source of planned and installed BMP's.
   d) Numbers of checks to make sure management plans (nutrient management, grazing management) are being followed by landowners.
   e) Number of checks to make sure practices are being operated and maintained properly.

[4] SNAP (Soil Nutrient Application Planner) Plus is Wisconsin's nutrient management software that calculates potential soil and phosphorus runoff losses on field basis while assisting in the economic planning of manure and fertilizer applications. Additional information can be found on the website http://snapplus.wisc.edu/.

f) The fields and practices selected and funded by a point source (adaptive management or water quality trading) compliance options will be carefully tracked to assure that Section 319 funds are not being used to implement practices that are part of a point source permit compliance strategy.

g) Number of new and alternative technologies and management measures assessed for feasibility, used, and incorporated into plan.

3) Water Quality Monitoring Reporting Parameters:
   a) Annual summer median total phosphorus and total suspended solids concentrations and loading values from USGS stream monitoring stations.
   b) Annual mean discharge and peak flow discharge from USGS stream monitoring stations.
   c) Total phosphorus, dissolved reactive phosphorus, total suspended solids, and clarity data from volunteer grab sampling (Lower Fox River Monitoring Program).
   d) Edge of field monitoring results.
   e) Macroinvertebrate Index of Biotic Integrity.

4) Administrative Review tracking and reporting will include:
   a) Status of grants relating to project.
   b) Status of project administration including data management, staff training, and BMP monitoring.
   c) Status of nutrient management planning, and easement acquisition and development.
   d) Number of cost-share agreements.
   e) Total amount of money on cost-share agreements.
   f) Total amount of landowner reimbursements made.
   g) Staff salary and fringe benefits expenditures.
   h) Staff travel expenditures.
   i) Information and education expenditures.
   j) Equipment, materials, and supply expenses.
   k) Professional services and staff support costs.
   l) Total expenditures for the county.
   m) Total amount paid for installation of BMP's and amount encumbered for cost-share agreements.
   n) Number of Water Quality Trading/Adaptive Management contracts.

13.3 Progress Evaluation

Due to the uncertainty of models and the efficiency of best management practices, an adaptive management approach should be taken with this subwatershed (Figure 49). Milestones are essential when determining if management measures are being implemented and how effective they are at achieving plan goals over given time periods. Milestones are based on the plan implementation schedule with short term (0-3 years), medium term (3-7 years), and long term (7-10 years) milestones. After the implementation of practices and monitoring of water quality, plan progress and success should be evaluated after each milestone period. In addition to the annual report an additional progress report should be completed at the end of each milestone period. The progress report will be used to identify and track plan implementation to ensure that progress is being made and to make corrections as necessary. Plan progress will be determined by minimum progress criteria for management practices, water quality monitoring, and information and education activities held. If lack of progress is demonstrated, factors resulting in milestones not being met should be included in the report. Adjustments should be made to the plan based on plan progress and any additional new data and/or watershed tools.

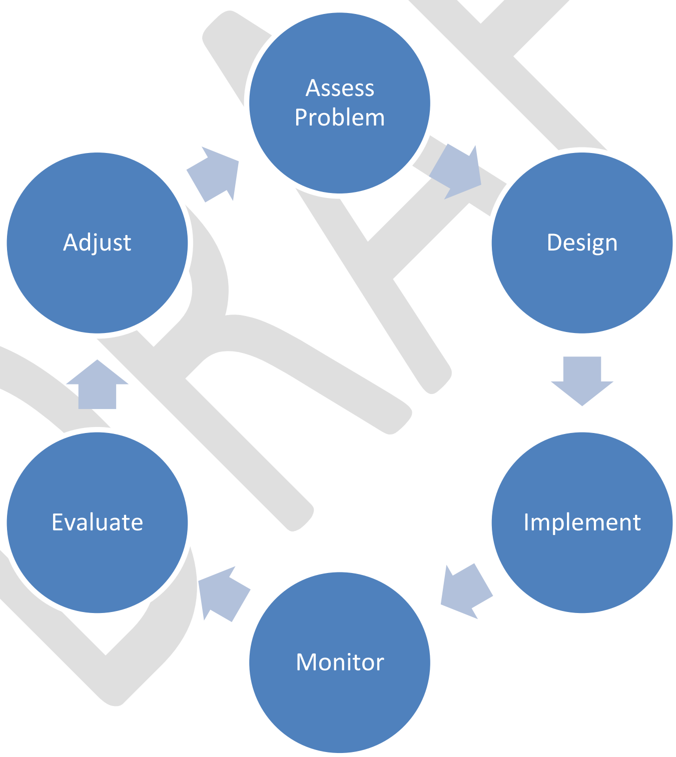

Figure 49. Adaptive Management Process

Water Quality Monitoring Progress Evaluation

This implementation plan recognizes that estimated pollutant load reductions and expected improvement in water quality or aquatic habitat may not occur immediately following implementation of practices due to several factors (described below) that will need to be taken into consideration when evaluating water quality data. These factors can affect or mask progress that plan implementation has made elsewhere. Consultation with the DNR and Water Quality biologists will be critical when evaluating water quality or aquatic habitat monitoring results. Milestones for pollutant load reductions are shown in Table 29 & Table 30. If the target values/goals for water quality improvement for the milestone period are not being achieved, the water quality targets or timetable for pollutant reduction will need to evaluated and adjusted as necessary.

