# Upper Maple River Watershed Management Plan

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CLINTON CONSERVATION DISTRICT

Friends of the Maple River

Michigan's Nonpoint Source Program

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# UPPER MAPLE RIVER

# WATERSHED MANAGEMENT PLAN

**JULY 13, 2010**
**PROJECT NO. G080001**

Michigan's Nonpoint Source Program

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## LIST OF ABBREVIATIONS/ACRONYMS

| | |
|---|---|
| BHEI | Bank Hazard Erosion Index |
| BMP | Best Management Practices |
| CAFO | Concentrated Animal Feeding Operations |
| CCD | Clinton County Conservation District |
| CCDC | Clinton County Drain Commissioner |
| CCRC | Clinton County Road Commission |
| CCRESA | Clinton County Regional Educational Service Agency |
| CCRP | Continuous Conservation Reserve Program |
| cfs | cubic feet per second |
| CNMP | Comprehensive Nutrient Management Plans |
| CREP | Conservation Reserve Enhancement Program |
| DO | Dissolved Oxygen |
| *E. coli* | *Echerichia coli* |
| EQIP | Environmental Quality Incentives Program |
| FOMR | Friends of the Maple River |
| FSA | USDA Farm Services Agency |
| FTC&H | Fishbeck, Thompson, Carr & Huber, Inc. |
| GAAMPS | General Acceptable Agricultural Management Practices |
| GCD | Gratiot County Conservation District |
| GCRC | Gratiot County Road Commission |
| GIRESD | Gratiot-Isabella Regional Education Service District |
| GIS | Geographic Information System |
| GLEAS | Great Lakes and Environmental Assessment Section |
| GPS | Global Positioning System |
| HIT | High-Impact Targeting System |
| I&E | information and education |
| LID | Low Impact Development |
| LLWFA | Landscape Level Wetland Functional Assessment |
| LWMD | Land and Water Management Division |
| L-THIA | Long Term Hydrologic Impact Analysis |
| MAEAP | Michigan Agriculture Environmental Assurance Program |
| MDEQ | Michigan Department of Environmental Quality |
| MDNR | Michigan Department of Natural Resources |
| MDNRE | Michigan Department of Natural Resources and Environment |
| MDOT | Michigan Department of Transportation |
| mg/L | milligrams per liter |
| MGSP | Michigan Groundwater Stewardship Programs |
| MNFI | Michigan Natural Features Inventory |
| MSUE | Michigan State University Extension |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | nonpoint source |
| NRCS | Natural Resources Conservation Service |
| P51 | Great Lakes Environmental Assessment Section, Procedure No. 51 |
| PDR | Purchase of Development Rights |
| PPP | Public Participation Process |
| Project | Upper Maple River Watershed Project |
| RUSLE | Revised Universal Soil Loss Equation |
| SCD | Shiawassee County Conservation District |
| SCDC | Shiawassee County Drain Commissioner |
| SCHD | Shiawassee County Health Department |
| SCRC | Shiawassee County Road Commission |
| SEMCOG | Southeast Michigan Council of Governments |
| SRESD | Shiawassee Regional Education Service District |
| State | State of Michigan |
| T&E | threatened and endangered |
| TMDL | Total Maximum Daily Load |
| USDA | U.S. Department of Agriculture |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| Watershed | Upper Maple River Watershed |
| WCR | Wetland Coastal Resources |
| WMP | Watershed Management Plan |
| WQS | Water Quality Standards |
| WRP | Wetlands Reserve Program |

# EXECUTIVE SUMMARY

A Watershed Management Plan (WMP) is a document that builds on the strengths of existing programs and resources and addresses water quality concerns within the watershed. The purpose of the WMP is to identify impairments to the watershed and restore the qualities necessary for a healthy ecosystem.

This WMP is intended to be used by a wide variety of stakeholders and it is structured so that the main body of the plan is easily understood. The detailed scientific explanations, analyses, and assessments, are placed in the appendices for individuals who would like information that is more specific.

The WMP is arranged in four parts, with the first part including the Table of Contents and a list of abbreviations and acronyms, which are identified the first time that are used in each chapter of the document. The second part is the narrative, divided into chapters, with several exhibits and tables embedded in the text, and a References Cited page at the end. The third part includes all of the full size figures referenced in the narrative. The fourth part includes the Appendices.

## WATERSHED DESCRIPTION

The Upper Maple River Watershed (Watershed) encompasses approximately 513 square miles and is part of the larger Maple River Watershed, one of six major tributaries of the Grand River. The Watershed was delineated into 16 subwatersheds. For the purposes of this project, the Upper Maple River begins Section 4 of Shiawassee Township, Shiawassee County, and flows northwest approximately 54.55 miles to the project end point in the Village of Maple Rapids, Section 5, Essex Township, Clinton County. The Watershed encompasses portions of Essex, Greenbush, Duplain, Dallas, Bengal, Bingham, Ovid, and Victor Townships in Clinton County; portions of Fairfield, Middlebury, Owosso, Caledonia, Sciota, Bennington, and Shiawassee Townships in Shiawassee County; and portions of Arcada, New Haven, Newark, North Star, Hamilton, North Shade, Fulton, Washington, and Elba Townships in Gratiot County. The Villages of Maple Rapids, Ovid, Elsie, Perrinton, and Ashley, the City of Fowler, and portions of the Cities of Ithaca, Laingsburg, and St. Johns are also within the Watershed.

## WATER QUALITY CONCERNS

A priority for the project is to focus local efforts in listed 303(d) non-attainment waters, resulting in recommendations for restoring water quality and eliminating the need for Total Maximum Daily Load (TMDL) development by the Michigan Department of Environmental Quality (MDEQ).

Six stream reaches within the Watershed do not comply with water quality standards and are listed on the state of Michigan 303(d), Water Quality Standards Non Attainment List for Water Bodies Requiring TMDLs (Category 5). The MDEQ identified the TMDL water bodies as having a presence of nuisance algal and plant growths, which is indicative of nutrient enrichment. The nuisance algal and plant growth impairs the ability of native aquatic life to reproduce and reduces the recreational potential of the stream.

Phosphorus is the primary nutrient of concern. Over or improper application of manure/fertilizers, lack of buffers at livestock holding facilities adjacent to channels, uncontrolled livestock access, and aging septic systems and/or improper septic system maintenance are the suspected sources of the phosphorus. Other impairments identified in the Watershed include sedimentation and impaired biological communities.

The biological assessment indicated that the physical habitat of the Upper Maple River and its tributaries is marginal due to human impacts throughout the watershed. Agricultural land use has led to a dense network of drainage, and sediment and nutrients are obvious pollutants on many of these drains.

## IMPAIRED AND THREATENED DESIGNATED USES

NPS pollution impairs and threatens water quality and the designated uses of the Watershed. Two designated uses are impaired, 1) other indigenous aquatic life and other wildlife, and 2) warm water fishery, while total body contact recreation (e.g. swimming), partial body contact recreation (e.g. wading), and navigation are threatened.

**1. Warmwater Fishery -** The Upper Maple River Watershed warm water fishery is impaired by nutrients (phosphorus) and threatened by sediment loading. Pathogens (bacteria), temperature, and pesticides and chemicals are suspected impairments to this designated use.

**2. Other Indigenous Aquatic Life and Wildlife -** The Upper Maple River Watershed other indigenous aquatic life and wildlife is impaired by nutrients (phosphorus) and threatened by sediment loading.

**3. Total Body Contact Recreation -** Total body contact recreation in the Upper Maple River Watershed is threatened with suspected impairments of nutrients and bacteria inputs into watershed.

**4. Partial Body Contact Recreation -** Partial body contact recreation, such as fishing, is threatened with suspected impairments of nutrient and bacteria inputs into watershed.

**5. Navigation -** All areas where navigation is possible are threatened due to log jams and obstructions.

## GOALS AND OBJECTIVES

The goals are based on reducing and/or eliminating the impacts of NPS pollutants within the Watershed, restoring or maintaining the designated uses, and supporting implementation of desired uses. The following goals have been prioritized based on decisions by the Steering Committee:

1. Protect and maintain waterbodies for agricultural use (met designated use).
2. Restore and maintain waterbodies for other indigenous aquatic life and wildlife use (impaired designated use).
3. Restore and maintain waterbodies for warmwater fishery use (impaired designated use).

4. Restore and maintain waterbodies for partial body contact recreational use (threatened designated use).
5. Restore and maintain waterbodies for total body contact recreational use (threatened designated use).
6. Protect and maintain waterbodies for navigational use (met designated use).
7. Preserve high-quality areas.
8. Promote and support desired uses identified during development of this watershed plan.
9. Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.
10. Create a sustainable strategy for implementing the watershed management plan.

The short-term objectives to reduce the known (k), suspected (s), and potential (p) pollutants in the Watershed are listed below.

| Prioritized Pollutants and Impairments to Designated Uses | Objectives |
|---|---|
| 1. Sediment (k) | Implement cropland management practices. |
| | Implement vegetative filtering practices. |
| | Implement recommended drain maintenance practices. |
| | Implement watershed focused land-use planning. |
| | Implement channel stabilization and erosion control techniques. |
| | Implement livestock management practices. |
| | Implement streambank stabilization, bio-engineering, and erosion control techniques. |
| | Produce educational materials and signs. |
| | Implement shoreline protection techniques. |
| 2. Nutrients (s), phosphorus (k) | Implement proper fertilizer application practices, manure management planning and implementation, and watershed focused land-use planning. |
| | Implement livestock management practices. |
| | Implement vegetative filtering practices and manure management planning and implementation. |
| | Implement turf management practices. |
| | Implement lakeshore management practices. |
| | Implement septic system management practices. |
| | Implement vegetative buffer practices. |
| | Implement MDNR population management practices. |
| 3. Pathogens (bacteria) (p) | Implement manure management planning and implementation. |
| | Implement vegetative buffering practices and manure management planning and implementation. |
| | Implement septic system management practices. |
| | Implement vegetative buffering practices. |
| | Implement MDNR population management practices. |
| 4. Temperature (p) | Implement vegetative buffering practices. |

| Prioritized Pollutants and Impairments to Designated Uses | Objectives |
|---|---|
| 5. Pesticides (p) | Implement proper pesticide application practices and watershed focused land-use planning. |
| | Implement turf management practices. |
| | Implement lakeshore management practices. |
| | Implement vegetative buffering practices. |
| 6. Obstructions (s) | Implement river friendly channel maintenance techniques and river restoration practices. |

## RECOMMENDATIONS

The Project Committees used the information from the inventories to determine the needed Best Management Practices (BMPs) for each subwatershed. During the selection process, the impairments and threats to the designated uses, the goals and objectives developed for the Watershed, and the established TMDLs were considered. The recommendations chosen for the Watershed include structural and vegetative BMPs, as well as management and policy BMPs.

The overall, highest priority goal of the watershed was to preserve agricultural use, even though the WMP identifies that same use as being the greatest contributor of nonpoint source pollution to the watershed. To be able to preserve agricultural lands and also maintain water quality, the following BMPs were selected to be used on those lands and other lands to reduce pollutant loadings to the Upper Maple River Watershed.

| Recommended Prioritized BMPs |
|---|
| Crop residue management |
| Cover crop |
| Field tile management |
| Critical area planting |
| Wetland restoration |
| Grassed waterways |
| Harvestable buffer/filter strips |
| Native plantings/landscaping |
| Storm water criteria or ordinance |
| Buffer overlay zone |
| Wetlands ordinance |
| Floodplain mapping overlay district |
| Cattle exclusion or controlled access or cattle crossing |
| Buffer/filter strips or setback near existing crossing |
| Alternative water sources |
| Buffer or setback at holding facility |
| Streambank stabilization |
| Hydrologic and morphologic studies; stormwater design criteria |
| Channel restoration |
| Constructed wetlands |
| Reconnect floodplains |
| Regional detention |
| Distribute educational materials to Lake users which coordinate all lake issues including: restrictions on |

| Recommended Prioritized BMPs |
|---|
| boat traffic, enhanced enforcement, limiting phosphorus use on lawns, and limiting keyhole access. |
| Nutrient management |
| Field tile management |
| Waste storage facility; composting facility |
| CNMPs; promote incorporation |
| Residential turf management practices |
| Identify and correct illicit discharge connections |
| Repair or replace aging septic systems |
| Recommend regular inspection and maintenance of septic systems through septic ordinance |
| MDNR waterfowl population management practices |
| Training on proper fertilizer application techniques |

As part of any watershed planning project, an Information and Education (I&E) Strategy is developed to create a framework for motivating watershed stakeholders, residents, and other decision makers to take the actions necessary to protect and improve water quality and environmental conditions. The Upper Maple River I&E Strategy will serve as a working document that outlines the major steps and actions needed to successfully improve and maintain water quality and environmental conditions in the Watershed. This I&E Strategy outlines an approach for raising awareness, educating stakeholders, and inspiring action. I&E has the following objectives:

| Information and Education Objectives |
|---|
| Increase public knowledge and broaden awareness of the Watershed. |
| Educate stakeholders about the positive and negative environmental impacts of land use activities. |
| Provide opportunities for comment and participation in implementing the WMP. |
| Develop partnerships among stakeholders by sharing ideas, resources, and facilitating cooperative activities that increase public awareness of watershed management and impact land use policies. |
| Create a sense of individual responsibility for the proper use and care of surface water resources. |

## EVALUATION

Measures of success are essential to any project to evaluate and assess the achievements of the project and determine the benefits to water quality and the quality of life that resulted from the implementation of BMPs. The success of the project toward meeting its goals of improving water quality and restoring the designated uses of the Watershed depends on many factors, all of which need to be continuously evaluated. Establishing monitoring targets, against which observed measurements are compared, help determine whether progress is being made toward targets and ultimately the watershed goals. This management plan describes evaluation measures to evaluate implementation of specific BMPs and outlines a water quality monitoring program to evaluate overall changes in watershed conditions.

## SUSTAINABILITY

The Upper Maple River Watershed Management Plan (WMP) was developed to assist watershed stakeholders in addressing the sediment and nutrient concerns facing the Upper Maple River and its tributaries. The plan provides an implementation strategy designed to meet the Watershed's goals and objectives.

The WMP outlines the actions that stakeholders can take to continue the implementation of the plan over the next 10 years. The following structure will ensure that the WMP will remain current and continue to improve in content.

**Future Tasks and Responsibilities**

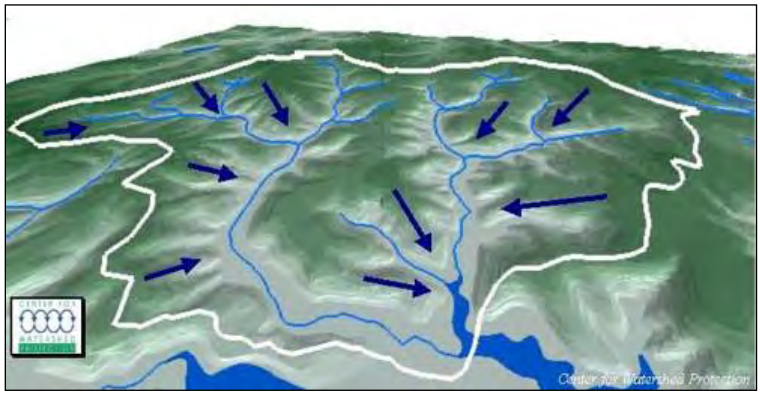
| Task | Potential Partners |
|---|---|
| Facilitate committees and meetings. Coordinate information with other counties in the Watershed. | Clinton Conservation District, Friends of the Maple River, County Drain Commissioners |
| Collect additional data and update the WMP with new data | Conservation Districts, Friends of the Maple River |
| Keep in regular contact with the Michigan Department of Natural Resources and Environment (MDNRE) (regulatory aspect) in regards to total maximum daily load (TMDL), etc., in the Watershed | Conservation Districts, Friends of the Maple River |
| Coordinate implementation of the Action Plan (overall coordination). Coordinate partners (road commissions, drain commissioners, NRCS, etc.) so they report information in a usable format (create new forms for partner to use, etc.). when structural and vegetative practices are installed | Clinton Conservation District, Friends of the Maple River, County Drain Commissioners, County Road Commissions, County Health Departments |
| Coordinate implementation of the Action Plan (overall coordination). Coordinate partners (townships, city, county officials) so they report information about changes in managerial practices and new ordinances which affect water quality | Clinton Conservation District, Friends of the Maple River |
| Implement the I&E Strategy | Clinton Conservation District, Friends of the Maple River, Clinton County Regional Educational Service Agency, County Health Departments |
| Implement the future monitoring plan. | Clinton Conservation District, Friends of the Maple River, Consultants, County Health Departments |
| Update the WMP | Clinton Conservation District, Friends of the Maple River, Consultants |

# 1.0 INTRODUCTION

## 1.1 PURPOSE OF WATERSHED MANAGEMENT PLAN

A watershed is an area of land, defined by hills and ridges, which drains to a common body of water (Exhibit 1). A Watershed Management Plan (WMP) documents the sources and causes of water pollution, and outlines a strategy to address activities which impair water quality within a watershed. The WMP gives an action-oriented approach to address the needs and proposed solutions for effectively managing and restoring all of the designated uses in the watershed. Input from all of the interested people in the watershed was considered during the development of the WMP, so it is a reflection of the ideas and goals of what the community wants for the watershed.

**Exhibit 1 – Watershed Illustration**




## 1.2 MISSION AND VISION STATEMENTS

The **MISSION** of the Upper Maple River Watershed Project (Project) is to preserve, improve, and educate the public regarding the wise use of the Maple River and its watershed.

Our **VISION** for the Watershed is to implement the WMP.

## 1.3 DESIGNATED USES

All surface waters of the state of Michigan are protected for the following designated uses:

- Agriculture
- Industrial water supply at the point of intake
- Public water supply at the point of intake
- Navigation
- Warmwater and/or coldwater fishery
- Other indigenous aquatic life and wildlife

- Partial body contact recreation
- Total body contact recreation between May 1 and October 31.

The purpose of the WMP is to identify and to restore the designated uses impacted by nonpoint source (NPS) pollution.

## 1.4 KEY ELEMENTS OF DEVELOPING A WMP

The key elements of developing a WMP are as follows:

1. *Understanding the watershed characteristics*, for example; land use, soils, topography, hydrology, significant natural resources, and the community profile.

2. *Identifying local agencies and citizens within the watershed and involve them in the watershed management planning process.* The procedure of forming the Steering Committee and other Committees is found in Appendix 1. The Public Participation Process (PPP) for enticing involvement in the development of the Upper Maple River WMP was as follows:

    a. Meetings: Steering Committee meetings, Information & Education (I&E) Committee meetings, Monitoring Committee meetings, WMP Review Committee meetings, and Public Meetings were held. Meetings were announced through press releases, signs posted on library and municipal bulletin boards, on community websites, and through e-mail distribution lists. All Committee meetings were open to the public and gave attendees the opportunity for comment. A list of individuals representing the communities at the meetings was generated.

    b. Newsletters and Print Media: Press releases were made to the local papers to announce public meetings and opportunities for public involvement. Newsletter inserts about the Watershed project and watershed education were distributed as appropriate. The I&E Committee created a project logo, using and modifying the existing logo used by the Friends of the Maple River (FOMR), and created a brochure about the project. Targeted households in the watershed received the brochure.

    c. Web site: The Clinton County Conservation District (CCD) web site at http://www.clintonconservation.org is the current website for information about the Upper Maple River Watershed. All newsletters and print media were posted on the CCD website and partners' websites (i.e., FOMR website www.friendsofthemapleriver.org).

    d. Presentations and dissemination: The CCD attended all Friends of the Maple River monthly meetings to update and continue gathering support for the Project. Presentations were made at township board meetings, community group gatherings, county commissioners' meetings, conservation organizations, and local organizations (i.e., Farm Bureau and Greenstone Farm

Credit Services). Also, the FOMR was very active during seasonal events and fairs. In addition, materials were distributed in local restaurants and taverns. This process allowed the audience or general public an opportunity to get more information about the WMP and what implications the WMP will have for their stakeholder group. Comments from those attending the presentations were incorporated into the WMP before it was submitted to the Michigan Department of Natural Resources and Environment (MDNRE).

3. *Identifying the designated and desired uses of the watershed*, including those uses currently impaired, threatened, or being met.

4. *Defining areas, identified as critical areas for restoration*, which are contributing a majority of the pollutants and are having a significant impact on the water body.

5. *Defining other areas, identified as priority areas for preservation*, which are important to the ecological health of the watershed.

6. *Identifying and prioritizing pollutants, sources, and causes* based on the inventory findings and the main concerns of the watershed.

7. *Determining watershed goals and the objectives and tasks for meeting those goals*. In a WMP, watershed goals are usually based on impairments to designated uses caused by certain pollutants. An objective is how the sources of pollutants will be reduced to protect or restore a designated use. The WMP identifies systems of Best Management Practices (BMPs) that address the causes of the sources of pollutants to meet those objectives. Cost estimates associated with BMP design and installation, and estimated pollutant load reductions expected with each BMP installation are also included. A BMP is a structural, vegetative, or managerial practice implemented to control sources or causes of NPS pollution, such as installation of filter strips, streambank stabilization techniques, or livestock exclusion fencing. The WMP includes a schedule to make significant progress toward meeting the objectives, and a prioritization of those objectives for which to address first.

8. *Identifying and analyzing existing local projects, programs, and ordinances*, which impact water quality within the watershed. Local programs were analyzed to determine if they were sufficient for protecting water quality, or if they needed to be revised and updated to include natural resource protection or additional zoning to protect water quality.

9. *Informing and involving the public to motivate them to take action* to protect the water quality in their watershed. The I&E Subcommittee developed an I&E Strategy to define the activities that will increase awareness, educate, and motivate the identified target audiences into action to improve water quality in the Upper Maple River Watershed.

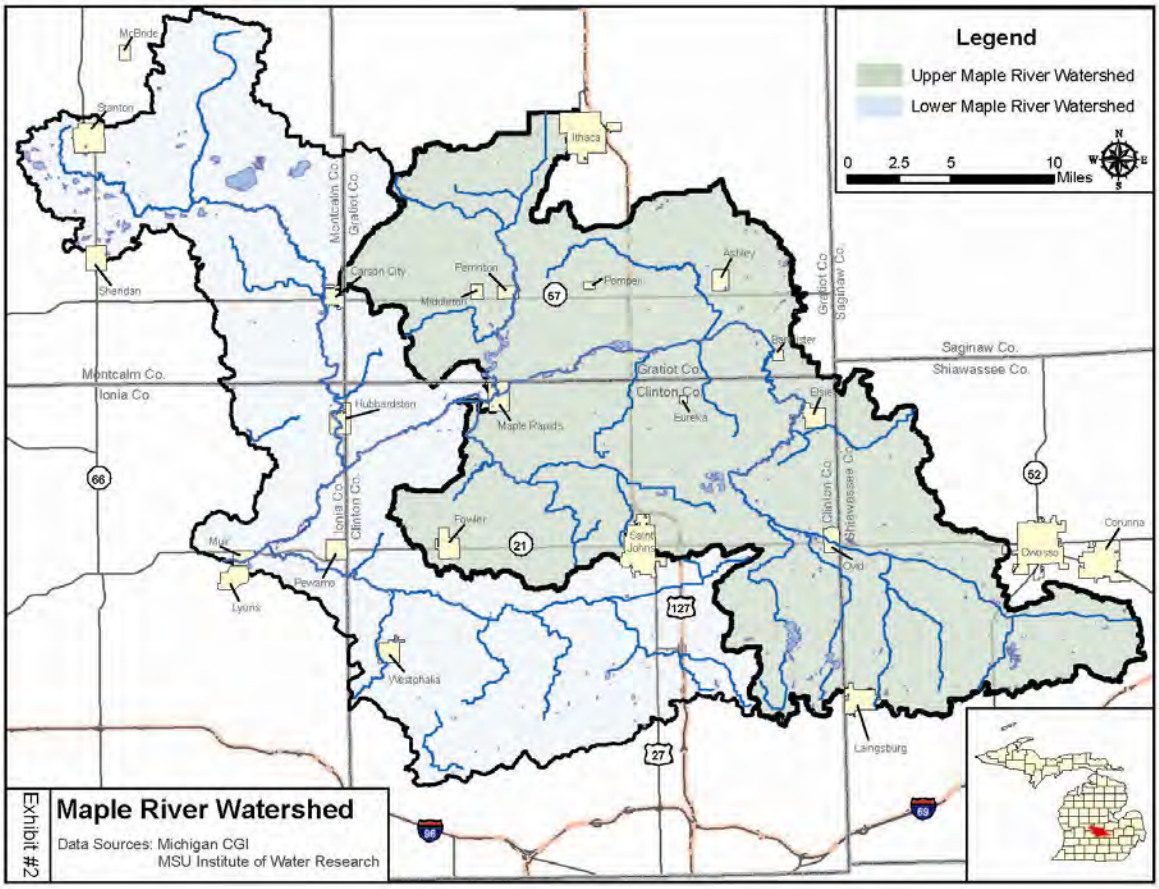
10. *Developing an evaluation process* to provide measures of the effectiveness of implementing the WMP and to increase the project sustainability by showing positive results.

