Lake Mauvaise Terre Watershed Implementation Plan

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1.0 Introduction

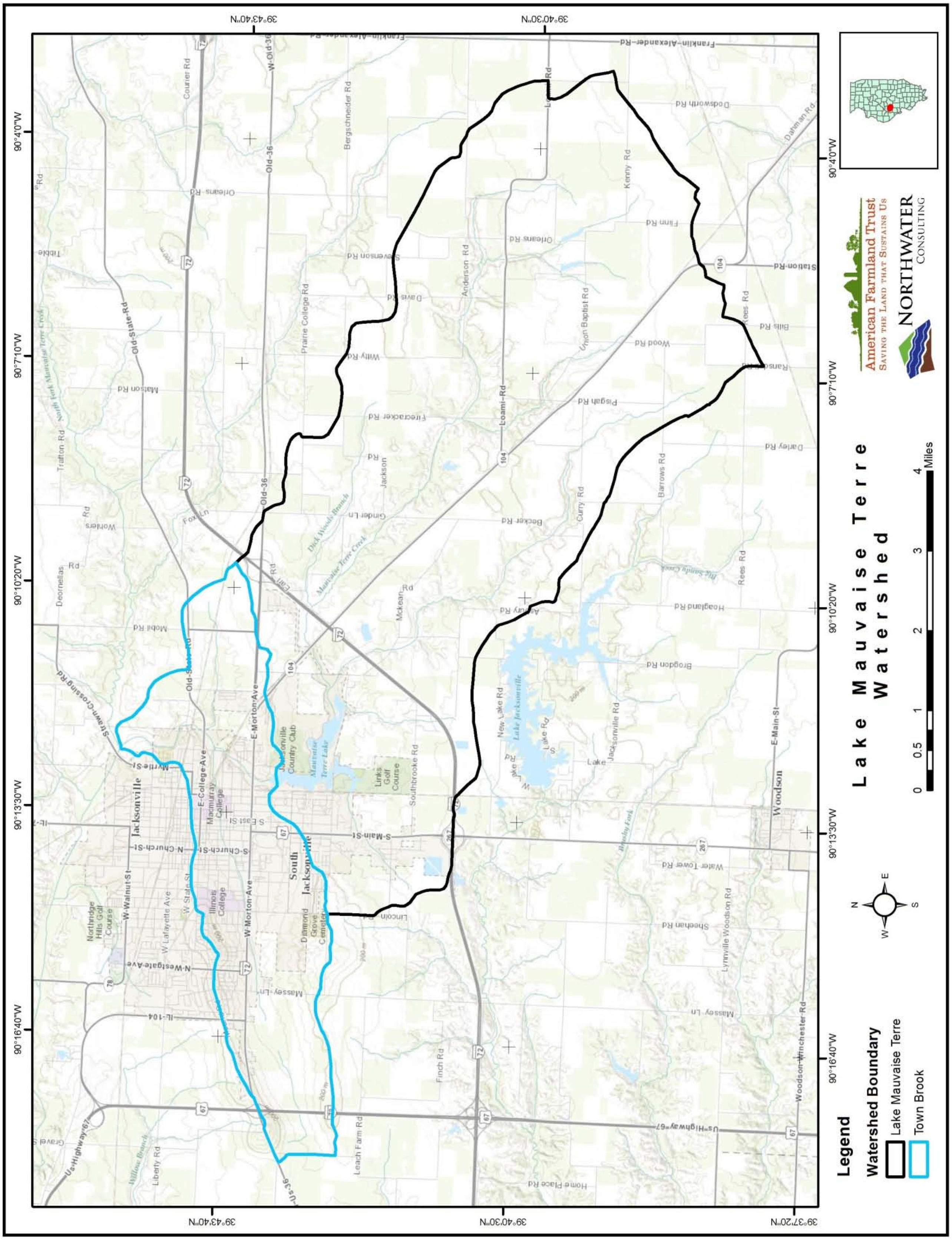
The Lake Mauvaise Terre Watershed Implementation Plan concentrates on defining a strategy to implement upland agricultural practices and structures that address soil losses from agricultural land and sediment and phosphorus loading into Lake Mauvaise Terre. The small, urban area of Town Brook is also included in the plan, which does not drain into Lake Mauvaise Terre. Town Brook has been incorporated into the plan due to interest from the City of Jacksonville as well as a desire by residents to protect and restore this valuable local resource. The purpose of this plan is to provide outreach, education and implementation activities to address primary upland watershed concerns.

Following a meeting held in Jacksonville that included concerned citizens, city officials and agricultural advisors, it was decided that a second plan will be developed to address in-stream and in-lake issues. Further research is required to identify appropriate agencies and resources to incorporate these concerns and a future amended plan shall incorporate in-stream and in-lake assessment and implementation strategies.

The Watershed Implementation Plan builds upon the 2007/2010 Lake Mauvaise Terre Total Maximum Load Report (TMDL). This report summarizes watershed conditions and includes a watershed characterization, largely derived from the TMDL. This watershed plan outlines watershed impairments, causes and sources, defines critical areas, and identifies specific Best Management Practices (BMPs) and other management measures. It provides pollution loading quantities and expected load reductions associated with management measures. The plan also provides cost estimates, water quality targets, responsible parties, technical and financial assistance required, milestones and a schedule, an education and outreach summary and component and, finally, a water quality monitoring strategy.

Aerial View of Lake Mauvaise Terre

Figure 1 - Lake Mauvaise Terre & Town Brook Watershed



2.0 Watershed Characterization

The watershed characterization component of the implementation plan is derived almost entirely from the 2007 TMDL document with the exception of Section 2.3 which provides a more current assessment of landuse and landcover.

The Lake Mauvaise Terre watershed lies totally within Morgan County, Illinois. The Lake was constructed by impounding Mauvaise Terre Creek above the North Fork of Mauvaise Terre Creek on the east side of Jacksonville. The Lake has a surface area of approximately 170 acres and serves as a back-up source of drinking water for the City of Jacksonville and surrounding communities. The Lake has been heavily impacted by decades of siltation, largely from agricultural land in the watershed. The Lake was listed as impaired in 1994 for manganese, phosphorus, nitrates, total suspended solids and excess algae growth.

The watershed (HUC 12 071300110402) includes an area that drains directly to Lake Mauvaise Terre, as well as the small Town Brook watershed that drains a portion of Jacksonville. The watershed area for Lake Mauvaise Terre is 21,402 acres and Town Brook is 5,765 acres for a total of 27,167 acres.

2.1 Geology & Soils

Most of the watershed is relatively flat as compared to stretches of Mauvaise Terre Creek west of Jacksonville. Much of the soil in the Lake Mauvaise Terre watershed contains background levels of manganese and iron oxide, and acidic properties of the soils could promote manganese and iron moving into solution and being transported in base flow or runoff. Lake Mauvaise Terre watershed soils are primarily listed as Ipava-Sable-Tama (16,073 acres or 75.1% of the watershed); and Rozetta-Keomah-Hickory (5,329 acres or 24.9% of watershed acres).

The official soil series descriptions describe the Ipava soil series as very deep, somewhat poorly drained, moderately slowly permeable soils formed in loess on uplands, with slopes ranging from 0 to 5 percent. The Sable series consists of very deep, poorly drained, moderately permeable soils formed in loess on nearly level broad summits of moraines and stream terraces. Slope ranges from 0 to 2 percent. The Sable series also has very weakly cemented iron and manganese concretions throughout five of the seven soil horizons (8-47 inches deep). Upper soil horizons (to 31 inches for Ipava and 23 inches for Sable) in these two series are described as slightly to moderately acidic. The Tama series consists of deep, moderately well-drained, moderately permeable soils formed in loess on upland and high stream benches. Slope ranges from 0 to 20 percent, and these soils are characterized as strongly acidic from zero to 45 inches deep.

The Rozetta series consists of very deep, well-drained soils formed in loess on uplands. Permeability is moderate. Slope ranges from 0 to 25 percent. This series is described as moderate to strongly acidic (0 to 50 inches deep), with some horizons (21-29 inches deep) having masses of iron and manganese accumulation. The Keomah series consists of very deep, somewhat poorly drained soils formed in loess on uplands and high stream terraces. They are moderately slowly to slowly permeable. Slopes range from 0 to 5 percent and most horizons (0 to 47 inches deep) are characterized as moderately to strongly acidic. Four of the nine soil horizons in this series are also described as having fine iron and manganese concretions. The Hickory series consists of very deep, well drained, moderately permeable soils on dissected till plains. They formed in till that can be capped with up to 20 inches of loess. Slope ranges from 5 to 70 percent. The upper horizons (up to 58 inches deep) are characterized as strongly to very strongly acidic, and have fine, rounded black iron-manganese nodules at 26-58 inches.

2.2 Climate

The National Weather Service (NWS) maintains a weather station at Jacksonville and data from it were used to generate climate statistics presented in this section. The Lake Mauvaise Terre watershed has a temperate climate and has cold winters and hot summers. The average, long-term precipitation (1970-2013) recorded at Jacksonville is 39.7 inches. The maximum annual precipitation is 60.05 inches (1993) and the minimum annual precipitation is 21.64 inches (1901). On average, there are 106.5 days with precipitation of at least 0.01 inch and 9.8 days with precipitation greater than 1 inch. Average snowfall is approximately 23.3 inches per year. Average maximum and minimum temperatures recorded at Jacksonville are 34.5° F and 16.0° F, in January and 86.6° F and 63.5° F in July (1970-2013 data). The average temperature recorded in January is 25.5° F and the average temperature recorded in July is 75.1° F.

2.3 Landcover & Landuse

In order to understand sources contributing to the lake impairments, landcover or landuse in the watershed were estimated. For the purposes of estimating watershed pollutant loading presented in Section 5.2, a custom landuse GIS layer was generated for the watershed (Figure 2). Tables 1 and 2 provide a breakdown of landuse/landcover categories and quantities, and Figure 2 shows the distribution throughout the watershed. The predominant land use in the watershed is agriculture. Cropland makes up about 71% (19,286 acres) of the total 27,167 acres in the entire watershed. The Lake Mauvaise Terre drainage has 16,875 acres of cropland (79%) and Town Brook has 2,411 acres (42%). Crops are primarily a corn-soy rotation with a small amount of wheat. Wheat is primarily grown for livestock operations, either for straw or manure application. Corn production represents 55% to 59% of the total cropland acres.

Table 1 - Lake Mauvaise Terre Drainage Landuse/Landcover

Landuse/Landcover Category	Area (acres)	Percent of Watershed
Row Crop	16,875	78.85%
Transportation/Road	840	3.92%
Grassland	692	3.23%
Forest	513	2.40%
Residential	421	1.97%
Pasture	381	1.78%
Golf Course	266	1.24%
Dewatering Area	240	1.12%
Open Water - Pond or Reservoir	235	1.10%
Farmhouse	135	0.63%
Wetland	120	0.56%
Park	109	0.51%

Landuse/Landcover Category	Area (acres)	Percent of Watershed
Open Water - Stream	101	0.47%
Farm Buildings and Barn Lots[1]	97	0.46%
Commercial Mix	69	0.32%
Manufacturing	61	0.28%
Warehousing	55	0.26%
Residential Open Space	50	0.23%
Vacant	27	0.13%
Residential Multi-Family	23	0.11%
Feed Area	22	0.10%
Government Facility	17	0.08%
Religious Facility	13	0.06%
Open Space	10	0.05%
Cultural and Entertainment	7	0.03%
Educational Facility	6	0.03%
Cemetery	5	0.02%
Confinement	5	0.02%
Communication	3	0.02%
Utilities and Waste Facility	3	0.01%
Multi-Family Apartments	1	0.004%
Total	**21,402**	

[1] – livestock numbers are unknown

Table 2 - Town Brook Drainage Landuse/Landcover

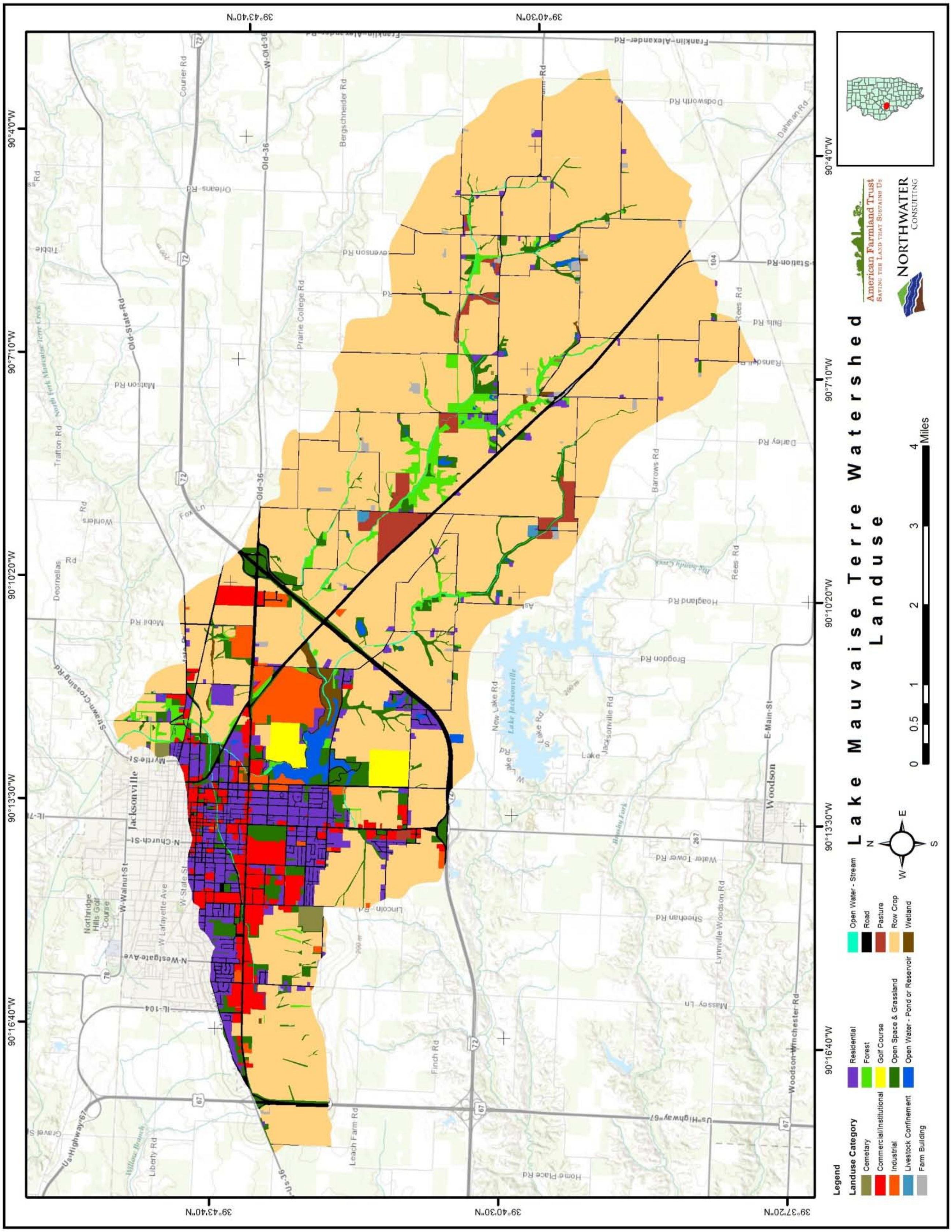
Landuse/Landcover Category	Area (acres)	Percent of Watershed
Row Crop	2,411	41.82%
Residential	829	14.38%
Transportation/Road	546	9.46%
Commercial Mix	423	7.33%
Grassland	181	3.13%
Government Facility	159	2.76%
Open Space	133	2.30%
Forest	123	2.14%
Educational Facility	114	1.98%
Park	106	1.83%
Mobile Home	100	1.74%
Warehousing	99	1.71%
Cemetery	79	1.36%
Residential Open Space	69	1.20%
Cultural and Entertainment	54	0.93%
Manufacturing	51	0.89%
Other Institutional	32	0.55%
Open Water - Stream	30	0.53%
Wetland	28	0.49%

Landuse/Landcover Category	Area (acres)	Percent of Watershed
Religious Facility	25	0.43%
Multi-Family Apartments	24	0.41%
Golf Course	19	0.33%
Shopping Mall	18	0.31%
Utilities and Waste Facility	15	0.27%
Office Space	15	0.26%
Farm Buildings and Barn Lots[1]	14	0.24%
Vacant	13	0.23%
Farmhouse	12	0.21%
Communication	10	0.18%
Nursery	9	0.15%
Vehicle Dealership	7	0.13%
Open Water - Pond or Reservoir	7	0.13%
Medical Facility	7	0.12%
Parking Lot	5	0.09%
Total	**5,765**	

[1] – livestock numbers are unknown

In Morgan County, approximately 57% of the corn croplands and 5% of the soybean crops are tilled using conventional tillage methods that leave little or no residue on the surface (Illinois Department of Agriculture). Another 24%of the corn acres and 16% of the soybeans are tilled by reduced tillage methods, which can reduce soil loss in comparison to conventional methods by 30%. The remaining 19% of corn croplands and 79% of soybean crops are planted either using mulch-till methods, in which at least 30% residue of the previous year's crop remains on the land after planting the new crop; or, without any tillage prior to planting, a process that can reduce soil loss by up to 75%. Mulch-till and no-till are considered conservation tillage systems that can significantly reduce soil loss. Management practices within the watershed vary by individual producer, but include practices like buffer strips. Although the total number of individual producers is unknown, many producers take advantage of cost-share programs through NRCS conservation programs. There are 6.3 acres of ground in the watershed enrolled in the Conservation Reserve and Enhancement Program (CREP) and 119 acres enrolled in the Conservation Reserve Program (CRP).

Figure 2 - Watershed Landuse/Landcover



2.4 Hydrology

There is one USGS flow gage in the watershed. This gage is on the North Fork Mauvaise Terre Creek near Jacksonville, IL (USGS gage number 05586000). The drainage area upstream of this gage is 29.1 square miles. According to the National Hydrography Dataset (NHD), there are a total of 168 miles of streams in the watershed, 18.3 miles of which are major streams; the remaining streams in the watershed are small tributaries, ephemeral streams and ditches (Table 3 and Figure 3).

Table 3 - Watershed Streams

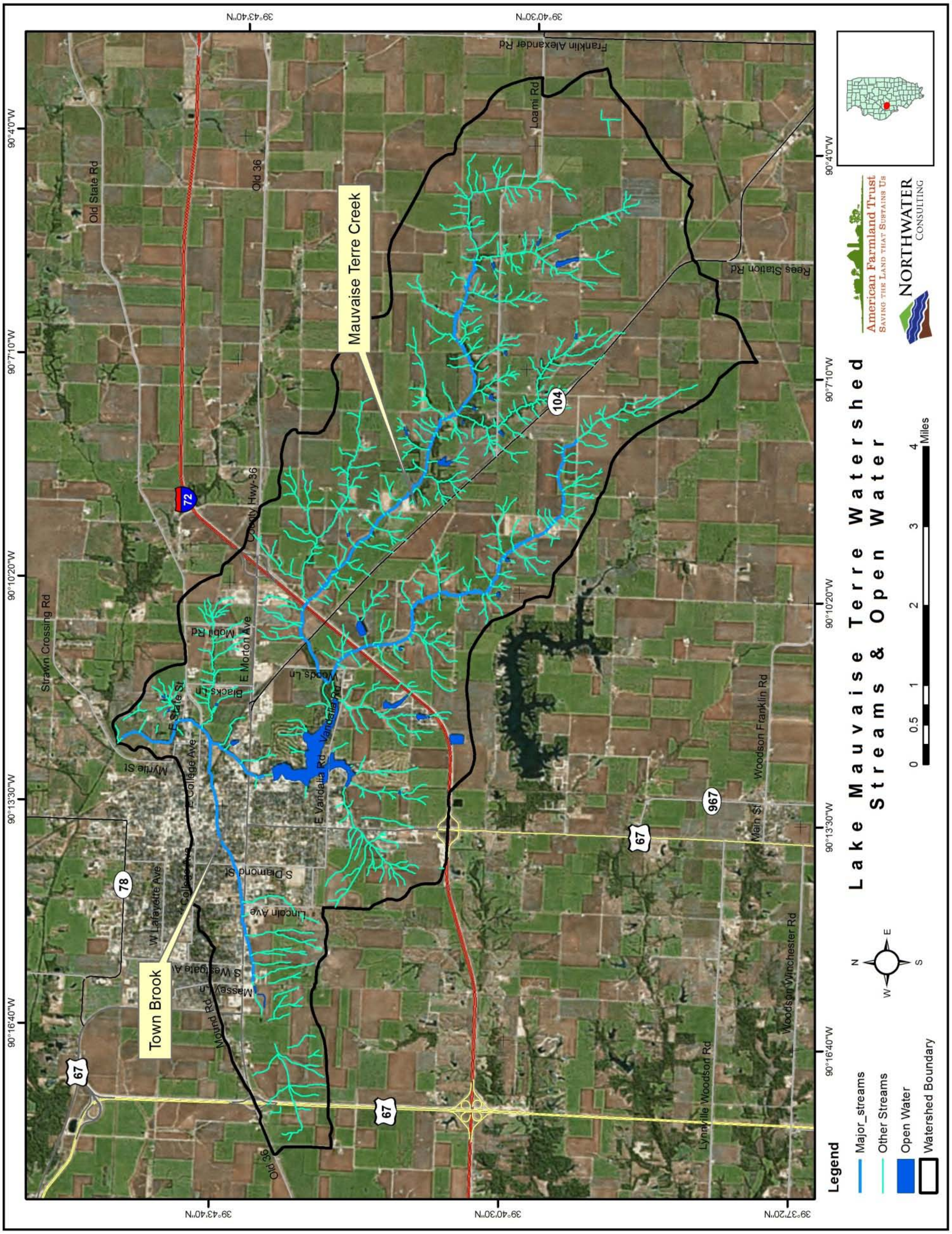
	Lake Mauvaise Terre		Town Brook	
	Stream Feet	Stream Miles	Stream Feet	Stream Miles
Major Stream	68,598	13	28,300	5.3
Tributary Streams & Ditches	654,210	124	138,771	26
Total	722,808	137	167,071	31

2.5 Urbanization and Growth

Jacksonville is the major urban area within the Lake Mauvaise Terre watershed; the city lies partially within the Lake Mauvaise Terre watershed as does a portion of the City of South Jacksonville. The population of Morgan County, according to the 2010 U.S. Census, which contains the Lake Mauvaise Terre watershed, was approximately 35,547, a decrease of 2.9% from 36,616 in 2000. According to the U.S. Census County Quick Facts, the 2013 Morgan County population estimate is 35,067, a 4.3% population decline from 2000.