The following criteria will be evaluated when water quality and aquatic habitat monitoring is completed after implementation of practices:

- Changes in land use or crop rotations within the same watershed where practices are implemented. (Increase in cattle numbers, corn silage acres, and/or urban areas can negatively impact stream quality and water quality efforts)
- Location in watershed where land use changes or crop rotations occur. (Where are these changes occurring in relation to implemented practices?)
- Watershed size, location where practices are implemented and location of monitoring sites.
- Climate, precipitation and soil conditions that occurred before and during monitoring periods. (Climate and weather patterns can significantly affect growing season, soil conditions, and water quality)
- Frequency and timing of monitoring.
- Percent of watershed area (acres) or facilities (number) meeting NR 151 performance standards and prohibitions.
- Percent of watershed area (acres) or facilities (number) that maintain implemented practices over time.
- Extent of gully erosion on crop fields within watershed over time. How many are maintained in perennial vegetation vs. plowed under each year?
- Stability of bank sediments and how much this sediment may be contributing P and TSS to the stream
- How “Legacy’ sediments already within the stream and watershed may be contributing P and sediment loads to stream?
- Presence and extent of drain tiles in watershed area in relation to monitoring locations. Do these drainage systems contribute significant P and sediment loads to receiving streams?
- Does monitored stream meet IBI and habitat criteria but does not meet TMDL water quality criteria?
- Are targets reasonable? Load reductions predicted by models could be overly optimistic.

Management Measures/Information and Education Implementation Progress Evaluation

Milestones for plan management measures are shown in Table 23 and milestones for Information and Education Plan Implementation are shown in Table 31. If less than 70% of the milestones are being met for each milestone period, the plan will need to evaluated and revised to either change the milestone(s) or to implement projects or actions to achieve the milestone(s) that are not being met.

Table 31. Information and Education Plan Implementation Goal Milestones.

Information and Education Plan Implementation Goal Milestones
Short Term (0-3 years)
a) Notice in local newspaper on completion of watershed plan.
b) Facebook/Website/or Page on county website developed for watershed information and updates.
c) 1 exhibit displayed or used at local library, government office, and/or local event.
d) Distribution of informational materials on watershed project and conservation practices to all eligible land owners.
e) At least 30 one on one contacts made with agricultural landowners.
f) At least 2 meetings held with agricultural landowners.
g) At least 2 educational workshops/tours held at a demonstration farm.
h) Annual newsletter developed and at least three issues distributed.
i) At least 2 meetings to share goals of watershed project have been held with local agricultural businesses and organizations.
j) At least one workshop held for non-operator landowners.
Medium Term (3-7 years)
a) At least 4 educational workshops held.
b) At least 3 meetings held with agricultural landowners.
c) At least one workshop held for non-operator landowners.
d) At least 2 municipalities/governing bodies in watershed adopt/amend current code or ordinance to match goals of watershed plan.
e) At least 10 people attend each educational workshop and meeting.
f) At least 4 issues of annual newsletter distributed.
Long Term (7-10 years)
a) Conduct survey of agricultural landowners on watershed issues (At least 75% surveyed can identify the major source of water pollution in the watershed and methods to protect water quality).
b) At least three issues of annual newsletter distributed.

If it has been determined that implementation milestones are not being met the following questions should be evaluated and included in the progress report:

- Did weather related causes postpone implementation?
- Was there a shortfall in anticipated funding for implementing management measures?
- Was there a shortage of technical assistance?
- Was the amount of time needed to install some of the practices misjudged?
- Were cultural barriers to adoption accounted for?

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Appendix A. Glossary of Terms and Acronyms.

BARNY- Wisconsin adapted version of the ARS feedlot runoff model that estimates amount of phosphorus runoff from feedlots.

Baseline –An initial set of observations or data used for comparison or as a control.

Best Management Practice (BMP) – A method that has been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Cost-Sharing- Financial assistance provided to a landowner to install and/or use applicable best management practices.

Ephemeral gully- Voided areas that occur in the same location every year that are crossable with farm equipment and are often partially filled in by tillage.

Geographic Information System (GIS) – A tool that links spatial features commonly seen on maps with information from various sources ranging from demographics to pollutant sources.

Index of Biotic Integrity – An indexing procedure commonly used by academia, agencies, and groups to assess watershed condition based on the composition of a biological community in a water body.

Lateral Recession Rate- the thickness of soil eroded from a bank surface (perpendicular to the face) in an average year, given in feet per year.

Natural Resources Conservation Service (NRCS) - Provides technical expertise and conservation planning for farmers, ranchers, and forest landowners wanting to make conservation improvements to their land.

Phosphorus Index (PI) – The phosphorus index is used in nutrient management planning. It is calculated by estimating average runoff phosphorus delivery from each field to the nearest surface water in a year given the field's soil conditions, crops, tillage, manure and fertilizer applications, and long term weather patterns. The higher the number the greater the likely hood that the field is contributing phosphorus to local water bodies.

Riparian – Relating to or located on the bank of a natural watercourse such as a river or sometimes of a lake or tidewater

Soil Nutrient Application Planner (SNAP) – Wisconsin's nutrient management planning software.

Spreadsheet Tool for Estimating Pollutant Load (STEPL) - Model that calculates nutrient loads (Phosphorus, Nitrogen, and Biological Oxygen Demand) by land use type and aggregated by watershed.

Soil and Water Assessment Tool (SWAT) – A small watershed to river basin-scale model to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices, and climate change. Model is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds.

Stream Power Index (SPI) – Measures the erosive power of overland flow as a function of local slope and upstream drainage area.

Total Suspended Sediment (TSS) - The organic and inorganic material suspended in the water column and greater than 0.45 micron in size.

Total Phosphorus (TP)- Measure of all forms of phosphorus in a sample.

Total Maximum Daily Load (TMDL) - A calculation of the maximum amount of pollutant that a water body can receive and still meet water quality standards.

United States Geological Survey (USGS) – Science organization that collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems.