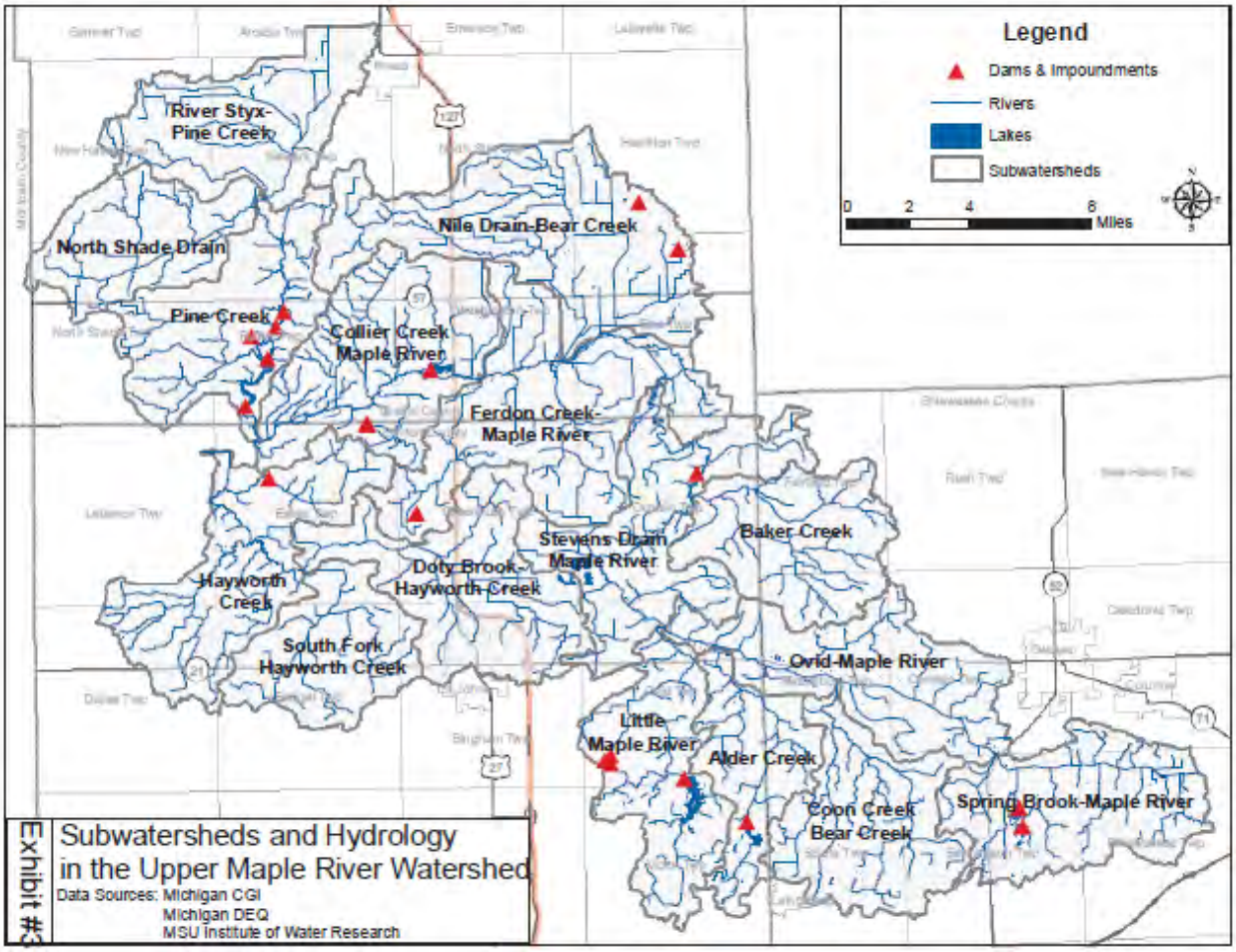
# 2.0 DESCRIPTION OF THE UPPER MAPLE RIVER WATERSHED

## 2.1 WATERSHED CHARACTERISTICS

### 2.1.1 GEOGRAPHIC SCOPE

The Upper Maple River Watershed (Watershed) is approximately 513 square miles and is part of the larger Maple River Watershed, one of six major tributaries of the Grand River (Exhibit 2 & Figure 1). The Watershed was delineated into 16 subwatersheds (Exhibit 3 & Figure 2). For the purposes of this Project, the Upper Maple River begins in Section 4 of Shiawassee Township, Shiawassee County, and flows northwest approximately 54.55 miles to the Project end point in the Village of Maple Rapids, Section 5, Essex Township, Clinton County. The Watershed encompasses portions of Essex, Greenbush, Duplain, Dallas, Bengal, Bingham, Ovid, and Victor Townships in Clinton County; portions of Fairfield, Middlebury, Owosso, Caledonia, Sciota, Bennington, and Shiawassee Townships in Shiawassee County; and portions of Arcada, New Haven, Newark, North Star, Hamilton, North Shade, Fulton, Washington, and Elba Townships in Gratiot County. The Villages of Maple Rapids, Ovid, Elsie, Perrinton, and Ashley; the City of Fowler; and portions of the Cities of Ithaca, Laingsburg, and St. Johns are also within the Watershed.






### 2.1.2 TOPOGRAPHY

The majority of the Watershed generally consists of nearly level till plains, sandy outwash plains, and lake plains. The major soils in this area are Parkhill, Lenawee, Selfridge, Capac, Marlett, Dixboro, and Corunna soils, which are generally well suited to agriculture. The elevations in the Watershed range from 950 to 1,050 feet in Shiawassee County to 639 to 650 feet in the north-central part of the Watershed in the lake plain area. Water that once covered the lake plain area used to drain through the old Grand River channel (now the Maple River), which is near Maple Rapids. The majority of the Watershed falls in the elevation range of 700 to 799 feet (Figure 3). Slopes range from nearly level to steep. Drainage in these soils is variable and ranges from very poorly drained to well drained (Figure 3).

### 2.1.3 GEOLOGY

The area known today as the Maple River Watershed was created by the advance and retreat of the southern face of massive ice shields during the ice age (USDA Soil Survey, 1978). As the face of the shield advanced and retreated, it removed surface material from the area, and exposed bedrock. Eventually, when water levels subsided, the cross-state water course was separated into the Bad River

Watershed to the east and north, and the Maple River Watershed to the south and west. The current river only occupies a very small portion of the riverbed that was formed when the ice was melting.

As a result of the original bedrock exposure in much of the riverbed, most of the water flowing through the watershed was groundwater. Currently, it is estimated that more than 50% of the water that flows through the watershed is groundwater, with the remainder from rain and other surface waters.

The water in the Maple River has high levels of minerals, due to direct bedrock exposure. The bedrock exposure is the reason that the only remaining salt marsh in the state is in the Maple River Watershed. The salt marsh is located near Maple Rapids.

### 2.1.4 SOILS

Soil type and texture class determine infiltration rates, water holding capacity, plant uptake of water, nutrient availability, erosion susceptibility, and pollutant removal capability. Soils in the Watershed vary greatly (Appendix 2). The differing soils in the Watershed allow for varying rates of surface penetration and soil saturation during rain events. If a soil has a slow infiltration rate, such as loam, the soil will at first absorb water until it is saturated, then the water will infiltrate very slowly as it moves deeper into the soil. The slowness of the infiltration allows precipitation to run off the surface because the soil cannot take in the water fast enough. The runoff will enter the drainage system, either a natural system or manmade, relatively quickly Drainage in these soils is also variable and ranges from very poorly drained to well drained (Figure 3). Figure 4 illustrates the hydrologic soils groups within the Watershed. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups (Table 2.1) according to the rate of water infiltration when the soils are not protected by vegetation, when they are thoroughly wet, and when they receive precipitation from long-duration storms.

**Table 2.1 – Hydrologic Soil Groups (*SCS Soil Survey*)**

| Hydrologic Soil Group | Definition |
|---|---|
| A | High Infiltration (low runoff potential, high rate of water transmission, well drained to excessively drained sands or gravely sands) |
| B | Medium Infiltration (moderate rate of water transmission, moderately well to well drained, moderately fine to medium coarse texture) |
| C | Low Infiltration (slow rate of water transmission, has layer that impedes downward movement of water, moderately fine to fine texture) |
| D | Very Low Infiltration (high runoff potential, very slow rate of water transmission, clays with high shrink/swell potential, permanent high water table, clay pan or clay layer at or near surface, shallow over nearly impervious material) |

Approximately 40% of the soils in the Watershed are hydric soils. Hydric soils are defined as poorly drained or somewhat poorly drained.

Hydric soils are:

- One of the indicators of wetlands
- Usually nutrient-rich and productive when drained for agricultural purposes
- Usually seasonally flooded and generally poorly suited for farming, except when drained
- Generally protected under wetlands regulations
- Poorly suited for development, especially for septic fields
- Locations for potential wetland restoration

***Soils Relationship to Best Management Practices (BMPs)***

Low Impact Development (LID) is rapidly becoming the mainstream technique for storm water management. The purpose of LID is to mimic nature by managing rainfall using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source. Many LID techniques rely on infiltrating storm water and runoff; therefore, it is important to consider soil properties, as well as geology, when implementing LID (Southeast Michigan Council of Governments [SEMCOG], 2008). LID is an extremely beneficial management technique for treating storm water in urbanizing areas of the watershed.

***Soils Relationship to Prime Farmland***

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) defines prime farmland as land with the best combination of physical and chemical characteristics for producing crops. This land must be available for agricultural use in order to receive a prime farmland designation. Prime farmland has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner, if it is treated and managed according to acceptable farming practices. Prime farmland soils may include those that are productive if artificially drained or managed to prevent flooding. A majority of the land in the Watershed is considered to be prime farmland, under this definition, but the placement of the farms and resulting impact from those farms has increased the potential for nonpoint source (NPS) pollution in the Watershed.

***Soils Relationship to Erosion***

Certain soils have greater potential for overland erosion. Specifically, three types of erosion can be predicted: sheet, rill, and gully. Sheet erosion occurs when rainfall hits the ground and runs off the land in a large sheet, with little to none of the water actually penetrating the surface of the land, while at the same time taking with it loose dirt particles. An example is a plowed agricultural field being used for row crops that is not currently planted. When it rains on this field with exposed soil, water runs off the bare surface into a drainage ditch that connects to a nearby stream. Rill erosion occurs when precipitation cuts small drainage pathways into the surface of the land, giving the precipitation little time to sink into the ground. An example is a crevice in a hillside that continues to increase in size every time it rains. As more soil is

carried away, a deeper crevice is carved into the hillside. Gully erosion occurs when rills become much larger. The depth of erosion defines the difference between rills and gullies. It is commonly accepted that rills can be easily repaired/removed by normal tillage practices, whereas gullies cannot. This Watershed has many soils that are susceptible to all three types of overland erosion.

### 2.1.5 HYDROLOGY

There are no known existing hydrology studies on the Watershed. However, information on precipitation patterns and high flows was obtained from gage station information for St. Johns, Michigan, by the Michigan Department of Natural Resources and Environment (MDNRE), Land and Water Management Division (LWMD), Flooding Frequency Discharge Request for the Maple River located at Maple Avenue (U.S. Geological Survey [USGS] Station 04115000 and is described below (http://www.climate-charts.com/USA-Stations/MI/MI207280.php).

***Precipitation Characteristics***

Precipitation in the Watershed ranges from around 30 to 35 inches per year, and is well distributed throughout the year. The growing season, from May to October, receives about 20 inches of rain, 62% of the annual precipitation amount. September is typically the wettest month of the year, with nearly 4 inches of rain on average.

***Surface Water***

The Watershed has an extensive network of streams, creeks, inland lakes, impoundments, and constructed drainageways. The Watershed was divided into 16 subwatersheds to better manage the Watershed as a whole in terms of pollutant identification and management recommendations. Table 2.2 lists the subwatersheds and their acreage. Figure 2 illustrates the subwatershed delineations.

**Table 2.2 – Contributing Acreage by Subwatershed (*MSU Institute of Water Research*)**

| Subwatershed | Acres |
|---|---|
| Nile Drain - Bear Creek | 30,784 |
| Ferdon Creek - Maple River | 29,500 |
| Collier Creek - Maple River | 24,109 |
| Hayworth Creek | 22,780 |
| Doty Brook - Hayworth Creek | 22,471 |
| Stevens Drain - Maple River | 22,464 |
| Ovid - Maple River | 21,084 |
| Spring Brook - Maple River | 20,687 |
| Pine Creek | 20,346 |
| River Styx - Pine Creek | 19,091 |
| Coon Creek - Bear Creek | 18,943 |
| Baker Creek | 17,496 |
| Little Maple River | 17,278 |
| South Fork Hayworth Creek | 14,586 |
| North Shade Drain | 14,565 |
| Alder Creek | 12,404 |

***High Flows/Flashiness***

The MDNRE LWMD estimated flow rates for the Maple River at Maple Avenue (USGS Station 04115000) in Section 5 of Essex Township (drainage area of 420 square miles) on January 2, 2003. The flow rates in cubic feet per second (cfs) associated with storms that are predicted to occur 10%, 2%, and 1% of the time in any given year, are listed in Table 2.3.

**Table 2.3 – Flow Rates by Storm Event Predictions for the Maple River *(MDNRE LWMD)***

| Storm Event Prediction in Any Given Year | Flow Rate (cfs) |
|---|---|
| 10% chance | 5,100 |
| 2% chance | 8,000 |
| 1% chance | 9,300 |

Increased drainage in certain areas can result in excessive flows in receiving streams. This excessive flow can be exhibited by higher peak flows, longer peak flow periods, or both. The results of excess flows can be increased streambank erosion, increased streambed scouring, sediment re-suspension, habitat destruction, and decreased diversity and number of fish and aquatic organisms. The stream inventory recorded evidence of high flows, but little streambank erosion.

Streams that rise and fall quickly during a storm are considered flashier than those that maintain a steadier flow. Streams become flashy when more runoff from the surface enters the streams, such is the case where increased impervious area in a watershed creates increased surface runoff to the streams. Evidence of “flashiness” was found in the majority of tributaries during the 2008 Biological and Aquatic Habitat Assessments; however, erosion of the streambanks is not severe. It appears as though the physical attributes of the Watershed and of the agricultural ditches prevent excessive water velocity. In other words, water levels rise and fall within the ditches with little downstream velocity.

***Groundwater (Recharge Areas) and Wellhead Protection***

Groundwater is a crucial part of the Watershed. Groundwater is the primary source of drinking water for the residential dwellings within the Watershed. While this Project deals mostly with surface water and the problems associated with NPS pollution, groundwater and surface water are intimately connected, and will have great influence on each other. Groundwater in the Watershed is found in glacial deposits of sand and gravel below the surface of the land. These water-storing deposits are called aquifers. The most productive aquifers are the thickest, and those that have little or no mud, silt, or clay in them, thus allowing for more water storage. Groundwater and surface water interact in areas known as recharge or discharge zones. The Upper Maple River has both groundwater recharge and discharge areas. Groundwater discharge is very important in coldwater streams. Groundwater input is consistent in temperature and volume, thus providing a stable stream environment. Groundwater recharge areas are:

- Critical to protecting our drinking water sources and maintaining our high-quality streams
- Usually upland areas with sandy or gravelly soils
- Found in the headwater areas, and in areas with higher elevation, mostly around the edges of the watershed

In areas where groundwater is used as the municipal drinking water supply, the area that contributes water to the municipal water supply well is called a wellhead protection area. Wellhead protection plans involve activities and management practices for protecting public groundwater supply systems from contamination. The Village of Maple Rapids in Essex Township, Clinton County; Village of Elsie in Duplain Township; Clinton County; and Owosso Township in Shiawassee County have designated wellhead protection areas to protect groundwater recharge areas. Areas that have plans for wellhead protection areas include the Village of Fowler in Dallas Township of Clinton County, the City of St. Johns in Bingham Township of Clinton County, the City of Ithaca in Newark Township of Gratiot County, and the City of Owosso in Owosso Township of Shiawassee County.

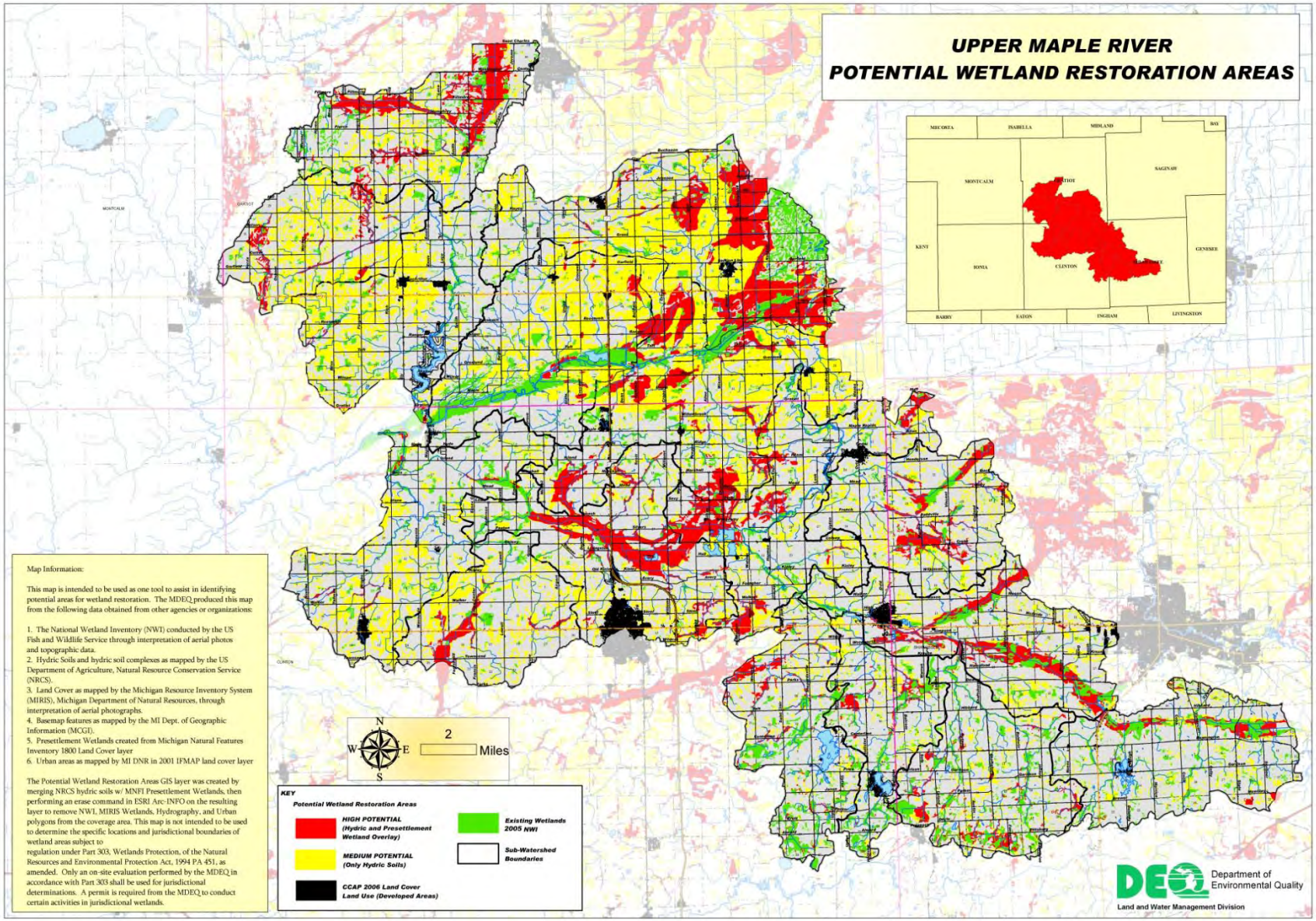
### 2.1.6 NATURAL RESOURCES AND RECREATIONAL USES

The Upper Maple River has important natural resources and recreational opportunities. The extent and value of those resources and opportunities are described below.

***Wetlands***

The Watershed is home to numerous types of wetlands, a majority of which are classified as palustrine by the National Wetland Inventory. Palustrine wetlands are associated with streams, creeks, swales, or are separate wetland features in the landscape. Other types of wetlands in the Watershed are riverine, associated with river systems, and lacustrine, associated with or adjacent to lakes. Wetlands in the Watershed range from forested wetlands with red and silver maple and sycamore to emergent vegetation such as cattail marshes and a salt marsh. Many shrub-scrub wetlands are also present. Figure 5 is a map of the approximate wetlands in the 1800s, created by the MDNRE. Exhibit 4 (Figure 6) is a map of Wetland Restoration Potential created by the MDNRE. The map shows hydric soils, circa 1800 wetlands, and existing wetlands. The intersection of the hydric soils and circa 1800 wetland areas indicate areas with a high potential for wetland restoration.

**Exhibit 4 – Upper Maple River Potential Wetland Restoration Areas**



Appendix 3 includes the MDNRE's *Upper Maple Watershed, Wetland Status and Trends, Presettlement to 2005* report. The purpose of the report is to note the existing (2005) size and number of wetlands present in the Watershed as compared to the size and number of wetlands found in the Watershed in the 1800s. The report also shows the trend, or if the number and size of wetlands is increasing or decreasing when comparing the two years. The report provides details for all subwatersheds.

Table 2.4 shows the wetland resources and trends for historical conditions, circa 1800, and existing conditions from 2005. Approximately 79% of wetlands have been drained or lost since the 1800s, mostly for use as agricultural land, with the highest loss of wetlands occurring in North Shade Drain, South Fork Hayworth Creek, and Doty Brook-Hayworth Creek subwatersheds.

**Table 2.4 – Upper Maple River Watershed – Wetland Resources Status and Trends, 2009 (*MDNRE*)**

| Subwatersheds | Sub-basin Acres | % Wetlands Presettlement | % Wetlands Current |
|---|---|---|---|
| North Shade Drain | 14,565 | 43 | 4 |
| South Fork Hayworth Creek | 14,586 | 32 | 3 |
| Doty Brook - Hayworth Creek | 22,471 | 36 | 4 |
| Ferdon Creek - Maple River | 29,500 | 59 | 7 |
| Nile Drain - Bear Creek | 30,784 | 64 | 11 |
| Stevens Drain - Maple River | 22,464 | 35 | 6 |
| Pine Creek | 20,346 | 38 | 6 |
| Baker Creek | 17,496 | 31 | 5 |
| Hayworth Creek | 22,780 | 29 | 6 |
| River Styx - Pine Creek | 19,091 | 41 | 8 |
| Ovid - Maple River | 21,084 | 32 | 8 |
| Collier Creek - Maple River | 24,109 | 51 | 14 |
| Spring Brook - Maple River | 20,687 | 23 | 11 |
| Little Maple River | 17,278 | 27 | 13 |
| Alder Creek | 12,404 | 25 | 12 |
| Coon Creek - Bear Creek | 18,943 | 26 | 13 |

The MDNRE has completed a Landscape Level Wetland Functional Assessment (LLWFA) of all existing and historically lost wetlands for the watershed. Additional information about the MDNRE LLWFA report can be found in Section 3.3.6. A complete LLWFA report is found in Appendix 4.

Wetlands are invaluable for a variety of water quality functions they naturally perform. These include, but are not limited to, the following:

- Denitrification: Studies show that in certain instances, wetlands can remove from 70% to 90% of nitrates. One study in the southeastern U.S. projected a 20-fold increase in nitrogen loadings to streams as a result of a total conversion to adjacent bottomland hardwood forested wetlands to cropland.

- Trapping sediments can keep large amounts of phosphorous from entering adjacent rivers and reduce sedimentation.