Aerial View of Lake Mauvaise Terre

Figure 3 - Watershed Streams & Open Water



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3.0 Causes & Sources of Watershed Impairments

The 2007 TMDL did not specifically address Town Brook; only Mauvaise Terre Creek (downstream of Town Brook) was addressed. For the purposes of this plan, Town Brook, although not a direct drainage to Lake Mauvaise Terre, is included in the overall watershed and addressed in the implementation plan. Impairments addressed will focus on Lake Mauvaise Terre, however, pollution loading and Best Management Practices (BMPs) have been included for Town Brook. The watershed area for Lake Mauvaise Terre is 21,402 acres and Town Brook is 5,765 acres for a total of 27,167 acres.

As noted in the 2007 TMDL for Lake Mauvaise Terre, the draft 2004 303(d) list identified Lake Mauvaise Terre (SDL) as being in partial support of the overall use, aquatic life, and public water supply designated uses, and in nonsupport of primary contact (swimming) and secondary contact (recreation) designated uses (Table 4).

Table 4 - 2004 Lake Mauvaise Terre Impairments

Waterbody Segment	Hydrologic Unit Code	Waterbody Name	Size (acres)	Year Listed	Listed for
IL_SDL	0713001104	Mauvaise Terre Lake	172	1994	Manganese, Phosphorus, Nitrates, Total Suspended Solids (TSS), excessive algal growth

Since completion of the TMDL, additional impairments have been identified for Lake Mauvaise Terre as noted in the 2014 303(d) list. Current designated uses that are not being supported include Aesthetic Quality, Aquatic Life and Fish Consumption. The only designated use that is being fully supported is Public and Food Processing Water Supplies. Designated uses not assessed are Primary Contact and Secondary Contact (Table 5).

Table 5 - 2014 Lake Mauvaise Terre Impairments

Waterbody Segment	Hydrologic Unit Code	Waterbody Name	Size (acres)	Year Listed	Listed for
IL_SDL	0713001104	Mauvaise Terre Lake	172	1994/2014	Turbidity, Dissolved Oxygen, Fluoride, Hexachlorobenzene, Mercury

This watershed implementation plan specifically addresses TMDL impairments of total suspended sediment (and turbidity), phosphorus, nitrates (as total nitrogen). The report also acknowledges dissolved Oxygen (DO), fluoride, mercury, hexachlorobenzene, and addresses manganese as a function of sediment load.

As noted in the TMDL, potential sources of phosphorus and nitrates to Mauvaise Terre Lake include agricultural sources, existing sediments, recreation activities (golf courses) and, possibly, failing private sewage disposal systems. The 2014 IEPA 303(d) report list sources of impairments as: atmospheric deposition – toxics, internal nutrient recycling, littoral/shore area modifications (non-riverine), unknown sources, golf courses, and runoff from forest/grassland/parkland.

The primary source of manganese to Mauvaise Terre Lake may be background sources due to naturally high concentrations in area soils; in-place lake sediments may also contribute. The primary potential source of low DO in Lake Mauvaise Terre is agricultural runoff as low DO is thought to be a function of excessive nutrients in the lake. Potential sources of TSS and turbidity include agricultural sources (erosion of crop ground), streambank erosion and urban runoff. In addition to agriculture, a source of phosphorus and nitrogen is also urban runoff.

The source of the fluoride impairment is likely naturally occurring background sources due to groundwater recharge. The source of mercury is thought to be atmospheric deposition and eroded sediment, and sources of hexachlorobenzene are likely agricultural pesticides and, to a lesser extent, industrial activities adjacent to the lake. Actively addressing agricultural runoff and soil erosion is the most effective way to address all impairments in Lake Mauvaise Terre.

3.1 Detailed Analysis of Pollution Sources

The following section provides sources descriptions identified at the significant subcategory level, along with estimates to the extent they are present in the watershed. Much of the information presented is directly referenced from the TMDL.

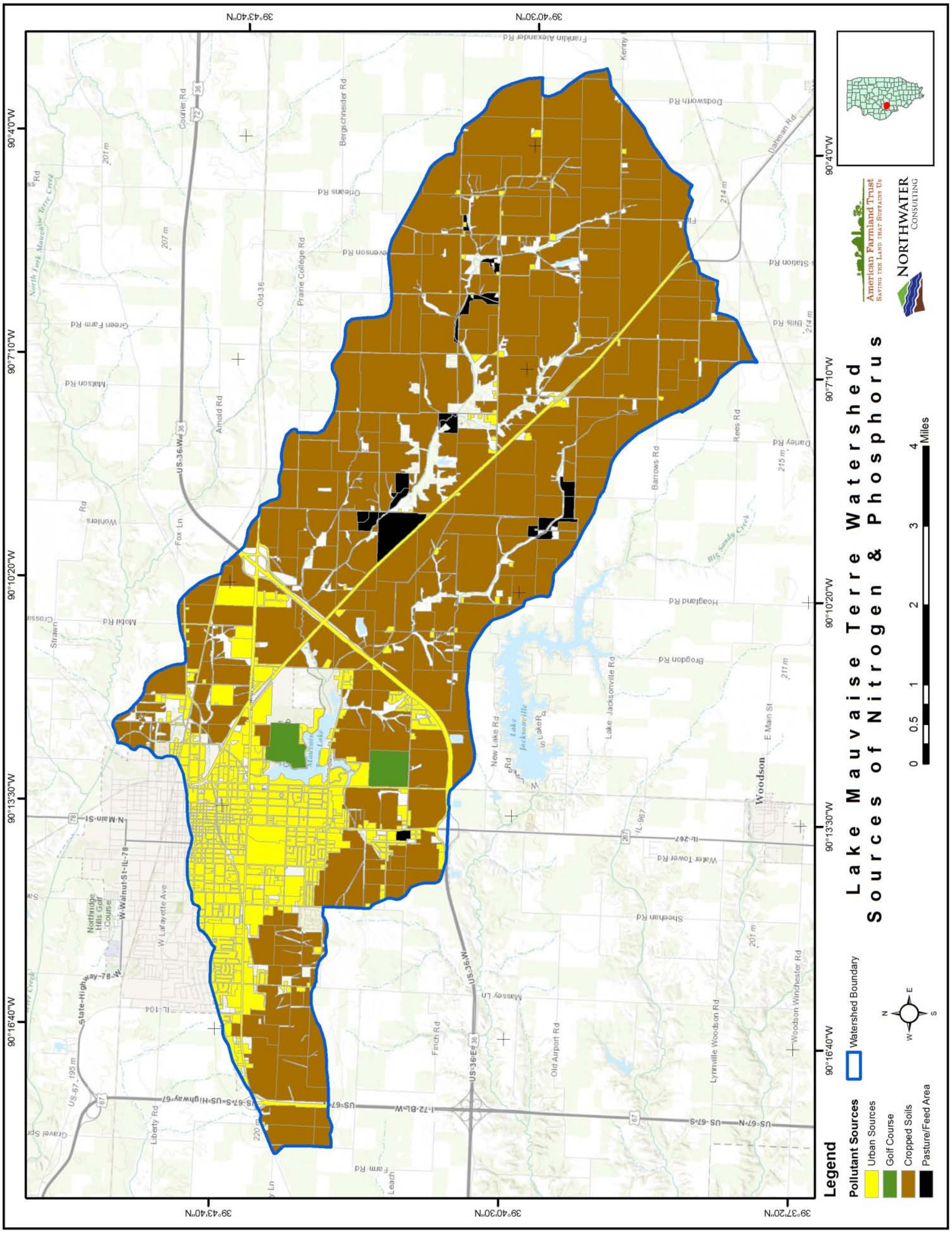
3.1.1 Phosphorus & Nitrates

Referencing the 2011 TMDL, internal phosphorus loading from the bottom sediments is the primary source of phosphorus to Lake Mauvaise Terre. TMDL model results indicate 18% of the phosphorus load is from external sources and 82% from an internal source. Phosphorus data collected at different water depths show higher concentrations of phosphorus near the lake bottom. Mauvaise Terre Lake is shallow and dissolved oxygen does not approach zero at any of the three monitoring stations (data collected in 1992, 1993 and 2005). The higher phosphorus concentrations, measured deeper in the water column, suggest mobilization of in-place sediments as a source.

External sources of phosphorus and nitrates are originating primarily from cropped soils in the watershed and, to a lesser degree, from pasture and urban areas, such as residential areas and farm homes, commercial and industrial development, urban parks and open space. Urban areas contribute nutrients primarily as a function of greater rates of runoff and less infiltration; the application of lawn fertilizers will also contribute to nutrient loading from urban areas. Recreation sources or golf courses and pasture operations are also identified as a source of nitrogen and phosphorus, and specifically referenced in the TMDL.

The entire watershed contains 285 acres of golf courses, or 1%; one of which is directly adjacent to the lake. The remaining external sources of nitrogen and phosphorus include a total of 19,286 acres (71%) of cropped soils, 4,540 acres (17%) of urban area, and 404 acres of pasture and small feed areas (1.5%). See Figure 4.

Figure 4 - Potential Sources of Nitrogen & Phosphorus



3.1.2 Total Suspended Solids

The primary sources of TSS in the watershed is cropped agricultural soils, actively eroding gullies and eroding streambanks. Secondary sources of TSS include urban areas, specifically residential and farm homes, barns and barn lots, livestock feed areas, confinements, roads and parking lots, and overgrazed pasture areas. Although these secondary sources do not account for a large percentage of the overall TSS load, they do produce high per-acre loadings. Erosion from crop ground accounts for 70% of the total watershed sediment load, streambank erosion is estimated to contribute 14% of the overall sediment load and observed gully erosion accounts for 5%. Secondary sources account for 8% of the total TSS load; the remaining load is originating from undeveloped areas of the watershed.

3.1.3 Manganese

As noted in the 2011 TMDL, the load duration curve for manganese shows that elevated concentrations are observed only at low flows. This indicates that groundwater/natural sources are likely contributors to manganese exceedances. It is difficult to specifically quantify groundwater sources and, therefore, manganese sources are described as a function of existing overall sediment load. Results indicate that annual sediment loading for Lake Mauvaise Terre is 19,029 tons and 22,407 tons for both Lake Mauvaise Terre and Town Brook, respectively. Eighty-eight severely eroding gullies were observed throughout the watershed and contribute 1,387 tons of sediment annually and an estimated 94 miles of potentially eroding streambanks contribute 3,797 tons annually.

3.1.4 Dissolved Oxygen

As previously noted, the primary source of low DO in Lake Mauvaise Terre is agricultural runoff, as low DO is often a function of excessive nutrients. Decreased levels of DO occur when oxygen-demanding inputs are greater than the waterbody's ability for diffusion. Excessive phosphorus loading can stimulate algal and aquatic plant life production and, when production is too high, anoxic conditions can be observed throughout the water column of a lake. Sources of the DO impairment are, therefore, similar to that of phosphorus; 18% of the phosphorus load is from external sources and 82% from an internal source. External sources include agricultural ground and recreational sources, specifically, golf courses. Two golf courses exist in the watershed, one of which is directly adjacent to Lake Mauvaise Terre; the watershed contains 285 acres of golf courses, or 1%. The remaining external sources of nitrogen and phosphorus include a total of 19,286 acres (71%) of cropped soils and 4,540 acres (17%) of urban area.

3.1.5 Fluoride, Mercury & Hexachlorobenzene

Sources of the fluoride impairment are natural background sources from groundwater recharge; mercury is occurring from atmospheric deposition and eroded sediment and hexachlorobenzene is thought to be originating from both agricultural areas (pesticides) and industrial activities adjacent to the lake. It is difficult to quantify groundwater recharge sources without detailed investigation and, therefore, the exact source of the fluoride impairment is unknown. Given that mercury is occurring from eroded sediment, the primary source is agricultural ground in the watershed which accounts for 19,286 acres, or 71% of the watershed. Because very little is known about the source of the hexachlorobenzene impairment, it is assumed to be originating from both pesticide use and industrial activities; sources include the 71% of the watershed in row crop agriculture and potentially the large 30-acre manufacturing facility directly adjacent to the spillway on Lake Mauvaise Terre. It is important to note that no data exists on pesticide use in the watershed and it cannot be confirmed that the manufacturing facility adjacent to the lake is actually a source.

Gully Erosion in the Watershed

4.0 Critical Areas

Critical areas are those locations throughout the watershed where implementation activities should be focused with the intent of achieving the greatest "bang-for-the-buck." Critical areas for the Lake Mauvaise Terre watershed (Lake Mauvaise Terre and Town Brook) include highly erodible land (HEL), eroding gullies identified through a field assessment and the mainstem of Town Brook. Actions addressing these critical areas will have the greatest value and benefit to the watershed. Figures 4 through 6 illustrate the critical areas in map format.

4.1 HEL Soils

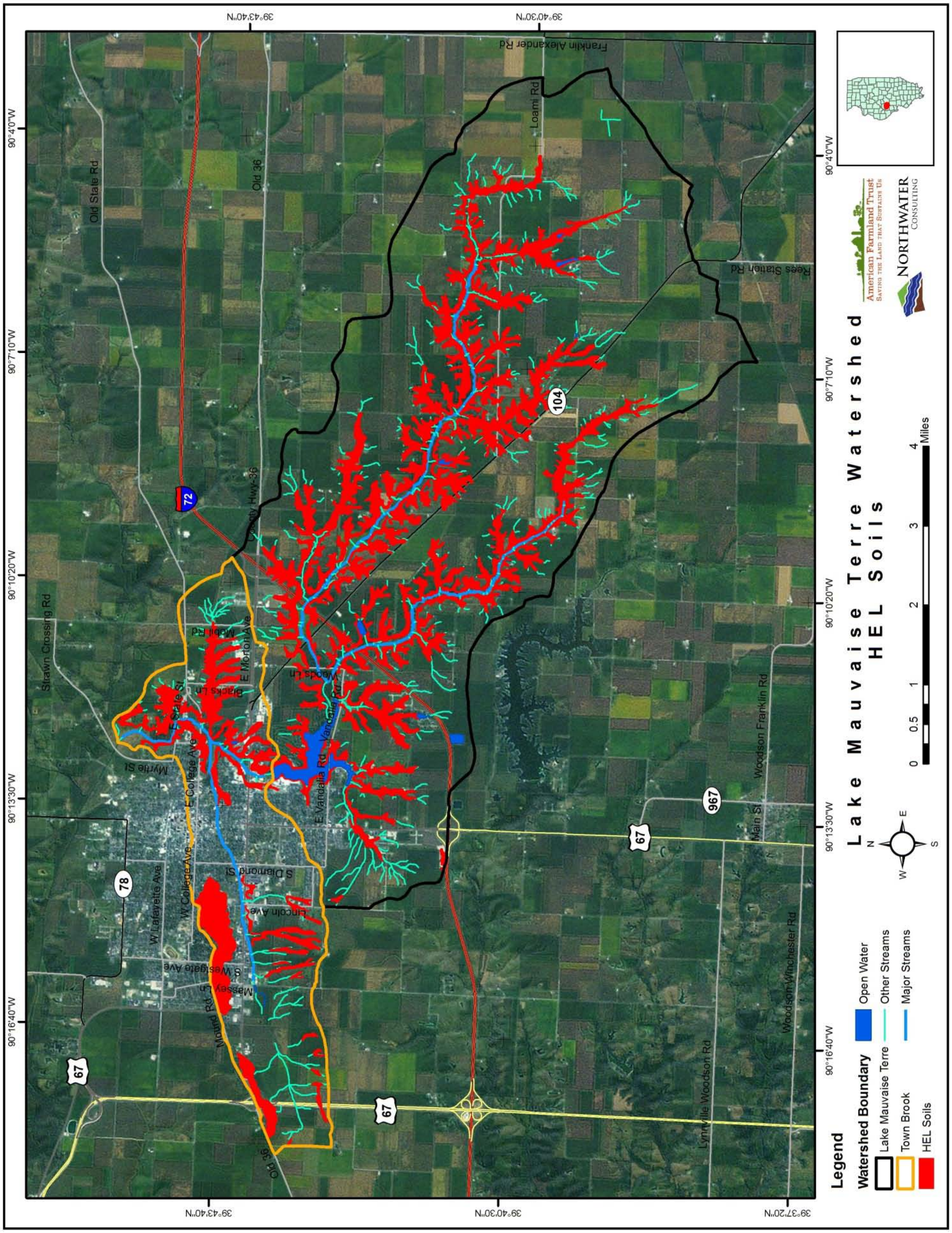
According to the NRCS, HEL is cropland, hayland or pasture that can erode at excessive rates, containing soils that have an erodibility index of eight (8) or higher. If a producer has a field identified as highly erodible land and wishes to participate in a voluntary NRCS cost-share program, that producer is required to maintain a conservation system of practices that keeps erosion rates at a substantial reduction of soil loss. Fields that are determined not to be highly erodible land are not required to maintain a conservation system to reduce erosion.

There are 4,497 acres (18%) of HEL soils throughout the watershed. Table 6 provides a breakdown of HEL soils for Lake Mauvaise Terre and Town Brook, and Figure 5 shows the distribution in the basin.