United States Environmental Protection Agency (USEPA) – Government agency to protect human health and the environment.

University of Wisconsin Extension (UWEX) – UW-Extension works with UW- System campuses, Wisconsin counties, tribal governments, and other public and private organizations to help address economic, social, and environmental issues.

Wisconsin Department of Natural Resources (WDNR) – State organization that works with citizens and businesses to preserve and enhance the natural resources of Wisconsin.

Appendix B. Lower Fox River TMDL SWAT model loading results for the East River Watershed.

EAST RIVER
TOTAL SUSPENDED SOLIDS

Sub-basin Loading Summary (lbs/yr)	
Baseline	19,796,496
TMDL	7,231,130
Reduction	12,565,366
% Reduction Needed	63.5%
Daily TMDL (lbs/day)	19,798

Land Use	Acres	% of Total
Agriculture	26,520	54.3%
Urban	4,423	9.1%
Urban-MS4	9,091	18.6%
Construction	256	0.5%
Natural Background	8,571	17.5%
TOTAL	**48,861**	**100.0%**

Sources	Total Suspended Solids Load (lbs/yr)			% Reduction	Allocated
	Baseline	Allocated	Reduction	from Baseline	(lbs/day)
Agriculture	15,364,278	4,511,822	10,852,456	70.6%	12,353
Urban (non-regulated)	581,660	581,660	-	-	1,592
Natural Background	279,417	279,417	-	-	765
LOAD ALLOCATION	**16,225,355**	**5,372,899**	**10,852,456**	**66.9%**	**14,710**
Urban (MS4)	2,622,118	1,573,271	1,048,847	40.0%	4,307
Construction	830,079	166,016	664,063	80.0%	455
General Permits	118,364	118,364	-	-	324
WWTF-Industrial	-	-	-	-	-
WWTF-Municipal	580	580	-	-	2
WASTELOAD ALLOCATION	**3,571,141**	**1,858,231**	**1,712,910**	**48.0%**	**5,088**
TOTAL (WLA + LA)	**19,796,496**	**7,231,130**	**12,565,366**	**63.5%**	**19,798**

Urban (MS4)	Total Suspended Solids Load (lbs/yr)			% Reduction	Allocated
	Baseline	Allocated	Reduction	from Baseline	(lbs/day)
Allouez	444,964	266,978	177,986	40%	731
Bellevue	511,765	307,059	204,706	40%	841
DePere	273,714	164,228	109,486	40%	450
Green Bay	1,119,137	671,482	447,655	40%	1,838
Ledgeview	272,538	163,523	109,015	40%	448

WWTF-Municipal	Total Suspended Solids Load (lbs/yr)			% Reduction	Allocated
	Baseline	Allocated	Reduction	from Baseline	(lbs/day)
Wrightstown SD#1	472	472	-	-	1
Wrightstown SD#2	108	108	-	-	-

EAST RIVER
TOTAL PHOSPHORUS

Sub-basin Loading Summary (lbs/yr)	
Baseline	48,748
TMDL	14,592
Reduction	34,156
% Reduction Needed	70.1%
Daily TMDL (lbs/day)	39.95

Land Use	Acres	% of Total
Agriculture	26,520	54.3%
Urban (non-regulated)	4,423	9.1%
Urban (MS4)	9,091	18.6%
Construction	256	0.5%
Natural Background	8,571	17.5%
TOTAL	**48,861**	**100.0%**

Sources	Total Phosphorus Load (lbs/yr)			% Reduction from Baseline	Allocated (lbs/day)
	Baseline	Allocated	Reduction		
Agriculture	38,020	6,123	31,897	83.9%	16.76
Urban (non-regulated)	2,195	2,195	-	-	6.01
Natural Background	853	853	-	-	2.34
LOAD ALLOCATION	**41,068**	**9,171**	**31,897**	**77.7%**	**25.11**
Urban (MS4)	5,797	4,058	1,739	30.0%	11.11
Construction	836	836	-	-	2.29
General Permits	322	322	-	-	0.88
WWTF-Industrial	-	-	-	-	-
WWTF-Municipal	725	205	520	71.7%	0.56
WASTELOAD ALLOCATION	**7,680**	**5,421**	**2,259**	**29.4%**	**14.84**
TOTAL (WLA + LA)	**48,748**	**14,592**	**34,156**	**70.1%**	**39.95**

Urban (MS4)	Total Phosphorus Load (lbs/yr)			% Reduction from Baseline	Allocated (lbs/day)
	Baseline	Allocated	Reduction		
Allouez	1,101	771	330	30.0%	2.11
Bellevue	1,076	753	323	30.0%	2.06
DePere	737	516	221	30.0%	1.41
Green Bay	2,122	1,485	637	30.0%	4.07
Ledgeview	761	533	228	30.0%	1.46

WWTF-Municipal	Total Phosphorus Load (lbs/yr)			% Reduction from Baseline	Allocated (lbs/day)
	Baseline	Allocated	Reduction		
Wrightstown SD#1	690	170	520	75.4%	0.47
Wrightstown SD#2	35	35	-	-	0.10

Appendix C. Baseline water quality data from field monitoring sites.