- Flood control: Studies in the midwest show floodwater flows can be reduced by 80% in watersheds with wetlands, as opposed to those without them.

- Groundwater Recharge: Returning water to underground aquifers is known as "groundwater recharge." Much of the water in a wetland used for recharge would have been deposited there during wet periods, so the wetland would not only stem flooding by retaining water, but by having that water available to recharge groundwater (http://www.water.ncsu.edu/watershedss/info/wetlands/function.html).

A major function of wetlands is the preservation of water quality. Wetlands are similar to living filters. They trap pollutants, such as nutrients and sediments, which can impair/impact the designated/desired uses of total and partial body contact, public water supply, and warmwater fishery. Wetlands also act as natural detention areas by storing floodwaters and releasing them slowly, which reduces peak flows and protects downstream property owners from flooding. The State of Michigan (State) has set a goal of 1% wetland restoration by 2010, and a 10% restoration goal by 2079.

According to the MDNRE website, the State received authorization from the federal government in 1984 to administer Section 404 of the federal Clean Water Act in most areas of the State. A State-administered 404 program must be consistent with the requirements of the federal Clean Water Act and associated regulations set forth in the Section 404(b)(1) guidelines. In other states, where an applicant must apply to the U.S. Corps of Engineers and a state agency for wetland permits, applicants in Michigan generally submit only one wetland permit application to the MDNRE. Currently, wetlands are regulated at the State under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 303). Part 303 indicates that a wetland is regulated if it is any of the following:

- Connected to one of the Great Lakes or Lake St. Clair
- Located within 1,000 feet of one of the Great Lakes or Lake St. Clair
- Connected to an inland lake, pond, river, or stream
- Located within 500 feet of an inland lake, pond, river, or stream
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, but are more than 5 acres in size
- Not connected to one of the Great Lakes or Lake St. Clair, or an inland lake, pond, stream, or river, and less than 5 acres in size, but the MDNRE has determined that these wetlands are essential to the preservation of the State's natural resources and has notified the property owner

The law requires that persons planning to conduct certain activities in regulated wetlands apply for and receive a permit from the State before beginning the activity. In accordance with Part 303, a local unit of

government can also regulate wetlands by ordinance, in addition to state regulation, if certain criteria are met.

No local wetland ordinances exist in the Upper Maple River Watershed, so a lack of wetland protection at the local level already exists.

***Threatened and Endangered Species***

Michigan Natural Features Inventory (MNFI) keeps records of element occurrences for rare, endangered, or threatened species or species of special concern throughout the State. In Clinton, Gratiot, and Shiawassee Counties, over 50 element occurrences are present, Appendix 5. These include plants, animals, and natural communities. One notable state species of special concern, and a federal candidate species, present in Clinton and Shiawassee Counties, is the Eastern Massasauga Rattlesnake, Michigan's only rattlesnake, and an inhabitant of wetlands, fens, and wet prairies (Figure 7). State endangered species include Epioblasma triquetra (Snuffbox), a mussel whose habitat is generally medium to large rivers in clear, gravel riffles; the Rallus elegans (King Rail Bird) which is associated with fresh water marshes; and the Plantago cordata, a plant or forb generally found in wet, wooded areas.

***Invasive Species***

Similar to all watersheds throughout the Great Lakes region, the Upper Maple River is negatively impacted by invasive species. Of particular concern are Eurasian water milfoil and the emerald ash borer. All of the lakes within the Upper Maple contain significant populations of milfoil. The aggressive nature of this plant and its impacts on native populations of plants and animals are well documented in the literature (Grace and Wetzel 1978, Smith and Barko 1990). Lake Ovid, in Sleepy Hollow State Park, contains large populations of milfoil weevils that are intended to control milfoil; results in Lake Ovid are reported to be positive. The emerald ash borer was first discovered in southeast Michigan in 2002 and quickly spread throughout the state. The insect has infested millions of ash trees, including most of those growing within the Upper Maple River watershed. Most, if not all, of these ash trees will succumb to the pest; long-term ecological damage remains to be seen. Grace, J.B., and R.G. Wetzel. 1978. The production biology of Eurasian watermilfoil (*Myriophyllum spicatum* L.): a review. J. Aquat. Plant Manage. 16: 1-11. Smith, C.S., and J.W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28: 55-64.

***Dams***

Dams drastically affect the ecological processes of river environments. Rivers emerging downstream of a dam may be substantially altered from the character of the river entering an impoundment above a dam. Flow patterns reflecting normal high and low water conditions over time may be altered, affecting stream

channel configuration and fisheries habitat. Besides affecting the channel shape and location, dams also limit the normal movement of fish and other aquatic organisms along a river's length.

There are approximately 20 regulated dams in the Watershed as indicated in Appendix 6. Only one dam, the Elsie Dam, exists on the mainstem of the Maple River. This dam is currently in a state of disrepair and is undergoing study to determine possible alternatives for future disposition. The majority of the dams have low hazard potential, however, there is significant hazard potential if the Cummings Lake Dam, Rainbow Lake Dam, or Sleepy Hollow Dam were to be breached.

***Fisheries and Macroinvertebrate Populations***

The MDNRE provided a list of the fish found in the Upper Maple River Watershed, Appendix 7. Historically, between 1949 and 1962, the MDNRE used to stock brook trout in Spring Brook Creek in Bennington Township, Shiawassee County. Currently, there are no coldwater fisheries in the Watershed.

Macroinvertebrates are animals without a backbone that can be seen with the naked eye. These bottom-dwelling animals include crustaceans and worms but most are aquatic insects. Beetles, caddisflies, stoneflies, mayflies, hellgrammites, dragonflies, true flies, and some moths are among the groups of insects represented in streams. Macroinvertebrates are excellent indicators of local water quality conditions. Benthic (stream bottom dwelling) macroinvertebrates are stationary, or they move very little in relation to a stream. The populations are generally abundant, and they are easy to catch and identify. Many macroinvertebrates are very sensitive to water conditions. Species that are filter feeders will be sensitive to suspended solids and sediment in the water column. Many species with exposed gills need very high levels of dissolved oxygen (DO). Sampling macroinvertebrates to determine species composition, diversity, and abundance will give a "snapshot" of the stream conditions at a given moment in time. While macroinvertebrate communities were found to be acceptable at several stations, they are generally toward the low end of that rating, and seem to be tending toward poor based on the biological assessment conducted by Wetland Coastal Resources (WCR) and Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) in 2008. The findings are detailed in Chapter 3.

***Recreation***

There are many opportunities for recreation in the Upper Maple River Watershed. There are eight access sites where boats, canoes, kayaks, etc., may be put into the creeks or river. There are four main parks in the Watershed, including Sleepy Hollow State Park in Clinton County, Reed County Park in Gratiot County, Motz County Park in Clinton County, and Bates Scout Park in Laingsburg. There are also six golf courses in the Watershed.

The County has predominantly been an agricultural county. However, there are a few state parks in the Watershed which offer a wide range of recreational opportunities.

The Sleepy Hollow State Park is located in Clinton County, in Laingsburg, 20 minutes north of Lansing. It covers more than 2,600 acres, with a river winding through it and Lake Ovid (approximately 410 acres in size) located in the center of the park. The Park boasts of many recreational opportunities for year-round use, such as: boating, canoeing, fishing, hiking, hunting, picnicking, equestrian, mountain biking, swimming, snowshoeing, cross country skiing, and snowmobiling.

In addition to Sleepy Hollow State Park, there are over 8,000 acres of State Game area in the watershed including the Maple River State Game Area in Clinton, Gratiot and Ionia Counties; the Gratiot-Saginaw State Game Area; and the Gratiot-Saginaw Connector State Game Area (which loosely connects the Maple River Game Area to the Gratiot-Saginaw State Game Area). The state game areas offer recreation such as hunting, boating, fishing, and hiking.

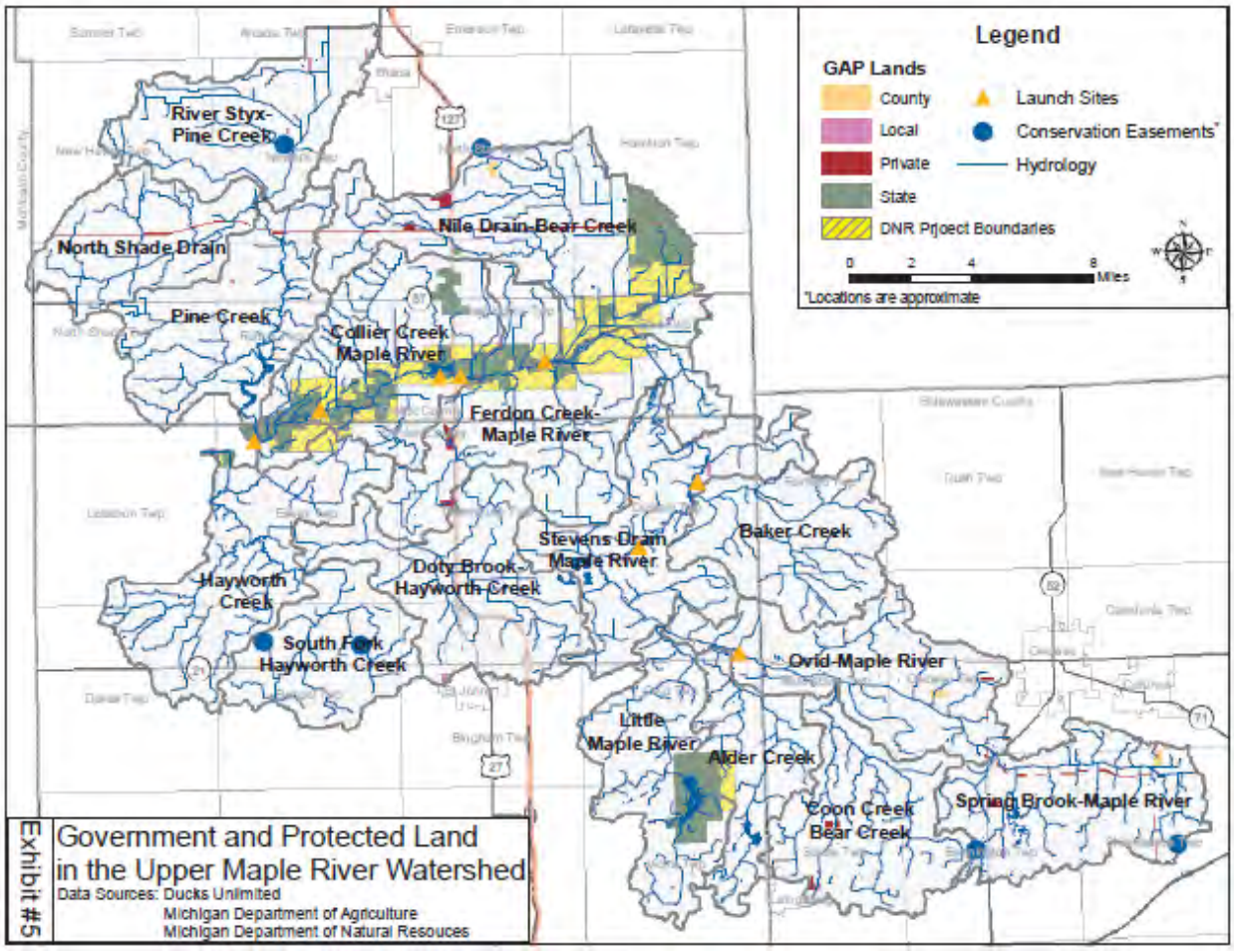
***Dedicated/Protected Lands***

Protected lands provide recreational opportunities, open space, wildlife habitat, and watershed protection. Generally, natural ecosystems, including animal and plant diversity, are preserved on protected lands, which make them very important to maintaining a high-quality watershed.

The Watershed has protected lands in the form of county, township, city, and village parks. Some private land has also been protected, including efforts by local land trusts and other private acquisitions. Currently, land in the Watershed is also enrolled in the PA-116 program, a State program to protect farmland from development for a specified number of years. The PA-116 lands are not mapped because the PA-116 agreements change almost daily. These agreements between the landowner and the State can be for anywhere from 10 to 90 years and are considered "temporary" agreements. According to the Michigan Department of Agriculture, Environmental Stewardship Division, Farmland and Open Space Preservation, approximately 1,030 active agreements were found covering approximately 80,855 acres in Clinton County (28% of the eligible farmland in the county), 934 active agreements covering 73,300 acres in Shiawassee County (26% of the eligible farmland in the county), and 2,696 active agreements covering 169,500 acres in Gratiot County (57% of the eligible farmland in the county).

The Purchase of Development Rights (PDR) program is a voluntary program, where a land trust or some other agency, usually linked to local government, makes an offer to a landowner to buy the development rights on the parcel. Once an agreement is made, a permanent deed restriction is placed on the property which restricts the type of activities that may take place on the land in perpetuity. In this way, a legally binding guarantee is achieved to ensure that the parcel will remain agricultural or as open (green) space forever. The deed restriction may also be referred to as a conservation easement. This is an excellent step toward more permanent land protection measures.

Approximately 8,010 acres of the State Game Area are within the Watershed. Figure 8 is a map showing the prime farmlands in the watershed which are available for PDR through the Michigan Farmland Preservation Program. Exhibit 5 (Figure 9) illustrates the Government and Protected lands in the Watershed along with permanent conservation easements that were purchased by the State, and permanent conservation easements that were donated by landowners. Clinton and Shiawassee Counties have approved PDR programs to purchase development rights for conservation easements.




Seven main tools are available for land preservation in Michigan: conservation easements, purchase of development rights, open space/conservation development, public purchase, USDA Land Conservation Programs, PA 116, and land donations, which are discussed in more detail in Appendix 16 of the Watershed Management Plan.

Green infrastructure is the interconnected network of open spaces and natural areas, such as wetlands, parks, forest preserves, and native plant vegetation, that naturally manages storm water, reduces the risk of flooding, and improves water quality. Governments generally spend less to install and maintain most green infrastructure systems, compared to traditional types of gray infrastructure. Other benefits of green

infrastructure include increased recreation and open space, increased habitat for wildlife, community building opportunities, and better air and water quality.

Many areas of green infrastructure have been removed in order for development and building to occur. The area located within the Watershed is especially important in this movement, since large amounts of green infrastructure still exist, especially along the stream corridors. The Watershed Steering Committee and the Friends of the Maple River (FOMR) organization can work together in their efforts to provide high quality environmental systems within the Watershed, protect ecological integrity for future generations, and promote long-term economic sustainability for the Upper Maple River Watershed.

The Wetlands Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS' goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection beyond that which can be obtained through any other USDA program. Table 2.5 shows the area of land enrolled in the wetland reserve program in the Watershed.

**Table 2.5 – Wetland Reserve Program Area in the Upper Maple River Watershed (*NRCS)***

| County | Township | Acres |
|---|---|---|
| Clinton | Greenbush Township | 70 |
| Clinton | Lebanon Township | 69.7 |
| Clinton | Ovid Township | 82.9 |
| Gratiot | Elba Township | 1,015.7 |
| Gratiot | Hamilton Township | 170.2 |
| Gratiot | Newark Township | 134.5 |
| Gratiot | North Star Township | 123.7 |
| Gratiot | Washington Township | 605.9 |
| Shiawassee | Fairfield Township | 196 |
| Shiawassee | Sciota Township | 74.2 |
| Shiawassee | Shiawassee Township | 34.5 |
| | **Total:** | 2,577.3 |

### 2.1.7 LAND USE AND DEVELOPMENT TRENDS

Land-use in the Watershed is primarily agricultural. Approximately 79% of land in the Watershed is classified as agricultural, however, this percentage could change rapidly in some subwatersheds if the current economic conditions improve and areas begin to redevelop. The resulting increase in impervious surfaces could have a direct impact on water quality. There has been little change in the land use in the Watershed since 1978. Land use percentages by subwatershed are listed in Table 2.6. Figure 10 is a map of the current land use in the Watershed from 1992.

**Table 2.6 - Land Use Percentages by Subwatershed (1992) (*USGS National Land Cover Database)***

| Subwatershed | Agriculture | Urban | Forest | Grassland | Wetland | Water |
|---|---|---|---|---|---|---|
| South Fork Hayworth Creek | 93.77 | 0.01 | 5.93 | 0 | 0.3 | 0 |
| North Shade Drain | 93.48 | 0.01 | 6 | 0 | 0.51 | 0 |
| Baker Creek | 91.18 | 0.58 | 5.95 | 0.01 | 2.28 | 0.01 |
| Stevens Drain - Maple River | 87.62 | 0.73 | 6.85 | 0.05 | 3.83 | 0.93 |
| Ovid - Maple River | 87.5 | 2.7 | 6.68 | 0.07 | 2.26 | 0.8 |
| Hayworth Creek | 87.42 | 0.85 | 10.38 | 0 | 1.28 | 0.07 |
| Doty Brook - Hayworth Creek | 86.2 | 3.73 | 8.8 | 0.04 | 0.71 | 0.52 |
| Pine Creek | 85.99 | 1.24 | 10.11 | 0.02 | 2.21 | 0.43 |
| Ferdon Creek - Maple River | 85.05 | 0.36 | 10.19 | 0.24 | 3.75 | 0.4 |
| River Styx - Pine Creek | 84.94 | 0.27 | 11.84 | 0.01 | 2.91 | 0.03 |
| Alder Creek | 81.89 | 1.46 | 10.76 | 0 | 4.19 | 1.7 |
| Coon Creek - Bear Creek | 81.81 | 0.06 | 11.58 | 0 | 6.46 | 0.09 |
| Little Maple River | 81.73 | 0.21 | 10.86 | 0 | 4.6 | 2.59 |
| Spring Brook - Maple River | 81.27 | 0.91 | 12.68 | 0.01 | 4.26 | 0.88 |
| Nile Drain - Bear Creek | 79.84 | 0.75 | 10.5 | 0.4 | 8.36 | 0.16 |
| Collier Creek - Maple River | 72.74 | 0.62 | 11.23 | 0.01 | 11.51 | 3.89 |

Farmland preservation is important in preserving water quality. The U.S. Environmental Protection Agency's (USEPA) study, *The Impact of Farmland Preservation Programs,* published in 1999, stated an increase to as little as 15% impervious surface cover results in a watershed's biotic integrity rating (for fish and macroinvertebrates) to decline to "fair" or worse; at a 25% impervious surface cover, only a few species tolerant to poor habitat and water quality can persist.

PDR programs in many counties have been successful in preserving land in large, contiguous clusters. The 1999 USEPA study also indicated that those large land clusters strategically located with respect to watersheds can have important implications for stream ecosystems. The preservation of as much as 75% to 85% of a watershed is critical to avoid compromising stream integrity.

### 2.1.8 POLITICAL LANDSCAPE

#### 2.1.8.1 COMMUNITY PROFILES

The Watershed is contained within parts of Clinton, Gratiot, and Shiawassee Counties, a mosaic of rural and small urban areas, mostly agricultural and rural residential. The Watershed sits in central Lower Michigan near Eaton and Ingham Counties, which have larger population centers with increased job opportunities, shopping centers, and cultural programming available all within close driving distance. Clinton, Gratiot, and Shiawassee Counties have retained a low population base, and a small-town and rural atmosphere. This rural and small-town atmosphere within driving distance of larger population

centers, especially with the existence of the US-127 highway, has made the Watershed a prime target for development.

### 2.1.9 DEMOGRAPHICS

Population continues to increase in rural and residential areas of the Watershed. The increase of population in the watershed from the 1990 census to the 2000 census was greater than 5%. As shown in Table 2.7, the population in all of the subwatersheds except Nile Drain - Bear Creek has increased slightly between 1990 and 2000. Similar trends are expected to continue.

**Table 2.7 – Population in the Upper Maple River Watershed (*1990 & 2000 Census*)**

| Subwatershed | Population in 1990 | Population in 2000 | Percentage of Change From 1990 to 2000 |
|---|---|---|---|
| Little Maple River | 1,528 | 1,922 | 25.8 |
| Alder Creek | 1,110 | 1,291 | 16.3 |
| Hayworth Creek | 1,740 | 1,917 | 10.2 |
| Collier Creek - Maple River | 1,486 | 1,616 | 8.7 |
| South Fork Hayworth Creek | 786 | 840 | 6.9 |
| Pine Creek | 1,665 | 1,758 | 5.6 |
| Spring Brook - Maple River | 2,888 | 3,051 | 5.6 |
| Ovid - Maple River | 3,427 | 3,614 | 5.5 |
| Stevens Drain - Maple River | 2,078 | 2,185 | 5.1 |
| River Styx - Pine Creek | 1,130 | 1,180 | 4.4 |
| North Shade Drain | 650 | 658 | 1.2 |
| Doty Brook - Hayworth Creek | 5,792 | 5,858 | 1.1 |
| Baker Creek | 1,495 | 1,507 | 0.8 |
| Ferdon Creek - Maple River | 1,783 | 1,795 | 0.7 |
| Coon Creek - Bear Creek | 2,088 | 2,093 | 0.2 |
| Nile Drain - Bear Creek | 1,420 | 1,400 | -1.4 |

According to the 2007 Census of Agriculture by the United States Department of Agriculture (www.agcensus.usda.gov), the number of farms in Clinton, Gratiot, and Shiawassee Counties have increased between 2002 and 2007; however, the number of acres of farmland has decreased (the average size of a farm is smaller in 2007 than in 2002). Table 2.8 gives additional information on the number of farms and farm sizes in the three counties in the Upper Maple River Watershed.

**Table 2.8 – 2007 Census of Agriculture County Profiles (United States Department of Agriculture [www.agcensus.usda.gov])**

| County | Year | Number of Farms | Land in Farms | Average Size of Farm |
|---|---|---|---|---|
| Clinton | 2007 | 1,231 | 271,558 | 221 |
| Gratiot | 2007 | 1,036 | 286,937 | 277 |
| Shiawassee | 2007 | 1,082 | 266,509 | 209 |

Figure 11 illustrates the areas of greatest population density and where development is most likely to occur.

# 3.0 WATERSHED CONDITIONS

## 3.1 DESIGNATED AND DESIRED USES

Water bodies have designated uses that are defined by the State of Michigan (State), as well as certain desired uses that vary from location to location. Local residents, industries, tourists, and recreational users involved with that particular water body will decide these desired uses.

### 3.1.1 DESIGNATED USES

The State has developed Water Quality Standards (WQS) under Part 4 of the Administrative Rules issued pursuant to Part 31 of the Natural Resources and Environmental Protection Act (1994 PA 451, as amended). Rule 100 (R323.1100) of the WQS states that all surface waters of the State are designated for, and shall be protected for, all of the following uses:

- Agricultural use
- Industrial water supply
- Public water supply at the point of intake
- Navigation
- Warmwater fishery
- Coldwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31

Current water quality impairments and specific threats to water quality must be identified and noted to create a focused Watershed Management Plan (WMP) for addressing nonpoint source (NPS) pollutants. The status of a designated use in a watershed can be unimpaired, impaired, threatened, or under review/unknown. Designated uses are considered impaired if the water does not meet the State's WQS. Designated uses are considered threatened when WQS may not be met in the future. Based upon data review and field assessments, the Steering Committee was able to determine the status of each designated use within the Watershed. Table 3.4 in Section 3.5 summarizes the status of each designated use.

Provided below is a brief description of each of the State-authorized designated uses.

***Agricultural***

Surface waters used for irrigation, livestock watering, and produce spraying must be consistently available and safe. In addition to water use on farms, agricultural water supply includes irrigation for

maintaining vegetative growth in nurseries, parks, and golf courses. Water resources should be free of pathogens and pesticides that could pose a health risk to livestock and humans.

***Other Indigenous Aquatic Life and Wildlife***

In addition to fish, other aquatic life and wildlife in the ecosystem should be considered in all management strategies. A stable and healthy habitat supports populations of wildlife that provide outdoor recreational opportunities like fishing, bird watching, and hunting. Healthy habitats have water conditions that are capable of supporting native plant and animal species.

***Warmwater Fishery***

According to the Michigan Department of Natural Resources and Environment (MDNRE) “Warmwater fishery use" means the ability of a waterbody to support a balanced, integrated, adaptive community of fish species which thrive in relatively warm water, including any of the following: bass, pike, walleye, and panfish.