Table 6 - HEL Soils

Lake Mauvaise Terre	
Acres HEL	Percent of Watershed
3,850	18
Town Brook	
Acres HEL	Percent of Watershed
1,147	20
Entire Watershed	
Acres HEL	Percent of Watershed
4,997	18

Figure 5 - HEL Soils



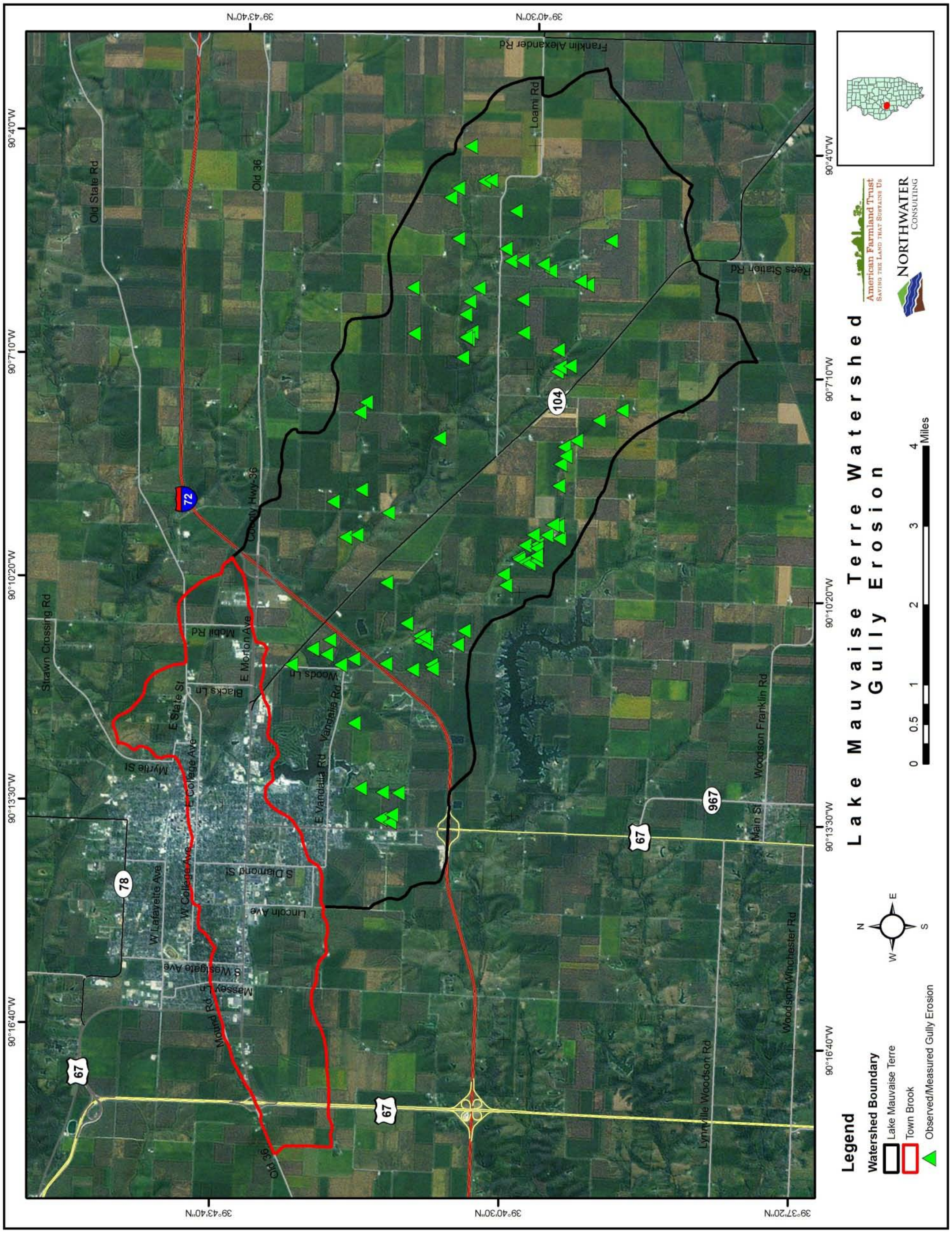
4.2 Eroding Gullies

Gully erosion is the removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by headward erosion or by slumping of the side walls unless steps are taken to stabilize the disturbance. Gully erosion occurs when water is channeled across unprotected land and washes away the soil along the drainage lines. Under natural conditions, runoff is moderated by vegetation which generally holds the soil together, protecting it from excessive runoff and direct rainfall. To repair gullies, the object is to divert and modify the flow of water moving into and through the gully so that scouring is reduced, sediment accumulates and revegetation can proceed. Stabilizing the gully head is important to prevent damaging water flow and headward erosion. In most cases, gullies can be prevented by good land management practices aimed at maintaining even infiltration rates and a good plant cover.

Eighty-eight (88) eroding gullies were observed and recorded during a watershed windshield survey and individual property assessments. It is estimated that these 88 gullies are delivering a total of 1,387 tons of sediment annually (See Section 5.1). Given that gully erosion was only observed in those areas assessed, it is very likely that additional gully erosion is present in the watershed and was not observed in the field. Priority should be given to stabilizing these 88 known gullies (Figure 6) and additional property assessments should be performed to document the full extent of gully erosion in the watershed.

Gully Erosion in the Watershed

Figure 6 - Eroding Gullies



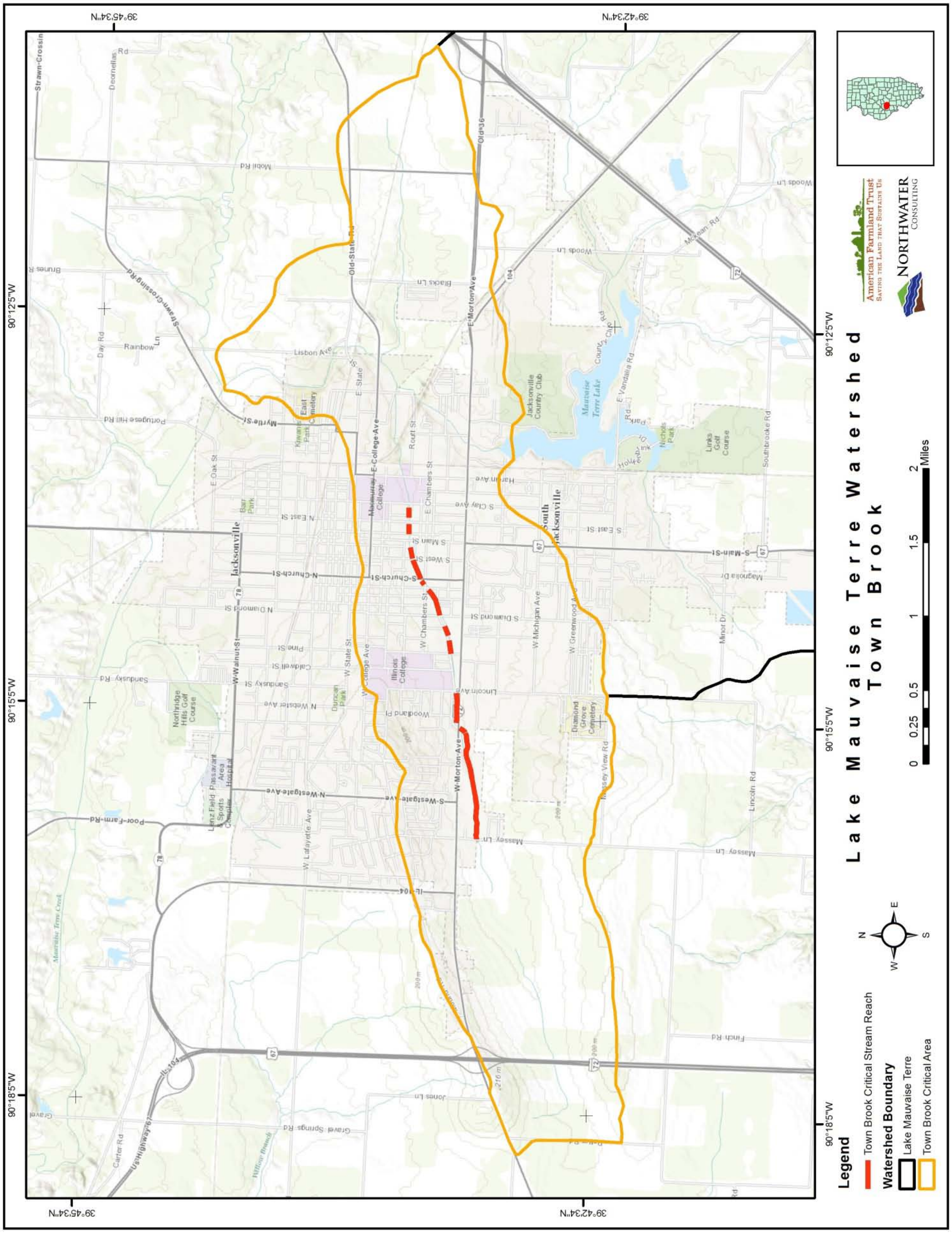
4.3 Town Brook

The Town Brook drainage is located in the center of Jacksonville, downstream of Lake Mauvaise Terre. After leaving Lake Mauvaise Terre, Mauvaise Terre Creek meets up with the Town Brook before eventually entering the Illinois River in Scott County. The Town Brook is a channelized ditch for almost its entire length and receives both agricultural and urban runoff. Town Brook has received attention recently as a local water resource in need of improvement. As a result, the Illinois Department of Natural Resources (IDNR) was approached about conducting a hydrologic survey of the Brook which is scheduled for the fall of 2014. The purpose of this study is to characterize the hydrology and explore options for restoration and improvement. Upon completion of this study, the results will be incorporated into the implementation plan as an addendum. Additionally, the City of Jacksonville holds regular stream clean-up days where members of the public help to remove accumulated trash.

Given the recent activities on the Brook and a need to improve water quality and address urban runoff, the Town Brook drainage has been designated as a critical area. Within the Brook itself, several critical stream reaches have also been classified as critical for instream treatments. Figure 7 illustrates the extent of the Town Brook critical watershed area, as well as critical stream reaches. Section 5 describes recommended BMPs for the Town Brook drainage, focusing on practices that will address excessive runoff and pollution loading and improve the hydrology of the Brook.

Jacksonville Flooding

Figure 7 - Town Brook Critical Watershed Area & Critical Stream Reaches



5.0 Pollution Loading, Nonpoint Source Management Measures & Load Reductions

5.1 Introduction & Methodology

In April of 2014, a watershed windshield survey was completed to gain an understanding of watershed conditions and features, collect field specific data, and discuss management measures with willing landowners. Data collected in the field included:

- Tillage practices
- Cover types
- Project (BMP) locations and site suitability
- Sources of sediment and gully erosion

Landowners with high priority BMP locations were contacted and a series of site visits were conducted. These site visits, combined with an interpretation of aerial imagery, resulted in the identification of a series of site-specific BMP locations. Drainage areas were then delineated for each site.

A spatially explicit and field-specific GIS-based pollution loading model (SWAMM) was then developed for the Lake Mauvaise Terre watershed. A model methodology is provided in Appendix A. This supporting model simulates surface runoff using the curve number approach, local precipitation, the Universal Soil Loss Equation (USLE), and Event Mean Concentrations (EMCs) specific to land use and soil types in the watershed. A custom and accurate land use layer was developed for the watershed to ensure model inputs represented actual watershed characteristics. In addition, information collected in the field was incorporated into the model, such as tillage practices, gully erosion and existing conservation practices. Model results were then reviewed against estimated TMDL plan loads for nitrogen and phosphorus; the TMDL did not calculate a sediment load. Table 7 provides TMDL estimates in annual per-acre loading and totals from the supporting field-based loading model. It is important to note that the TMDL-generated loads for phosphorus and nitrogen are based on a very limited set of water quality data, especially for high flow events that generate a majority of the overall annual load and, therefore, the supporting model values are higher than the TMDL values.

5.2 Pollution Loading

Overall pollution load estimates in the Lake Mauvaise Terre and Town Brook watersheds are presented in this section. Estimates are provided for loading resulting from direct runoff, observed gully erosion, and streambank erosion. Gully erosion was observed in the field to the extent it was visible and is summarized in Table 8. Streambank erosion was not directly assessed; estimates were made using GIS, an average bank height and an average lateral recession rate. Major streams received an average eroding bank height of 3 feet and an average lateral recession rate of 0.1ft/yr, or moderate. All other tributary streams received an average eroding bank height of 1.5 ft and a lateral recession rate of 0.05ft/yr.

Results from the GIS based pollution load model are illustrated in Figures 8 through 10.

Table 7 - Pollution Loading from Direct Runoff

Pollutant	Annual TMDL Load (lbs/ac/yr) [Total Load]	Supporting Model (lbs/ac/yr) [Total Load]
Lake Mauvaise Terre		
Nitrogen	(11.5)[245,260]	(17.9)[383,409]
Phosphorus	(2.33)[49,909]	(3.02)[64,654]
Sediment	N/A	(0.89)[19,029]
Town Brook		
Nitrogen	N/A	(12.87)[74,184]
Phosphorus	N/A	(1.95)[11,250]
Sediment	N/A	(0.59)[3,378]

Table 8 - Pollution Loading from Gully Erosion

Gully Sediment load (tons)	Gully Phosphorus Load (lbs/yr)	Gully Nitrogen Load (lbs/yr)
1,387	1,665	2,220

Table 9 - Pollution Loading from Streambank Erosion

Stream Type	Length Eroding Bank (ft)	Streambank Sediment load (tons)	Streambank Phosphorus Load (lbs/yr)	Streambank Nitrogen Load (lbs/yr)
Lake Mauvaise Terre				
Major Stream	69,964	828	994	1,325
Tributary Stream	327,422	982	1,178	1,571
Town Brook				
Major Stream	29,704	356	427	570
Tributary Stream	69,069	207	248	331
Grand Total	**496,159**	**2,373**	**2,847**	**3,797**

The supporting field-based model was utilized to calculate load reductions resulting from the installation of recommended BMPs presented in Section 5.3.

Typical Cropped Field in the Watershed

Figure 8 - Modeled Annual Nitrogen Loading

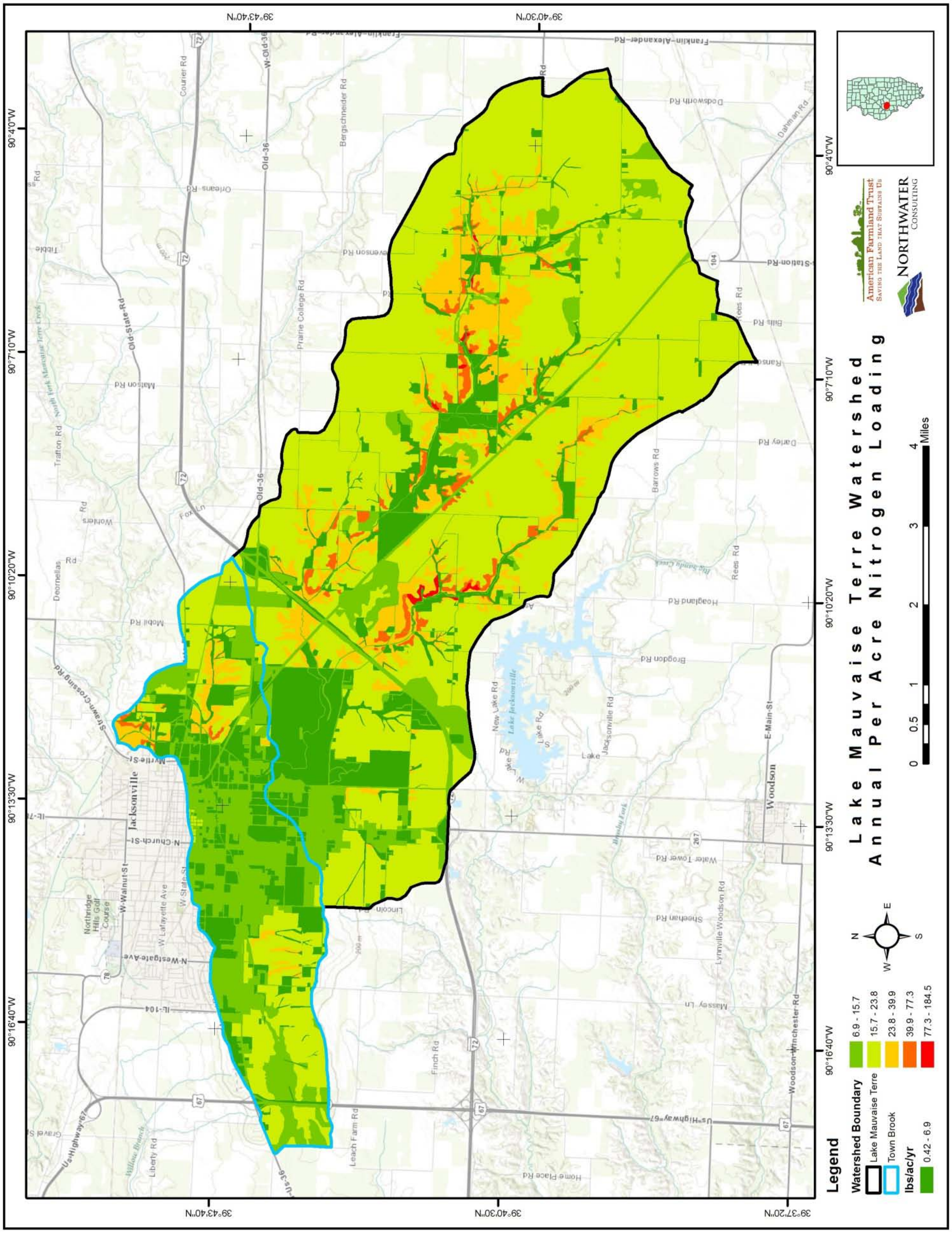


Figure 9 - Modeled Annual Phosphorus Loading

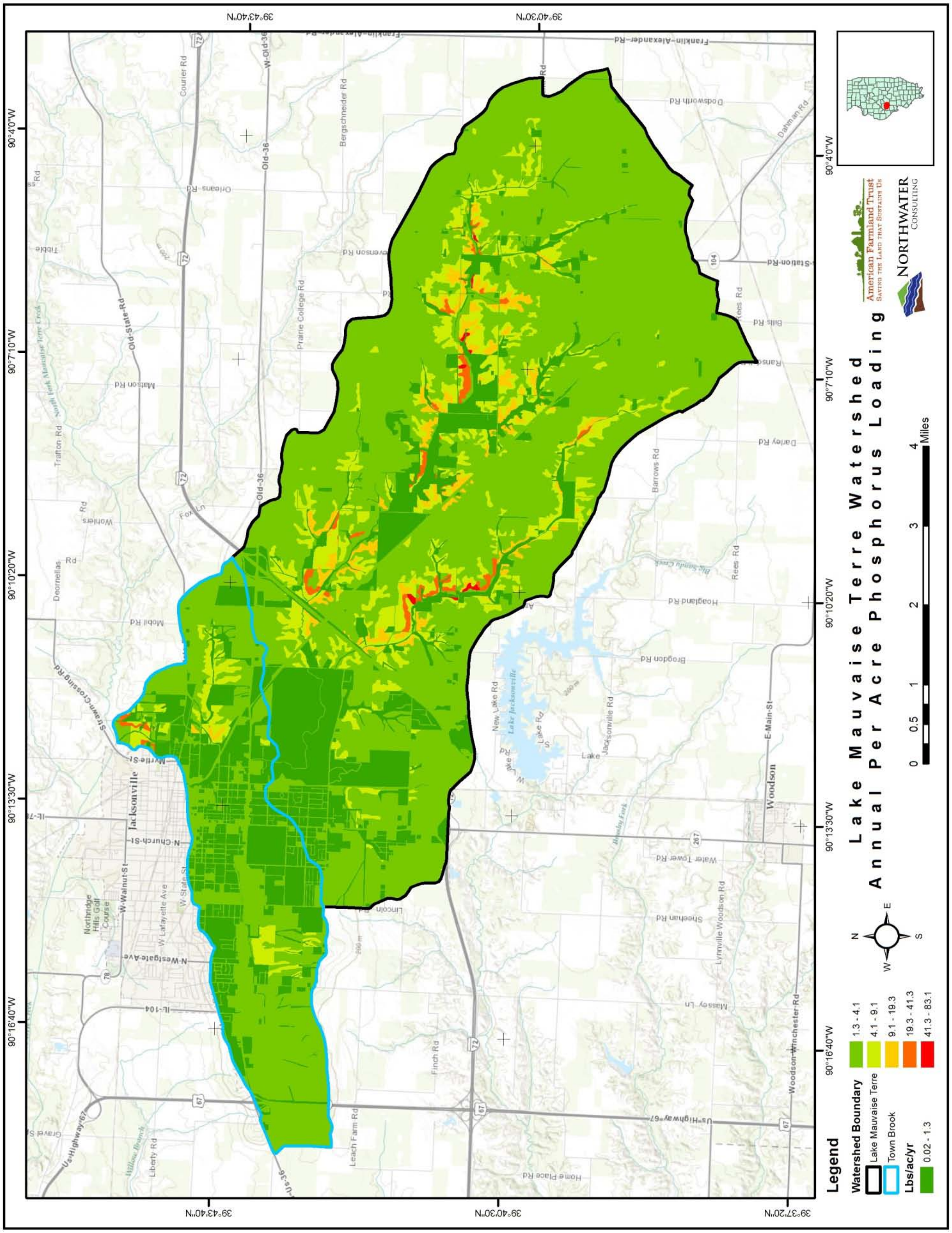
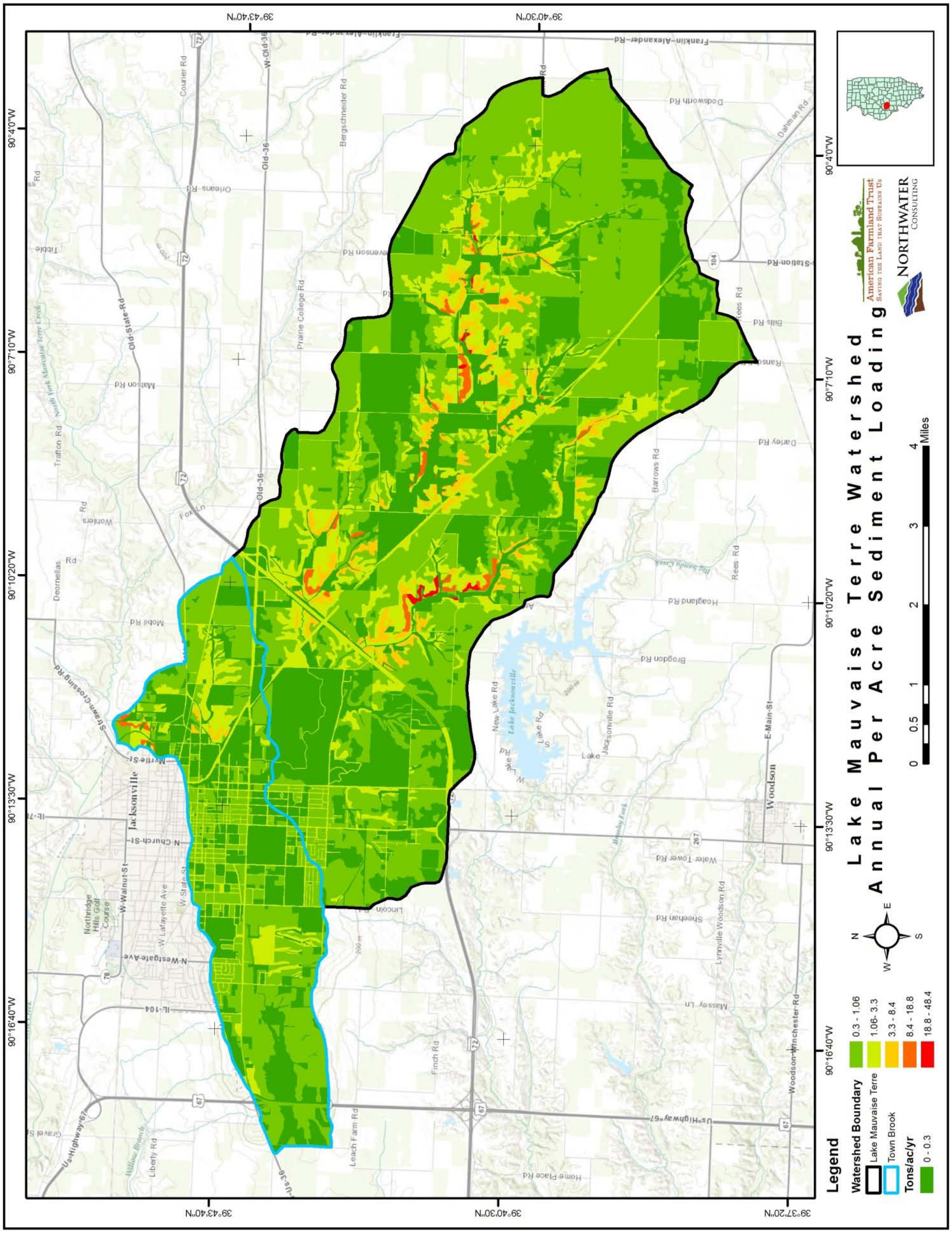


Figure 10 - Modeled Annual Sediment Loading



5.3 Best Management Practices & Expected Load Reductions

This section will describe the Best Management Practices (BMPs) recommended for each watershed, their applicable quantities and expected annual pollution load reductions.