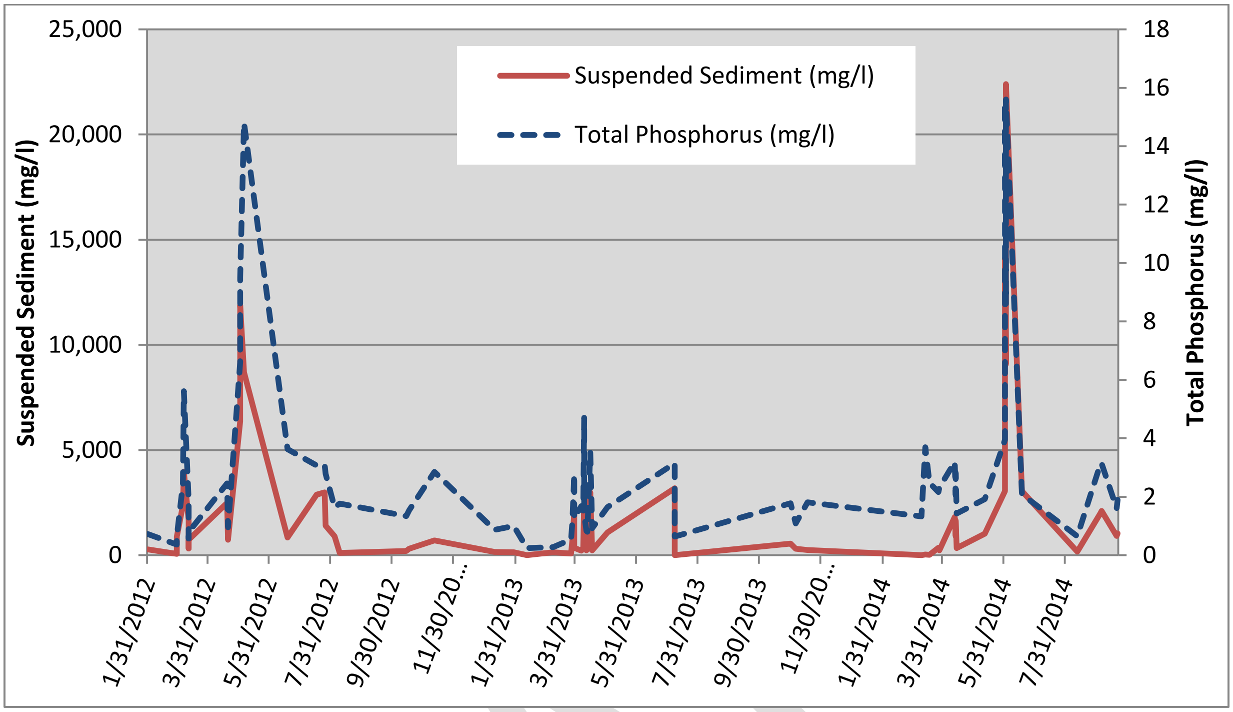


Figure 50. Baseline water quality data from 2012-2014 from USGS East River Waterway 1 Station (441624088045601) near Greenleaf, WI.

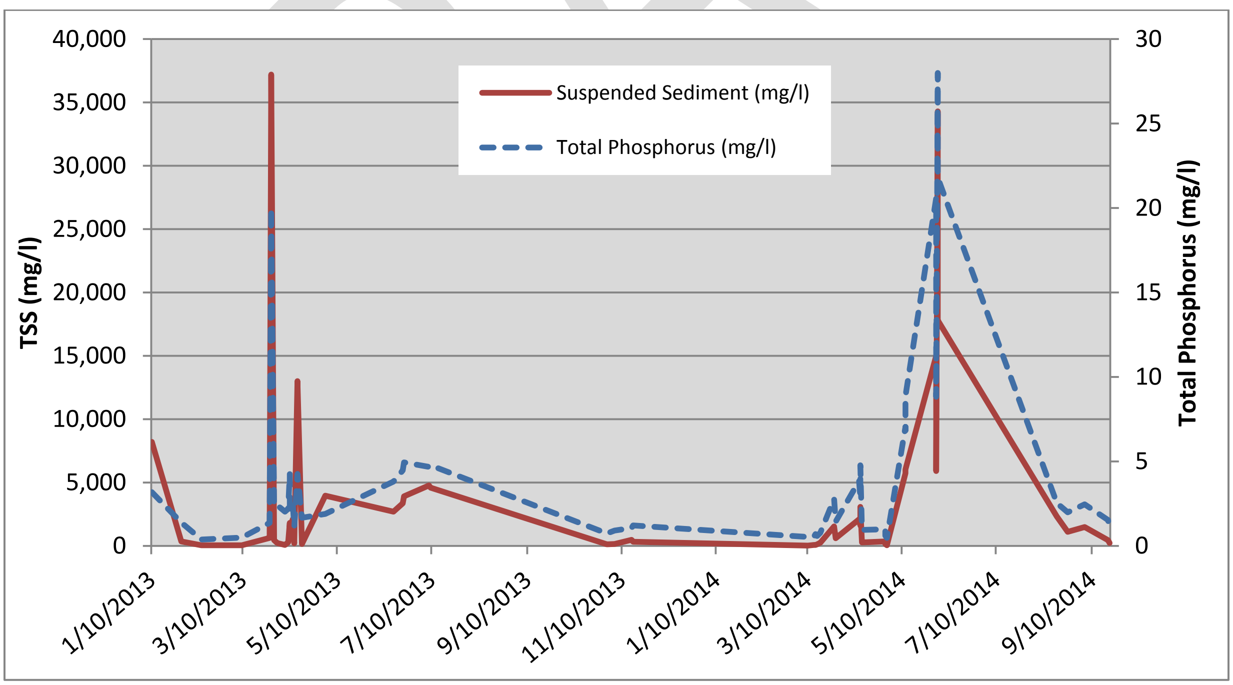


Figure 51. Baseline water quality data from 2013-2014 from USGS East River Waterway 2 Station (441546088082001) near Greenleaf, WI.