***Partial Body Contact Recreation***

Water-related activities, like fishing and boating, that do not require full body immersion are referred to as partial body contact recreation. Water quality must meet standards of less than 1,000 counts/100 mL of *E. coli* for recreational uses (MDNRE, 1999).

***Navigation***

Waterways that provide adequate depth and width for recreational canoeing and kayaking must maintain open, navigable conditions.

***Total Body Contact Recreation***

Total body contact recreation refers to any activity that will result in the submersion of the head (e.g., swimming). Safety concerns arise when the eyes and nose are submerged, and the possibility of ingesting the water exists. WQS for total body contact recreation must be met between May 1 and October 31. During this time, *E. coli* must be below 130 counts per 100 mL, as a 30-day geometric mean.

***Coldwater Fishery***

A coldwater fishery has summer water temperatures below 60°F and is able to support natural or stocked populations of trout. There are no designated trout streams in the Watershed, as indicated in the Fisheries section in Chapter 2.

***Industrial Water Supply***

Industry depends on large quantities of cool, clean water for material washing or as a coolant. The Watershed contains no industrial water intakes. However, industrial water supply is still a designated use, as water intakes may be needed in the future.

***Public Water Supply at the Point of Intake***

Municipal water supplies must have safe and adequate supplies of surface water. Water quality must be sufficient for conventional water treatment to produce safe and palatable water for human consumption and food processing. The Watershed contains no intakes for public water supply.

### 3.1.2 DESIRED USES

Resources that are not listed as a designated use in the Part 4 Rules may still have significant local importance. These uses for the Watershed's resources have been included in this WMP as desired uses.

Table 3.1 below depicts desired uses identified by the Steering Committee. Further discussion regarding goals, objectives, costs, and implementation schedule of the desired uses can be found in Chapter 5 – Goals and Objectives and Chapter 6 – Implementation Plan.

**Table 3.1 – Desired Uses**

| Desired Use | Description/Objective |
|---|---|
| Adequate drainage | Maintain existing drainage for current land uses. |
| Habitat preservation | Identify historic coldwater fisheries and develop a strategy to restore streams to coldwater fishery standards. |
| Fish are safe to eat | High mercury levels in fish have resulted in fish consumption advisories. Encourage legislation that reduces mercury. Provide education on guidelines for safe levels of fish consumption. |

## 3.2 WATER QUALITY STANDARD AND GUIDELINES

For purposes of defining water quality within this WMP, the following standards were applied:

- Total Suspended Solids – MDNRE accepts an informal target of 80 mg/L (milligrams per liter) total suspended solids for wet weather events
- Dissolved Oxygen (DO) – 5 mg/L (Michigan water quality standard established by R323.1064 Rule 64.(1))

- Total Phosphorus – Total Maximum Daily Load (TMDL) for Pine Creek has target of 0.08 mg/L. TMDL for Upper Maple and Peet Creek have target of 0.06 mg/L. The rest of the Watershed has a narrative standard (Appendix 8)

- pH – 6.5-9 s.u. (Michigan water quality standard established by R323.1053 Rule 53)

Water quality standards by designated use for all waters of the State, as determined by the MDNRE, can be found in Appendix 8.

## 3.3 WATERSHED INVENTORY AND CONDITIONS

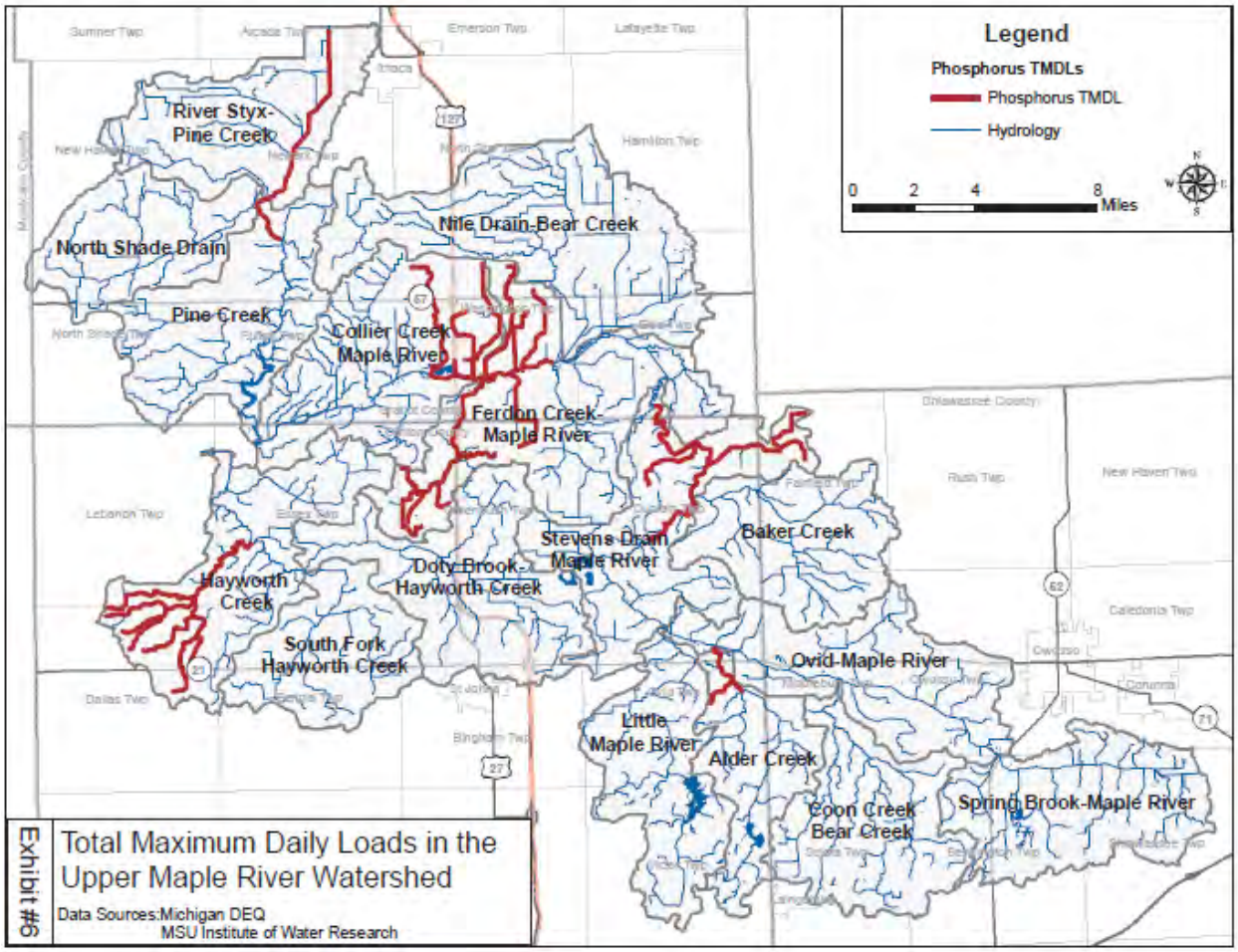
An assessment of Watershed conditions and its overall health was completed to assess the water quality and to identify potential pollutants entering the Upper Maple River Watershed. Existing documents and data were reviewed, and detailed sampling was conducted to characterize water quality parameters throughout the Watershed. Field assessments included Biological and Aquatic Habitat Assessments, a Stream Crossing Survey, a Tillage Survey, and a Streambank Erosion Assessment which were conducted to gather water quality data and NPS data.

### 3.3.1 TOTAL MAXIMUM DAILY LOADS

The U.S. Environmental Protection Agency (USEPA) Clean Water Act requires Michigan water bodies that are not attaining one or more designated use to establish TMDL to enable water quality standards to be met and maintained. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet applicable water quality standards. The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and NPS pollution to restore and maintain the quality of their water resources. Appendix 9 includes the TMDL reports for water bodies in the Watershed. Exhibit 6 (Figure 12) depicts the location of TMDLs within the Watershed. It should be noted that the North Shade Drain, as a tributary of Pine Creek, does not have a TMDL but has similar conditions of Pine Creek, which does have a TMDL, and is therefore being treated in a similar manner in listing its impairments throughout this WMP. This WMP focuses on TMDLs for phosphorus, excess algal growth, organic enrichment, and other anthropogenic substrate alterations and other flow regime alterations.

**Table 3.2 - List of Impaired Reaches Within the Upper Maple River Watershed**
(Source: MDNRE Integrated Report, 2008)

| Location | Stream Miles | Impaired Use | Cause |
|---|---|---|---|
| Pine Creek | 9.00 | Other Indigenous aquatic life and wildlife | Nuisance plant growths, phosphorus |
| Alder Creek Drain | 3.39 | Other Indigenous aquatic life and wildlife | Excessive algal growth, organic enrichment (sewage) biological indicators, total phosphorus |
| Maple River | 18.78 | Other Indigenous aquatic life and wildlife | Aquatic plants - native, total phosphorus |
| Ferdon Creek and Maple River | 30.89 | Other Indigenous aquatic life and wildlife | Excessive algal growth, total phosphorus |
| Collier Creek and Maple River | 15.83 | Other Indigenous aquatic life and wildlife | Total phosphorus |
| Peet Creek | 23.06 | Other Indigenous aquatic life and wildlife | excessive algal growth, organic enrichment (sewage) biological indicators, total phosphorus |



### 3.3.2 BIOLOGICAL (PROCEDURE 51)

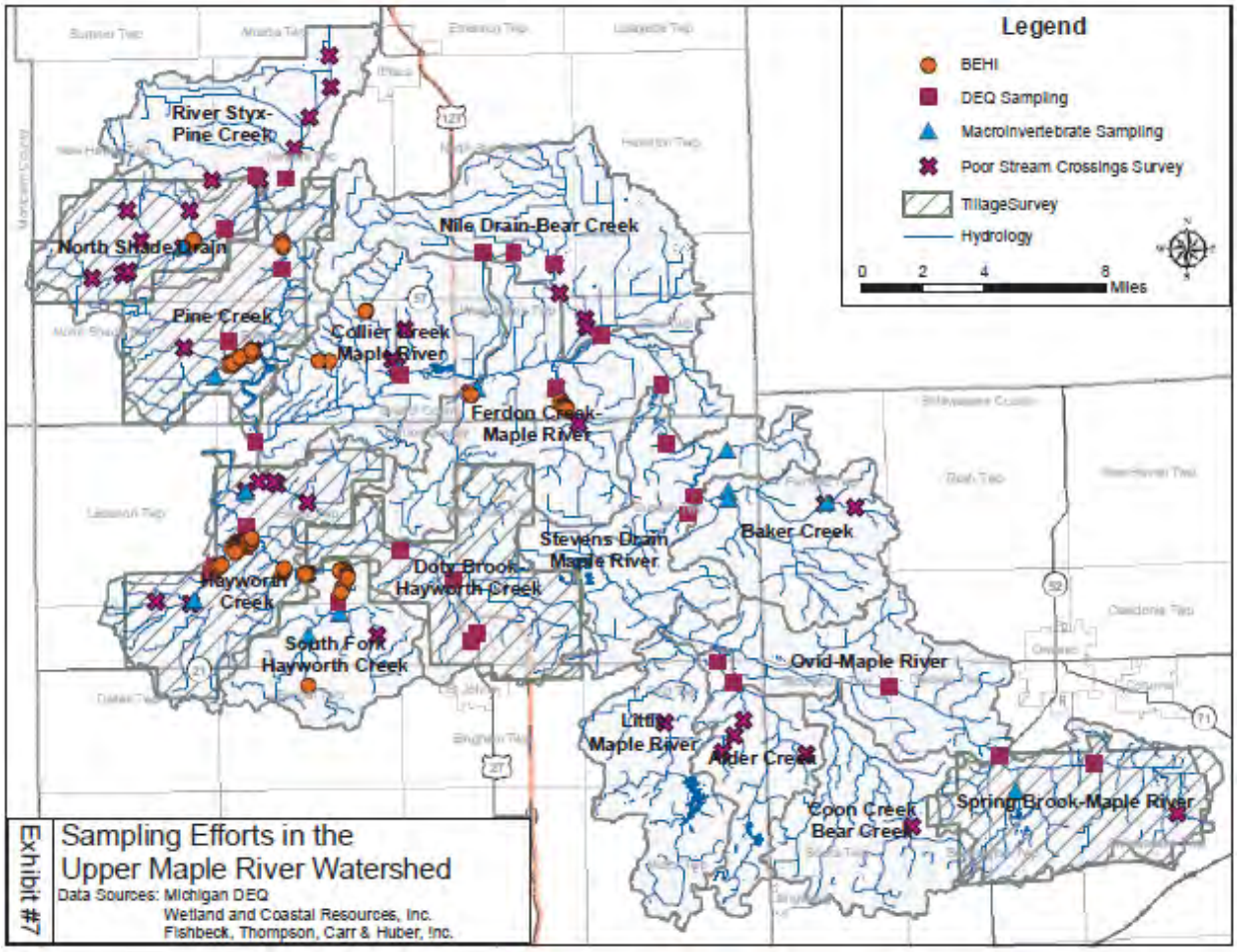
An assessment of the physical habitat and biological community of the Upper Maple River Watershed and its tributaries was completed by Wetland Coastal Resources in October 2008. The purpose of the assessment was to characterize the quality of the watercourses and to provide information necessary for making recommendations for improvements in water quality.

Protocols set forth in the Surface Water Assessment Section, Procedure No. 51 (P51) (MDNRE 1997 and MDNRE 2002) were used to complete the biological assessment. P51 is a rapid assessment technique that is used by the MDNRE to rate streams based upon their physical habitat and aquatic community.

The biological assessment indicated that the physical habitat of the Upper Maple River and its tributaries is marginal due to human impacts throughout the Watershed. Agricultural land use has led to a dense network of drainage, and sediment and nutrients are obvious pollutants on many of these drains.

While macroinvertebrate communities were found to be acceptable at several stations, they are generally toward the low end of that rating and seem to be tending toward poor. Mayflies and caddisflies were collected at many stations; but, overall, the families represented by the largest number of individuals are considered to be relatively tolerant of degraded water quality (Hilsenhoff 1988). Families of macroinvertebrate considered to be sensitive were rare throughout the watershed. Further, despite extensive sampling, stoneflies were not found at any of the sampling stations; generally, stoneflies are found in the highest quality waters. A copy of the report is located in Appendix 10.

In addition to the assessments of 15 stations conducted for inclusion in the Watershed Management Plan, several past studies have documented results of fish, macroinvertebrate, and habitat sampling on the Upper Maple River and its tributaries. These studies were completed by the MDNRE. Results indicate that the Maple River headwaters, which have been dredged, were either threatened or impaired in all studies, while the middle portion of the river near Shepardsville Road rated higher for both habitat and macroinvertebrates. Sediment, nutrients, and habitat loss through channel modification were mentioned as the primary impairments in all previous studies. Exhibit 7 (Figure 13) shows the recent P51 sampling locations and past MDNRE sampling locations.




### 3.3.3 STREAM INVENTORY

A stream crossing survey, tillage survey, and streambank assessment survey were completed with this project. The stream reaches that were inventoried as part of the current project are included on Figure 13. The majority of the Upper Maple River and its tributaries were inventoried with this project. The data sheet templates as well as detailed results and summaries of the inventories are found in Appendix 11. Three main categories of NPS pollutants were identified in the Watershed during the stream inventory, including livestock access, lack of riparian buffers, and stream crossings. The highest contributing NPS pollutants found during the inventory were sediment and nutrients.

***Stream Crossing Survey***

A survey of stream crossings was conducted by volunteers from the Friends of the Maple River, Clinton and Shiawassee Conservation Districts, and the Clinton County Drain Commissioners Office. The purpose of the survey was to collect general information to aid in identifying critical areas in the watershed, to be used to help identify sites for biological surveys, and to provide photographic and written documentation of the watershed that could be used from the office.

A total of 20 tributaries were surveyed using data sheets that were developed by the Monitoring Committee and preapproved by MDNRE staff. Binders were prepared for each of the 20 tributaries that included a cover sheet with instructions, a map of the watershed, and data sheets. In addition to instructions provided in each binder, an instructive presentation was given to the Friends of the Maple River (FOMR) at their monthly meeting.

Upon completion, each binder was reviewed and analyzed. Every stream crossing that appeared to be relatively degraded was recorded in a Geographic Information System (GIS) database. Similarly, streams appearing to be of high quality based on the crossing survey were compiled into a separate database to aid in identification of high-quality, or “priority”, areas within the watershed. The final product was a GIS shapefile containing all of the “degraded” and higher quality stream crossings that could be overlaid on the Watershed to illustrate spatial distribution of the sites.

***Tillage Survey***

A field survey was conducted to help understand the types of tillage practices in the Watershed and their potential impacts to water quality. Survey sites were selected based on priority/ranking (using results from the biological and aquatic habitat assessments, streambank erosion assessment, stream crossing survey, TMDL locations, and High-Impact Targeting System [HIT] results). Survey locations were selected from each priority level and included locations in Doty Brook, North Shade Drain, Hayworth Creek, Spring Brook, and Pine Creek Subwatersheds. The sites surveyed included all agricultural lands visible from the road inside each subwatershed boundary. The surveyors evaluated crop residue on fields in regard to the following % residue categories: 0-10%, 10-30%, and >30%. Maps with aerial imagery showing survey areas were used with the data sheets in the field. GIS was used to analyze the data sheets in order to estimate the acreage of every field surveyed. The results, for the most part, aligned with the priority levels of each subwatershed. Higher priority subwatersheds had a higher percent of fields with 0-10% crop residue and fewer fields with >30% crop residue. Lower priority subwatersheds had a lower percent of fields with 0-10% crop residue and a greater number of fields with >30% crop residue. It is important to note that the spring was much wetter than normal, delaying typical tillage practices in many of the subwatersheds. A summary of the results is tabulated in Table 3.2. The full results of the tillage survey are included in Appendix 11.

**Table 3.3 – Tillage Survey Results**

| Tillage Survey Results | Subwatershed | | | | |
|---|---|---|---|---|---|
| | Doty Brook | North Shade Drain | Hayworth Creek | Spring Brook | Pine Creek |
| Total Acres in survey area | 21,190 | 14,529 | 21,044 | 21,138 | 19,573 |
| Actual acres surveyed | 7,854 | 10,676 | 14,117 | 8,732 | 13,941 |
| Percent of total area | 37.1% | 73.5% | 67.1% | 41.3% | 71.2% |
| Percent of survey area with 0-10% residue | 35.1% | 65.2% | 35.9% | 20.6% | 36.6% |
| Percent of survey area with 10-30% residue | 9.4% | 14.1% | 10.2% | 29.2% | 21.8% |
| Percent of survey area with >30% residue; cropped | 55.5% | 20.7% | 12.9% | 21.6% | 10.7% |
| Percent of survey area with >30% residue; pasture, wheat, hay | No Data | No Data | 41.0% | 28.6% | 30.8% |

### 3.3.4 HIT SYSTEM

HIT is a web-accessible tool that is designed to focus limited conservation resources on the most serious erosion and pollution problem. HIT relies on advanced geographical information systems technology and innovative applications of computer modeling. The HIT system provides data on sediment delivery and agricultural erosion based on soil types, slopes, proximity to water, and management practices. The HIT tool estimates the amount of sediment that deposits into waterways by each subwatershed annually and in tons per acre per year. The Clinton Conservation District used the HIT model to rank the subwatersheds in the Upper Maple River Watershed based on tons of sediment per acre per year. The predicted rate of sedimentation in each subwatershed was considered when prioritizing critical areas in the Upper Maple River Watershed for both restoration and preservation. Further, the HIT modeling results were used to estimate existing sediment pollutants loading from cropland and to compare risk areas in the Upper Maple River subwatersheds with results found during the field inventories. The HIT modeling results are included in Table 3.3.

**Table 3.4 – HIT Model Results for Sediment Loading and Rates**

| Name | Acres | Total (tons/year) | Rate (tons/ac/year) | HIT Ranking |
|---|---|---|---|---|
| Collier Creek-Maple River | 24,128 | 2,749 | 0.114 | 1 |
| Pine Creek | 20,362 | 2,177 | 0.107 | 2 |
| South Fork Hayworth Creek | 14,597 | 1,546 | 0.106 | 3 |
| Spring Brook-Maple River | 20,702 | 2,182 | 0.105 | 4 |
| Hayworth Creek | 22,798 | 2,377 | 0.104 | 5 |
| Coon Creek-Bear Creek | 18,958 | 1,794 | 0.095 | 6 |
| Baker Creek | 17,509 | 1,635 | 0.093 | 7 |
| Little Maple River | 17,292 | 1,423 | 0.082 | 8 |
| Alder Creek | 12,414 | 994 | 0.08 | 9 |
| Nile Drain-Bear Creek | 30,808 | 2,468 | 0.08 | 10 |
| North Shade Drain | 14,576 | 1,121 | 0.077 | 11 |
| Doty Brook-Hayworth Creek | 22,488 | 1,730 | 0.077 | 12 |
| Ovid-Maple River | 21,100 | 1,558 | 0.074 | 13 |
| River Styx-Pine Creek | 19,106 | 1,387 | 0.073 | 14 |
| Stevens Drain-Maple River | 22,482 | 1,460 | 0.065 | 15 |
| Ferdon Creek-Maple River | 29,523 | 1,859 | 0.063 | 16 |
| **Total:** | 328,843 | 28,460 | 1.395 | |

### 3.3.5 BEHI ASSESSMENT

The Bank Erosion Hazard Index (BEHI) assessment was conducted to increase the understanding of the Watershed's characteristics and the impact of changes on stream stability, to provide a basis for water quality recommendations, and to help determine critical areas. Bank erosion rates are quantified to develop sediment loading calculations and prioritize critical erosion sites.

A BEHI assessment was conducted on select reaches of the Maple River and its tributaries. Erosion sites were evaluated using a modified version of the BEHI model (Rosgen 2001). The BEHI model incorporates measurable field parameters into a relative predictive index. The BEHI values were modified for this study through the addition of a factor accounting for bank length. Erosion rates for each individual site were calculated based upon a formula developed using field indicators of erosion, MDNRE's *Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual*, June 1999, and results of the BEHI model. The resulting relative values were used to ascertain which sites are likely to produce the most sediment on an annual basis, and also to prioritize potential bank stabilization efforts. Parameters measured for the modified BEHI model are included in Appendix 11.

The BEHI data was entered into a Trimble XT Global Positioning System (GPS) and associated with a GPS point for location of each eroded bank. Following data collection, results were downloaded from the GPS and processed via the BEHI model on a spreadsheet. Erosion results were then ranked and classified according to BEHI categories of "low," "moderate," "high," "very high," and "extreme". For purposes of this study, the BEHI model category of "very low" was assumed to correspond to relatively

stable banks and was of little value. Thus “very low” ranking erosion sites were neither assessed in the field nor included in the BEHI modeling analysis.

The total length of channel traversed by foot was approximately 10 miles, or 20 miles including both left and right banks. Erosion sites were evaluated quantitatively, representing a total eroded bank length of approximately 8.2 miles (43,203 feet), or 41% of the total length assessed, as shown in Figure 13. Erosion sites appear to be distributed randomly in terms of location and severity.

A copy of the BEHI model spreadsheet is provided in Appendix 11.

### 3.3.6 LANDSCAPE-LEVEL WETLAND FUNCTIONAL ASSESSMENT

Relatively new methods are currently emerging to support broader evaluation of wetland functions on a watershed or landscape scale, typically based on remotely sensed or GIS data. This level of functional assessment is typically used to support watershed planning, zoning decisions, definition of wetland restoration priorities, and similar purposes at the local or regional level. In additional, landscape level assessment can assist in setting priorities for more detailed monitoring of wetland condition and function, and will play a role in the statewide and regional evaluation of wetland status and trends.

MDNRE Land and Water Management Division (LWMD) is using cutting edge geographic information technology to improve the evaluation of wetlands on a watershed scale, in a cooperative effort supported by multiple agencies and organizations. This effort was adapted from a U.S. Fish and Wildlife Service (USFWS) technique developed in the Northeast by Mr. Ralph Tiner and his staff. Although wetland evaluation presents a complex challenge given the scope and diversity of these resources, wetlands play a critical role in maintenance of water quality and quantity, and wetland protection and restoration should be an integral component of watershed planning.

The LWMD’s current approach uses a computer model to integrate wetland maps—updated with current aerial photography—with hydrologic data, site topography, and other ecological information, to evaluate the wetland functions provided by each mapped wetland area. The resulting analysis can be used to provide a generalized map of current wetland functions within a watershed, the loss of wetland function associated with past land use changes, and potential wetland restoration areas.