BMPs can be described as a practice or procedure to prevent or reduce water pollution and address stakeholder concerns. BMPs typically include treatment requirements, operating procedures, and practices to control runoff and abate the discharge of pollutants. This section of the plan will describe both site-specific BMPs, as well as those that can be applied to a field as a whole or basin-wide to achieve measurable load reductions in phosphorus, nitrogen and sediment.

The major difference between site-specific and basin-wide practices presented in this section is landowner willingness to implement. A site-specific BMP has been assessed in the field alongside a willing landowner and 1) verified to be applicable to that specific location and 2) determined to be a project that the landowner is willing to move forward with implementing.

A basin-wide practice, although very similar to site-specific, has not been discussed with or approved by the corresponding landowner and currently there is no assurance that the practice will be implemented. Basin-wide BMPs include projects that can be applied throughout the watershed, to a field as a whole, or verified to be applicable to a site during the watershed windshield survey. Basin-wide practices also include those that were identified through an interpretation of aerial imagery and existing GIS layers.

Estimates of the expected pollution load reductions associated with recommended practices are included in this section. Load reductions are calculated using average pollutant reduction percentages based on existing literature and local expertise. Average pollutant reduction percentages can be found in Table 10.

Table 10 - Average Pollutant Reduction Percentages

BMP	Reduction % Nitrogen	Reduction % Phosphorus	Reduction % Sediment
WASCB/Terrace[1]	20-40%	40-70%	55-85%
Grade Control/Riffle[1]	2-5%	10-40%	15-40%
Detention Basin/Pond	40%	50%	70%
Pasture Management System	60%	70%	85%
Feed Area Waste System	80%	90%	90%
Sediment Basin	20-25%	40-45%	55%
Grassed Waterway	30-55%	20-45%	40-55%
Filter Strip	30-50%	40-55%	45-65%
Porous Pavement	60%	55%	70%
Rain Garden	40%	45%	70-72%
Rain Barrel	40%	45%	70-72%
Wetland[2]	20-40%	25-45%	40-70%
No-Till	70-90%	65-85%	60-75%
Cover Crop	70-90%	65-85%	60-80%

[1] – Controls 100% of gully erosion
[2] – Reduction percentage used for two-stage ditch; two-stage ditch reduction includes 100% reduction in streambank erosion

5.3.1 Best Management Practice Summary

This section provides a brief description of each BMP recommend in the plan, both basin-wide and site-specific.

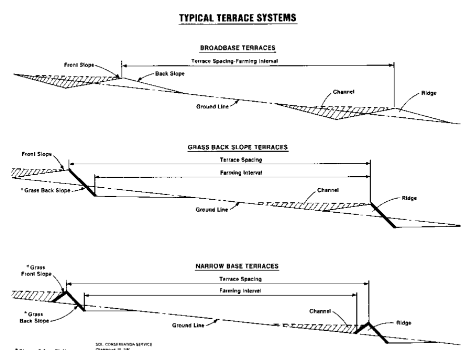
Cover Crops

A cover crop is a temporary vegetative cover that is grown to provide protection for the soil and improve soil conditions. Cover crops can be applied over a broad area in the watershed, primarily where no-till or strip-till is occurring. Cover crops are recommended for all fields where no-till is currently being practiced.

No-Till

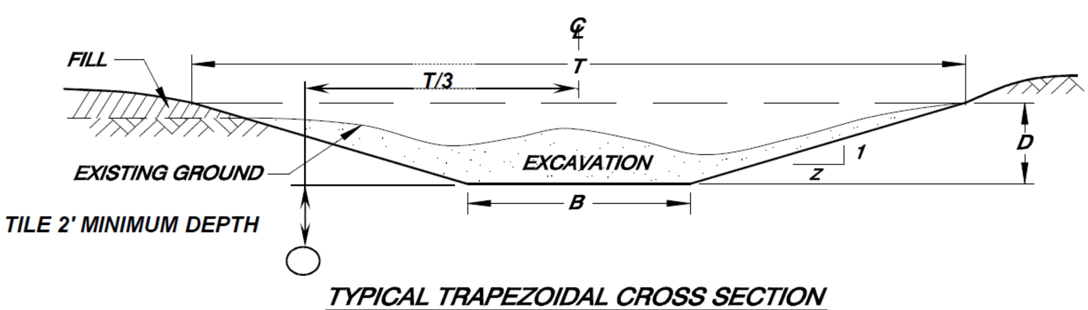
No-till can be defined as farming where the soil is left relatively undisturbed from harvest to planting. During the planting operation, a narrow seedbed is prepared or holes are drilled in which seeds are planted. A switch from conventional tillage to no-till is often a prerequisite for the installation of cover crops and, therefore, is recommended for all fields in the watershed where conventional tillage is occurring.

Water and Sediment Control Basins (WASCB)/Terrace



Earth embankment and/or channel constructed across a slope to intercept runoff water and trap soil. WASCBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Terraces, similar to a WASCB in design, are placed in areas where concentrated flow paths are less defined, such as long, wide-sloping fields. These practices are both popular with landowners in the watershed and applicable in many situations.

Grassed Waterway



A grassed waterway is a grassed strip in a field that acts as an outlet for water to control silt, filter nutrients and limit gully formation. Grassed waterways are applicable in the watershed in areas with very large drainage areas and low-moderate slopes. Although these practices are not popular with local producers, they are often the only feasible practice in a field that drains a very large area.

Constructed Wetland

A constructed wetland is a shallow water area constructed by creating an earth embankment or excavation area. Constructed wetlands can include a water control structure and are designed to mimic natural wetland hydrology, store sediment and filter nutrients. Constructed wetlands have been identified for areas near the lake where golf course runoff is a potential source of nutrient loading.

Filter Strip

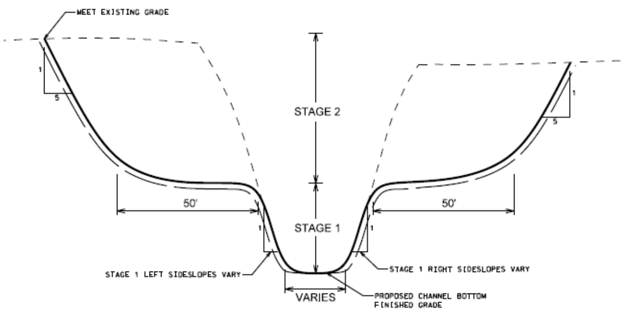
A filter strip is a narrow band of grass or other permanent vegetation used to reduce sediment, nutrients, pesticides and other contaminants. Only those areas directly adjacent to an openly flowing ditch or stream where existing buffer areas are either inadequate or nonexistent were selected for the placement of filter strips.

Grade Control Structure/Rock Riffle

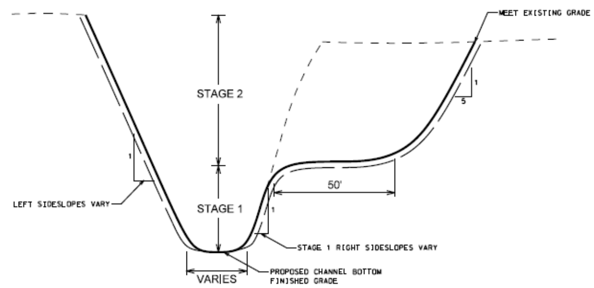
A grade control structure or rock riffle is a rock structure constructed in a stream channel or gully to stabilize grade. In the Lake Mauvaise Terre watershed, grade control structures are recommended at locations where slopes are very steep and gully erosion is considered very severe; areas where WASCBs, terraces or grassed waterways are just not feasible.

Two-Stage Ditch

Two-stage ditches are drainage ditches that have been modified by adding benches that serve as floodplains within the overall channel. This form is more consistent with fluvial form and process and, therefore, leads to greater channel stability. The benches can also function as wetlands during certain times of the year, reducing ditch nutrient loads.



TWO-STAGE DITCH TYPICAL CROSS SECTION
N.T.S. TWO BENCHES



TWO-STAGE DITCH TYPICAL CROSS SECTION
N.T.S. ONE BENCH (LEFT OR RIGHT)

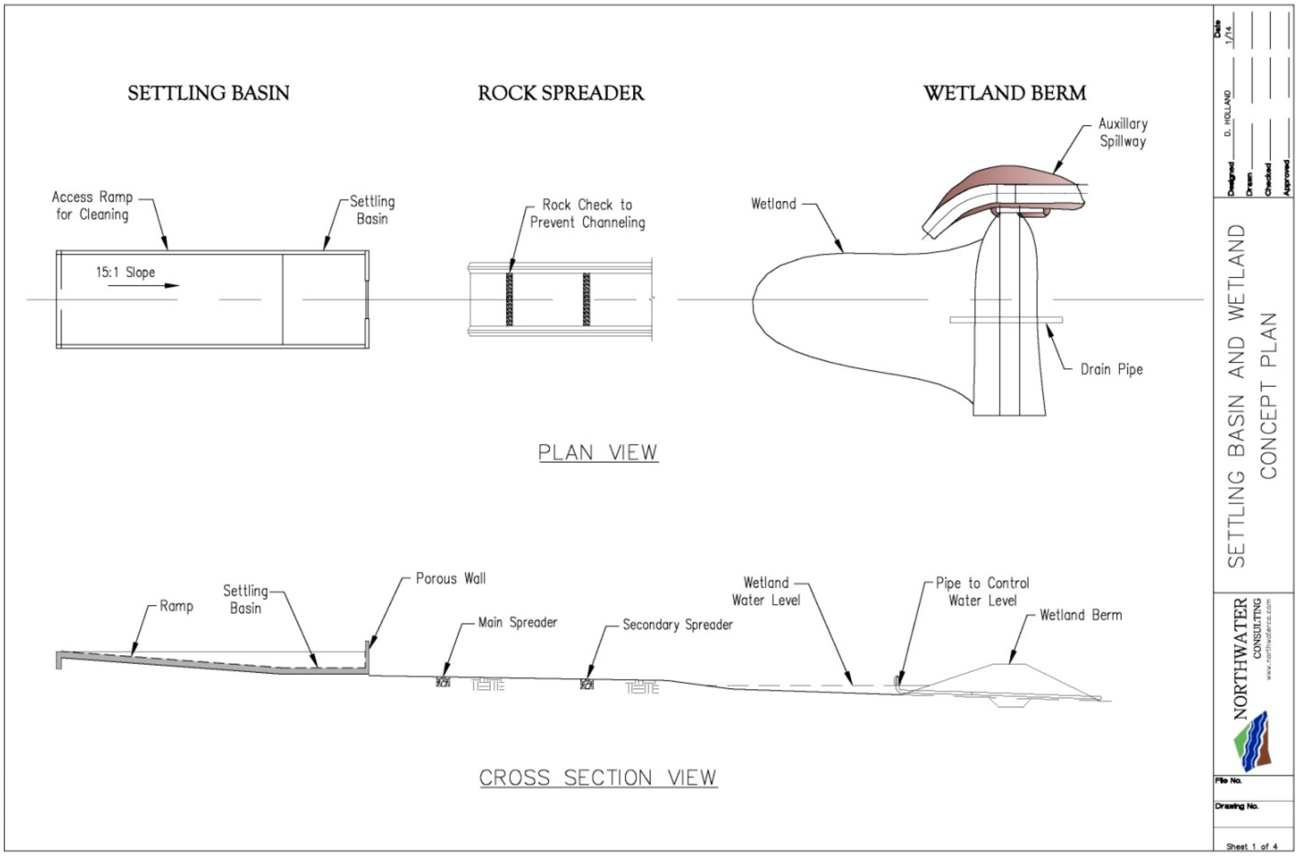
A two-stage ditch is recommended primarily for the Town Brook, however, one site was noted upstream from Lake Mauvaise Terre in a channelized section of Mauvaise Terre Creek.

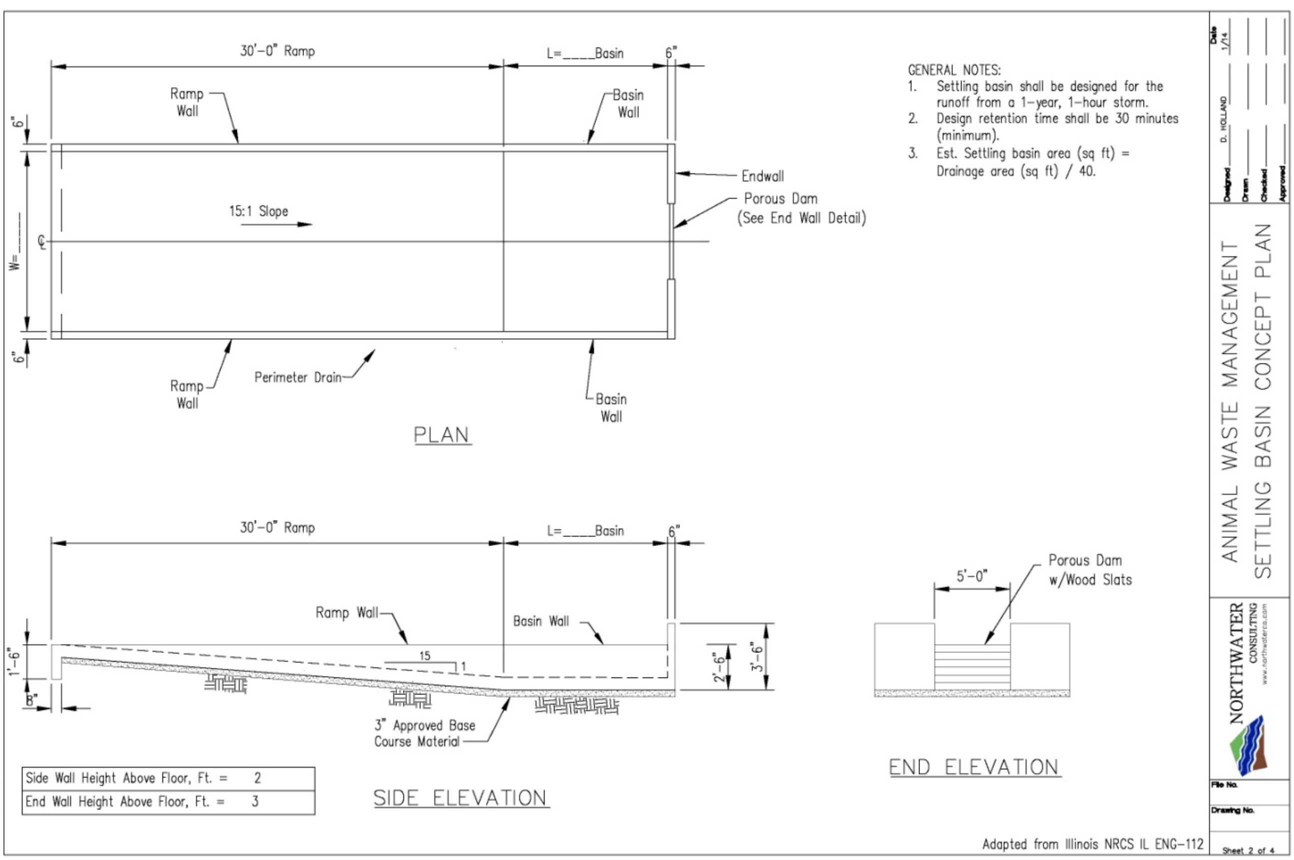
Detention Basin/Pond

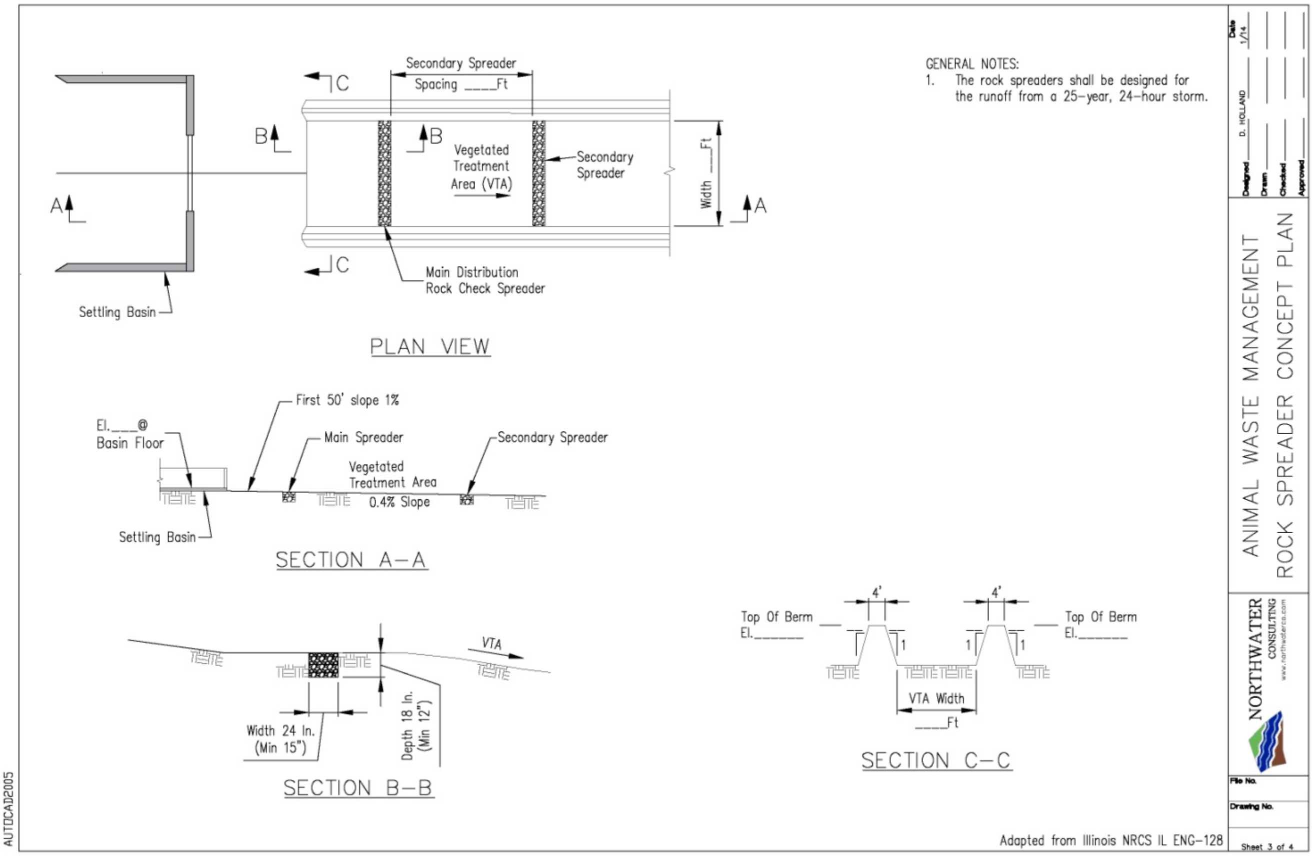
A detention basin or pond is a sediment or water impoundment made by constructing an earthen dam. Detention basins are recommended for both urban and agricultural areas. In the Town Brook watershed, several basins are recommended to address the current lack of stormwater detention.