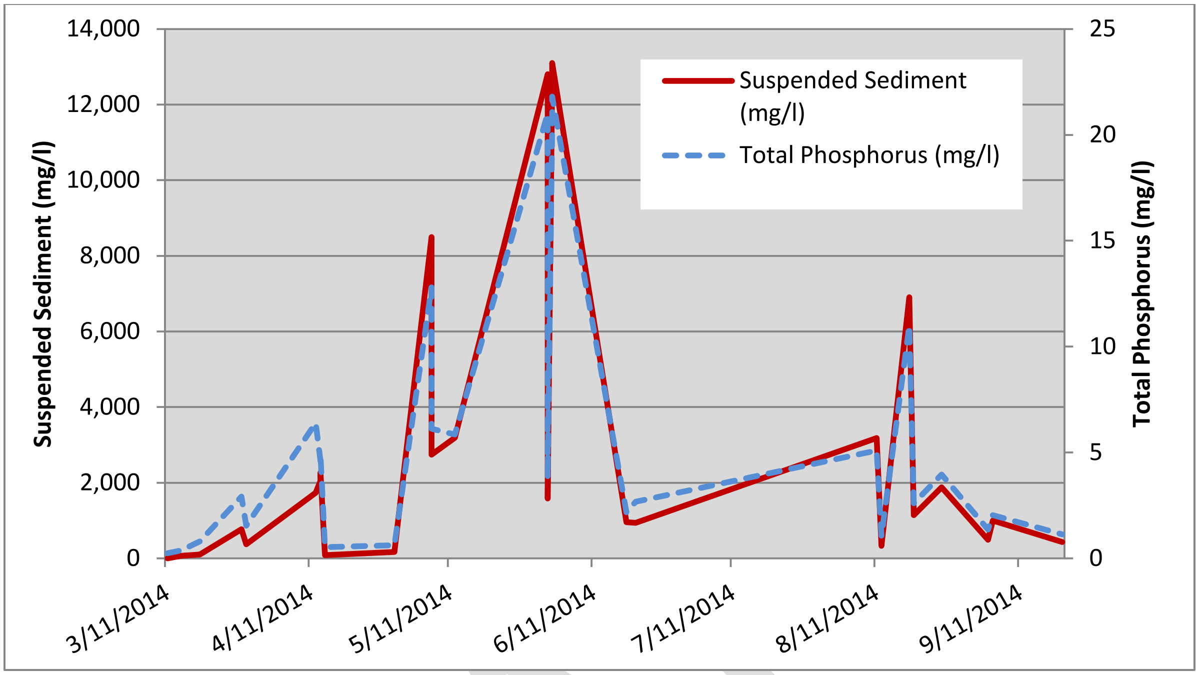


Figure 52. Baseline Water quality data from 2014 from USGS East River Waterway 3 Station (441520088004501) near Greenleaf, WI.