The LWMD project is being carried out in cooperation with both the Environmental Science and Services Division and Water Bureau; with financial assistance from the USEPA Wetlands and Nonpoint Source Programs; with technical assistance from USFWS and Ducks Unlimited (DU); and in partnership with local watershed planners.

The MDNRE has completed a State-wide Landscape Level Wetland Functional Assessment (LLWFA) of all existing and historically lost wetlands. This methodology inventoried existing wetlands, determined the functions they are performing, and prioritized them for protection and preservation. In addition, historically lost wetlands were reviewed to determine the functions they once provided, and prioritize which wetlands should be restored in order to obtain the most significant water quality improvements. Areas were prioritized for wetland restoration, based on the impacts that wetland loss has had on the ecosystem, such as reduced flood storage, degradation of wildfowl habitat, or elimination of a nutrient sink. Results from the LLWFA in the Upper Maple River Watershed are as follows: 13 wetland functions were analyzed. It was found that only 2 functions still have approximately 100% of the predicted original capacity left, including Conservation of Rare and Imperiled Wetlands and Waterfowl and Waterbird Habitat, when comparing Pre-European settlement to the year 2005. The wetland functions which appeared to have the highest losses of wetlands are Amphibian Habitat, Fish Habitat, Streamflow Maintenance, Flood Water Storage, Stream Shading and Interior Forest Bird Habitat. The full LLWFA report is included in Appendix 4. Figure 6 illustrates the areas for wetland restoration where functions could be restored to provide the greatest benefit for the Watershed.

### 3.3.7 POINT SOURCE

Several point sources exist in the Upper Maple River Watershed. The National Pollutant Discharge Elimination System (NPDES) permits are required to use public resources for waste disposal and limit the amount of pollutants that may be discharged to surface waters of the State. The Upper Maple River Watershed has 6 groundwater discharge permits and 32 active NPDES discharge permits within its hydrologic boundary, 17 of which are Concentrated Animal Feeding Operations (CAFO) permits. The active NPDES discharge permits include permits for the Villages of Elsie, Ovid, Maple Rapids, Ashley, and Perrinton, and the City of St. Johns. A list of the point sources in the watershed is included in Appendix 12.

## 3.4 WATERSHED POLLUTANT SUMMARY

The most significant NPS pollutant in the Watershed is sediment, followed by nutrients, pathogens and bacteria, high temperature, and pesticides. The various NPS pollutants have differing impact on the designated uses. Provided below is a brief description of common NPS pollutants and the typical degradation they impose on the designated uses.

***Impacts of Sediment on Designated Uses***

The deposition of an excessive amount of sediment in a stream will cover spawning habitat and generally degrade the aquatic habitat of fish and macroinvertebrate species. Excessive sediment also carries and deposits nutrients, impedes navigation of the watercourse and can lead to increased streambank erosion.

***Impacts of Nutrients on Designated Uses***

Nutrients, including phosphorus and nitrogen, are necessary for the growth and reproduction of aquatic plants and for a healthy river, when in balance. However, excessive nutrients can cause dense algal growths known as algal blooms. After the elevated nutrient source has been depleted, an algal bloom will die and decompose, reducing DO levels. Healthy warmwater fish and macroinvertebrate populations require DO levels to remain around 5 mg/L, while coldwater fish require DO levels of 7 mg/L. When lower DO levels are sustained for a period of time, fish and macroinvertebrate communities change to more tolerant species, and the stream or lake will no longer support a diverse species population.

***Impacts of Thermal Pollution on Designated Uses***

Thermal pollution occurs when a water body is greatly influenced by an influx of water above or below its natural temperature, usually making the water body warmer. Thermal pollution can result in both increased water temperatures and reduced DO levels. This is detrimental to the aquatic life, especially if the water temperature historically supports a coldwater fishery and can no longer do so because of temperature increase.

***Impacts of Pesticides on Designated Uses***

Pesticides leach through the soil and enter the groundwater and surface water and may have negative impacts on wildlife. Certain pesticides may also cause other environmental problems such as increased health risks or drinking water problems. Storm water runoff can cause large concentrations of pesticides to enter the water within a short time period.

***Impacts of Pathogens/Bacteria on Designated Uses***

Bacterial pollution impairs the watercourse's designated uses of partial and total body contact recreation. Pathogens and bacteria are present in manure and septic system runoff, and high concentrations in surface water may pose severe health risks. The impact of *E. coli* pollution is a public health and safety issue. Fecal coliform bacteria, found in manure or septic systems, can cause serious health problems and can be an indicator of other serious pathogens and disease-carrying organisms.

## 3.5 DESIGNATED USE SUMMARY

Information gathered from the field assessments, data reviews, and pollution assessments were used by the Steering Committee to determine the impairment status of each designated use in the subwatersheds. Table 3.4 depicts designated use status as either unimpaired (M), impaired (I) or threatened (T). The pollutants and sources of pollutants are identified as known (k) if they were documented and measured during any of the inventory methods. Pollutants and sources were identified

as suspected (s) if indications or impacts of them were observed, but the pollutants or sources themselves were not measured. Potential (p) pollutants were identified based upon land use conducive to serving as a source of that pollutant, but no visual observation or measurements were made.

The following reasoning was used to determine the designated use status:

- Agriculture: Met in all subwatersheds since water was determined to be safe and available for irrigation, livestock watering, and produce spraying.
- Navigation: If the channel/ditch is wide and deep enough to canoe, navigation is possible. All possible areas are threatened due to log jams and obstructions.
- Warmwater Fishery: Impaired if it received a poor bug score (-9 to -5); threatened if the bug score was -4 or -3; and met if the bug score was -2 to 9.
- Other Indigenous Aquatic Life and Wildlife: Impaired if TMDL exists and impaired if P51 assessment resulted in habitat score of 56 to 104; threatened if habitat score was between 105 and 125; met if habitat score was ≥126.
- Partial Body Contact Recreation: Waters in all of the subwatersheds are used for this use. All subwatersheds are potentially threatened with nutrient and bacteria inputs into the watershed.
- Total Body Contact Recreation: If a lake in the subwatershed is used for swimming or a channel/ditch is deep enough for swimming, the designated use was deemed potentially threatened with nutrients and bacteria inputs to the Watershed.
- Coldwater Fishery: No streams are currently designated coldwater streams able to support trout habitat.
- Public Water Supply: Not a use at this time.
- Industrial Water Supply: Not a use at this time.
- It should be noted that the North Shade Drain, as a tributary of Pine Creek, does not have a TMDL but has similar conditions of Pine Creek, which does have a TMDL, and is therefore being treated in a similar manner in listing its impairments throughout this WMP.

**Table 3.5 - Designated Use by Subwatershed** (Source: MDNRE 2008 Integrated Report)

| Subwatershed | Designated Use | | | | | |
|---|---|---|---|---|---|---|
| | Agricultural | Navigation | Warmwater Fishery | Other Indigenous Aquatic Life and Wildlife | Partial Body Contact Recreation | Total Body Contact Recreation |
| River Styx - Pine Creek | M (k) | M (k) | I (k) | I (PHOS & ASA TMDLs) (k) | T (p) | T (p) |
| North Shade Drain | M (k) | T (s) | I (k) | I (PHOS & ASA) (k) | T (p) | T (p) |
| Pine Creek | M (k) | T (s) | T (k) | I (PHOS & ASA TMDLs) (k) | T (p) | T (p) |
| Collier Creek - Maple River | M (k) | T (s) | I (k) | I (PHOS TMDL) (k) | T (p) | T (p) |
| Nile Drain - Bear Creek | M (k) | T (s) | M (k) | M (k) | T (p) | T (p) |
| Ferdon Creek - Maple River | M (k) | T (s) | I (k) | I (PHOS & ASA TMDL) (k) | T (p) | T (p) |
| Hayworth Creek | M (k) | T (s) | T (k) | I (PHOS TMDL) (k) | T (p) | T (p) |
| South Fork Hayworth Creek | M (k) | M (k) | I (k) | I (k) | T (p) | T (p) |
| Doty Brook - Hayworth Creek | M (k) | M (k) | T (k) | T (ASA TMDL) (k) | T (p) | T (p) |
| Stevens Drain - Maple River | M (k) | T (s) | M (k) | I (PHOS TMDL) (k) | T (p) | T (p) |
| Baker Creek | M (k) | M (k) | I (k) | T (ASA TMDL) (k) | T (p) | T (p) |
| Ovid - Maple River | M (k) | T (s) | M (k) | M (k) | T (p) | T (p) |
| Little Maple River | M (k) | T (s) | M (k) | M (k) | T (p) | T (p) |
| Alder Creek | M (k) | T (s) | M (k) | M (PHOS TMDL) (s) | T (p) | T (p) |
| Coon Creek - Bear Creek | M (k) | M (k) | M (k) | M (k) | T (p) | T (p) |
| Spring Brook - Maple River | M (k) | T (s) | M (k) | M (k) | T (p) | T (p) |

M = Met or unimpaired I = Impaired T = Threatened k = Known s = Suspected p = potential
ASA = Other anthropogenic substrate alterations
Flow = Other flow regime
PHOS = Phosphorus
TMDL = Total maximum daily load

# 4.0 IDENTIFICATION AND PRIORITIZATION OF POLLUTANTS, SOURCES, AND CAUSES

Once specific pollutants were identified, the focus of investigation turned to possible sources. To reduce the pollutants impairing the designated uses of the Watershed, it was necessary to determine where the pollutants originate as well as why the pollutant is impairing the Watershed. Investigations were conducted throughout the Watershed to identify pollutant sources. Field investigations included assessment of streambank erosion, stream crossings, surrounding land use practices, and water quality. The sources and causes of pollutants were verified through Procedure 51, a nonpoint source (NPS) survey including a stream crossing survey and tillage survey, the use of the High-Impact Targeting System (HIT) model results, and the results of the Bank Erosion Hazard Index (BEHI) as previously discussed in Section 3.3, Watershed Inventory and Conditions. In addition, the Steering Committee also provided input on the sources and causes of pollutants throughout the project. By identifying the cause of the pollutant source, implementation efforts can be directed to correct the condition that is generating the pollutant. This helps to ensure that the most appropriate designs and successful control measures are implemented or installed.

## 4.1 NONPOINT SOURCES

To identify sources of NPS pollution, both a windshield assessment and walking assessment were completed. Assessment focused on impairments identified in the State's 303(d) Integrated Report, but any notable observations regarding other potential pollutants were also recorded. Several of the major sources of NPS pollution are discussed below.

***Livestock***

Livestock in the Watershed were identified as having an impact on water quality by being a source of nutrients and pathogens and bacteria. Causes of the pollutant sources were identified as lack of buffer or setback at holding facilities adjacent to the channel, uncontrolled livestock access, and over or improper application of manure to fields. Dozens of animal agriculture facilities are present in the Watershed that house well over a total of 50,000 cattle and swine.

***Cropland***

Based on the farming practices observed for croplands, it was determined that croplands have an impact on water quality by being a source of sediment, nutrients, and pesticides. Causes of the pollutant sources were identified as tillage practices, lack of buffers, dense drainage networks, over or improper application of manure/fertilizers, and over or improper application of pesticides.

***Septic Systems***

Septic systems were identified as having a potential impact on water quality by being a potential source of nutrients and pathogens/bacteria. The Shiawassee County Health Department (SCHD) has a program called “Point of Sale Inspections” where septic systems must be inspected and approved prior to the land being sold. Results of point of sale inspections are as follows:

- Approximately 25% of inspected systems were found to be "Not in Compliance" with current septic field construction requirements. This percentage was consistent for both townships within the watershed and all townships in the county, so it is a fair indication that there are a significant number of "dated" septic systems with the potential to generate pollution beyond currently acceptable limits.

- Across the county, they have found that about 7% (essentially 1 out of 15) of the systems that have been inspected are in some state of failure. In these instances, excessive pollution is likely resulting.

- It was unclear how many of the inspected septic systems have a direct impact to the Maple River or its tributaries.

Since septic systems were not inspected with this project, they are indicated as a potential source until monitoring data or inspections can verify if they are a source of pollutant.

***Streambank Erosion***

Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) conducted a streambank erosion assessment in Fall 2008 and Spring 2009 on several of the Maple River tributaries, to determine where erosion is occurring throughout the system, Appendix 11. It was determined that streambank erosion has an impact on water quality by being a source of sediment. Erosion sites were evaluated using a modified BEHI model. Detailed streambank analysis results are found in Section 3.3.5 and Appendix 11 of this document.

***Drain Maintenance***

The entirety of the Upper Maple River watershed is very effectively drained. The term dense drainage network refers to the well, and sometimes improperly maintained, system of field tiles, roadside ditches, designated county drains, and private drains that transport the water and sediment from the watershed. No matter where a drop of water falls within the watershed, it does not travel far before entering the drainage system.

A summary of the pollutants identified in each subwatershed is listed in Appendix 13. A comprehensive summary of pollutants identified throughout the Watershed can be found in Table 4.1. The table prioritizes designated uses, pollutants of concern contributing to the degradation of the designated uses, the known and suspected sources of these pollutants, and summarizes data that documents the presence of the sources or causes based on the Watershed assessments. The Monitoring Committee evaluated each designated use and prioritized the pollutants based on the degree of impairment, and the feasibility of reducing the pollutant to desirable levels. The pollutants and sources of pollutants are identified as known (k) if they were documented and measured during any of the inventory methods. Pollutants and sources were identified as suspected (s) if indications or impacts of them were observed, but the pollutants or sources themselves were not measured. Potential (p) pollutants were identified based upon land use conducive to serving as a source of that pollutant, but no visual observation or measurements were made. Additional inventories should be conducted within five years to reassess the Watershed and determine if suspected sources have become known.

**Table 4.1 – Pollutant, Sources, and Causes of Impairments Summary for Entire Watershed**

| Designated Use | Prioritized Pollutant | Prioritized Source | Prioritized Cause | Documented Presence in Watershed |
|---|---|---|---|---|
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened) | 1. sediment (k) | 1. cropland (k) | 1. tillage practices (k) | Agriculture is dominant land use; the tillage survey indicated a percentage of the watersheds having (0%-10% tillage) as follows: Doty Brook (35.1%), North Shade Drain (65.2%), Hayworth Creek (35.9%), Spring Brook (20.6%), and Pine Creek (36.6%) |
| | | | 2. lack of buffers (k) | 365.5 miles of unbuffered channel |
| | | | 3. dense drainage network (k) | Observed during nonpoint source survey |
| | | 2. streambanks (k) | 1. altered morphology and hydrology (k) | Over 43,000 feet of eroded streambanks |
| | | | 2. uncontrolled livestock access (k) | 13 sites identified; 11,000 feet of channel impacted |
| | | | 3. removal of vegetation (k) | 365.5 miles of unbuffered channel |
| | | 3. gravel roads (k) | 1. runoff to roadside ditch or drain (k) | Observed during nonpoint source surveys |
| | | 4. rill and gully erosion (k) | 1. concentrated flow from roadside ditch (s) | 3 sites identified |
| | | 5. lakeshore erosion (k) | 1. boat traffic/seawalls/wave action (k) | Approximately 4,000 feet of eroded Lake Riparian Areas shoreline |
| | | 6. streambed (k) | 1. headcutting (culvert placement) (s) | Observed during nonpoint source survey |
| | | | 2. headcutting (altered morphology/hydrology) (s) | Observed during nonpoint source survey |
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened) | 2. nutrients (s); phosphorus (k) – total maximum daily load | 1. cropland (s) | 1. over or improper application of manure/fertilizers (s) | Row-crop agriculture is dominant land use; 94 animal agriculture facilities |
| | | 2. livestock (s) | 1. lack of buffer or setback at holding facilities adjacent channel (s) | 2 holding facilities adjacent channel |
| | | | 2. uncontrolled livestock access (s) | 13 sites identified; 11,000 feet of channel impacted |
| | | 3. dense areas of maintained landscapes (s) | 1. over or improper application of fertilizers (s) | Lake Riparian Areas |
| | | | 2. lack of riparian buffer on lakes (s) | Lake Riparian Areas |
| | | 4. septic systems (s) | 1. aging systems and/or improper maintenance (s) | Health department records |
| | | 5. golf courses (s) | 1. over or improper application of fertilizers (s) | Reaches of Ferdon Creek bisect golf course lands |
| | | | 2. lack of buffers (k) | Observed during nonpoint source survey |

**Table 4.1 – Pollutant, Sources, and Causes of Impairments Summary for Entire Watershed**

| Designated Use | Prioritized Pollutant | Prioritized Source | Prioritized Cause | Documented Presence in Watershed |
|---|---|---|---|---|
| | | 6. ducks and geese (s) | 1. maintained lawn to edge of water (s) | Lake Riparian Areas |
| | | | 2. overpopulation of waterfowl (s) | Lake Riparian Areas |
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened)<br><br>Partial Body Contact Recreation (threatened)<br><br>Total Body Contact Recreation (threatened) | 3. pathogens and bacteria (p) | 1. livestock (p) | 1. over or improper application of manure (p) | Row-crop agriculture is dominant land use; 94 animal agriculture facilities |
| | | | 2. lack of buffer or setback at holding facilities adjacent channel (s) | 2 holding facilities adjacent channel |
| | | 2. septic systems (p) | 1. aging systems and/or improper maintenance (p) | Health department records |
| | | 3. ducks and geese (p) | 1. maintained lawn to edge of water (p) | Lake Riparian Areas |
| | | | 2. overpopulation of waterfowl (p) | Lake Riparian Areas |
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened) | 4. high temperature (p) | 1. lack of riparian canopy (p) | 1. removal of riparian vegetation (p) | 365.5 miles of unbuffered channel |
| | | | 2. dense drainage network (p) | Observed during nonpoint source survey |
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened) | 5. pesticides (p) | 1. cropland (p) | 1. over or improper application of pesticides (p) | Agriculture is dominant land use; the tillage survey indicated a percentage of the watersheds having (0%-10% tillage) as follows: Doty Brook (35.1%), North Shade Drain (65.2%), Hayworth Creek (35.9%), Spring Brook (20.6%), and Pine Creek (36.6%) |
| | | 2. dense areas of maintained landscapes (p) | 1. over or improper application of pesticides (p) | Lake Riparian Areas |
| | | | 2. lack of riparian buffer on lakes (p) | Lake Riparian Areas |

**Table 4.1 – Pollutant, Sources, and Causes of Impairments Summary for Entire Watershed**

| Designated Use | Prioritized Pollutant | Prioritized Source | Prioritized Cause | Documented Presence in Watershed |
|---|---|---|---|---|
| Other Indigenous Aquatic Life and Wildlife (impaired)<br><br>Warmwater Fishery (impaired and threatened) | 5. pesticides (p) continued | 3. golf courses (s) | 1. over or improper application of pesticides (s) | Reaches of Ferdon Creek bisect golf course lands |
| | | | 2. lack of buffers (k) | Observed during nonpoint source survey |
| | | 4. orchards (p) | 1. over or improper application of pesticides (s) | Reaches of Ferdon Creek bisect orchards |
| | | | 2. lack of riparian buffers (k) | Observed during nonpoint source survey |
| Navigation | 6. Obstructions (k) | 1. Log-jams and excessive sedimentation (k) | 1. erosion and natural processes (k) | Observed during nonpoint source survey |

**NOTES:**

**Known (k)** = documented and measured during any of the inventory methods.

**Suspected (s)** = indications or impacts of them were observed, but the pollutants or sources themselves were not measured.

**Potential (p)** = identified based upon land use conducive to serving as a source of that pollutant, but no visual observation or measurements were made.

**Dense drainage network** = the entirety of the Upper Maple River Watershed is very effectively drained. The term dense drainage network refers to the well, and sometimes improperly maintained, system of field tiles, roadside ditches, designated county drains, and private drains that transport the water and sediment from the watershed. No matter where a drop of water falls within the watershed, it does not travel far before entering the drainage system.

**Dense areas of maintained landscapes** = for the most part, the UMR watershed is sparsely populated. Population centers such as towns, villages and lakeshores have dense housing communities. Many of the lakes within the watershed contain riparian lands that are intensively landscaped; the use of fertilizers, and pesticides is typical in these areas.

**Uncontrolled livestock access** = refers to channels which are open to grazing and/or indiscriminant access by livestock.

**Lack of buffer or setback at holding facilities adjacent channel** = several livestock pens were observed proximate to stream channels. These pens contained relatively significant populations of animals. The ground slope or drainage systems appeared to direct runoff directly to the channel. There was no apparent regard for a setback or buffer in locating the facilities.

**Animal agriculture facilities** = generally refer to locations which house, or appear to house, more than 12 large animals such as cows, horses, or pigs.

## 4.2 POLLUTANT LOADING BY SUBWATERSHED

Pollutant loadings were calculated by subwatershed to enable the Steering Committee to have a comprehensive understanding of which subwatersheds were contributing the most pollutants into the Watershed, and develop corrective measures to address the same. Table 4.1 presents a comprehensive summary of pollutants, sources, and causes identified throughout the Watershed. Table 4.2 presents loadings from the NPS sites for Streambank Erosion, Gully Erosion, and Livestock Access Sites, along with the HIT model results for Cropland Erosion.

The pollutant loadings from the NPS sites were calculated using the Michigan Department of Environmental Quality (MDEQ) *Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual*, June 1999. The pollutant loadings from cropland were calculated using the HIT model. Additional information on the HIT model results can be found in Section 3.3.4.

Total Maximum Daily Load (TMDL) reports completed by the MDEQ in 2007 (Pine Creek) and 2009 (Upper Maple River and Peet Creek) address the water bodies currently listed as impaired due to excessive nutrient loadings, as well as those water bodies upstream of the listed bodies, since they contribute nutrients to the impaired reaches. Total daily loads estimated using the L-THIA model were 40.7 lbs/day (pounds per day), 77.3 lbs/day, and 11.9 lbs/day to Pine Creek, the Upper Maple River, and Peet Creek, respectively. Agricultural land use accounts for 38.2 lbs/day to Pine Creek, 69.6 lbs/day to the Upper Maple and 8.1 lbs/day to Peet Creek. The current average concentration of total phosphorus is 0.22 mg/L (milligrams per liter) in Pine Creek, 0.108 mg/L in the Upper Maple, and 0.331 mg/L in Peet Creek. The TMDL process establishes the allowable loadings of pollutants for a water body, based on the relationship between pollution sources and in-stream water quality conditions. The reports are included in Appendix 9.