Livestock Feed Area Waste System

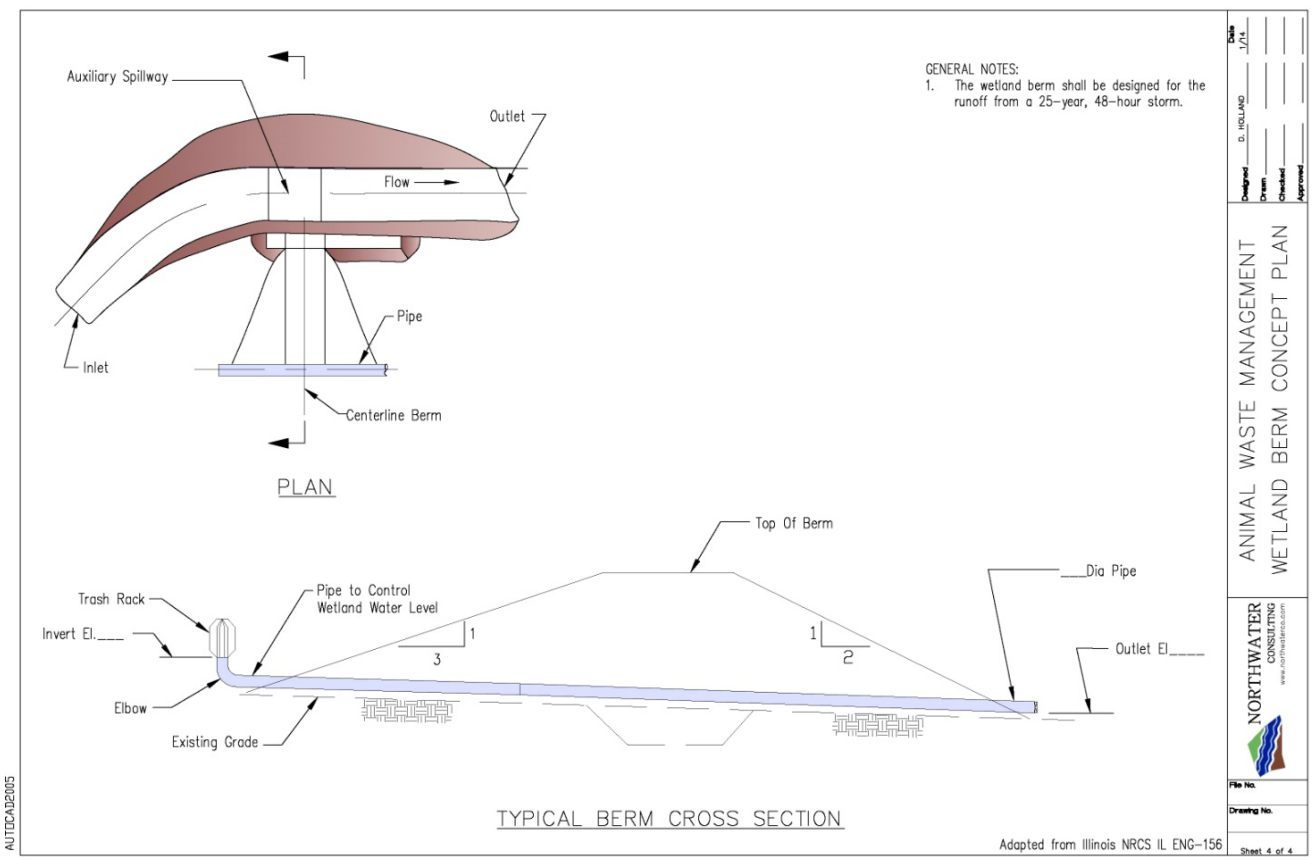
Once a site has been identified in the watershed, an integrated system can be constructed to manage livestock waste. The feed area system includes three individual practices working in series; a settling basin to capture solids, a rock spreader and vegetated swale for initial waste treatment and, finally, a treatment wetland to capture and treat the remaining waste. A conceptual design is presented below.


SETTLING BASIN
ROCK SPREADER
WETLAND BERM
Access Ramp for Cleaning
Settling Basin
15:1 Slope
Rock Check to Prevent Channeling
Wetland
Auxillary Spillway
Drain Pipe
PLAN VIEW
Ramp
Settling Basin
Porous Wall
Main Spreader
Secondary Spreader
Wetland Water Level
Pipe to Control Water Level
Wetland Berm
CROSS SECTION VIEW
SETTLING BASIN AND WETLAND CONCEPT PLAN
NORTHWATER CONSULTING
Date 1/14
Designed D. HOLLAND
Drawn
Checked
Approved
File No.
Drawing No.
Sheet 1 of 4
AUTOCAD2005


30'-0" Ramp
L=____Basin
6"
Ramp Wall
Basin Wall
15:1 Slope
W=____
Endwall
Porous Dam (See End Wall Detail)
Ramp Wall
Perimeter Drain
Basin Wall
PLAN
GENERAL NOTES:
1. Settling basin shall be designed for the runoff from a 1-year, 1-hour storm.
2. Design retention time shall be 30 minutes (minimum).
3. Est. Settling basin area (sq ft) = Drainage area (sq ft) / 40.
30'-0" Ramp
L=____Basin
Ramp Wall
Basin Wall
15
1
1'-6"
8"
2'-6"
3'-6"
3" Approved Base Course Material
Side Wall Height Above Floor, Ft. = 2
End Wall Height Above Floor, Ft. = 3
SIDE ELEVATION
5'-0"
Porous Dam w/Wood Slats
END ELEVATION
Adapted from Illinois NRCS IL ENG-112
ANIMAL WASTE MANAGEMENT SETTLING BASIN CONCEPT PLAN
NORTHWATER CONSULTING
Date 1/14
Designed D. HOLLAND
Drawn
Checked
Approved
File No.
Drawing No.
Sheet 2 of 4
AUTOCAD2005



Secondary Spreader
Spacing ____Ft
Vegetated Treatment Area (VTA)
Secondary Spreader
Width ____Ft
Settling Basin
Main Distribution Rock Check Spreader
PLAN VIEW
First 50' slope 1%
El.____@ Basin Floor
Main Spreader
Secondary Spreader
Vegetated Treatment Area
0.4% Slope
Settling Basin
SECTION A–A
VTA
Width 24 In. (Min 15")
Depth 18 In. (Min 12")
SECTION B–B
Top Of Berm El.______
VTA Width ____Ft
SECTION C–C
GENERAL NOTES:
1. The rock spreaders shall be designed for the runoff from a 25–year, 24–hour storm.
Adapted from Illinois NRCS IL ENG–128
ANIMAL WASTE MANAGEMENT
ROCK SPREADER CONCEPT PLAN
NORTHWATER CONSULTING
Sheet 3 of 4
AUTOCAD2005



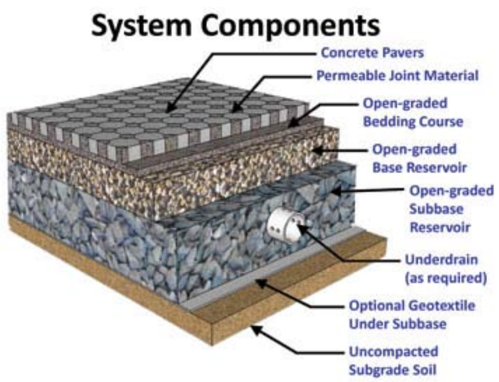
Auxiliary Spillway
Outlet
Flow
Pipe
Inlet
Centerline Berm
PLAN
Top Of Berm
Trash Rack
Invert El.____
Pipe to Control Wetland Water Level
Elbow
Existing Grade
__Dia Pipe
Outlet El____
TYPICAL BERM CROSS SECTION
GENERAL NOTES:
1. The wetland berm shall be designed for the runoff from a 25–year, 48–hour storm.
Adapted from Illinois NRCS IL ENG–156
ANIMAL WASTE MANAGEMENT
WETLAND BERM CONCEPT PLAN
NORTHWATER CONSULTING
Sheet 4 of 4
AUTOCAD2005

Pasture Management System

Once a site has been identified, an integrated pasture management system is designed to control runoff. This system includes a diversion to route contributing drainage (clean water) around the pasture, two WASCBs placed in the pasture to control erosion and trap solids within the pasture, and a wetland constructed at the base of the pasture to treat any contaminated runoff draining to the stream.

Rain Barrels, Rain Gardens & Porous/Permeable Pavement

A combination of rain barrels, rain gardens, and porous pavement are recommended, primarily in the Town Brook urban or residential areas of the watershed.



A rain barrel is a barrel used as a cistern to hold rainwater from residential roof runoff. A rain garden is a planted depression that allows rainwater runoff from impervious urban areas, including roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be absorbed. Porous/Permeable Pavement is a method of paving that allows stormwater to seep into the ground as it falls rather than running off into storm drains and waterways. Permeable pavements function similarly to sand filters, in that they filter the water by forcing it to pass through different aggregate sizes and typically some sort of filter fabric. Therefore, most of the treatment is through physical (or mechanical) processes. As precipitation falls on the pavement, it infiltrates down into the storage basin where it is slowly released into the surrounding soil.

5.3.2 Basin-Wide Best Management Practices

In the Lake Mauvaise Terre Watershed, basin-wide practices include cover crops, no-till, water and sediment control basins (WASCBs), wetlands, grassed waterways, filter strips, grade control, detention basins/ponds, two-stage ditches, rain gardens, rain barrels, and porous pavement. Basin-wide BMP recommendations can be applied to the majority of urban and agricultural areas within the watershed.

Basin-Wide BMP quantities, expected load reductions (N, P, and sediment) and locations are presented in this section. The information is broken out for Town Brook, the direct drainage to Lake Mauvaise Terre and the basin (HUC 12) as a whole. Tables 11 through 15 provide annual load reductions by BMP and Figure 11 shows the distribution within the watershed. Both a change in tillage to no-till and the widespread adoption of cover crops will have the greatest benefit on water quality and achieve the highest total load reductions. Installing filter strips and ponds upstream of Lake Mauvaise Terre will also achieve large reductions in nitrogen, phosphorus and sediment. In the urban areas of the Town Brook watershed, detention basins are the most effective practice and will result in the greatest load reductions, in addition to providing flood reduction benefits.

For detention basins in urban areas such as Town Brook, consideration should be given to less traditional and more naturalized designs; for both new construction and retrofitting existing basins. The concept of naturalized detention basins is gaining popularity. In a naturalized basin, the lawn on the basin slopes and bottom is replaced with a variety of meadow plants that simulates a wetland system. These plants have deeper roots that are more efficient at aiding rainwater infiltration and pollution removal than turf grass. There are many benefits to this naturalized approach and this concept should be actively pursued in Town Brook.

Table 11 - Basin-Wide Cover Crops; Quantities & Load Reductions

Watershed	Acres Cover Crop	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Lake Mauvaise Terre	14,963	95,688	22,286	6,651
Town Brook	1,984	11,375	2,438	664
Total	**16,947**	**107,064**	**24,725**	**7,315**

Table 12 - Basin-Wide No-Till; Quantities & Load Reductions

Watershed	Acres No-Till	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Lake Mauvaise Terre	9,468	101,951	22,070	6,728
Town Brook	1,674	16,249	3,234	913
Total	**11,142**	**118,199**	**25,304**	**7,640**

Table 13 - Basin-Wide Rain Barrels & Rain Gardens; Quantities & Load Reductions

Watershed	Treatment Area Rain Barrel/Rain Garden	Number Rain Barrel/Rain Garden	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Lake Mauvaise Terre	220	110	963	88	51
Town Brook	433	216	2,074	198	103
Total	**654**	**326**	**3,038**	**286**	**155**

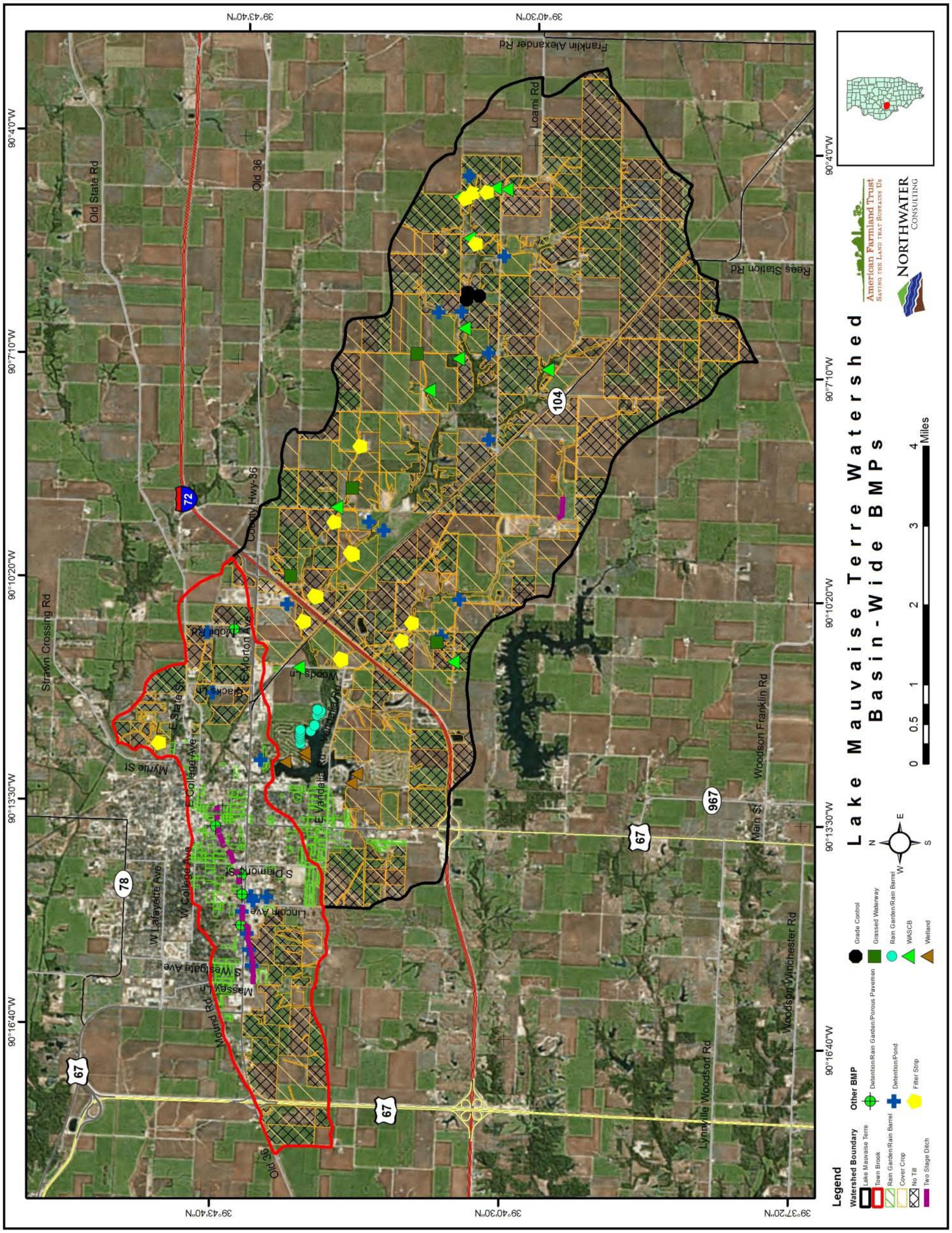
Table 14 - Basin-Wide Two-Stage Ditch; Quantities & Load Reductions

Watershed	Feet Two-Stage	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Lake Mauvaise Terre	3,214	94	51	40
Town Brook	11,711	258	148	144
Total	**14,925**	**353**	**199**	**184**

Table 15 - Basin-Wide Other BMPs; Quantities & Load Reductions

BMP TYPE	Watershed	Number BMP	Acres BMP	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Detention	Town Brook	9	N/A	1,821	309	134
Detention/Rain Garden	Town Brook	1	N/A	120	21	8.5
Filter Strip	Lake Mauvaise Terre	N/A	7	7,450	2,043	977
Filter Strip	Town Brook	N/A	1	69	14	5.96
Grade Control	Lake Mauvaise Terre	6	N/A	444	388	289
Grassed Waterway	Lake Mauvaise Terre	N/A	7	1,634	201	74
Pond	Lake Mauvaise Terre	11	N/A	17,255	2,922	886
Pond	Town Brook	1	N/A	546	104	39
Porous Pavement/Detention	Town Brook	N/A	2	18	2.63	0.61
Porous Pavement/Rain Garden	Town Brook	6	2	145	18	6.12
Rain Garden/Rain Barrel	Lake Mauvaise Terre	3	N/A	21	2.75	1.19
WASCB	Lake Mauvaise Terre	60	N/A	1,360	507	196
Wetland	Lake Mauvaise Terre	N/A	35	1,407	250	90
Total		**97**	**54**	**32,290**	**6,782**	**2,708**

Figure 11 - Basin-Wide BMPs



5.3.3 Site-Specific Best Management Practices

Site-specific BMPs are those practices where a field visit and negotiations with a landowner have resulted in the identification of a feasible project at a specific location. Each practice presented in this section has been approved by the landowner and submitted concurrently with this plan as part of a Section 319 implementation grant. Site-specific practices are located throughout the watershed, upstream of Lake Mauvaise Terre and include WASCBs/sediment basins, a terrace, grassed waterways, a pond, grade control/riffles, a feed area waste system, and a pasture management system. Load reductions and BMP quantities are included in Table 16 and Figure 12 illustrates their location within the watershed. Once implemented, these practices will reduce pollutant loads delivered to Lake Mauvaise Terre annually by 15,650 lbs for nitrogen, 4,131 lbs for phosphorus and 1,733 tons for sediment. This represents a 9% reduction in total sediment load delivered to the lake annually compared to an overall sediment reduction target of 53%.