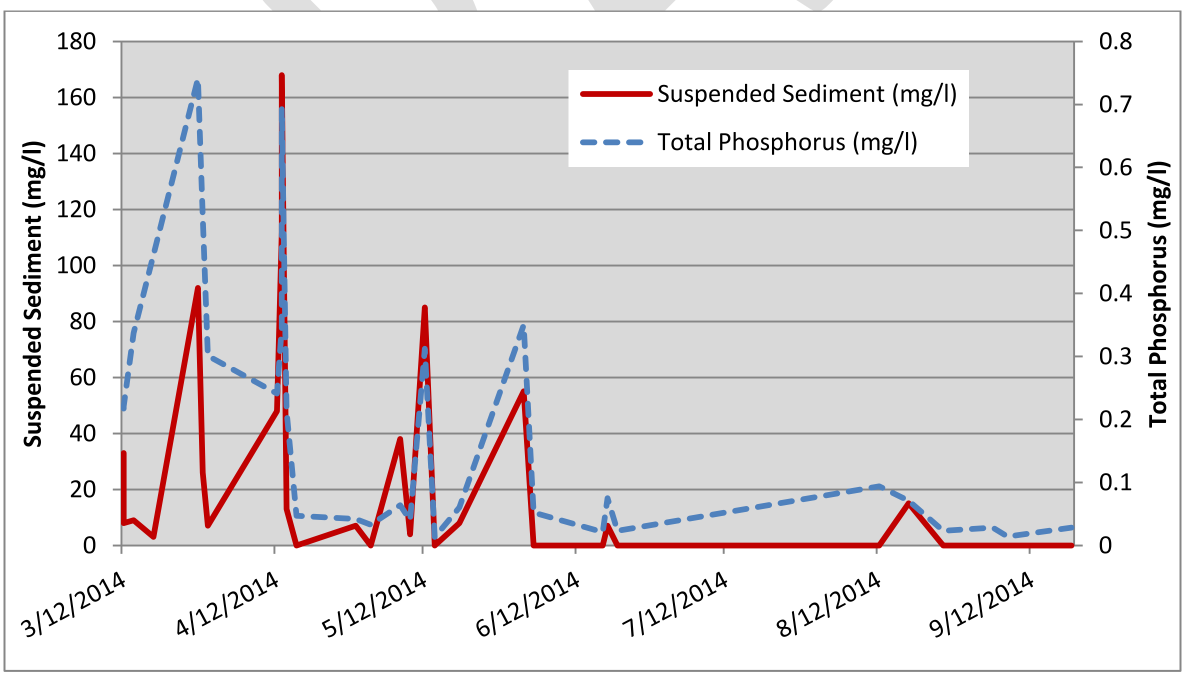
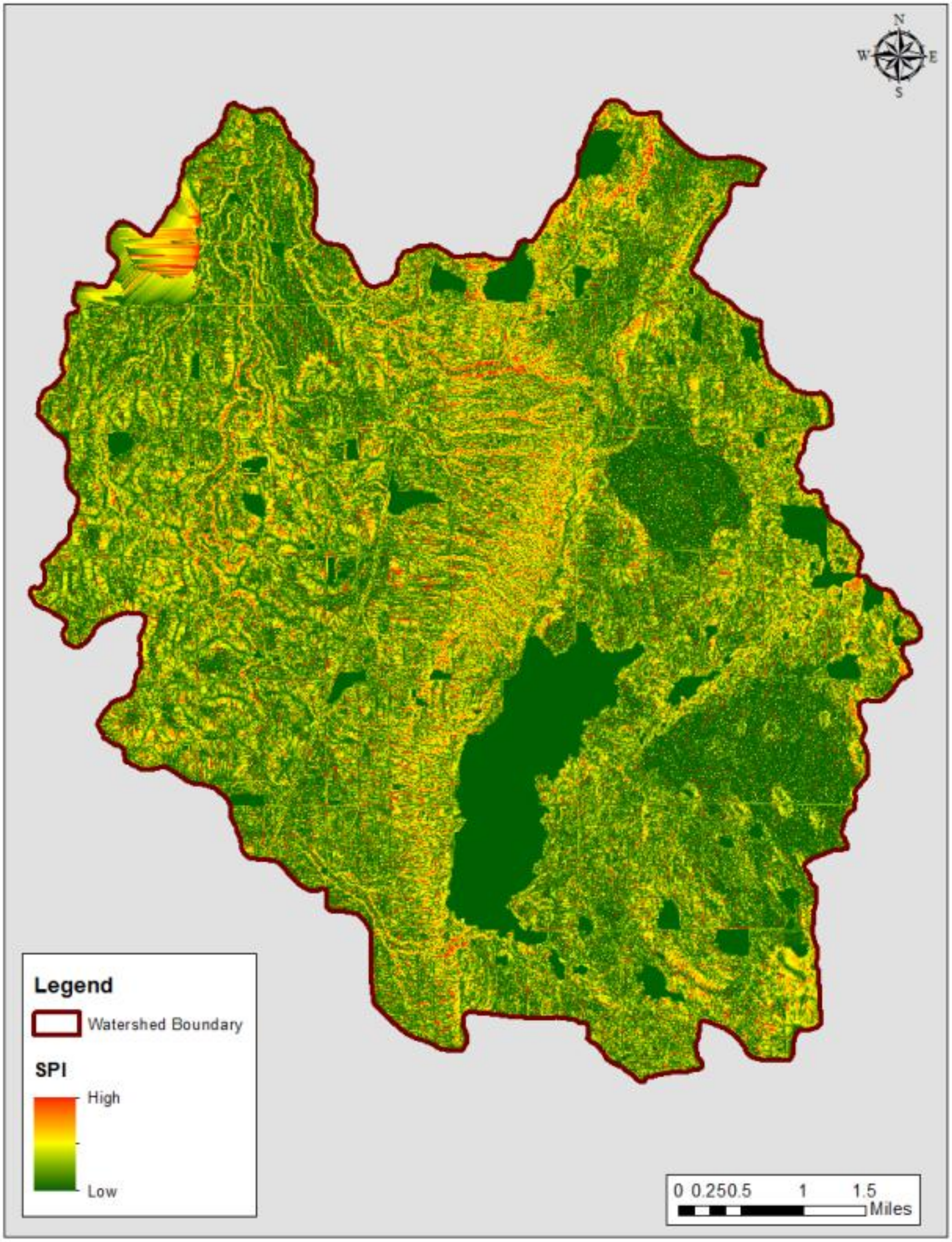


Figure 53. Baseline water quality data from 2014 from USGS East River Tile Outlet Station (441520088004501) near Greenleaf, WI.

Appendix D. Stream Power Index



Appendix E. STEPL inputs & results for best management practices.

Upland Practices applied to Cropland:

A combined Best Management Practice efficiency of 74% for total phosphorus and 88% for total sediment was used for conservation practices applied to cropland. This assumes that a combination of practices will be applied to the majority (≈75%) of the crop fields in the watershed. Combined BMP scenarios were calculated using the STEPL program's BMP Efficiency Calculator to get a general combined practice efficiency. The scenarios run and their combined efficiencies are shown below (Table 32). Nutrient management planning was not included the calculation since the majority (>90%) of agriculture land is already covered under nutrient management. The fact that the majority of the land is under nutrient management but water quality remains poor indicates that the current implementation of this practice is not performing as it should be. Improvement of current nutrient management and implementation of newer practices will likely increase the amount of reductions from cropland but are not quantifiable with current available data.

Table 32. Best management practices combined efficiencies.

Practice Combination	% reduction (phosphorus)	% reduction (sediment)
Contour/Strip Farming & Reduced Tillage	75.20	85.10
Cover Crop & Reduced Tillage	58.70	83.70
Field Border & Reduced Tillage	86.30	91.30
Field Border & Reduced Tillage & Cover Crops	90.60	92.60
Conservation Rotation & Reduced Tillage	67.00	88.70
Reduced Tillage & Vertical Manure Injection	56.00	75.00
Field Border & Reduced Tillage & Vertical Manure Injection	89.00	91.30
Cover Crop & Vertical Manure Injection & Reduced Tillage	70.10	78.80
Average Practice Efficiency	74.11	88.28

Table 33. STEPL Inputs for combined cropland practices and load reductions.

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data					Load Reductions	
Watershed	Cropland				P Reduction	Sediment Reduction
	P	Sediment	BMPs	% Area BMP Applied	lb/year	t/year
W1	0.555	0.66	Combined BMPs-Calculated	75	13,377.17	2,516.36

Riparian Buffers:

In order to determine load reductions from riparian buffers in the STEPL model, the amount of land the buffers are treating is needed. A GIS hydrology analysis tool was used to determine the catchment area of each riparian buffer needed (Figure 54). A total of 722 acres would be treated with needed riparian buffers which is 5.5% of cropland.