**Table 4.2 Sediment and Nutrient Loading - NPS Sites and HIT Model Results**

| Subwatershed | Streambank Erosion (NPS Inventory) | | | Gully Erosion (NPS Inventory) | | | Livestock Access (NPS Inventory) | | | Total NPS Loadings | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment Loading (tons/yr) | Phosphorus Loading (lbs/yr) | Nitrogen Loading (lbs/yr) | Sediment Loading (tons/yr) | Phosphorus Loading (lbs/yr) | Nitrogen Loading (lbs/yr) | Sediment Loading (tons/yr) | Phosphorus Loading (lbs/yr) | Nitrogen Loading (lbs/yr) | Sediment Loading (tons/yr) | Phosphorus Loading (lbs/yr) | Nitrogen Loading (lbs/yr) | Cropland Sediment Content (HIT Model Results) | Phosphorus Content (HIT) (lbs/yr) | Nitrogen Content HIT) (lbs/yr) | Total Sediment (NPS + HIT) (tons/yr) | Phosphorus Content (NPS + HIT) (lbs/yr) | Nitrogen Content (NPS + HIT) (lbs/yr) |
| Collier Creek - Maple River | 1,065 | 905 | 1,811 | | | | | | | 1,065 | 905 | 1,811 | 2,749 | 2,337 | 4,673 | 3,814 | 3,242 | 6,484 |
| Nile Drain - Bear Creek | | | | | | | | | | | | | 2,468 | 2,098 | 4,196 | 2,468 | 2,098 | 4,196 |
| Hayworth Creek | 483 | 411 | 821 | | | | 625 | 531 | 1,063 | 1,108 | 942 | 1,884 | 2,377 | 2,020 | 4,041 | 3,485 | 2,962 | 5,925 |
| Spring Brook - Maple River | 0 | 0 | 0 | 440 | 374 | 748 | | | | 440 | 374 | 748 | 2,182 | 1,855 | 3,709 | 2,622 | 2,229 | 4,457 |
| Pine Creek | 414 | 352 | 704 | 365 | 310 | 621 | 108 | 92 | 184 | 887 | 754 | 1,508 | 2,177 | 1,850 | 3,701 | 3,064 | 2,604 | 5,209 |
| Ferdon Creek - Maple River | 1,153 | 980 | 1,960 | | | | | | | 1,153 | 980 | 1,960 | 1,859 | 1,580 | 3,160 | 3,012 | 2,560 | 5,120 |
| Coon Creek - Bear Creek | 12 | 10 | 20 | | | | | | | 12 | 10 | 20 | 1,794 | 1,525 | 3,050 | 1,806 | 1,535 | 3,070 |
| Doty Brook - Hayworth Creek | | | | | | | | | | | | | 1,730 | 1,471 | 2,941 | 1,730 | 1,471 | 2,941 |
| Baker Creek | | | | | | | | | | | | | 1,635 | 1,390 | 2,780 | 1,635 | 1,390 | 2,780 |
| Ovid - Maple River | | | | | | | | | | | | | 1,558 | 1,324 | 2,649 | 1,558 | 1,324 | 2,649 |
| South Fork Hayworth Creek | 197 | 167 | 335 | | | | | | | 197 | 167 | 335 | 1,546 | 1,314 | 2,628 | 1,743 | 1,482 | 2,963 |
| Stevens Drain - Maple River | | | | | | | | | | | | | 1,460 | 1,241 | 2,482 | 1,460 | 1,241 | 2,482 |
| Little Maple River | | | | | | | | | | | | | 1,423 | 1,210 | 2,419 | 1,423 | 1,210 | 2,419 |
| River Styx - Pine Creek | 0 | 0 | 0 | | | | | | | 0 | 0 | 0 | 1,387 | 1,179 | 2,358 | 1,387 | 1,179 | 2,358 |
| North Shade Drain | 6 | 5 | 10 | | | | | | | 6 | 5 | 10 | 1,121 | 953 | 1,906 | 1,127 | 958 | 1,916 |
| Alder Creek | 128 | 109 | 218 | | | | 128 | 109 | 218 | 256 | 218 | 435 | 994 | 845 | 1,690 | 1,250 | 1,063 | 2,125 |
| **TOTAL** | 3,458 | 2,939 | 5,879 | 805 | 684 | 1,369 | 861 | 732 | 1,464 | 5,124 | 4,355 | 8,711 | 28,460 | 24,191 | 48,382 | 33,584 | 28,546 | 57,093 |

Pine Creek TMDL subwatersheds
Upper Maple TMDL Subwatersheds
Peet Creek TMDL Subwatersheds

## 4.3 IDENTIFICATION OF CRITICAL AREAS FOR RESTORATION

Critical areas for restoration are those subwatersheds that have the most potential of contributing the greatest amounts of NPS pollution which impair or threaten water quality in the Watershed. The identification of critical sites within the critical areas defines the sites to target the implementation of Best Management Practices (BMPs). The Steering Committee determined the critical areas for restoration based on the locations of the TMDLs, and results of the biological assessment (P51), tillage survey, streambank assessment survey (BEHI), and HIT model. Table 4.3 shows the prioritization of subwatersheds for restoration based on results of the previously identified assessments. Each subwatershed was given a ranking under each category, 1 being the worst condition. The reasoning behind the rankings is as follows.

- For Morphology/BEHI (streambank erosion) rankings by subwatershed, rankings were based upon load estimates from NPS surveys. If erosion was observed in a subwatershed but no estimates were made, the subwatershed was ranked lower than one in which an estimate was made. If no erosion was observed, the subwatershed was ranked at the bottom.
- For 303(d) list rankings, if a TMDL for phosphorus exists in the subwatershed, a ranking of 1 was given; if a TMDL for anthropogenic substrate alterations exists, a ranking of 2 was given; if there is no TMDL in the subwatershed, a rank of 3 was given.
- For livestock operations, all problem sites within a subwatershed were summed, and rankings were based upon the number of problem sites per subwatershed.
- For the stream crossings, the number of “poor” crossings was summed within each of the subwatersheds. Subwatersheds were prioritized based upon the relative presence of “poor” stream crossings.
- The tillage survey results were ranked according to the least amount of residue measured in each of the surveyed subwatersheds.
- For the HIT model results, subwatersheds were ranked from having the most sediment load, given a rank of 1, to the least sediment loads, given a rank of 16.

Overall, Pine Creek, Hayworth Creek, and Collier Creek–Maple River subwatersheds have the highest priority, since they were ranked in the top five priority subwatersheds for four of the five pollutants in the watershed (sediment, nutrients, high temperature, and pesticides). Also, a TMDL exists in all subwatersheds. The priorities for high, medium, and low were determined based on the results of the ranking, where high priorities had a total ranking of less than 25, medium priorities had a total ranking 25-35 and low priorities had rankings greater than 36. Exhibit 8 (Figure 14) depicts the critical areas for restoration.

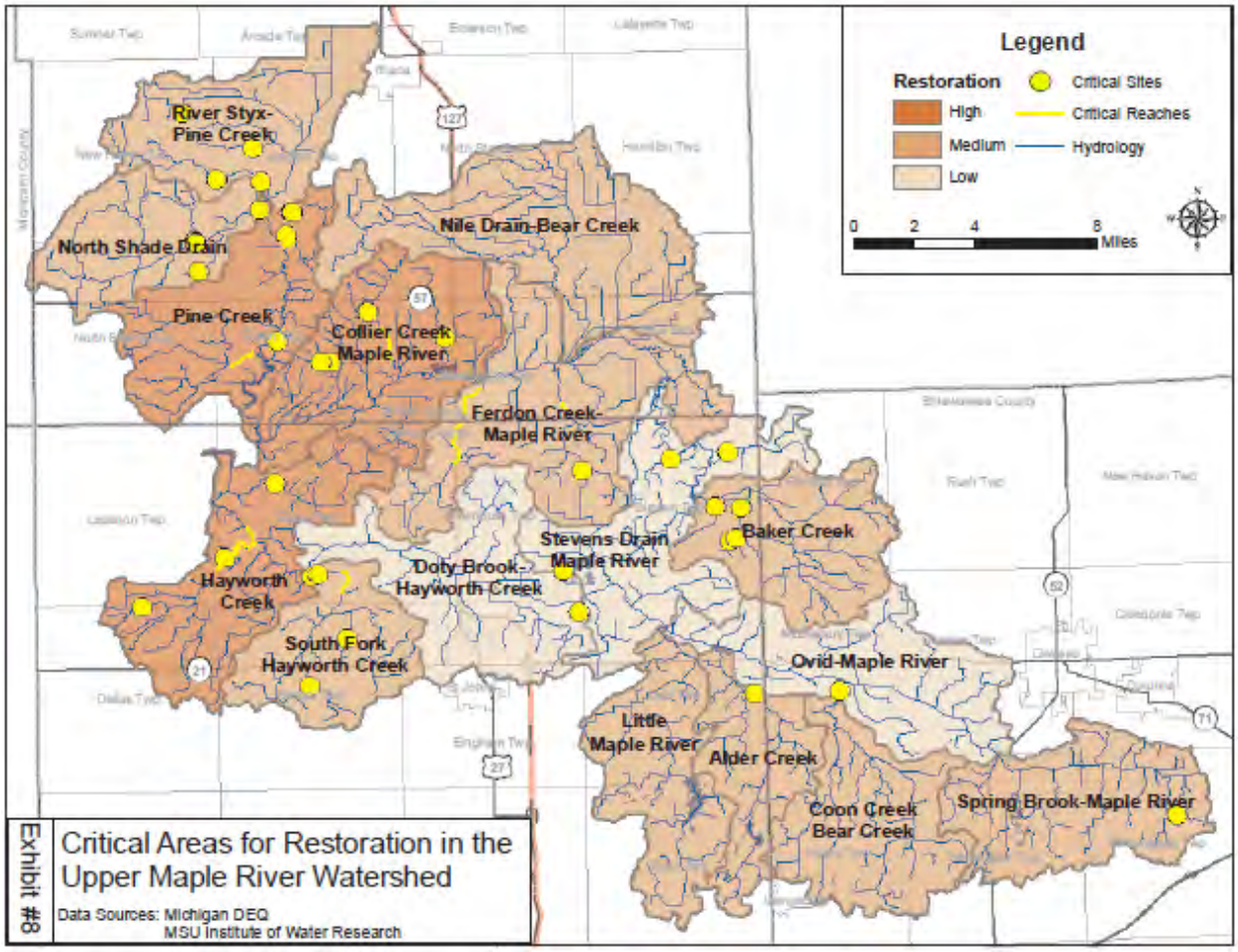



Exhibit #8

Critical Areas for Restoration in the Upper Maple River Watershed

Data Sources: Michigan DEQ
MSU Institute of Water Research

**Table 4.3 – Critical Areas for Restoration**

| Subwatershed Priority | Subwatershed | Morphology/BEHI (streambank erosion and sedimentation) (1 = worst with highest NPS loads) | 303 (d) list (1 = worst with existing TMDL) | Livestock Operations (nutrients and pathogens) (1 = worst with highest number of livestock operations) | Stream Crossing Survey (1 = worst with highest number of poor stream crossings) | Tillage Survey (1 = worst with least amount of residue) | HIT Model Results (cropland erosion and sedimentation) (1 = worst with highest sediment load) | Total |
|---|---|---|---|---|---|---|---|---|
| High | Pine Creek | 4 | 1 | 1 | 5 | 2 | 2 | 15 |
| High | Hayworth Creek | 3 | 1 | 2 | 1 | 3 | 5 | 15 |
| High | Collier Creek-Maple River | 2 | 1 | 4 | 5 | 6 | 1 | 19 |
| Medium | South Fork Hayworth Creek | 5 | 3 | 2 | 6 | 6 | 3 | 25 |
| Medium | North Shade Drain | 9 | 3 | 3 | 2 | 1 | 11 | 29 |
| Medium | Alder Creek | 6 | 1 | 4 | 4 | 6 | 9 | 30 |
| Medium | Spring Brook-Maple River | 7 | 3 | 5 | 7 | 5 | 4 | 31 |
| Medium | Baker Creek | 6 | 2 | 5 | 6 | 6 | 7 | 32 |
| Medium | Ferdon Creek-Maple River | 1 | 1 | 5 | 5 | 6 | 16 | 34 |
| Medium | Nile Drain-Bear Creek | 6 | 3 | 5 | 4 | 6 | 10 | 34 |
| Medium | River Styx-Pine Creek | 9 | 1 | 2 | 3 | 6 | 14 | 35 |
| Medium | Coon Creek-Bear Creek | 8 | 3 | 5 | 7 | 6 | 6 | 35 |
| Medium | Little Maple River | 6 | 3 | 5 | 7 | 6 | 8 | 35 |
| Low | Doty Brook-Hayworth Creek | 6 | 2 | 5 | 8 | 4 | 12 | 37 |
| Low | Stevens Drain-Maple River | 6 | 1 | 3 | 8 | 6 | 15 | 39 |
| Low | Ovid-Maple River | 6 | 3 | 5 | 8 | 6 | 13 | 41 |

## 4.4 IDENTIFICATION OF PRIORITY AREAS FOR PRESERVATION AND PROTECTION

Priority areas for preservation and protection include subwatersheds that have high quality features necessary for healthy ecosystems. The identification of critical sites within the priority areas is to target ecologically significant parcels to protect. Many agencies have interest in protecting properties along and near the Maple River for the purpose of connecting a greenway that includes the riparian area of the river. The headwater areas of the watershed contain high biological diversity and have the most occurrences of threatened and endangered (T&E) species.

The Steering Committee determined the priority areas for preservation and protection based on existing information about ecologically sensitive areas and land use priorities, including prime farmland, permanently protected lands and their buffer areas, historic and existing wetlands, acres enrolled in the Wetlands Reserve Program (WRP), and the maps created for Clinton and Shiawassee Counties for Potential Conservation areas. Clinton and Shiawassee Counties have approved Purchase of Development Rights Programs which enables identified prime farmland to be eligible for State funding to preserve those lands. The MDNRE would like to preserve land that has high natural resource and outdoor recreation values, primarily located within MDNRE project boundaries, so preservation of the buffer around the state game areas was considered important in this project. Michigan Natural Features Inventory (MNFI) completed a “patch analysis” for the entire state of Michigan. The patch analysis identified areas that should be under conservation easements because of the high natural resource value of that area. Preservation of these areas was considered important in this project. Table 4.4 shows the priority subwatersheds for preservation and protection based on their existing high quality features. Exhibit 9 (Figure 15) depicts the priority areas for preservation and protection.

River Styx–Pine Creek, Ferdon Creek–Maple River, and the north one-half of Baker Creek have medium priority for restoration. The high, medium, and low priorities were determined based on the total ranking scores, where high had a score less than 40, medium had a score from 41-49, and low had a score from 50–60.

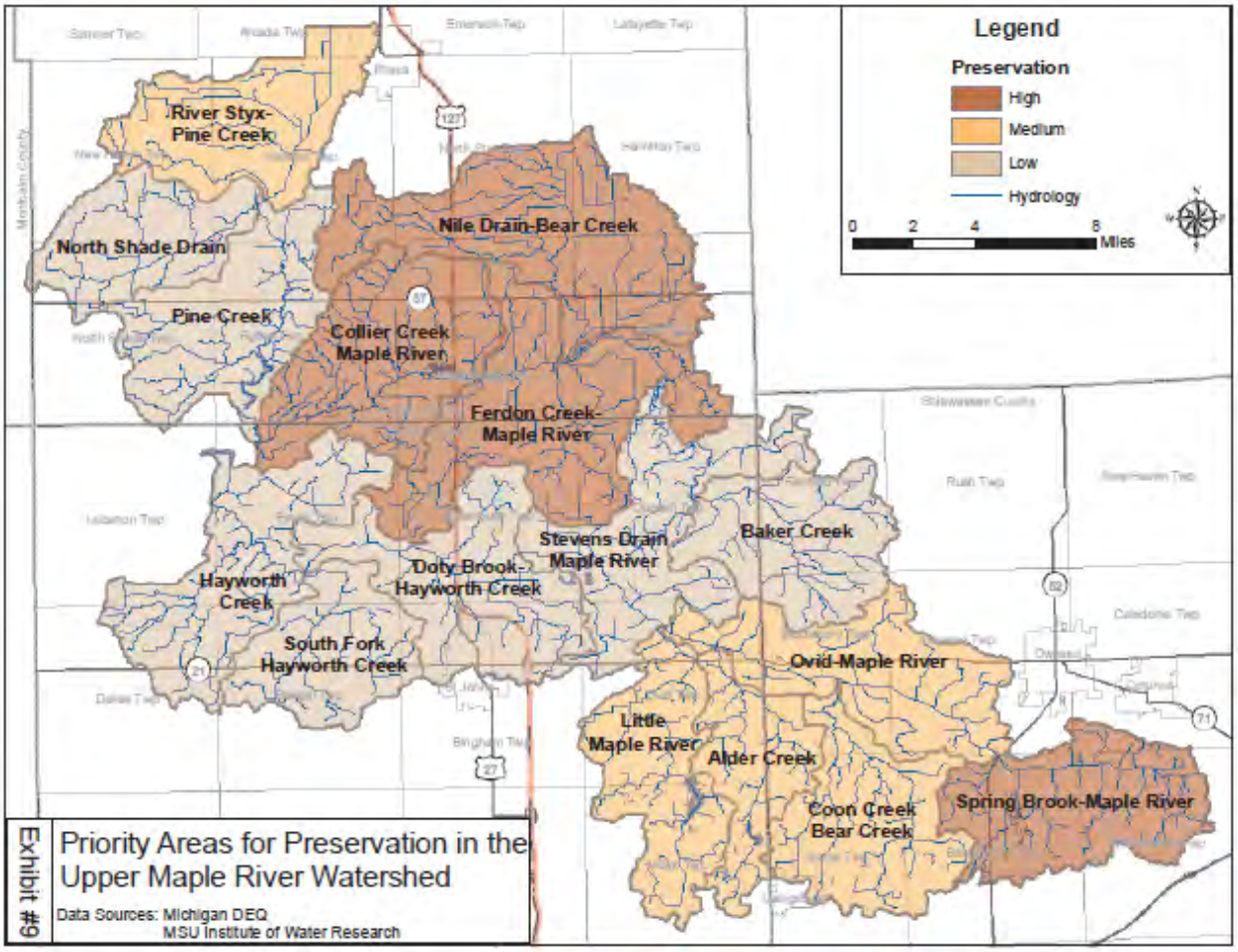

Legend
Preservation
High
Medium
Low
Hydrology
0 2 4 8 Miles
River Styx-Pine Creek
North Shade Drain
Pine Creek
Nile Drain-Bear Creek
Collier Creek Maple River
Ferdon Creek-Maple River
Stevens Drain Maple River
Baker Creek
Hayworth Creek
Doty Brook-Hayworth Creek
South Fork Hayworth Creek
Ovid-Maple River
Little Maple River
Alder Creek
Coon Creek Bear Creek
Spring Brook-Maple River
Exhibit #9
Priority Areas for Preservation in the Upper Maple River Watershed
Data Sources: Michigan DEQ
MSU Institute of Water Research

**Table 4.4 – Priority Areas for Preservation and Protection**

| Subwatershed | Subwatershed Priority | Priority Areas for Preservation and Protection | | | | | | MNFI Potential Conservation Areas (Patch Analysis –1=most area within the PCA area) | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Purchase of Development Rights Lands (1= highest % ac. prime farmland) | Green Infrastructure (1=most permanently protected lands) | Wetland acres enrolled in WRP (1=most enrolled) | Wetlands acres lost since circa 1800 (1=most critical to preserve) | Michigan Natural Features Inventory (1=most sections w/T&E) | MDNRE Project Boundaries (1=most MDNRE buffer area) | | |
| Collier Creek-Maple River | High | 16 | 1 | 4 | 4 | 5 | 2 | 2 | 30 |
| Nile Drain-Bear Creek | High | 15 | 2 | 1 | 1 | 10 | 1 | 1 | 30 |
| Ferdon Creek-Maple River | High | 13 | 4 | 3 | 2 | 6 | 3 | 3 | 34 |
| Spring Brook-Maple River | High | 4 | 7 | 5 | 16 | 2 | 5 | 5 | 39 |
| Ovid-Maple River | Medium | 5 | 10 | 5 | 11 | 1 | 5 | 9 | 41 |
| Little Maple River | Medium | 9 | 3 | 5 | 13 | 9 | 5 | 4 | 43 |
| Coon Creek-Bear Creek | Medium | 2 | 14 | 5 | 14 | 3 | 5 | 6 | 44 |
| River Styx-Pine Creek | Medium | 5 | 8 | 5 | 5 | 12 | 5 | 13 | 48 |
| Alder Creek | Medium | 7 | 5 | 4 | 14 | 7 | 4 | 12 | 49 |
| Baker Creek | Low | 1 | 16 | 5 | 10 | 4 | 5 | 14 | 50 |
| Pine Creek | Low | 11 | 12 | 5 | 6 | 11 | 5 | 7 | 52 |
| North Shade Drain | Low | 2 | 15 | 5 | 3 | 12 | 5 | 16 | 53 |
| Stevens Drain-Maple River | Low | 13 | 9 | 2 | 8 | 8 | 5 | 8 | 53 |
| Doty Brook-Hayworth Creek | Low | 8 | 13 | 5 | 6 | 12 | 5 | 11 | 55 |
| South Fork Hayworth Creek | Low | 11 | 6 | 6 | 8 | 12 | 5 | 15 | 57 |
| Hayworth Creek | Low | 10 | 11 | 5 | 12 | 12 | 5 | 10 | 60 |

# 5.0 GOALS AND OBJECTIVES OF THE WATERSHED

## 5.1 GOALS FOR THE UPPER MAPLE RIVER WATERSHED

The Steering Committee used the results of the information collected during the course of the Project and the status of the designated uses to develop the goals for the Watershed. The goals are based on reducing and/or eliminating the impacts of nonpoint source (NPS) pollutants within the Watershed, restoring or maintaining the designated uses, and supporting desired uses. The following goals have been prioritized based on decisions by the Steering Committee:

1. Protect and maintain water bodies for agricultural use (met designated use).
2. Restore and maintain water bodies for other indigenous aquatic life and wildlife use (impaired designated use).
3. Restore and maintain waterbodies for warmwater fishery use (impaired designated use).
4. Restore and maintain waterbodies for partial body contact recreational use (threatened designated use).
5. Restore and maintain waterbodies for total body contact recreational use (threatened designated use).
6. Protect and maintain waterbodies for navigational use.
7. Preserve high-quality areas.
8. Promote and support desired uses identified during development of this watershed plan.
9. Educate stakeholders about the Watershed and the impacts that stakeholders have on the Watershed.
10. Create a sustainable strategy for implementing the Watershed Management Plan (WMP).

Table 5.1 lists the goals and objectives for segments of the impaired, threatened, and met designated uses for water bodies within the Watershed, and the pollutants, sources, and causes, which were introduced in Table 4.1. The information presented in Table 5.1 is prioritized by designated uses, pollutants, sources and causes, as determined by the Steering Committee.