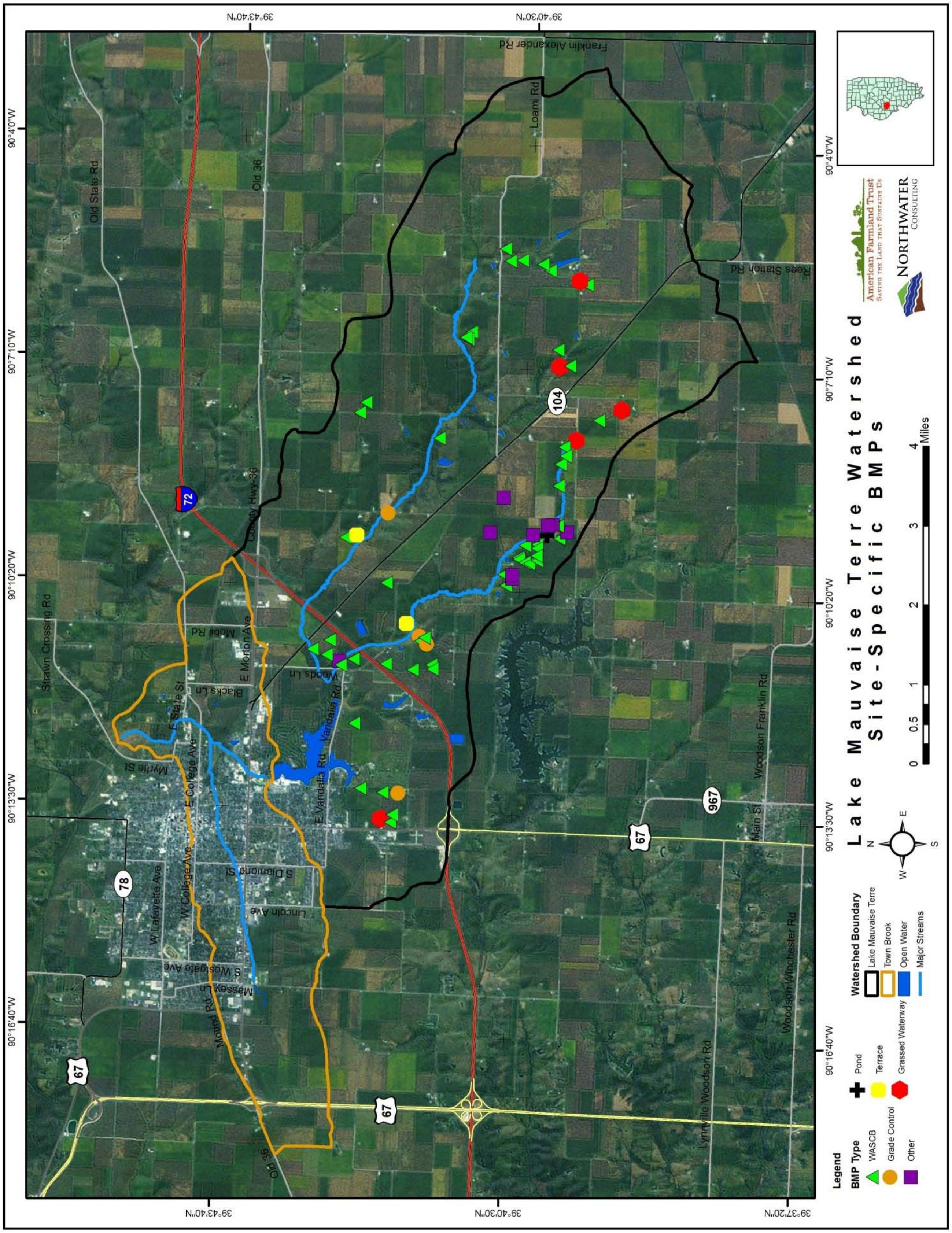
Table 16 - Site-Specific BMPs; Quantities & Load Reductions

BMP Number	BMP Code	BMP Type	Number Structures	Acres Structure	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
1	A	WASCB	2	0	28	13	7.16
2	A	Terrace	1	0	136	75	36
3	A	Grade Control	1	0	16	13	6.43
4	A/B	WASCB	7	0	268	140	68
5	B	WASCB	7	0	144	41	13
5	A	Waterway	1	3.5	2,016	257	87
6	A/B	WASCB	4	0	159	61	25
7	A	WASCB	4	0	191	71	35
8	A	WASCB	3	0	139	49	23
9	A	WASCB	6	0	225	100	57
10	A	WASCB	5	0	131	46	19
11	A	WASCB	5	0	65	34	22
12	A/B	Sediment Basin	2	0	484	139	46
13	A	Riffle	2	0	28	22	17
14	A	WASCB	5	0	193	68	35
15	A	WASCB	1	0	10	3.96	1.82
16	A	Riffle	2	0	66	53	42
17	A	Sediment Basin	1	0	184	54	18
18	A	WASCB	7	0	347	142	65
19	A	WASCB	6	0	229	91	44
20	A	WASCB	10	0	158	77	46
21	A	WASCB	24	0	983	443	266
24	A/B/C/D	WASCB	9	0	345	143	77
25	A	Pond	1	0	450	71	16
26	A/B	WASCB	6	0	167	51	20
27	A	WASCB	3	0	56	14	3.49

BMP Number	BMP Code	BMP Type	Number Structures	Acres Structure	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
28	A	WASCB	1	0	42	13	4.32
29	A	Waste System	1	0	57	12	0.66
30	A	Pasture System	5	0	406	57	15
31	A/B	WASCB	8	0	500	130	48
32	A	WASCB	4	0	245	69	28
33	A	WASCB	9	0	1,304	367	111
34	A	WASCB	12	0	749	151	31
35	A	Waterway/Grade	1	2.75	2,741	307	85
36	A/B	WASCB	4	0	185	60	20
37	A	WASCB	3	0	153	50	17
38	A	WASCB	18	0	433	169	82
39	A	Grade Control	1	0	62	43	17
40	A	Waterway	1	1.8	502	68	30
41	A	WASCB	6	0	636	206	66
42	A	WASCB	4	0	47	19	9.96
43	A	WASCB	2	0	82	23	9.94
44	A	WASCB	8	0	190	71	35
45	A	WASCB	2	0	100	44	23
		Grand Total	**215**	**8.05**	**15,650**	**4,131**	**1,733**

Location of Pasture Management System

Figure 12 - Site-Specific BMPs



5.3.4 Supplemental Nonpoint Source Management Measures

Six additional management measures are proposed or likely needed to achieve water quality benefits. These management measures will require additional data collection and, therefore, expected load reductions cannot be estimated accurately at this time. Once the appropriate information is collected, the Watershed Implementation Plan will be updated to include additional BMP locations, expected load reductions, estimated costs and responsible entities.

1. An assessment of streambank erosion and the implementation of additional stabilization measures.
2. Additional landowner outreach, site visits and the identification/treatment of gully erosion.
3. Implementation of in-lake controls such as shoreline stabilization and in-lake sediment traps.
4. Additional stormwater detention in the Town Brook watershed.
5. Inventorying and addressing potential pollution sources from steep forested areas throughout the watershed.
6. Conversion of cropland to native grasses.

Streambanks

An attempt was made to estimate the contribution of nutrients and sediment from streambank erosion, however, those estimates have been extrapolated and are based on very limited information; a targeted streambank erosion inventory and assessment is required to accurately quantify bank erosion and identify the appropriate locations and extent of stabilization measures required. It is recommended that all perennial streams in the watershed be walked and assessed by a qualified streams specialist. Data should be recoded using GPS and should include:

- Eroding bank height, length and estimated lateral recession rates
- Location of required stone toe protection required and an estimate of length
- Location of required grade control/riffle structures

Section 5.2 describes general and extrapolated annual estimates of watershed-wide loading from streambank erosion; 2,373 tons of sediment, 3,797 lbs of nitrogen, 2,847 lbs of phosphorus. These estimates are likely very conservative and it is realistic to assume that a large investment in addressing streambank erosion will result in a least a 50% reduction in the totals noted above.

Gully Erosion

Gully erosion in the watershed was evaluated to the extent it was visible. Many observed locations are addressed with site-specific BMPs in Section 5.3.3. Additional gully erosion is likely occurring in the watershed and any effective management measures will require additional knowledge of location and extent/severity. It is recommended that a program be initiated to survey all potential gully erosion in the watershed. A gully survey should be targeted to all crop fields not previously assessed with slopes greater than 2%. Data should be recoded using GPS and should include:

- Gully length, width and depth
- An estimate of the number of years eroding

- Applicable management measure or BMP

Section 5.2 provides field-verified estimates of loading from 88 gullies; 1,387 tons sediment, 2,220 lbs of nitrogen and 1,665 lbs of phosphorus. It is likely that a more extensive survey will result in the identification of additional eroding gullies and, therefore, it is reasonable to assume that any future load reductions achieved will total those loading figures presented above.

In-Lake Management Measures

Watershed stakeholders have identified the potential need for in-lake management measures such as shoreline stabilization and the construction of an in-lake sediment dam. More information is required to determine the feasibility of these measures. Recommendations include:

- Conduct a shoreline erosion survey to determine the extent of shoreline erosion and estimate the quantity of stabilization measures required.
- Conduct a feasibility study for the installation of an in-lake sediment dam. The feasibility study should address permit requirements, estimated costs, siting and expected pollution load reductions.

Stormwater Detention; Town Brook

Numerous stormwater detention basin locations have been identified within the Town Brook watershed and evaluated in Section 5.3.3. Additional opportunities should be explored by the City of Jacksonville to further identify detention basin locations, retrofit existing structures and explore local regulations that will offer more stringent stormwater management controls. Recommendations include:

- Identify and map all remaining potential detention basin locations within the watershed.
- Identify all existing structures where retrofitting opportunities exist.
- Conduct a review/audit of current stormwater management ordinances and implement the necessary changes.

Section 5.3.2 provides expected annual load reductions for recommended detention basins; 148 tons of sediment, 1,959 lbs of nitrogen and 333 lbs of phosphorus. It is expected that any additional stormwater detention in Town Brook will result in similar load reductions.

Management of Forested Areas

Much of forested portion of the watershed is located on steep slopes directly adjacent to streams. Little is known about these areas in terms of actual rates of erosion and slope instability. It is believed that some of the steep forested sections of the watershed are also significant sources of erosion, primarily from concentrated flow area and gully erosion. It is recommended that all forested areas in the watershed within 1,000 ft of a stream be assessed to determine the location of needed BMPs.

Native Grass Conversion

Over three quarters of the watershed is being farmed. Implementation all of basin-wide and site-specific practices outlined in the plan will only be successful in meeting the sediment reduction target; more work is required to meet targets for nitrogen and phosphorus. A reduction in the amount of soils being farmed in the watershed will result in both reduction of sediment and nutrients entering Lake Mauvaise Terre. Taking productive farm ground out of production is very unpopular with producers, even with the existing incentive programs. However, some opportunities may exist to convert cropped HEL soils. As noted in Section 4.1, the watershed contains 4,997 acres of HEL soils (18%); of this, 2,799 acres, or 56%, are cropped HEL soils. Converting all cropped HEL soils to native grasses could result in estimated annual load reductions of 84,806 lbs nitrogen, 30,398 lbs of phosphorus and 8,703 tons of sediment.

6.0 Costs, Technical Assistance & Responsible Parties

BMP costs were calculated based on professional judgment and expertise, rates provided by the NRCS, and unit costs provided in other similar watershed plans. Cost estimates should be considered as estimates only and revisited during implementation.

6.1 Cost Estimates

Tables 17 through 23 provide a detailed breakdown of cost estimates for all basin-wide, site-specific BMPs, and all supplemental management measures. The total cost of implementing all basin-wide BMPs is $9,505,029; the total cost of implementing all site-specific BMPs is $648,275. The cost to implement all supplemental management measures is $30,054,400. The majority of the costs for these supplemental management measures is attributed to the conversion of 2,799 acres of crop ground to native grasses and assumes a per-acre purchase price of $10,000 and a per-acre restoration cost of $600.

In addition to the costs presented in this section for BMP implementation, there will be costs associated with technical assistance provided by Extension (described in Section 6.3.1), as well as consultants. The University of Illinois Extension Service is an education program for residents of the state. Extension provides education, outreach and technical assistance in the field of agriculture as well as other sectors such such as nutrition, energy and youth education. It is estimated that costs for Extension and private consultants could range from $400,000 - $600,000 over the course of ten years.

Table 17 - Cost Estimates; Basin-Wide Cover Crops

Watershed	Acres Cover Crop	Cost Cover Crop
Lake Mauvaise Terre	14,963	$1,047,410
Town Brook	1,984	$138,863
Total	**16,947**	**$1,186,273**

Table 18 - Cost Estimates; Basin-Wide No-Till

Watershed	Acres No-Till	Cost No-Till
Lake Mauvaise Terre	9,468	$662,752
Town Brook	1,674	$117,160
Total	**11,142**	**$779,912**

Table 19 - Cost Estimates; Basin-Wide Rain Barrel/Rain Garden

Watershed	Treatment Area Rain Barrel/Rain Garden	Number Rain Barrel/Rain Garden	Cost Rain Barrel/Rain Garden
Lake Mauvaise Terre	220	110	$402,600
Town Brook	433	216	$790,560
Total	**654**	**326**	**$1,193,160**

Table 20 - Cost Estimates; Basin-Wide Two-Stage Ditch

Watershed	Feet Two-Stage	Cost Two Stage
Lake Mauvaise Terre	3,214	$446,746
Town Brook	11,711	$1,873,760
Total	**14,925**	**$2,320,506**

Table 21 - Cost Estimates; All Other Basin-Wide BMPs

TYPE	Watershed	Number BMP	Acres BMP	Cost BMP
Detention	Town Brook	9	N/A	$540,000
Detention/Rain Garden	Town Brook	1	N/A	$60,000
Filter Strip	Lake Mauvaise Terre	N/A	7	$3,500
Filter Strip	Town Brook	N/A	1	$250
Grade Control	Lake Mauvaise Terre	6	N/A	$54,000
Grassed Waterway	Lake Mauvaise Terre	N/A	7	$28,000
Pond	Lake Mauvaise Terre	11	N/A	$330,000
Pond	Town Brook	1	N/A	$60,000
Porous Pavement/Detention	Town Brook	N/A	2	$1,263,281
Porous Pavement/Rain Garden	Town Brook	6	2	$1,127,067
Rain Garden/Rain Barrel	Lake Mauvaise Terre	3	N/A	$10,980
WASCB	Lake Mauvaise Terre	60	N/A	$180,000
Wetland	Lake Mauvaise Terre	N/A	35	$367,500
	Total	**97**	**54**	**$4,024,578**

Table 22 - Cost Estimates; Site-Specific BMPs

BMP Number	BMP Code	BMP Type	Number Structures	Acres Structure	Total Cost
1	A	WASCB	2	0	$4,725
2	A	Terrace	1	0	$5,125
3	A	Grade Control	1	0	$7,200
4	A/B	WASCB	7	0	$12,100
5	B	WASCB	7	0	$12,350
5	A	Waterway	1	3.5	$22,625
6	A/B	WASCB	4	0	$10,000
7	A	WASCB	4	0	$7,600
8	A	WASCB	3	0	$6,025
9	A	WASCB	6	0	$13,375
10	A	WASCB	5	0	$10,750
11	A	WASCB	5	0	$10,000
12	A/B	Sediment Basin	2	0	$7,810
13	A	Riffle	2	0	$17,500
14	A	WASCB	5	0	$9,375
15	A	WASCB	1	0	$2,575
16	A	Riffle	2	0	$16,500
17	A	Sediment Basin	1	0	$13,400
18	A	WASCB	7	0	$10,000
19	A	WASCB	6	0	$12,000
20	A	WASCB	10	0	$19,700
21	A	WASCB	24	0	$45,000
24	A/B/C/D	WASCB	9	0	$16,800
25	A	Pond	1	0	$30,000
26	A/B	WASCB	6	0	$13,000
27	A	WASCB	3	0	$8,800
28	A	WASCB	1	0	$3,925
29	A	Waste System	1	0	$28,000
30	A	Pasture System	5	0	$14,320
31	A/B	WASCB	8	0	$15,950
32	A	WASCB	4	0	$9,200
33	A	WASCB	9	0	$36,500
34	A	WASCB	12	0	$37,825
35	A	Waterway/Grade	1	2.75	$20,975
36	A/B	WASCB	4	0	$10,050
37	A	WASCB	3	0	$8,600
38	A	WASCB	18	0	$42,700
39	A	Grade Control	1	0	$9,200
40	A	Waterway	1	1.8	$5,700
41	A	WASCB	6	0	$18,875
42	A	WASCB	4	0	$7,925

BMP Number	BMP Code	BMP Type	Number Structures	Acres Structure	Total Cost
43	A	WASCB	2	0	$6,120
44	A	WASCB	8	0	$20,250
45	A	WASCB	2	0	$7,825
		Grand Total	**215**	**8.05**	**$648,275**

Table 23 - Cost Estimates; Supplemental Nonpoint Source Management Measures

Management Measure	Quantity	Total Cost
Streambank Assessment	1	$60,000
Gully Assessment	1	$90,000
Lake Shoreline Assessment	1	$15,000
In-Lake Dam Feasibility Study	1	$50,000
Town Brook Detention Basin Inventory and Ordinance Review	1	$80,000
Forest Survey	1	$90,000
Native Grass Conversion	2,799 acres	$29,669,4000
Grand Total	N/A	**$30,054,400**

6.2 Responsible Parties

Farmer/Landowner In the Lake Mauvaise Terre watershed, there are varying business arrangements on who farms the land and makes important conservation decisions. If the farmer is the landowner, then the farmer–landowner is considered the primary responsible party. If the person/entity who owns the land is an absentee owner, then it could be either the farmer-tenant or the absentee landowner is the responsible party. In some cases, the conservation practices decisions are made together in a collaborative fashion by the tenant and landowner. Frequently, the lease terms will determine who makes conservation decisions on the agricultural parcel.

Soil Water Conservation District (SWCD) In many Illinois counties, it is the local county SWCD that takes a lead role in providing information, guidance and funding arrangements for local conservation practices on farmland in the county. The Morgan County SWCD is less of a lead in providing local farmers and landowners with conservation programs than in many Illinois counties, but it still plays an important role in referring farmers to agencies or programs which can be helpful to implementing conservation practices on the land.

Natural Resources Conservation Service (NRCS) The United States Department of Agriculture has local offices in most Illinois counties which include the NRCS. The Morgan County NRCS office is responsible for the Lake Mauvaise Terre watershed. The NRCS provides both conservation technical assistance and financial assistance to farmers and landowners. One of the programs frequently used for financial assistance is the Environmental Quality Incentive Program (EQIP). Most applicable to the Lake Mauvaise Terre watershed, the EQIP program provides cost sharing for implementation of approved conservation program practices. The farmer/landowner applies to the NRCS for conservation program funds and they are assisted by NRCS staff to complete the application process, certify the practices and make payments.

Another program likely relevant to the watershed is the Conservation Stewardship Program (CSP); the NRCS provides conservation program payments. CSP participants will receive an annual land use payment for operation-level environmental benefits they produce. Under CSP, participants are paid for conservation performance: the higher the operational performance, the higher their payment.

Farm Service Agency (FSA) Included in the USDA local offices are officials of the FSA who also provide some conservation-oriented programs; specifically, they provide the administrative structure for the federal Conservation Reserve Program (CRP) and also support the state Conservation Reserve and Enhancement Program.

US Fish & Wildlife Service (USFWS) The USFWS provides technical assistance to local watershed protection groups. It also administers several grant and cost-share programs that fund habitat restoration. The USFWS also administers the federal Endangered Species Act and supports a program called Endangered Species Program Partners, which features formal or informal partnerships for protecting endangered and threatened species and helping them to recover. These partnerships include federal partners, as well as states, tribes, local governments, nonprofit organizations, and individual landowners.

Illinois Environmental Protection Agency (IEPA) The federal EPA has offices in some states to implement programs in those and other states. In Illinois, the IEPA Bureau of Water's Office of Watershed Management provides program direction and financial assistance for water quality protection through the Clean Water Act Section 319 program.

Illinois Department of Agriculture (IDOA) The IDOA's Bureau of Land and Water Resources distributes funds to Illinois' 98 soil and water conservation districts for programs aimed at reducing soil loss and protecting water quality. It also helps to organize the state's annual soil survey to track progress toward the goal of reducing soil loss on Illinois cropland to tolerable levels. The Bureau also provides technical and financial support for streambank stabilization.

Illinois Department of Natural Resources (IDNR) IDNR provides technical assessments of streams for the IDOA's streambank stabilization program. The request for local assessment assistance comes through the local SWCD. The IDNR also manages other state programs related to wildlife and forestry, and oversees the state portion of the Conservation Reserve and Enhancement Program.

City of Jacksonville (City) The City is the owner of Lake Mauvaise Terre and has ownership and stewardship responsibility for the Lake.

6.3 Technical & Financial Assistance

Section 6.3 will list and describe the technical assistance required to implement the plan, as well as the funding mechanisms/sources that should be explored to fund plan recommendations.

6.3.1 Technical Assistance

In addition to the programs of conservation technical assistance provided by the SWCD, NRCS, EPA, IDOA, FSA, USFWS and IDNR, there are conservation technical assistance resources provided through the University of Illinois Cooperative Extension Service (Coop Ext.) and by private professional consultants. Funding cuts have reduced the Cooperative Extension's ability to provide much direct technical assistance. Many producers rely upon private consultants: certified crop advisors (CCA) or Technical Service Providers (TSP) for technical expertise.

6.3.2 Financial Assistance

Key sources of financial assistance for the Lake Mauvaise Terre watershed are listed below:

Environmental Protection Agency: Section 319 program funds for nonpoint source pollution, which requires a match of either cash or in-kind services, or a combination of both cash and in-kind contributions, will be a major source of funding for the Lake Mauvaise Terre project. The Illinois Green Infrastructure Grant Program (IGIG), Illinois Clean Lakes Program, the Lake Education Assistance Program, the Priority Lake and Watershed Implementation Program, the Source Water Protection Program, the Wastewater and Drinking Water State Revolving Loan Program and the Water Quality and 401 Certification Program are all potential sources of additional EPA assistance.

USDA NRCS EQIP The Environmental Quality Incentives Program is a cost-share program for farmers and landowners to share the expenses of implementation and maintenance of approved soil and water conservation practices on farmland for qualified entities.