Table 34. STEPL Inputs for Riparian Buffers and Load Reductions.

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data					Load Reductions	
Watershed	Cropland				P Reduction	Sediment Reduction
	P	Sediment	BMPs	% Area BMP Applied	lb/year	t/year
W1	0.04125	0.03575	Filter strip	5.5	931.8	136.3

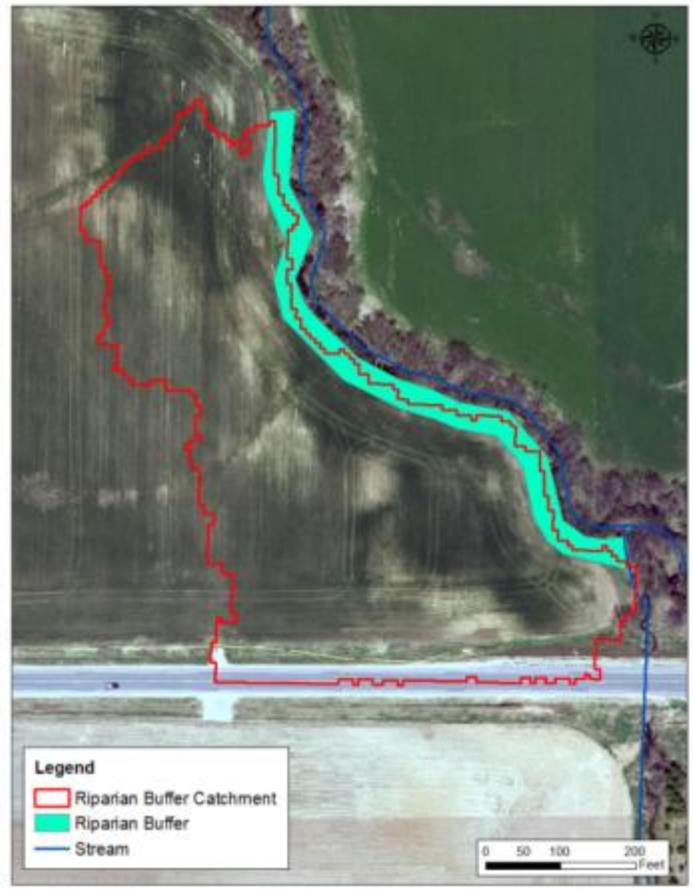


Figure 54. Riparian buffer catchment.

Wetland Restoration:

Reductions from wetland restorations were determined with the same method as riparian buffers. Catchment area was determined for each restorable wetland using GIS hydrology tools.

Table 35. STEPL inputs and load reductions for wetland restoration.

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data					Load Reductions	
Watershed	Cropland				P Reduction	Sediment Reduction
	P	Sediment	BMPs	% Area BMP Applied	lb/year	t/year
W1	0.038	0.0475	Wetland Restoration	9.5	926.77	181.10

Constructed Treatment Wetland for Subsurface Drainage:

Reductions from Constructed Treatment wetlands to treat tile drainage were determined by a assuming that one ½-1 acre size treatment wetland would treat 30 acres.

Table 36. STEPL inputs and load reductions for treatment wetlands.

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data					Load Reductions	
Watershed	Cropland				P Reduction	Sediment Reduction
	P	Sediment	BMPs	% Area BMP Applied	lb/year	t/year
W1	0.002992	0.00527	Constructed Treatment Wetland	0.68	132.28	30.14

Grassed Waterway:

Load reductions from grassed waterways were estimated by assuming an average height and width for gullies identified by the stream power index and field walks. A total 113,137 feet of gullies were identified in this analysis. An 85% implementation rate was assumed equating to approximately 96,166 ft of grassed waterways installed in the watershed. A 70% sediment delivery ratio was applied to the load reduction with the assumption that not all sediment from eroding gullies will reach the East River.

Table 37. STEPL inputs for gully dimensions and load reductions from grassed waterways/WASCOB's.

1. Gully dimensions in the different watersheds														
Watershed	Gully	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Length (ft)	Years to Form	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft3)	Nutrient Correction Factor	Annual Load (ton)	Load Reduction (ton)	Annual Load (ton)-ncf	Load Reduction (ton)-ncf
W1	Gully1	0.75	0.75	0.50	96166.00	1.00	0.95	Silt Loam	0.04	1.00	1532.65	1456.01	1532.65	1456.01

Concentrated Flow Area Planting:

Load reductions from concentrated flow area plantings were also estimated by assuming an average height and width for concentrated flow areas identified by the stream power index. Since concentrated flow area plantings would be applied to less severe gullies, the estimated heights and depths were less than the measurements applied to grassed waterways. A 70% sediment delivery ratio was applied to the load reduction with the assumption that not all sediment from eroding gullies will reach the East River.

Table 38. STEPL inputs for gullies/concentrated flow and load reductions from concentrated flow area planting.

1. Gully dimensions in the different watersheds														
Watershed	Gully	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Length (ft)	Years to Form	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft3)	Nutrient Correction Factor	Annual Load (ton)	Load Reduction (ton)	Annual Load (ton)-ncf	Load Reduction (ton)-ncf
W1	Gully2	0.50	0.10	0.25	84912.00	1.00	0.95	Silt Loam	0.04	1.00	270.66	257.12	270.66	257.12

Appendix F. Strategy to meet Lower Fox TMDL phosphorus reduction target.