**Table 5.1 - Goals and Objectives**

| Prioritized Designated Use | Goal | Pollutants and Impairments to Designated Uses | Sources | Causes | Objectives |
|---|---|---|---|---|---|
| 1. Agriculture | Protect and maintain waterbodies for agricultural use | No pollutants impairing or threatening use. | N/A | N/A | Implement farmland conservation and preservation tools. Encourage use of General Acceptable Agricultural Management Practices. |
| 2. Other Indigenous Aquatic Life and Wildlife<br><br>3. Warmwater Fishery | Restore and maintain waterbodies for other indigenous aquatic life and wildlife use.<br><br>Restore and maintain waterbodies for warmwater fishery use. | 1. Sediment (k) | 1. Cropland (k) | 1. Tillage practices (k) | Implement cropland management practices. |
| | | | | 2. Lack of buffers (k) | Implement vegetative filtering practices. |
| | | | | 3. Dense drainage network (k) | Implement recommended drain maintenance practices |
| | | | 2. Streambanks (k) | 1. Altered morphology and hydrology (k) | Implement watershed focused land-use planning. Implement channel stabilization and erosion control techniques. |
| | | | | 2. Uncontrolled livestock access (k) | Implement livestock management practices. |
| | | | | 3. Removal of vegetation (k) | Implement streambank stabilization, bio-engineering, and erosion control techniques. |
| | | | 3. Gravel roads (k) | 1. Runoff to roadside ditch or drain (k) | Implement streambank stabilization and erosion control techniques. |
| | | | 4. Rill and gully erosion (k) | 1. Concentrated flow from roadside ditch and agricultural land (k) | Implement streambank stabilization and erosion control techniques. |
| | | | 5. Lakeshore erosion (k) | 1. Boat traffic/seawalls/wave action (k) | Produce educational materials and signs. |
| | | | | 2. Vegetation removal | Implement shoreline protection techniques. Implement erosion control techniques. |
| | | | 6. Streambed (k) | 1. Headcutting (culvert placement) (s) | Implement channel stabilization and erosion control techniques. |
| | | | | 2. Headcutting (altered morphology/hydrology) (s) | Implement channel stabilization and erosion control techniques. |

**Table 5.1 - Goals and Objectives**

| Prioritized Designated Use | Goal | Pollutants and Impairments to Designated Uses | Sources | Causes | Objectives |
|---|---|---|---|---|---|
| 2. Other Indigenous Aquatic Life and Wildlife | Restore and maintain waterbodies for other indigenous aquatic life and wildlife use. | 2. Nutrients (s); Phosphorus (k) – total maximum daily load | 1. Cropland (k) | 1. Over or improper application of manure/fertilizers (s) | Implement proper fertilizer application practices, manure management planning and implementation, and watershed focused land-use planning. |
| | | | 2. Livestock (k) | 1. Uncontrolled livestock access (k) | Implement livestock management practices. |
| 3. Warmwater Fishery continued | Restore and maintain waterbodies for warmwater fishery use. continued | | | 2. Lack of buffer and/or setbacks at holding facilities adjacent channel (k) | Implement vegetative filtering practices and manure management planning and implementation. |
| | | | 3. Dense areas of maintained landscapes (s) | 1. Over or improper application of fertilizers (s) | Implement turf management practices. |
| | | | | 2. Lack of riparian buffer on lakes (s) | Implement lakeshore management practices. |
| | | | 4. Septic systems (s) | 1. Improper maintenance (s) | Implement septic system management practices. |
| | | | 5. Golf course (s) | 1. Over or improper application of fertilizers (s) | Implement turf management practices. |
| | | | | 2. Lack of buffers (k) | Implement vegetative filtering practices. |
| | | | 6. Ducks and geese (s) | 1. Maintained lawn to edge of water (s) | Implement vegetative buffer practices. |
| | | | | 2. Overpopulation of waterfowl (s) | Implement MDNRE population management practices. |

**Table 5.1 - Goals and Objectives**

| Prioritized Designated Use | Goal | Pollutants and Impairments to Designated Uses | Sources | Causes | Objectives |
|---|---|---|---|---|---|
| 2. Other Indigenous Aquatic Life and Wildlife | Restore and maintain waterbodies for other indigenous aquatic life and wildlife use. | 3. Pathogens (bacteria) (p) | 1. Livestock (p) | 1. Over or improper application of manure (p) | Implement manure management planning and implementation. |
| | | | | 2. Lack of buffer and/or setbacks at holding facilities adjacent channel (s) | Implement vegetative buffering practices and manure management planning and implementation. |
| 3. Warmwater Fishery continued | Restore and maintain waterbodies for warmwater fishery use. | | 2. Septic systems (p) | 1. Improper maintenance (p) | Implement septic systems management practices. |
| | | | 3. Ducks and geese (p) | 1. Maintained lawn to edge of water (s) | Implement vegetative buffering practices. |
| | | | | 2. Overpopulation of waterfowl (p) | Implement MDNRE population management practices. |
| | | 4. Temperature (p) | 1. Lack of riparian canopy (p) | 1. Removal of riparian vegetation (p) | Implement vegetative buffering practices. |
| | | 5. Pesticides (p) | 1. Cropland (p) | 1. Over or improper application of pesticides (p) | Implement proper pesticide application practices and watershed focused land-use planning. |
| | | | 2. Dense areas of maintained landscapes (p) | 1. Over or improper application of pesticides (p) | Implement turf management practices. |
| | | | | 2. Lack of riparian buffer on lakes (p) | Implement lakeshore management practices. |
| | | | 3. Golf courses (p) | 1. Over or improper application of pesticides (p) | Implement proper pesticide application practices and watershed focused land-use planning. |
| | | | | 2. Lack of riparian buffer (p) | Implement vegetative buffering practices. |
| | | | 4. Orchards (p) | 1. Over or improper application of pesticides (p) | Implement proper pesticide application practices and watershed focused land-use planning. |
| | | | | 2. Lack of riparian buffer (p) | Implement vegetative buffering practices. |

**Table 5.1 - Goals and Objectives**

| Prioritized Designated Use | Goal | Pollutants and Impairments to Designated Uses | Sources | Causes | Objectives |
|---|---|---|---|---|---|
| 4. Partial Body Contact Recreation | Restore and maintain waterbodies for partial body contact recreational use | 1. Pathogens (Bacteria) (p) | 1. Livestock (p) | 1. Over or improper application of manure (p) | Implement manure management planning and implementation. |
| | | | | 2. Lack of buffer and/or setbacks at holding facilities adjacent channel (s) | Implement vegetative buffering practices and manure management planning and implementation. |
| | | | 2. Septic systems (p) | 1. Improper maintenance (p) | Implement septic system management practices. |
| | | | 3. Ducks and geese (p) | 1. Maintained lawn to edge of water (p)<br>2. Overpopulation of waterfowl (p) | Implement vegetative buffering practices.<br>Implement MDNRE population management practices. |
| 5. Total Body Contact Recreation | Restore and maintain waterbodies for total body contact recreational use | 1. Pathogens (Bacteria) (p) | 1. Livestock (p) | 1. Over or improper application of manure (p) | Implement manure management planning and implementation. |
| | | | | 2. Lack of buffer and/or setbacks at holding facilities adjacent channel (s) | Implement vegetative buffering practices and manure management planning and implementation. |
| | | | 2. Septic systems (p) | 1. Improper maintenance (p) | Implement septic system management practices. |
| | | | 3. Ducks and geese (p) | 1. Maintained lawn to edge of water (p)<br>2. Overpopulation of waterfowl (p) | Implement vegetative buffering practices.<br>Implement MDNRE population management practices. |
| 6. Navigation | Protect and maintain waterbodies for navigational use | 1. Obstructions (s) | 1. Log-jams (k) and excessive sedimentation | 1. Erosion and natural processes (k) | Implement river friendly channel maintenance techniques and river restoration practices. |

NOTES:
Known (k) = documented and measured during any of the inventory methods.
Suspected (s) = indications or impacts of them were observed, but the pollutants or sources themselves were not measured.
Potential (p) = identified based upon land use conducive to serving as a source of that pollutant, but no visual observation or measurements were made.

## 5.2 OBJECTIVES FOR THE WATERSHED GOALS

The goals of the WMP will be accomplished by implementing techniques to address the causes of the sources of NPS pollution, and by meeting the objectives of harnessing existing positive community awareness, utilizing locally driven experienced agency resources, retaining qualified staff, and selecting qualified contractors.

The objectives to meet the goals of protecting and maintaining waterbodies for the agricultural and navigational designated uses that are currently being met can be achieved by reducing sediment and nutrient pollution in the Watershed, as shown in Table 5.1 - Goals and Objectives. This objective will be accomplished by implementing Best Management Practices (BMPs) to specifically address the sources and causes of pollutants.

The goals of restoring and maintaining the impaired designated uses of the Watershed (Other Indigenous Aquatic Life and Wildlife, Warmwater Fishery) and the goals of restoring and maintaining the threatened designated uses (Partial Body Contact Recreation, Total Body Contact Recreation) can also be achieved by reducing sediment and nutrient pollution in the Watershed as shown in Table 5.1 - Goals and Objectives. This objective will be accomplished by:

1. Implementing BMPs to specifically address the sources and causes of pollutants in the Watershed; and

2. Developing and implementing specific land-use recommendations using a Watershed-based approach. Working with communities to protect water quality and reduce NPS pollution on a multi-township or county-wide basis through the revision of master plans, addition of ordinances for natural resource protection, and zoning to protect water quality.

The goal of preserving the high quality areas can be achieved by reducing sediment and nutrient pollution in the Watershed through promoting the use of preservation tools. The Steering Committee discussed the objectives for this goal, with assistance from the Policy Committee, to identify the tools and programs available for preservation and conservation. This objective will be accomplished by developing and implementing specific land preservation and protection measures using a Watershed-based approach. For example, preserving farmland is the overall goal, but this WMP presents opportunities for improved practices for reducing impacts of the farming practices through a Purchase of Development Rights (PDR) program. Refer to Chapter 6 explains this more.

The goals of supporting and promoting the desired uses in the Watershed will be accomplished by following the objectives indicated in Table 3.1 of the WMP. These objectives will be achieved by working with agencies and groups to implement actions identified in Table 3.1 - Desired Uses.

The goal of increased awareness about the watershed will be addressed with the implementation of the information and education (I&E) strategy. Objectives for this goal are presented in Chapter 7 - I&E Strategy.

Objectives for the sustainability goal are presented in Chapter 9 - Sustainability. The Steering Committee will continue to work toward sustaining the momentum for meeting the goals and objectives established for the Watershed through continuing to network closely with the Friends of the Maple River organization and acting on opportunities to coordinate with adjacent watersheds.

# 6.0 IMPLEMENTATION PLAN

A Best Management Practice (BMP) is a land management practice that is implemented to control sources or causes of pollution. Three types of BMPs can treat, prevent, or reduce water pollution:

- Structural BMPs are practices that require construction activities to install, such as installing livestock crossings, grade stabilization structures, or rock rip rap.
- Vegetative BMPs are practices that use plants to stabilize eroding areas, such as planting grasses, trees, or shrubs in a riparian buffer.
- Managerial BMPs are practices that involve changing the operating procedures at a site.

## 6.1 RECOMMENDED STRUCTURAL AND VEGETATIVE BMPS

The Project Committees used the information from the inventories to determine the needed BMPs for each subwatershed. A large number of BMPs are recommended to solve nonpoint source (NPS) pollution problems in the Upper Maple River Watershed; however, certain specific BMPs will be critical to meeting the goals of the Watershed project.

The BMPs were selected from a review of existing practices compiled and recommended by the Michigan Department of Natural Resources and Environment (MDNRE), the Michigan Department of Transportation (MDOT), the Natural Resources Conservation Service (NRCS) Field Office Technical Guide, and the State-wide Low Impact Development Manual. These selections were further reviewed during meetings with landowners and producers to ensure reasonability of implementation. A complete list of references can be found in the References section. A master BMP list is included in Appendix 14. Individual structural and vegetative BMPs were selected to control NPS of pollution from areas in the Watershed. The prioritized BMPs are based on innovative drain maintenance practices, findings from the inventory, and prioritized pollutants. The critical and priority subwatersheds, listed for the prioritized BMPs in Table 6.1, follow the order in which they were prioritized in Table 4.3. The quantities of recommended BMPs are based on the inventories conducted for this project, as well as recommendations from the Steering Committee. An inventory will need to be conducted on areas not fully assessed, as described in Chapter 4, in order to quantify the BMPs for those areas. The Action Plan outlined in Table 6.1 includes a detailed list of activities that describe the actions needed to be taken to achieve the project goals and objectives. Table 6.2 lists the measurable milestones, monitoring components, evaluation criteria, and responsible partners for those actions listed in the Action Plan.

## 6.2 MANAGERIAL STRATEGIES

The Project Committees determined the needed managerial strategies for each subwatershed, based on the existing land use policies, agricultural management practices, and government regulations. Numerous

strategies can be used to protect land and water in the Upper Maple River Watershed; however, certain specific preservation techniques will be critical to meeting the goals of the Watershed project.

The resulting selection of strategies is needed to control NPS pollution from areas in the Watershed. The strategies were prioritized based on prioritized pollutants. The management strategies are outlined in Table 6.1, which includes a detailed list of management activities that describe the actions needed to be taken to achieve the Project goals and objectives.

Management practices include protection measures for priority areas for preservation, which are areas identified to protect and prevent future impacts to water quality. These areas are described in Section 4.4 and in Table 4.4.

## 6.3 WETLAND RESTORATION/PRESERVATION

Wetlands slow and retain surface water, providing water storage and streambank/shoreline stabilization; therefore, restoring and preserving wetlands is a critical step toward maintaining and improving water quality within the Watershed. The MDNRE has completed the Landscape Level Wetland Functional Assessment for the Watershed. Specific details regarding the assessment can be located in Section 3.3.6 of the Watershed Management Plan (WMP). This information can be used to develop policies and practices for wetland restoration and preservation. A goal of 2% wetland restoration has been set for this Watershed, which equates to approximately 2,040 acres.

Wetland preservation/protection can be accomplished in several different ways, such as conservation easements and local wetland ordinances. Additional information on protection tools can be found in Appendix 16.

## 6.4 LAND USE PLANNING

The way land is managed, its patterns, relationship to natural resources, and how water is managed onsite all have impact on the water quality in the Watershed. Land management generally occurs at the local level.

Ordinances can be used as a foundation for the institutionalization of Watershed stewardship behavior. A Policy Review Document was created to analyze subdivision codes, zoning regulations, parking and street standards, and other local standards and ordinances adopted by Clinton, Gratiot, and Shiawassee Counties, Fulton Township, and the Village of Ovid that impact water quality. The document also identifies gaps in water resource protection.

The Policy Committee provided valuable input and expertise in developing the recommendations for the Watershed based on the results of the policy review. The Committee reviewed specific model ordinances for the Watershed that included standards and consistent language for each strategy that could be adopted by the communities to strengthen their resource protection measures. Appendix 15 includes the Policy Review Document and a table of the report's findings.

The results of this policy review reveal specific areas of the existing development rules that are generally good in their efforts of Watershed protection and other areas that need improvement. The principles presented in the policy review document can be adapted to develop goals and objectives for the community Master Plan. They align with two specific "Principles of Smart Growth" that are directly related to environmental protection (Smart Growth Network):

- Preserve Open Space, Farmland, Natural Beauty, and Critical Environmental Areas

  Open space preservation supports smart growth goals by bolstering local economies, preserving critical environmental areas, improving our communities' quality of life, and guiding new growth into existing communities. Clinton and Shiawassee County have adopted Purchase of Development Rights Programs to preserve agricultural land. Gratiot County has identified areas that should be preserved, but have not yet adopted a program.

- Strengthen and Direct Development Toward Existing Communities

  Smart growth directs development toward existing communities already served by infrastructure, seeking to utilize the resources that existing neighborhoods offer, and conserve open space and irreplaceable natural resources on the urban fringe. Clinton County's Future Land Use Plan identifies an urban service area in which is the preferred area for development and growth.

As the case with many local municipal and state regulations, agricultural land uses are exempt from those rules. Some communities have addressed that gap by requiring certain water quality BMPs be used when farmland is enrolled in a land protection or conservation arrangement. The "Healthy Water, Rural Pride" initiative is being promoted in several Watersheds in southwest Michigan and could become a model for other areas. The status of the initiative should be monitored for its success and transferability to other Watersheds.

Not all of the principles in this review will be applicable to the communities and should be considered as guidelines rather than milestones. The use of the principles to begin discussion on these issues will eventually lead to protecting natural and aquatic resources and revising the Master Plan, if necessary.

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement cropland management practices | Pine Creek | 240 acres | 2,250 acres of Crop residue management; cover crop; field tile management; critical area planting; wetland restoration | $300/acre | NRCS, CCD, MSUE, DU (1 hour/acre at $25/hour) | USDA Farm Bill programs, USFWS grant funding, DU funding | $72,000 | $675,000 |
| | Hayworth Creek | 190 acres | | | | | $57,000 | |
| | Collier Creek | 380 acres | | | | | $114,000 | |
| | S. Fork Hayworth Creek | 60 acres | | | | | $18,000 | |
| | North Shade Drain | 60 acres | | | | | $18,000 | |
| | Alder Creek | 80 acres | | | | | $24,000 | |
| | Spring Brook | 180 acres | | | | | $54,000 | |
| | Baker Creek | 75 acres | | | | | $22,500 | |
| | Ferdon Creek | 85 acres | | | | | $25,500 | |
| | Nile Drain | 200 acres | | | | | $60,000 | |
| | River Styx | 85 acres | | | | | $25,500 | |
| | Coon Creek | 200 acres | | | | | $60,000 | |
| | Little Maple River | 150 acres | | | | | $45,000 | |
| | Doty Brook | 85 acres | | | | | $25,500 | |
| | Stevens Drain | 80 acres | | | | | $24,000 | |
| | Ovid-Maple River | 100 acres | | | | | $30,000 | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement vegetative filtering/buffering practices | Spring Brook | 1,000 ft | 3,000 ft of grassed waterways | $1.70/ft | NRCS, CCD, MSUE, DU (1 hour/acre at $25/hour) | USDA Farm Bill programs | $1,700 | $5,100 |
| | Doty Brook | 2,000 ft | | | | | $3,400 | |
| | Pine Creek | 27 miles | 386 miles of harvestable buffer/filter strips; native plantings | $9,000/mile (assuming 50 ft wide) | | | $243,000 | $3,474,000 |
| | Hayworth Creek | 29 miles | | | | | $261,000 | |
| | Collier Creek | 24 miles | | | | | $216,000 | |
| | S. Fork Hayworth Creek | 24 miles | | | | | $216,000 | |
| | North Shade Drain | 27 miles | | | | | $243,000 | |
| | Alder Creek | 12 miles | | | | | $108,000 | |
| | Spring Brook | 10 miles | | | | | $90,000 | |
| | Baker Creek | 14 miles | | | | | $126,000 | |
| | Ferdon Creek | 33 miles | | | | | $297,000 | |
| | Nile Drain | 61 miles | | | | | $549,000 | |
| | River Styx | 31 miles | | | | | $279,000 | |
| | Coon Creek | 9 miles | | | | | $81,000 | |
| | Little Maple River | 13 miles | | | | | $117,000 | |
| | Doty Brook | 17 miles | | | | | $153,000 | |
| | Stevens Drain | 32 miles | | | | | $288,000 | |
| | Ovid-Maple River | 23 miles | | | | | $207,000 | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement recommended drain maintenance practices, focused land-use planning, channel stabilization, and erosion control techniques | Entire Watershed | 3 counties | 3 Storm water criteria or ordinances | $5,000/ ordinance | County and Township Planning Commissions, Economic Development Committees | People and Land Grants, Rural Development funding | $15,000 | $15,000 |
| | | 3 counties | 3 Buffer overlay zone ordinances | $5,000/ ordinance | | | $15,000 | $15,000 |
| | | 23 communities | 23 Wetlands ordinances | $5,000/ ordinance | | | $115,000 | $115,000 |
| | | 23 communities | 23 Floodplain mapping overlay districts | $5,000/ ordinance | | | $115,000 | $115,000 |
| Implement livestock management practices | Pine Creek | 4,100 ft of channel | 18,475 ft of cattle exclusion or controlled access or cattle crossing | $1.50/ft | NRCS, CCD, MDA, MDEQ, local farmers | USDA Farm Bill programs | $6,150 | $27,713 |
| | Hayworth Creek | 6,975 ft of channel | | | | | $10,463 | |
| | Collier Creek | 2,800 ft of channel | | | | | $4,200 | |
| | Alder Creek | 1,600 ft of channel | | | | | $2,400 | |
| | Ferdon Creek | 2,500 ft of channel | | | | | $3,750 | |
| | Stevens Drain | 500 ft of channel | | | | | $750 | |
| | S. Fork Hayworth Creek | 500 ft of channel | 500 ft of buffer/filter strips or setback near existing crossing | $9,000/mile | | | $900 | $900 |
| | Pine Creek | 3 sites | 10 sites for alternative water sources | $3,700/each | | | $11,100 | $7,400 |
| | Hayworth Creek | 2 sites | | | | | $7,400 | |
| | Collier Creek | 1 site | | | | | $3,700 | |
| | S. Fork Hayworth Creek | 1 site | | | | | $3,700 | |
| | Alder Creek | 1 site | | | | | $3,700 | |
| | Ferdon Creek | 1 site | | | | | $3,700 | |
| | Stevens Drain | 1 site | | | | | $3,700 | |
| | Pine Creek | 1 site | 9 sites for buffer or setback at holding facility | $2,500/site | | | $2,500 | $22,500 |
| | Hayworth Creek | 1 site | | | | | $2,500 | |
| | Collier Creek | 1 site | | | | | $2,500 | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| | S. Fork Hayworth Creek | 1 site | | | | | $2,500 | |
| | North Shade Drain | 1 site | | | | | $2,500 | |
| | River Styx | 3 sites | | | | | $7,500 | |
| | Stevens Drain | 1 site | | | | | $2,500 | |
| Implement streambank stabilization, bio-engineering, and erosion control techniques | Collier Creek | 160 ft of channel | 260 ft of streambank stabilization | 100/ft | NRCS, CCD, consultants, Drain Commissioners, MDNRE | CMI, GLRI, USFWS | $16,000 | $26,000 |
| | North Shade Drain | 100 ft of channel | | | | | $10,000 | |
| | Pine Creek | 1 study/ subwatershed | 5 hydrologic and morphologic studies; storm water design criteria | $20,000/study | | | $20,000 | $100,000 |
| | Hayworth Creek | | | | | | $20,000 | |
| | Collier Creek | | | | | | $20,000 | |
| | S. Fork Hayworth Creek | | | | | | $20,000 | |
| | Ferdon Creek | | | | | | $20,000 | |
| | Pine Creek | 8,525 ft of channel | 44,480 ft of channel restoration; streambank stabilization | $100/ft | | | $852,500 | $4,448,000 |
| | Hayworth Creek | 7,365 ft of channel | | | | | $736,500 | |
| | Collier Creek | 15,900 ft of channel | | | | | $1,590,000 | |
| | S. Fork Hayworth Creek | 1,395 ft of channel | | | | | $139,500 | |
| | Ferdon Creek | 11,295 ft of channel | | | | | $1,129,500 | |
| | Collier Creek | 3,000 ft of channel | 9,395 ft of buffer/filter strips | $1.70/ft | | | $5,100 | $15,972 |
| | S. Fork Hayworth Creek | 1,395 ft of channel | | | | | $2,372 | |
| | Ferdon Creek | 5,000 ft of channel | | | | | $8,500 | |
| | Pine Creek | 135 acres | 2,040 acres of wetland restoration; constructed wetland; reconnect floodplains; regional detention | $5,000/acre | | | $675,000 | $10,200,000 |
| | Hayworth Creek | 105 acres | | | | | $525,000 | |
| | Collier Creek | 175 acres | | | | | $875,000 | |
| | S. Fork Hayworth Creek | 85 acres | | | | | $425,000 | |
| | North Shade Drain | 115 acres | | | | | $575,000 | |
| | Alder Creek | 35 acres | | | | | $175,000 | |
| | Spring Brook | 50 acres | | | | | $250,000 | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| | Baker Creek | 90 acres | | | | | $450,000 | |
| | Ferdon Creek | 305 acres | | | | | $1,525,000 | |
| | Nile Drain | 330 acres | | | | | $1,650,000 | |
| | River Styx | 125 acres | | | | | $625,000 | |
| | Coon Creek | 50 acres | | | | | $250,000 | |
| | Little Maple River | 55 acres | | | | | $275,000 | |
| | Doty Brook | 150 acres | | | | | $750,000 | |
| | Stevens Drain | 135 acres | | | | | $675,000 | |
| | Ovid-Maple River | 100 acres | | | | | $500,000 | |
| Produce educational materials and signs | Lake areas | See "I&E Strategy" | Distribute educational materials to lake users which coordinate all lake issues including: restrictions on boat traffic, enhanced enforcement, limiting phosphorus use on lawns, and limiting keyhole access | Costs included in “I&E Strategy” | See "I&E Strategy" | See "I&E Strategy" | | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement proper fertilizer application practices | Pine Creek | 8,750 acres | 139,105 acres of nutrient management; field tile management | $250/acre | NRCS, CCD, MSUE, DU (1 hour/acre at $25/hour) | USDA Farm Bill programs | $2,187,500 | $34,801,250 |
| | Hayworth Creek | 9,960 acres | | | | | $2,490,000 | |
| | Collier Creek | 8,770 acres | | | | | $2,217,500 | |
| | S. Fork Hayworth Creek | 6,840 acres | | | | | $1,710,000 | |
| | North Shade Drain | 6,800 acres | | | | | $1,700,000 | |
| | Alder Creek | 5,080 acres | | | | | $1,270,000 | |
| | Spring Brook | 8,400 acres | | | | | $2,100,000 | |
| | Baker Creek | 7,980 acres | | | | | $1,995,000 | |
| | Ferdon Creek | 12,550 acres | | | | | $3,137,500 | |
| | Niles Drain | 12,300 acres | | | | | $3,075,000 | |
| | River Styx | 8,100 acres | | | | | $2,025,000 | |
| | Coon Creek | 7,750 acres | | | | | $1,937,500 | |
| | Little Maple River | 7,050 acres | | | | | $1,762,500 | |
| | Doty Brook | 9,700 acres | | | | | $2,425,000 | |
| | Stevens Drain | 9,850 acres | | | | | $2,462,500 | |
| | Ovid-Maple River | 9,225 acres | | | | | $2,306,250 | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement manure management practices | Livestock facilities | 30 facilities | 30 waste storage facilities/ composting facilities | $50,000 each | NRCS, CCD | USDA Farm Bill programs | $1,500,000 | $1,500,000 |
| | Livestock facilities | 30 facilities | 30 CNMPs; promote incorporation | $5,000 each | | | $150,000 | $150,000 |
| Implement turf management practice | Residential areas | 925 acres | 925 acres of residential turf management practices | | NRCS, MSUE | Rural Development | | |
| Implement lakeshore management and shoreline protection practices | Pine Creek | 4.7 miles | 9.4 miles of buffer/filter strips; native landscaping | $9,000/mile | NRCS, Drain Commissioners, Consultants | Lake Associations | $42,300 | $84,600 |
| | Alder Creek | 2.1 miles | | | | | $18,900 | |
| | Spring Brook | 2.1 miles | | | | | $18,900 | |
| | Little Maple River | 0.5 miles | | | | | $4,500 | |
| Implement septic system management practices | Rural residential | TBD | Identify and correct illicit discharge connections | | County Health Departments | Water Quality Monitoring funding | | |
| | | 770 systems | 770 repairs or replacements of aging septic systems | $7,500/each | | Rural Development | $5,775,000 | $5,775,000 |
| | | Clinton, Gratiot, and Shiawassee Counties | Recommend regular inspection and maintenance of septic systems through septic ordinance | | | Rural Development | | |

**Table 6.1 – Implementation Action Plan**

| Prioritized Objectives | Critical and Priority Areas | Estimated Quantity | Recommended Prioritized BMPs | Estimated Average Unit Costs | Technical Assistance | Financial Assistance | Total Costs (Over 10 Years) | Total Costs for Objective |
|---|---|---|---|---|---|---|---|---|
| Implement MDNRE waterfowl population management practices | Lake areas | 1 plan/lake | MDNRE waterfowl population management practices | $3,000/each | MDNRE, Consultants | MDNRE | $12,000 | $12,000 |
| Implement proper pesticide application practices | Entire Watershed | 1/year | Training on proper application techniques | $2,500/each | NRCS, CCD | NRCS, MSUE | $25,000 | $25,000 |
| Implement river friendly channel maintenance techniques and river restoration practices | Entire Watershed | Observed, not quantified | Channel maintenance and stream restoration practices | TBD | CDCs, Consultants | CDCs | TBD | TBD |
| | | | | | | | Total Cost | $61,610,434 |

BMP – Best Management Practices
CCD – Clinton County Conservation District
CDC – County Drain Commissioners
CMI – State of Michigan's Clean Michigan Initiative
CNMPs – Comprehensive Nutrient Management Plans
DU – Ducks Unlimited
GLRI – Great Lakes Restoration Initiative
MDA – Michigan Department of Agriculture
MDEQ – Michigan Department of Environmental Quality
MDNRE – Michigan Department of Natural Resources and Environment
MSUE – Michigan State University Extension
NRCS – Natural Resources Conservation Service
TMDL – Total Maximum Daily Load
USDA – U.S. Department of Agriculture
USFWS – U.S. Fish and Wildlife Service

The following estimation methods were used to determine the estimated quantities for each objective and BMP:

*Implement cropland management practices* – The number of acres for crop residue management, cover crop, field tile management, critical area planting, and wetland restoration were calculated using the High Impact Targeting System (HIT) model and results of the tillage survey. Specifically, those lands determined by the HIT model to be contributing 0.4 ton of sediment per acre per year were selected, and then adjusted based upon the appropriate tillage survey results. For example, the HIT model selected 647 acres from the Pine Creek subwatershed. The tillage survey for Pine Creek indicated that 37% of the area surveyed contained 0-10% crop residue. Therefore, 647 multiplied by 0.37 equals 240 acres.