USDA FSA CRP The CRP is a land conservation program administered by the FSA. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

USDA FSA CREP The CREP is an offshoot of the CRP. Administered on the federal level by the FSA, CREP targets high-priority conservation issues identified by local, state, or tribal governments or non-governmental organizations. In exchange for removing environmentally sensitive land from production and introducing conservation practices, farmers and agricultural land owners are paid an annual rental rate. Participation is voluntary, and the contract period is typically 10–15 years, along with other federal and state incentives as applicable per each CREP agreement. In Illinois, the CREP administrative agency is the Illinois Department of Natural Resources. IDNR provides additional and generous financial incentives on top of a FSA CREP contract, including payments for additional 15 and 25-year contract extensions; IDNR also offers a permanent easement option. Farmers and landowners locally apply for support through the county SWCD for CREP consideration and funding.

USFWS Partners Program restores, improves, and protects fish and wildlife habitat on private lands through alliances between the USFWS, other organizations and individuals, while leaving the land in private ownership.

Private Funds This category of financial assistance can come from private foundations, individual farmers, and landowners and can be used as cash match for Section 319 funds or as private contributions to Lake Mauvaise Terre conservation activity.

City of Jacksonville The City has resources it can allocate to be used as match for 319 funds, EQIP cost share or as contributions to watershed or in-lake conservation practices.

American Farmland Trust AFT is providing 319 matching funds for Lake Mauvaise Terre Outreach and Education from private foundation sources.

7.0 Information & Education

American Farmland Trust (AFT) received a CWA 319 grant for education and outreach activities in the Lake Mauvaise Terre watershed in September of 2013. AFT first contacted the Morgan County Treasurer's property tax records office to determine the number and relative sizes of agricultural parcels in the watershed to determine the best methods for producer and landowner outreach. The agricultural parcels were plotted into a GIS-generated watershed map. The number of agricultural parcels greater than 10 acres in size and the list of respective agricultural landowners derived a list of about one hundred potential contacts. Due to the small number of potential watershed participants for a social indicator survey, AFT sought and was granted a release of the social indicator survey requirement by EPA.

Next, AFT contacted the Morgan County USDA-NRCS Office to learn about the level of conservation activity by farmers in the watershed. Due to privacy restrictions, NRCS was unable to share individual producer activity, but was able to confirm a significant amount of conservation work had taken place in the last decade and that there were a relatively few number of larger watershed farmers who hadn't actively participated in conservation programs.

AFT reached out to a small number of watershed farmers and landowners to gauge the local agricultural community's receptivity to a watershed project promoting conservation measures and who might be most interested in participating. AFT also solicited interest in the use of conservation cover crops. As the initial interest in cover crops seemed to be relatively high, AFT sponsored, through the Morgan County SWCD, a fall cover crop education meeting and field day. While these meetings were not restricted to watershed famers and landowners, several from the watershed attended and expressed interest in trying cover crops on their farms. The Lake Mauvaise Terre watershed project was publicly announced through the initial cover crop meeting.

After the 2013 harvest, AFT contracted with Northwater Consulting to provide technical expertise for planning project conservation practices. Northwater did a preliminary field survey of the watershed to ascertain the level of conservation practices visible from a road survey and aerial maps. Northwater also met with a prominent local farmer and repeated the watershed review to determine which fields make the largest contribution to field erosion and which farmers had the potential for greatest sediment reduction into Lake Mauvaise Terre.

In November 2013, AFT and Northwater met with the Mayor of the City of Jacksonville and several city aldermen to explain the watershed project and how a successful implementation project could protect Lake Mauvaise Terre. For several decades, the City had been planning a dredging project to improve the water-holding capacity of the Lake. A significant rain event in June of 2011 caused significant flooding in the County and the City, overwhelmed the storage capacity of the Lake and knocked out the City's water treatment plant, forcing several weeks of severe water measures for the citizens of Jacksonville. In the summer of 2012, the need for action to increase capacity in the Lake was again demonstrated by severe drought and low Lake water levels. By 2013, the Mayor and City Council were very interested to learn about any project which held the possibility to reduce sedimentation into the Lake. AFT and Northwater presented the project proposal to the Council at their December 2013 monthly meeting. AFT and Northwater also explained the CWA 319 grant process and timeline for a subsequent Implementation grant. At the January 2013 Council meeting, the City voted to financially support an Implementation 319 grant for upland conservation practices.

In January 2013, AFT and Northwater participated in a project meeting at the IL EPA office with multiple state and federal agencies, conservation organizations and representatives of the City of Jacksonville. The purpose of the meeting was to update everyone on the project and determine what resources might be available for the Lake Mauvaise Terre project. Several potential sources of support were identified, but no new financial commitments were made to the project.

In February 2013, AFT negotiated a contract with a retired and well-known farmer from Morgan County to do local watershed coordination and outreach. The Watershed Coordinator contacted targeted farmers and landowners individually to determine willingness to adopt conservation measures to reduce soil losses and protect the Lake from sedimentation. Through March and April 2013, the Coordinator facilitated watershed field access for Northwater to do technical producer outreach, take field measurements and make practice recommendations. Several hundred structural and conservation practices were recommended and many farmer commitments were made, if an Implementation 319 grant is successful.

In June 2013, after planting was completed, AFT hosted a meeting to update interested parties on the progress of the project and to solicit suggestions going forward. The meeting was well attended by local residents, farmers, landowners, state and local officials. The former mayor of Jacksonville gave a brief history and overview of the problems of Lake Mauvaise Terre and how the current dredging project, combined with the planned watershed conservation work, could extend the life and function of Lake Mauvaise Terre. Several members of the current City Council were in attendance and expressed future support for the project. Media interviews were made and future interviews were planned for a local radio public affairs show.

Moving forward into implementation, continued outreach with watershed landowners will be required. Relationships exist with those producers engaged in a recent Section 319 grant application, and dialog and communication will continue as any practices are designed and ultimately constructed. Private consultants will work directly with these producers on practice survey and design and follow up, once construction is complete to verify each BMP is built according to specifications. The City of Jacksonville intends to develop an Operation and Maintenance (O&M) plan with each landowner that will define and guide construction requirements and future maintenance activities.

The AFT, the local Watershed Coordinator, SWCD and the City of Jacksonville will continue outreach efforts into the future to encourage the adoption of basin-wide BMPs; work is currently underway to enroll producers in cover crops and this effort will continue. Enrollment into existing programs, such as CRP and EQIP, will also continue, guided by the local NRCS and SWCD and supported by the AFT and the City of Jacksonville. The City will work to implement recommended supplemental management measures as resources permit following completion of any near-term grants, such as a Section 319 grant for targeted BMP implementation.

8.0 Implementation Milestones & Schedule

Implementation milestones and goals are intended to be measured by NRCS EQIP contracts, 319 funded cost-share measures, City of Jacksonville and SWCD initiated projects. The goals are meant to be both measurable and realistic given that much of the farm field construction work must be accomplished seasonally to avoid growing crops and agricultural planting and harvest activities. Specific milestones and a schedule/timeframe are presented in Table 24. Direct outreach and communication one-on-one with landowners is vital to the success of future implementation activities and will be a component of every effort to secure the adoption of the BMPs listed below. This communication and outreach will also help to ensure practices are maintained over time.

An aggressive years 1-2 implementation schedule is presented in Table 24. Each practice described in years 1 & 2 is accompanied by a written commitment by the producer contingent on funding; successful education and outreach up to this point has resulted in landowners willing to implement a substantial number of specific practices.

Table 24 - Implementation Milestones & Timeframe

Timeframe	Milestone
Years 1-2	1. Prepare O&M Plans for targeted BMPs and continue one-one-one communication with willing producers. 2. Installation of 195 targeted WASCBs 3. Install 1 terrace. 4. Plant 500 acres of cover crops. 5. Convert conventional tillage to no-till on 20 fields 6. Install 2 sediment basins 7. Install 2 ponds 8. Install 8 acres of grassed waterways 9. Install 2 acres of filter strips

Timeframe	Milestone
	10. Install 2 pasture management systems 11. Install 1 feed area waste system 12. Install 2 rock riffles and 2 grade control structures 13. Assess and map streambanks for streambank stabilization 14. Conduct detention basin survey and stormwater ordinance review 15. Conduct additional landowner outreach 16. Conduct in-lake sediment dam feasibility study
Years 3-5	1. Conduct additional one-on-one outreach with producers 2. Prepare O&M Plans for BMPs as necessary through direct communication 3. Install 100 additional WASCBs 4. Install or upgrade 10 terraces 5. Plant 1,000 acres of cover crops 6. Convert conventional tillage to no-till on 20 fields 7. Install 6 grade control structures 8. Install 5 sediment basins 9. Install 2 ponds 10. Install 10 acres of grassed waterways 11. Install 5 acres of filter strips 12. Install 2 constructed wetlands 13. Install 1,000 feet of streambank stabilization 14. Install 2,000 feet of lake shore rip rap 15. Install 100 rain barrels in Town Brook 16. Install 1 acre of rain gardens in Town Brook 17. Install 1 acre of porous pavement in Town Brook 18. Install 4 urban detention basins in Town Brook 19. Install 2,000 feet of Two-Stage Ditch 20. Assess and map gully erosion 21. Assess forested areas 22. Conduct lake shoreline erosion survey
Years 6 -10	1. Conduct additional one-on-one outreach with producers 2. Prepare O&M Plans for BMPs as necessary through direct communication 3. Install 300 additional WASCBs 4. Install or upgrade 25 terraces 5. Plant 5,000 acres of cover crops 6. Convert conventional tillage to no-till on 40 fields 7. Install 5 new sediment basins/ponds 8. Install 10 acres of grassed waterways 9. Install 5 acres of filter strips 10. Install 2 constructed wetlands 11. Install 5,000 feet of streambank stabilization 12. Install 5,000 feet of lake shore rip rap 13. Install 200 rain barrels in Town Brook 14. Install 2 acres of rain gardens in Town Brook 15. Install 2 acres of porous pavement in Town Brook 16. Install 6 urban detention basins in Town Brook 17. Install 10,000 feet of Two-Stage Ditch 18. Covert 10 acres of cropped HEL soils to native grasses

Table 25 summarizes BMP milestones or objectives, those responsible entities and the primary technical/financial assistance required. The implementation milestones or objectives presented below are intended to be achievable and realistic over a 10-year period and follow the site-specific, basin-wide, and supplemental practices described in Section 5. Although alone, these implementation milestones do not entirely meet water quality targets as presented in Section 9, they will result in substantial improvements to water quality and the future attainment of water quality standards in the watershed.

Table 25 - Summary Table; Implementation Objectives, Responsible Parties & Technical Assistance

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
	Basin Wide BMPs/Education & Outreach	
BMP: Cover Crops **Objective:** Install 6,500 acres	Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS/AFT/ Extension ***Funding Mechanism***: 319 Grant/Private funds/EQIP
BMP: No-Till **Objective**: Convert 80 fields	Landowner/SWCD/NRCS	***Technical Assistance:*** SWCD/NRCS/Consultants ***Funding Mechanism***: 319 Grant/Private Funds/EQIP
BMP: Detention basins/ponds/sediment basins **Objective:** Install 8 detention basins/ponds and 12 sediment basins	Landowners/SWCD/NRCS	**Technical Assistance:** NRCS/SWCD /Consultants **Funding Mechanism:** NRCS/SWCD/319/IGIG/ Private funds
BMP: Wetland Creation **Objective:** Create 4 wetlands	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants **Funding Mechanism**: 319/Private funds
BMP: Streambank and Shoreline Stabilization **Objective:** Assess and document streambank and lake shoreline erosion	Landowner/IDOA/IDNR	**Technical Assistance:** IDOA/IDNR/Consultant **Funding Mechanism:** IDOA/319/EPA/Private funds
BMP: Filter strips/grassed waterway **Objective:** Install 12 acres	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA /Consultants **Funding Mechanism**: EQIP/319/CRP/CREP
BMP: Grade Control/Riffle **Objective:** Install 6	Landowners SWCD/NRCS/IDOA	**Technical Assistance:** SWCD/NRCS/Coop Ext. **Funding Mechanism:** EQIP/SWCD/NRCS/319
BMP: Two-Stage Ditch **Objective:** Install 12,000 ft	Landowners /NRCS	**Technical Assistance:** NRCS/Consultants/The Nature Conservancy **Funding Mechanism:** EQIP/City/319
BMP: Education and Outreach **Objective:** Stakeholder engagement	AFT/SWCD/NRCS/Coop Ext.	**Technical Assistance:** SWCD/NRCS/Coop Ext. **Funding Mechanism:** 319/Private funds
BMP: Rain Barrels/Rain Gardens/Porous Pavement **Objective:** Install 300 rain barrels, 4 acres of rain gardens and porous pavement	Landowners /City	**Technical Assistance:** SWCD/IEPA. **Funding Mechanism:** 319/Private funds
	Site-Specific BMPs	
BMP: Grassed Waterway **Objective:** Install 8 acres	Farmer/Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants **Funding Mechanism**: 319 Grant/Private Funds/EQIP/City funds
BMP: WASCB/Terrace **Objective:** Install 196	Farmer/Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS/Consultant ***Funding Mechanism:*** 319 Grant/Private Funds/EQIP/City funds
BMP: Pasture/Feed Area BMPs **Objective:** Install 1 feed area waste system and 1 pasture mgmt. system	Farmer/Landowner /NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism**: 319 Grant/Private Funds/EQIP/City funds

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
BMP: Sediment Basin **Objective:** Install 2	Farmer/Landowner/SWCD	***Technical Assistance***: SWCD/NRCS/IDNR/IDOA ***Funding Mechanism***:319 Grant/Private Funds/IDOA/City funds
BMP: Pond **Objective:** Install 1	Farmer/Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS/Consultant ***Funding Mechanism***: 319 Grant/Private Funds/EQIP/CRP/City funds
BMP: Grade Control/Riffle **Objective:** Install 4	Farmer/Landowner/IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism**: 319 Grant/Private Funds / EQIP/WRP
	Supplemental Management Measures	
BMP: Streambank Survey **Objective:** Conduct 1 study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism**: 319 Grant/IDOA Funds
BMP: Gully Survey **Objective:** Conduct 1 study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism**: 319 Grant/IDOA Funds
BMP: Lake Shoreline & In-Lake Dam Feasibility Study **Objective:** Conduct 1 study	City of Jacksonville	**Technical Assistance**: Consultant **Funding Mechanism**: 319 Grant/City Funds
BMP: Detention Basin Survey & Ordinance Review **Objective:** Conduct 1 study	City of Jacksonville	**Technical Assistance**: Consultant **Funding Mechanism**: 319 Grant/City Funds/IGIG
BMP: Forest Erosion Survey **Objective:** Conduct 1 study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/ Consultant **Funding Mechanism**: 319 Grant
BMP: Native Grass Conversion **Objective:** 2,779 acres	Farmer/Landowner/IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant/ USFWS **Funding Mechanism**: 319 Grant/Private Funds/ CRP/EQIP/ Quail Forever / USFWS

9.0 Water Quality Targets

This section will describe water quality targets and those implementation actions required to meet targets.

Water quality targets for the Lake Mauvaise Terre watershed were generated directly from the 2007/2010 TMDL. Established TMDL targets for nitrogen and phosphorus were used, whereas the sediment reduction target was established using the TMDL target for reductions in manganese. Given that the source of manganese is likely eroded sediment, using the same target for sediment reduction was deemed realistic. Furthermore, because the other lake impairments of fluoride, mercury, DO, and hexachlorobenzene are thought to be originating from natural sources such as sediment and agricultural runoff (DO as a function of excessive nutrients), meeting TMDL targets for nitrogen, phosphorus, and manganese will result in the delisting of these other pollutants. Because no water quality data exists for Town Brook, nor has a specific TMDL been completed for it, the water quality targets presented below are also applied to Town Brook.

In order to meet standards for Lake Mauvaise Terre, a 57% reduction in nitrogen is required, a 53% reduction in phosphorus is required, and a 53% reduction in sediment is required. Tables 26 through 28 compare water quality targets to expected BMP load reductions. Results indicate that with the exception of sediment in the Lake Mauvaise Terre watershed, implementing all site-specific and basin-wide practices will still not meet the target reduction percentages. The sediment target will be exceeded if all site-specific and basin-wide practices are implemented. In order to achieve water quality targets, supplemental management measures are needed and described in Section 5.3.4:

1. An assessment of streambank erosion and the implementation of stabilization measures.
2. Additional landowner outreach, site visits and the identification/treatment of gully erosion.
3. Implementation of in-lake controls, such as shoreline stabilization and in-lake sediment traps.
4. Additional stormwater detention in the Town Brook watershed.
5. Inventorying and addressing potential pollution sources from steep forested areas throughout the watershed.
6. Conversion of cropland to native grasses (cropped HEL soils).

Due to a need to additional data collection, load reductions were not estimated for the supplemental management measures 1-5 above. Once the information has been obtained and tabulated, the plan will be updated to incorporate the appropriate load reductions and an evaluation will be made as to how these supplemental management measures address water quality goals and targets.

Pollution load reductions for the conversion of cropland to native grasses are estimated to be 84,806 lbs/yr for nitrogen, 30,398 lbs/yr for phosphorus and 8,703 tons/yr for sediment. Because the sediment target is already met with the implementation of both site-specific and basin-wide BMPs, the conversion of 2,799 acres of cropped HEL soils will further exceed water quality targets for sediment. Implementing 2,799 acres of cropland conversion will still not meet the 57% reduction target for nitrogen, however, it will achieve a total reduction of 56%; an additional 1% reduction, or 4,576 lbs/yr of nitrogen, is expected to be achieved following data collection efforts under supplemental management measures 1-5 and any subsequent practice implementation such as streambank or gully stabilization.

Implementing all cropland conversion, combined with all site-specific and basin-wide practices, will significantly improve reductions in phosphorus and will exceed the current target of 53% for an overall reduction in phosphorus of 88%. Implementation of the other supplemental measures will result in further reductions in phosphorus loading.

Table 26 - Lake Mauvaise Terre Site-Specific BMP Load Reductions & Water Quality Targets

Total Nitrogen Load (lbs/yr)	383,409	**Total Phosphorus Load (lbs/yr)**	64,654	**Total Sediment Load (tons/yr)**	19,029
Nitrogen Load Reduction (lbs/yr)	15,650	**Phosphorus Load Reduction (lbs/yr)**	4,131	**Sediment Load Reduction (tons/yr)**	1,733
Nitrogen Reduction Target	57%	**Phosphorus Reduction Target**	53%	**Sediment Reduction Target**	53%
Reduction % Achieved	4%	**Reduction % Achieved**	6%	**Reduction % Achieved**	9%

Table 27 - Lake Mauvaise Terre Basin-Wide BMP Load Reductions & Water Quality Targets

Total Nitrogen Load (lbs/yr)	383,409	**Total Phosphorus Load (lbs/yr)**	64,654	**Total Sediment Load (tons/yr)**	19,029
Nitrogen Load Reduction (lbs/yr)	132,579	**Phosphorus Load Reduction (lbs/yr)**	28,523	**Sediment Load Reduction (tons/yr)**	9,332
Nitrogen Reduction Target	57%	**Phosphorus Reduction Target**	53%	**Sediment Reduction Target**	53%
Reduction % Achieved	35%	**Reduction % Achieved**	44%	**Reduction % Achieved**	49%

Table 28 - Town Brook Basin-Wide BMP Load Reductions & Water Quality Targets

Total Nitrogen Load (lbs/yr)	74,184	**Total Phosphorus Load (lbs/yr)**	11,250	**Total Sediment Load (tons/yr)**	3,378
Nitrogen Load Reduction (lbs/yr)	21,300	**Phosphorus Load Reduction (lbs/yr)**	4,049	**Sediment Load Reduction (tons/yr)**	1,354
Nitrogen Reduction Target	57%	**Phosphorus Reduction Target**	53%	**Sediment Reduction Target**	53%
Reduction % Achieved	29%	**Reduction % Achieved**	36%	**Reduction % Achieved**	40%

10.0 Water Quality Monitoring Strategy

The purpose of the monitoring strategy for the Lake Mauvaise Terre watershed is to utilize existing monitoring data (existing IEPA stations) and continue to monitor the condition and health of the watershed in a consistent and on-going manner. In addition, the strategy seeks to add two monitoring stations, one to collect data on Town Brook (currently, no monitoring data exists for Town Brook) and one to isolate inflows to the Lake from Mauvaise Terre Creek (current sampling sites are within the lake).

The strategy allows for evaluation of the overall health of the watershed and its changes through time. Another key purpose is to assess the effectiveness of plan implementation projects, and their cumulative watershed-scale contribution towards achieving the goals and objectives of the plan. Whilst programmatic monitoring tracks progress through achievement of actions, this section outlines a strategy to directly monitor the effectiveness of the actions.

Monitoring environmental criteria, as outlined in this strategy, is an effective way to measure progress toward meeting water quality objectives. One potential problem with in-stream indicators is the issue of isolating dependent variables. There are likely many variables influencing the monitoring results, so making conclusions with regard to one specific constituent should be done with caution. It should be noted, however, that the indicators are excellent for assessing overall changes in a watershed's condition.