As described on pages 74-77, this plan estimates, using STEPL, a 63% reduction in P loading(N = 16,282 lbs. P) will be achieved when a combination of practices are implemented on 75% (N = 9,861 ac) of cropland acres and reductions from other sources (e.g., eroding streambanks, pastures) are achieved in the Upper East River watershed. This P reduction falls short of the Lower Fox TMDL non-point agricultural P load reduction of 84% (N= 21,164 lbs. P). Using STEPL, the estimated amount of additional P reduction needed to meet 84% TMDL P reduction goal is 4,882 lbs. P.

The remaining amount of P reduction (4,882 lbs. P) will be achieved via the two measures listed below.

1. Implementation of practices described in plan on 3,600 additional cropland/pasture acres (NOTE: the number of additional acres was determined from this plan's estimated 13,377 lbs. P reduction on 9,861 acres = 1.36 lbs./P average reduction; 3,600 acres x 1.36 lbs./P = 4,896 lbs. P).
2. Implementation of new practices or technologies (described on pages 67-68) that is either currently under development or has not yet been evaluated/measured for effectiveness.

These two measures may or may not be implemented within this plan's ten year schedule. As this plan is implemented not only will actual implemented practices and pollutant load reductions be calculated and compared to plan milestones, but new or additional practices (e.g., aerial cover crop seeding, gypsum applications, tile line outlet treatment structures) are planned for evaluation to determine feasibility and pollutant reduction efficiencies (see table 23). Once determined, this information will be incorporated into the plan and may help meet the overall TMDL P reduction goal for this watershed. This plan contains several milestones to complete adaptive management by incorporating new information, over time. If it becomes clear from such evaluation, that the 84% TMDL P reduction will not be met within the plan's ten year schedule, this plan will be revised with a new schedule (and revised load reduction estimates) to include additional or new practices to achieve the Lower Fox TMDL P reduction goal.

Appendix G. Lower Fox River Surface Water Monitoring Summary

A summary of the WDNR Lower Fox River Surface Water Monitoring Strategy provided by Keith Marquardt (WDNR) on September 25, 2014:

Surface Water Monitoring for the Lower Fox TMDL

The primary objective for the Lower Fox River Basin monitoring project is to identify long term trends for phosphorus and suspended solids loading to the Fox River and Green Bay from major tributaries. This will provide an early warning of rising trends, and information for management issues that may arise. The principal water quality parameter of interest is total phosphorus, which is typically the limiting nutrient that affects aquatic plant growth and recreational water uses. Data collected for this project may also be used in the future to support the following objectives:

- Determining water quality standards attainment
- Identifying causes and sources of water quality impairments
- Supporting the implementation of water management programs
- Supporting the evaluation of program effectiveness

To this end, in 2013, the Wisconsin Department of Natural Resources (WDNR) convened a Lower Fox Monitoring Committee to develop and subsequently implement a surface water monitoring plan to evaluate the effectiveness of TMDL implementation in the Lower Fox River Basin. The Lower Fox River Basin comprises approximately 640 sq. miles, and, in general, extends from the outlet of Lake Winnebago to Green Bay. In general, the Basin contains 39 miles of the Fox River (referred to as the main stem) and 13 streams (referred to as tributaries) flowing into the Fox River.

The Lower Fox TMDL Monitoring Committee included representation from the University of Wisconsin Green Bay, (UWGB), the United States Geological Survey (USGS), the Oneida Nation, the WDNR, and municipal wastewater representatives.

The Committee noted that due to the size of the basin and complexity of source inputs (both point and nonpoint source pollution including urban runoff, rural runoff, and discharges) and the lack of currently available funding for surface water monitoring, that the scope of monitoring may be limited at the start. However, the current and proposed monitoring is sufficient to provide a baseline network (framework) that can be expanded upon in the future to accommodate implementation efforts occurring in the basin [for example, if conservation practices are focused in a particular sub-watershed, additional monitoring activities should accompany the implementation efforts].

Surface water monitoring in the Lower Fox was divided into two (2) components: the **Main Stem** (the Fox River itself) and the **Tributaries** (13 total).

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Main Stem
The Lower Fox River Main Stem monitoring includes the weekly collection of water samples from 3 or 4 monitoring locations from roughly March through October for a total of 35 weeks. Water samples will be analyzed at the Wisconsin State Laboratory of Hygiene (or a state certified laboratory) for analysis of total suspended solids (TSS), total phosphorus (TP), dissolved P, volatile organic solids, chlorophyll A, and dissolved oxygen (D.O.) . In addition, flow data will be collected at each of the four (4) main stem locations. The four (4) monitoring locations on the Main Stem include: the Lake Winnebago outlet (Neenah – Menasha dam), the De Pere dam, the mouth of the Fox River, and a proposed location near Wrightstown bridge.

Tributaries
For the 13 streams flowing into the Fox River, surface water quality monitoring will be conducted at one location at each of the 13 tributary sites on a monthly basis from May through October 2015 (for a total of 6 monthly monitoring events at 13 locations).

On each sampling date, volunteers will collect and ship surface water samples to the Wisconsin State Laboratory of Hygiene for the analysis of TP, TSS, and dissolved reactive phosphorus (DRP). In addition, volunteers will utilize transparency tubes to assess and document the transparency of each stream on each date.

See location map.

BIOLOGICAL ASSESSMENT and Secchi
Currently, volunteers are anticipated to perform Secchi depth and conduct submergent aquatic vegetation surveys in Lower Green Bay on a periodic basis.
To assess the biological health of the streams, macroinvertebrate samples will be collected during September or October and delivered to UW-Superior for identification to lowest taxonomic level on a periodic basis, currently proposed to be every 3 to 5 years.

Other
When warranted, based on water quality results, additional monitoring may be required. The WDNR will perform monitoring for confirmation prior to delisting the impaired water segments.

All sampling will be conducted in accordance with WDNR protocol.