Three IEPA monitoring stations exist for Lake Mauvaise Terre (Table 29 and Figure 13). One additional site on Town Brook and one on Mauvaise Terre Creek are also proposed and presented in Table 29 and Figure 13. Given the historical data currently available, it is recommended that monitoring continue at existing sites, ideally, under direction from the IEPA. The proposed monitoring categories and associated recommendations are summarized in Table 30. Monitoring activities should be coordinated with the IEPA and additional resources should be sought, such as the RiverWatch program through the National Great Rivers Research and Education Center (NGRREC) or through volunteers, as needed. Physical and biological data should be collected at the Town Brook and Mauvaise Terre Creek monitoring sites to augment water quality information since no biological data exists. The City of Jacksonville and/or local volunteers could manage a sampling program on Town Brook.

Due to the uncertainty in securing resources for edge-of-field monitoring to measure the effectiveness of BMPs, it is recommended that a more detailed monitoring plan be developed alongside future implementation actions, if funding permits.

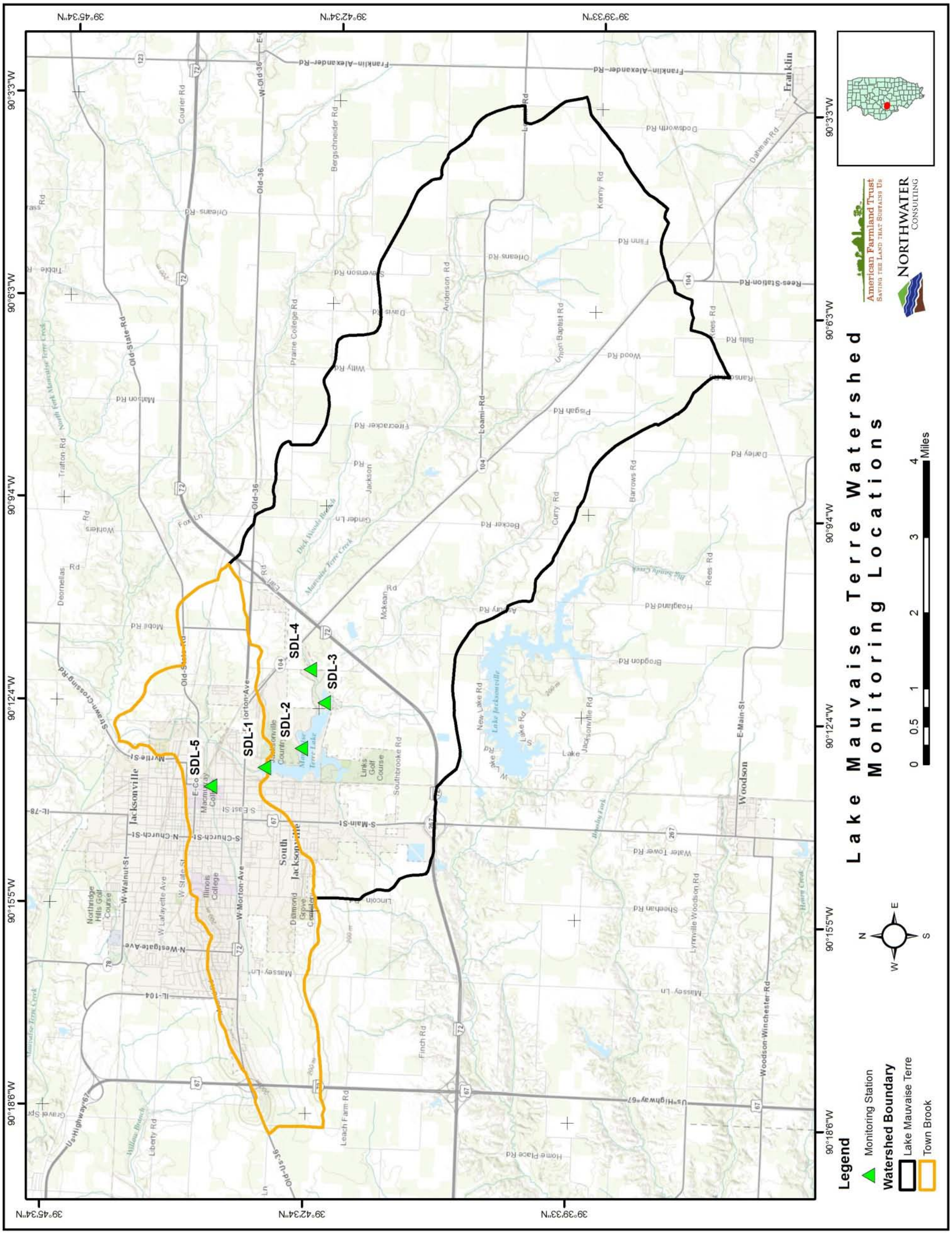
Table 29 - Existing & Proposed Monitoring Sites & Description

Station ID	Site Description	Notes
SDL-1	Mauvaise Terre Lake, Near Dam Midway Between Spillway	Existing IEPA monitoring site
SDL-2	Mauvaise Terre Lake, 800 yd E. of Ramp N. of Docks	Existing IEPA monitoring site
SDL-3	Mauvaise Terre Lake, Mid Lake South of Red Brick House	Existing IEPA monitoring site
SDL-4	Mauvaise Creek, upstream of Woods Lane bridge crossing	New monitoring site for Mauvaise Terre Creek
SDL-5	Town Brook, upstream of Hardin Ave Bridge Crossing.	New monitoring site for Town Brook

Table 30 - Summary of Monitoring Categories & Recommendations

Monitoring Category	Summary of Recommendations
Stream flow	Measure stream flow during every sampling event, if conditions permit.
Ambient water quality	Utilize IEPA and local volunteers to execute regular monitoring for water quality.
Physical and biologic assessment	Develop and execute monitoring for fish, macroinvertebrates, habitat and channel morphology on Town Brook and Mauvaise Terre Creek.
BMP effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices. Develop a detailed monitoring plan in combination with implementation activities.
Monitoring Partnerships	Coordinate with the IEPA. Explore/Implement a volunteer monitoring program for Town Brook through RiverWatch or local volunteers.
Storm event runoff monitoring	Conduct additional monitoring during storm events. Existing monitoring data lacks high-flow events.

Figure 13 - Monitoring Locations



10.1 Water Quality Monitoring

Monthly and storm-event water quality monitoring should be considered for all stations in the watershed (Figure 13). Efforts should focus initially on collecting additional storm-event data followed by a regular sampling program.

Table 31 includes the minimum parameters that should be considered for monitoring. Quantitative benchmarks that indicate impairment conditions are also illustrated in this table. The establishment of baseline conditions is important in order to evaluate trends and changes in water quality over time through implementation. Parameters such as total phosphorus, total suspended sediment, and total nitrogen should be analyzed considering flow volumes in order to make relative comparisons year to year, as concentrations of pollutants vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation.

Table 31 - Baseline Water Quality Analysis Parameters

Analyte	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/l
Total Nitrogen	Less than 10 mg/L
Total Suspended Sediment (TSS)	Less than 750 mg/l
Manganese	Less than 150 ug/l
Turbidity	Less than 20 NTU
Dissolved Oxygen	No less than 6.0 mg/l (IEPA standards)
Temperature	Less than 90° F (IEPA standards)
pH	Between 6.5 – 9.0 (IEPA standards)
Flow	--

10.2 Stream Bioassessment

Aquatic stream monitoring should be considered annually or at the maximum of 3 to 5-year increments. Two stations are recommended in the watershed; one on Town Brook, and one on Mauvaise Terre Creek upstream of the Lake. Table 32 shows the typical stream bioassessment techniques that can be applied to the monitoring program.

Table 32 - Stream Bioassessment Metrics

Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (IBI)	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	**Exceptional** (50-60) **Very Good** (49-42) **Good** (41-34) **Fair** (33-27) **Poor** (26-17) **Very Poor** (<17)
Macroinvertebrate Biotic Index (MBI) or Macroinvertebrate Index of Biologic Integrity (MIBI)	Index indicative of stream quality based on the macro-invertebrate species and populations.	**Excellent** (< 5.0) **Good** (5.0 – 5.9) **Fair** (6.0-7.5) **Poor** (7.4-8.9) **Very Poor** (> 8.9)

Monitoring	Definition	Benchmark Indicators
Qualitative Habitat Evaluation Index (QHEI)	Index indicative of habitat quality that incorporates substrate, in-stream cover, channel morphology, riparian zone, bank erosion and riffle/pool condition.	**Excellent** (>70) **Good** (55-69) **Fair** (43-54) **Poor** (30-42) **Very Poor** (<17-29)
Stream Condition Index (SCI)	Index that incorporates macroinvertebrate community, habitat and water quality components to grade the quality of a stream.	**Exceptional** (>70) **Good** (49.4-69.8) **Fair** (24.6-49.3) **Poor** (0-24.5)
Mussels	Live and dead mussels collected and species and populations indicative of stream condition.	Qualitative based on species diversity, population and live and dead specimens
Channel Morphology	Establish fixed cross-section and longitudinal profile of channel along a 1,500-foot-long fixed reach. Monitor regularly to assess changes in channel.	Entrenchment ratio Width/depth ratio bankfull Bed material Cross-sectional area Water slope

Appendix A

Pollution Load Model Methodology

NORTHWATER CONSULTING

Lake Mauvaise Terre Watershed SWAMM Pollutant Load Model Methodology

sWAMM™

Spatial Watershed Assessment & Management Model

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Pollutant Loading Model Methodology

1.0 Introduction

A GIS spatially based pollution load model or SWAMM (Spatial Watershed Assessment and Management Model) was developed to estimate field level annual pollutant loading from, phosphorus, nitrogen, and sediment. Constructed using soils, landuse and precipitation data the model provides annual loading for individual land parcels within the Lake Mauvaise Terre watershed. Results are organized through a unique combination of landuse and soils, delineated into individual units of pollution loading. Accepted equations for calculating runoff and soil erosion are integrated into the model to provide realistic estimations of the quantity and distribution of annual pollution loading throughout the study area. The model was calibrated against loading estimates provided in the 2010 TMDL. A time period of 12/31/1982 to 12/31/2013 was used for generating rainfall values.

The GIS data set is organized in such a way that results can easily be queried by landuse. Results can also be analyzed based on user defined boundaries and presented in map format, easily overlaid on existing base maps. The model includes 5,738 unique records from which to assess pollution loading. The following methodology document provides key model equations and values, references and summary statistics.

2.0 Methodology

The custom SWAMM model consists of two primary components:

- Universal Soil Loss Equation (USLE) Component
- Event Mean Concentration (EMC) Component

2.1 USLE Component

The overall analysis methodology modified by Northwater from:

Mitasova and Lubos Mitas: Modeling soil detachment with RUSLE3d using GIS, 1999; University of Illinois. http:/skagit.meas.ncsu.edu/~helena/gmslab/erosion/usle.html

The Universal Soil Loss Equation (USLE) component of the model is applied to agricultural land uses within the watershed (Row Crops). The USLE methodology incorporated into the model is summarized below:

- 1:24,000 NRCS Soil Survey Geographic Database (SSURGO) Digital Soils.
- Selected appropriate soil types and relevant USLE factors identified and calculated from SSURGO soils dataset.
- USLE erosion calculated with the following equation: LS * K * C * R *P.

Table 1 - USLE factors

Landcover	C factor	K factor	LS factor	R factor	P factor
Agriculture Crops (Row Crops)	Initial Values Provided by County NRCS Final Values: 0.45-0.08 (for no-till)	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values or from local NRCS Staff	180	0.3-1

2.2 EMC Component

A) All formulas and selected variables are derived from: *STEPL (Spreadsheet Tool for Estimation of Pollutant Load) Version 3, Tetra Tech, 2004.* For Bacteria, Schueler's Simple Method (1987) is modified for calculating bacterial loads.

B) Event Mean Concentration Values and Curve Numbers were derived from the following sources:

1. *Nonpoint Source Pollution and Erosion Comparison Tool (N-SPECT) Technical Guide, Version 1.0 Release 1, November 2004.*
2. *Lower DuPage River Watershed Plan Pollution Load Model Methodology, 2010.*
3. *V3 Companies, 2008. Elkhart River Watershed Management Plan, Appendix J; Pollutant Load Model Documentation for Critical Areas.*
4. *Price, Thomas H., 1993. Unit Area Pollutant Load Estimates for Lake County Illinois Lake Michigan Watersheds.*
5. *Todd D. Stuntebeck, Matthew J. Komiskey, Marie C. Peppler, David W. Owens, and Dennis R. Frame 2011. Precipitation-Runoff Relations and Water-Quality Characteristics at Edge-of-Field. Stations, Discovery Farms and Pioneer Farm, Wisconsin, 2003–08.*
6. *Northwater Consulting. 2013. Spatial Watershed Assessment and Management Model. Prepared for Chicago Metropolitan Agency for Planning, Chicago, IL.*

D) Precipitation: annual precipitation, number of rain days and correction factors using the following weather station: Jacksonville Station ID 114442. A period of 31 years was used (1982-2013).

Table 2 – Rainfall Factors

Average Number of Rain Days	Rain Days Correction Factor	P Value (inches)
113.3	**0.44**	**0.709**

E) Delivery Ratio; distance based delivery ratio: *Minnesota Board of Water & Soil Resources, "Pollution Reduction Estimator Water Erosion - Microsoft Excel® Version September 2010."*

Polygon distance from major stream (ft) $^{\wedge -0.2069}$

Table 3 - Pollutant Load Model Values

Model	Rain days	Correction Factor (precipitation and rain days)	Curve Number (by soil hydrologic group)	Runoff (by soil hydrologic group in inches)	EMC for N, P, TSS, Bacteria
All landuse	see table above	see table above	See below	Calculated using the following equation: $Q = \frac{(P - (Ia \times S))^2}{P + 0.8 \times S}$ $S = \frac{1000}{CN} - 10$ Q = Runoff (inches) P = Precipitation (inches) S = Potential max retention (inches) CN = Curve Number Ia = Initial abstraction factor; set to 0 for annual runoff and 0.2 for first flush, 10 and 25yr events	See Table Below

Table 4 - Event Mean Concentrations & Curve Numbers

Landuse Category	EMC N (mg/l)	EMC P (mg/l)	EMC TSS (mg/l)	Curve # A Group	Curve # B Group	Curve # C Group	Curve # D Group
Cemetery	3.1	0.46	153	49	69	79	84
Commercial Mix (HIGH)	3.2	0.42	206	92	93	94	95
Commercial Mix (MEDIUM)	3	0.4	153	89	90	91	92
Commercial Mix (LOW)	3	0.4	153	84	85	86	87
Communication (LOW)	2.1	0.3	65	49	69	79	84
Confinement (HIGH)	13.5	2.6	240	89	92	94	95
Cultural and Entertainment (HIGH)	2.16	0.3	206	92	93	94	95
Cultural and Entertainment (LOW)	2	0.29	153	84	85	86	87
Dewatering Area	1.4	0.13	150	74	83	88	90
Educational Facility (HIGH)	3.2	0.42	153	91	94	96	97
Educational Facility (MEDIUM)	3	0.4	150	89	92	94	95
Educational Facility (LOW)	3	0.4	150	85	88	89	91
Farm Buildings and Barn Lots (HIGH)	7.1	0.6	300	85	86	87	88
Farm Buildings and Barn Lots (MEDIUM)	3.1	0.42	160	78	79	80	81
Farm Buildings and Barn Lots (LOW)	2.2	0.33	72	57	72	79	80
Farmhouse (HIGH)	3.3	0.5	300	77	85	90	92
Farmhouse (MEDIUM)	3.1	0.42	160	57	72	81	86
Farmhouse (LOW)	2.2	0.33	72	46	65	77	82
Feed Area (HIGH)	13.5	1.3	390	89	92	94	95
Forest	1.4	0.13	60	39	61	74	80
Golf Course	3.6	0.6	84	39	61	74	80
Government Facility (HIGH)	3.6	0.42	206	92	93	94	95
Government Facility (MEDIUM)	3.2	0.4	153	87	88	89	90
Government Facility (LOW)	3.2	0.4	153	84	85	86	87
Grassland	0.7	0.15	30	30	58	71	78

Landuse Category	EMC N (mg/l)	EMC P (mg/l)	EMC TSS (mg/l)	Curve # A Group	Curve # B Group	Curve # C Group	Curve # D Group
Manufacturing (HIGH)	2.8	0.36	245	92	93	94	95
Medical Facility (HIGH)	3.2	0.42	153	91	94	96	97
Mobile Home (MEDIUM)	3.1	0.4	153	57	72	81	86
Mobile Home (LOW)	2.16	0.32	72	46	65	77	82
Multi-Family Apartments (HIGH)	3.2	0.32	306	89	92	94	95
Multi-Family Apartments (MEDIUM)	3.1	0.3	291	88	89	90	91
Nursery	3.6	0.4	240	32	58	72	79
Office Space (HIGH)	3.2	0.42	153	92	93	94	95
Office Space (MEDIUM)	3.2	0.42	153	87	88	89	90
Open Space	0.8	0.25	35	49	69	79	84
Open Water - Pond or Reservoir	0.375	0.025	1.5	98	98	98	98
Open Water - Stream	1.25	0.11	3.1	98	98	98	98
Other Institutional (HIGH)	3.6	0.42	206	92	93	94	95
Other Institutional (MEDIUM)	3.2	0.4	153	87	88	89	90
Park	1.25	0.3	65	72	73	75	77
Parking Lot	2.3	0.34	390	98	98	98	98
Pasture (HIGH)	10.2	1.8	200	75	84	89	91
Pasture (MEDIUM)	6.75	1	100	67	78	85	89
Pasture (LOW)	3.46	0.8	50	30	58	71	78
Religious Facility (HIGH)	3.2	0.42	153	92	93	94	95
Religious Facility (MEDIUM)	3.1	0.4	135	87	88	89	90
Residential (HIGH)	3.2	0.32	291	77	85	90	92
Residential (MEDIUM)	3.1	0.3	153	57	72	81	86
Residential (LOW)	2.16	0.3	72	46	65	77	82
Residential Multi-Family (HIGH)	3.2	0.32	291	77	85	90	92
Residential Open Space	1.25	0.3	65	72	73	75	77
Road	2.3	0.34	390	98	98	98	98
Row Crop	4.8	0.65	N/A*	74	83	88	90
Shopping Mall (HIGH)	3.2	0.49	206	92	93	94	95
Utilities and Waste Facility (HIGH)	2.3	0.4	206	85	86	91	93
Utilities and Waste Facility (MEDIUM)	2.1	0.34	153	81	84	87	88
Vacant	1.4	0.3	70	72	73	75	77
Vehicle Dealership (HIGH)	3.1	0.49	153	92	93	94	95
Warehousing (HIGH)	2.8	0.4	206	92	93	94	95
Warehousing (MEDIUM)	2.6	0.31	153	88	89	90	91
Warehousing (LOW)	2.6	0.31	153	85	86	87	88
Wetland	0.7	0.01	1	85	85	85	85

****USLE equation used**

3.0 Model Calibration

Model calibration was performed to verify the model results against TMDL results and average per acre loading results for the Midwest. The calibration and verification served three purposes:

1. Quality Assurance / Quality Control – to find and correct user errors in the model scripts and algorithms.
2. To evaluate whether stream-flow (runoff) and pollutant loading were in the correct ranges based on existing data and literature.
3. To calibrate model by adjusting parameters so that cumulative model results represent regional averages.

The model is estimating accumulated/delivered pollutant loading, represented mostly in the literature. Important notes on the model include:

- The model does not directly account for point source pollution.
- The model estimates annual pollutant mobilization from individual parcels of land and does not take into account storage, fate and transport watershed processes.
- The model accounts for precipitation runoff; but not base flow, point source discharges or drainage-tile contributions.

The model was also calibrated based using the delivery ratio; to account for differences between the delivery of sediment versus the delivery of dissolved pollutants. Since the delivery ratio is based on studies of sediment transport and not dissolved pollutants, an adjustment or multiplier of **1.25** was applied to the delivery ratio for nitrogen, phosphorous and bacteria to get the results within acceptable regional ranges. The assumption was made that dissolved pollutants are delivered at a slightly higher rate than that of sediment.

4.0 Model Notes

1. A custom landuse layer was created for the watershed by interpreting recent aerial imagery and digitizing/labeling polygons. The initial Landuse layer was provided by the GIS department at the City of Jacksonville and modified as needed.
2. Data on field specific tillage practices and existing BMPs was incorporated.
3. High, medium and low areas were determined based on a visual interpretation of density. High areas generally represented greater than 50% impervious, medium 25-50% impervious and low, less than 25%.
4. Pasture was classified into high, medium and low based on pasture quality and the observed impact to water quality during a windshield survey.
5. The stream/waterbody file used to run proximity calculations for the purposes of determining a delivery ratio was modified using NHD data and includes only open water.