*Implement vegetative filtering/buffering practices* – The estimates for grassed waterways were based on field survey data. Estimates for buffer strips were based upon review of aerial photography.

*Implement recommended drain maintenance practices, Watershed focused land use planning, channel stabilization, and erosion control techniques* – Policy Review Document.

*Implement livestock management practices* – Estimates were based upon field survey data.

*Implement streambank stabilization, bio-engineering, and erosion control techniques* – Estimates were based upon field survey data. Wetland restoration acreage was estimated based upon data provided in the Landscape Level Wetland Functional Assessment, conducted by the MDNRE. Existing wetland acreage was subtracted from historic wetland acreage, to determine acreage of wetland lost. This number was then multiplied by 0.02, resulting in a restoration goal of 2% of total wetlands lost.

*Produce educational signs and materials* – Information and Education Strategy.

*Implement proper fertilizer application practices* – Estimates were derived from 1992 land use data files. Specifically, agricultural land use was extracted from the data, and the total number of acres per subwatershed was multiplied by a factor of 0.5 to account for farms that may currently be under nutrient management programs, suggested by the Steering Committee as 50%.

*Implement manure management practices* – Estimates were based upon field survey data. The total number of animal agriculture facilities was summed, and then multiplied by a factor of 0.3 to account for Concentrated Animal Feeding Operations (CAFOs) and other farms that may currently have waste storage facilities or other manure management practices in place or are certified in the Michigan Agricultural Environmental Assurance Program (MAEAP), suggested by the Steering Committee as 30%.

*Implement turf management practices* - Estimates were derived from 1992 land use data files. Specifically, residential land use was extracted from the data, and the total number of acres was multiplied by a factor of 0.3 to account for residences that have fertilized lawns.

*Implement lakeshore management and shoreline protection practices* – Estimates for buffer strips were based upon review of aerial photography of lakes and estimating amount of unbuffered shorelines.

*Implement septic system management practices* – Estimates were based upon Shiawassee County Health Department Point of Sale data, which indicates that 7% of systems are causing pollution. Based upon U.S. Census data, approximately 11,000 homes exist in the Watershed, and using the estimate of 7%, about 770 would have problems.

*Implement MDNRE waterfowl population management practices* – One management plan per lake should be sufficient to address overpopulation of waterfowl.

*Implement proper pesticide application practices* – Since pesticides are a suspected source, a training workshop on proper application practices was suggested by the Steering Committee.

*Implement river friendly channel maintenance techniques and river restoration practices* – Sedimentation is a wide-spread problem observed throughout the Watershed. Although drains are well maintained and log jams are typically removed, the need for river restoration still exists. While log jams and sediment bars were observed during NPS surveys, no quantification was attempted as part of this planning effort.

The estimation methods were presented and approved by the MDNRE and the Steering Committee on December 15, 2009. The critical and priority areas in Table 6.1 follow the prioritization determined in Tables 4.3 and 4.4.

**Table 6.2 – Measureable Milestones**

| Prioritized Objectives | Measurable Milestones (1-5 years) | Measurable Milestones (5-10 years) | Monitoring Components | Evaluation Criteria | Responsible Partner |
|---|---|---|---|---|---|
| Implement cropland management practices | Address 225 acres through BMP implementation | Address 450 acres through BMP implementation | Pollutant reduction calculations | Prevent 28,460 tons/year (calculated by HIT model) of sediment from entering surface waters | Conservation Districts, NRCS, MDNRE |
| Implement vegetative filtering/buffering practices | Install 300 ft of grassed waterways, 38.6 miles of stream buffer, address 1 site of gully erosion through BMP implementation | Install 600 ft of grassed waterway, 77.2 miles of stream buffer, and 2 sites of gully erosion through BMP implementation | USDA NRCS yearly status reviews; photos of BMPs installed to reduce sediment; pollutant reduction calculations; water quality monitoring (Phosphorus (P), Nitrate/Nitrite (N)), TMDL report, MDNRE biosurveys, macroinvertebrate sampling; water temperature | Reduction in number of areas with lack of buffers and gully erosion sites contributing pollutants; miles of buffer installed; prevent 805 tons of sediment, 684 lbs/year of phosphorus and 1,369 lbs/year of nitrogen (calculated from NPS inventory for gully erosion) from entering surface water; meet WQS for *E. coli*; portfolio of photos with supporting documentation; meet MDNRE recommendations for normal phosphorus and nitrogen levels; all locations score "0" or greater in future macroinvertebrate surveys | NRCS, DU, USFWS, Conservation Districts, County Drain Commissioners, MDNRE, FOMR, Consultants, Volunteers |
| Implement recommended drain maintenance practices, Watershed focused land use planning, channel stabilization, and erosion control techniques | Draft ordinances and standards (3 communities) | Adopt and implement ordinances and standards for communities in critical areas (6 communities) | Ordinance and standards status | 100% of communities adopt ordinances and standards | Local units of government, County Drain Commissioners |
| Implement livestock management practices | Install 1,848 ft of exclusion fencing, 50 ft of buffers, 1 watering facility, and 1 setback on feedlot | Install 3,696 ft of exclusion fencing, 100 ft of buffers, 2 watering facilities, and 2 setbacks on feedlot | USDA NRCS yearly status reviews; before and after photos; pollutant reduction calculations; water quality monitoring; TMDL report | Eliminate all identified *E. coli* contributing sites, reduction in number of areas contributing pollutants; prevent 861 tons/year of sediment, 732 lbs/year of phosphorus, and 1,464 lbs/year of nitrogen (calculated from NPS inventory for livestock); meet WQS for partial body contact recreation and total body contact recreation 100% of the time in the Watershed | NRCS, Conservation Districts, MDNRE, County Drain Commissioners, FOMR, Consultants |
| Implement streambank stabilization, bio-engineering, and erosion control technique | Stabilize 4,475 ft of eroding streambank; restore 204 acres of wetland | Stabilize 8,950 ft of eroding streambank; restore 408 acres of wetland | County Road Commission reports; County Drain Commissioner Reports; photos of BMPs installed to reduce sediment; pollutant reduction calculations; bank pins | Reduction in number of streambanks contributing sediment; prevent 3,458 tons/year of sediment, 2,939 lbs/year of phosphorus, and 5,879 lbs/year of nitrogen (calculated from NPS inventory for streambank erosion); portfolio of photos with supporting documentation | County Road Commissions, County Drain Commissioners, landowners, Conservation Districts, MDNRE, FOMR |

**Table 6.2 – Measureable Milestones**

| Prioritized Objectives | Measurable Milestones (1-5 years) | Measurable Milestones (5-10 years) | Monitoring Components | Evaluation Criteria | Responsible Partner |
|---|---|---|---|---|---|
| Produce educational materials and signs | Design and install 3 educational signs. | Measure reduction of lakeshore erosion | Number of signs and before and after photos of erosion sites | Number of signs posted in the Watershed, reduction in lakeshore erosion resulting from behavior changes due to sign | Lake Associations, Conservation Districts, FOMR |
| Implement proper fertilizer application practices | Address 13,910 acres through nutrient management plans | Address 27,821 acres through nutrient management plans | Water quality monitoring upstream and downstream of acres with plans | Meet MDNRE recommendations for normal phosphorus and nitrogen levels | NRCS, Conservation Districts, MSUE, DU, Landowners, Golf Courses |
| Implement manure management planning and implementation | Install 3 waste storage facilities with CNMPs | Install 6 waste storage facilities with CNMPs | Water quality monitoring | Eliminate all identified *E. coli* contributing sites; meet WQS for partial body contact recreation and total body contact recreation 100% of the time in the Watershed | NRCS, Conservation Districts, Landowners |
| Implement turf management practice | Eliminate application of phosphorus fertilizer on 93 acres | Eliminate application of phosphorus fertilizer on 186 acres | Pollutant reduction calculations; water quality monitoring (Phosphorus (P), Nitrate/Nitrite (N)), TMDL report | Meet MDNRE recommendations for normal phosphorus and nitrogen levels. | NRCS, Conservation Districts, Landowners |
| Implement lakeshore management and shoreline protection practices | Implement 1 mile of shoreline management | Implement 2 miles of shoreline management | USDA NRCS yearly status reviews; photos of BMPs installed to reduce sediment; pollutant reduction calculations; water quality monitoring (Phosphorus (P), Nitrate/Nitrite (N)), TMDL report. | Meet MDNRE recommendations for normal phosphorus and nitrogen levels. | Lake Associations, Conservation Districts, FOMR |
| Implement septic system management practice | Identify illicit discharges; repair or replace 77 aging septic systems | Correct 50% of illicit discharges; repair or replace 154 aging septic systems | BMPs implemented to eliminate sources | Eliminate all identified *E. coli* contributing sites; meet WQS for partial body contact recreation and total body contact recreation 100% of the time in the Watershed | Local units of government, Conservation Districts, MDNRE, Health Depts., Lake Associations, Environmental Organizations, FOMR |
| Implement MDNRE waterfowl population management practices | Reduce waterfowl population by 10% | Reduce waterfowl population by 20% | Water quality monitoring | Meet WQS for partial body contact recreation and total body contact recreation 100% of the time in the Watershed | MDNRE, Conservation Districts, FOMR |

**Table 6.2 – Measureable Milestones**

| Prioritized Objectives | Measurable Milestones (1-5 years) | Measurable Milestones (5-10 years) | Monitoring Components | Evaluation Criteria | Responsible Partner |
|---|---|---|---|---|---|
| Implement proper pesticide application practices | Conduct 1 training session per year, for a total of 5 | Conduct 2 training sessions per year, for a total of 10 | Fish toxicity | Implement BMPs on areas where pesticide loading is a problem | Conservation Districts, MDNRE, Drain Commissioners, FOMR, Consultants |
| Implement river friendly channel maintenance techniques and river restoration practices. | Complete inventory of channel maintenance needs | Complete 10% of channel maintenance needs | Photos of BMPs installed to reduce sediment; pollutant reduction calculations | Miles of channel maintained or river restored. | NRCS. CCD, Consultants, County Drain Commissioners, MDNRE |

BMP – Best Management Practices
CCD – Clinton County Conservation District
CNMP – Comprehensive Nutrient Management Plan
DU – Ducks Unlimited
FOMR – Friends of the Maple River
HIT – High-Impact Targeting System
MDNRE - Michigan Department of Natural Resources and Environment
MSUE - Michigan State University Extension
NRCS – Natural Resources Conservation Service
TMDL – Total Maximum Daily Load
USDA – U.S. Department of Agriculture
USFWS – U.S. Fish and Wildlife Service
WQS – Water Quality Standards

## 6.5 ESTIMATED POLLUTION REDUCTIONS FROM PROPOSED ACTIONS AND BMPS

### 6.5.1 POLLUTANT LOADINGS AND REDUCTION GOALS FROM TMDL REPORTS

Total Maximum Daily Load (TMDL) reports completed by the MDEQ in 2007 (Pine Creek) and 2009 (Upper Maple River and Peet Creek) address the water bodies currently listed as impaired due to excessive nutrient loadings, as well as those water bodies upstream of the listed bodies, since they contribute nutrients to the impaired reaches. The overall objective of the TMDLs is to reduce total phosphorus loads to Pine Creek to concentrations below 0.08 mg/L (milligram per liter), and to the Upper Maple River and its tributaries and Peet Creek to concentrations below 0.06 mg/L. The current average concentration of total phosphorus is 0.22 mg/L in Pine Creek, 0.108 mg/L in the Upper Maple, and 0.331 mg/L in Peet Creek. To reach the phosphorus target in Pine Creek, the proposed load reduction is from 38.2 to 12.2 lbs/day. In the Upper Maple, the proposed load reduction from the entire nonpoint source is from 70.3 lbs/day to 19.2 lbs/day. For Peet Creek, the load must be reduced from 8.3 lbs/day to 0.63 lbs/day. Therefore, the reduction goals for the TMDL subwatersheds are:

- Pine Creek Subwatersheds: 26 lbs/day
- Upper Maple Subwatersheds: 51.1 lbs/day
- Peet Creek Subwatershed: 7.67 lbs/day

### 6.5.2 POLLUTANT LOADINGS AND REDUCTIONS FROM NPS SITES

According to the MDEQ *Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual*, June 1999, 100% pollutant reductions are assumed from the implementation of BMPs on the identified NPS sites; which means that once the system of BMPs is established, the stabilized condition is assumed to control the pollutant if properly maintained. Table 4.2 in Chapter 4 quantified the sources of pollutant loading. If all the NPS sites are addressed in the following TMDL subwatershed, phosphorus will be reduced as follows:

- Pine Creek Subwatersheds: 754 lbs/yr = 2.1 lbs/day
- Upper Maple Subwatersheds: 2,103 lbs/yr = 5.8 lbs/day
- Peet Creek Subwatershed: 942 lbs/yr = 2.6 lbs/day

Loadings and reductions from the NPS sites over the entire Watershed are estimated to be as follows:

- Sediment – 5,124 tons/yr = 14.03 tons/day
- Phosphorus – 4,355 lbs/yr = 11.93 lbs/day
- Nitrogen – 8,177 lbs/yr = 22.4 lbs/day

### 6.5.3 POLLUTANT LOADINGS AND REDUCTIONS FROM CROPLAND

Table 4.2 of the WMP presents the estimate of the loadings from cropland, based on the HIT model calculation. The total phosphorus loads from cropland in the TMDL subwatersheds are:

- Pine Creek Subwatersheds: 3,029 lbs/yr = 8.3 lbs/day
- Upper Maple Subwatersheds: 6,003 lbs/yr = 16.4 lbs/day
- Peet Creek Subwatershed: 2,020 lbs/yr = 5.5 lbs/day

These loadings calculated from the HIT model were ground-truthed to ensure that the model was accurately reflecting the conditions in the Watershed. Using this model to estimate reductions, however, has several limitations. The HIT tool allows only seven categories to address reductions: a 30 ft grass buffer, no till on worst 5% of erosion sites, no till on worst 10% of erosion sites, mulch till on worst 5% of erosion sites, mulch till on worst 10% of erosion sites, grass plantings on worst 5% of erosion sites, and grass plantings on worst 10% of erosion sites.

Pollutant loadings calculated from the HIT model for the entire Upper Maple River Watershed are listed in Table 4.2

- Sediment – 28,460 tons/yr = 77.97 tons/day
- Phosphorus – 24,191 lbs/yr = 66.28 lbs/day
- Nitrogen – 48,382 lbs/yr = 132.55 lbs/day

### 6.5.4 POLLUTANT REDUCTIONS TO MEET TMDL GOALS

For the Pine Creek subwatersheds, addressing all of the NPS sites and all of the cropland sites will result in a reduction of 10.4 lbs/day, which is 40% of the needed reduction.

For the Upper Maple River subwatersheds, addressing all of the NPS sites and all of the cropland sites will result in a reduction of 22.2 lbs/day, which is 43% of the needed reduction.

For the Peet Creek subwatershed, implementing practices to address the pollutants at all NPS sites and all of the cropland sites will result in a reduction of 8.1 lbs/day, which is meeting the reduction goal of 7.67 lbs/day.

The remaining needed reductions to meet the TMDL goals for Pine Creek and Upper Maple River subwatersheds will be attained through implementing other practices, as recommended in Table 6.1 and as described below. The feasible and attainable goals for BMP implementation were determined to be approximately 10% of the practices in 5 years and 20% by 2020. The pollutant loadings will be measured after 5 years of implementation, and the progress toward the goal will be evaluated. Implementation

schedules and practices will then be adjusted to ensure that the TMDL goals will be met. Additional sites will be determined as follows:

*Implement cropland management practices* – Table 6.1 identifies lands determined by the HIT model to be contributing 0.4 ton of sediment per acre per year. Additional lands could be added that are contributing less that 0.4 ton of sediment per year. Also, the tillage survey results indicated that 37% of the area surveyed contained 0-10% crop residue. If the fields that contained 10-30% residue were included, an additional 2,034 acres would be considered for cropland management practices.

*Implement livestock exclusion practices* – A total of 4,100 feet of streambank were identified as having uncontrolled access in Pine Creek. If all of these sites were addressed, additional loadings of phosphorus would be reduced.

*Implement streambank stabilization, bio-engineering, and erosion control techniques* – Wetland restoration acreage was estimated based upon data provided in the Landscape Level Wetland Functional Assessment, conducted by the MDNRE. The current wetland restoration goal is 2% of total wetlands lost. If the goal was raised to 5%, and additional 3,060 acres of wetlands would be restored to address erosion.

*Implement proper fertilizer application practices* – Currently, lands under nutrient management programs were estimated to be 50% of existing acreage. The number could actually be less than that, suggesting that if only 40% of the acreage were under nutrient management programs, another 27,821 acres could benefit from nutrient management programs.

*Implement manure management practices* – Currently, agricultural operations with waste storage facilities or other manure management practices in place or are certified in the MAEAP were estimated to 30% of existing operations. The number could actually be less than that, suggesting that if only 20% of the facilities had manure management practices, an additional 10 facilities could work toward reducing the phosphorus loading to the subwatersheds.

*Implement turf management practices* – Currently, residences that have fertilized lawns were estimated to be 30% of existing residences. The number could actually be more than that, suggesting that if 40% of the lawns were fertilized, then an additional 308 acres could utilize turf management practices to reduce phosphorus.

*Implement septic system management practices* – Currently, the census data estimates that 7% of the 11,000 homes in the Watershed have septic system failures. If the percentage was actually greater, at 10% for example, and additional 330 systems would be repaired or replaced to reduce pollutants.

### 6.5.5 LIMITATIONS OF MODELS USED IN WATERSHED MANAGEMENT PLANNING

The methods for estimating the pollutant loadings and reductions in the Upper Maple River Watershed included information from several resources.

First, the HIT model was used to estimate sediment loadings and reductions on cropland. According to HIT experts at Michigan State University, practices using the seven categories will never lead to 100% reduction. The tool is limited in that it only allows the user to use these specified categories and focuses on sheet flow. The data estimates are likely low, since no other type of erosion is considered. The intent of the tool, however, is to provide erosion estimates for prioritizing high risk sites, comparing common practices, and determining cost-effectiveness. The tool should be coupled with additional details to be precise with loadings and reductions.

Second, the Long Term Hydrologic Impact Analysis (L-THIA) model was used to estimate phosphorus loadings and reduction goals in the impaired subwatersheds. The model assumes that phosphorus loadings are from land-based sources. Loadings from these sources are determined based on land uses in the drainage basins. Daily loads of total phosphorus are estimated using basic input options in the L-THIA model, such as Watershed specific land use and soil type proportions, default curve numbers, and average precipitation rates.

Third, pollutant loadings and reductions on specific NPS sites were calculated based on the *MDEQ Pollutant Controlled Calculations and Documentation for Section 319 Watersheds Training Manual*, June 1999. The manual uses the Revised Universal Soil Loss Equation (RUSLE) and other simple algorithms to calculate nutrient and sediment loads for nonurban BMPs.

The use of these different models to estimate loadings and reductions in the Watershed result in differences of what can be expected for the implementation of BMPs. Because these models have different parameters, they will never align, nor should they, since they are being used to measure different characteristics about the Watershed. The recommendation to move forward, however, is to use a consistent model to ensure that progress can more accurately be measured. The most accurate measurement to begin with is the estimate of loadings and reductions at the specific nonpoint source sites, and then use of the HIT model since that was ground-truthed in the Watershed.

Table 6.1 assigns BMPs to all sites to reduce the source of pollutants. Table 6.2 describes the current measurable goals for 5 years and 10 years.

# 7.0 INFORMATION AND EDUCATION STRATEGY

## 7.1 GOALS AND OBJECTIVES OF I&E STRATEGY

The Information and Education (I&E) Strategy includes updating specific groups about the goals and progress of Watershed management projects; familiarizing stakeholders with the sources of nonpoint source (NPS) pollution and associated water quality problems; and educating municipalities, community groups, and schools about the negative impacts of NPS pollution on the Watershed. Many of the I&E activities need to be conducted on a Watershed-wide basis since it is important for everyone to understand their roles and responsibilities as residents in the Watershed. The Goals and Objectives of the strategy are tied to the prioritized pollutants, designated uses, and critical/priority areas, and should be implemented in the order in which it is presented.

The I&E Strategy has been formulated into a working document that outlines major educational opportunities and actions needed to successfully maintain and improve water quality in the Watershed. Appendix 17 presents the I&E Strategy.

The I&E Strategy has the following objectives, which will all be met if the Strategy is implemented:

- Increase public knowledge and broaden awareness of the Watershed.
- Educate stakeholders about the positive and negative environmental impacts of land use activities.
- Provide opportunities for comment and participation in implementing the Watershed Management Plan (WMP).
- Develop partnerships among stakeholders by sharing ideas, resources, and facilitating cooperative activities that increase public awareness of watershed management and impact land use policies.
- Create a sense of individual responsibility for the proper use and care of surface water resources.

## 7.2 IDENTIFYING TARGET AUDIENCES

The target audiences include individuals or groups known to impact or be impacted by the project and whose support is needed to achieve the goals of the project. The I&E Committee identified the following targeted audiences associated with the identified pollutants:

- All Watershed Residents – Public awareness of Watershed and all pollutants
- Urban Residents (areas with sewer infrastructure) – Public awareness of Watershed and all pollutants
- Hunters, Fishers, Outdoor Enthusiasts – Public awareness of Watershed and all pollutants
- Teachers and Students – Public awareness of Watershed and all pollutants
- Local Businesses and Restaurants – Public awareness of Watershed and all pollutants

- Home Owners/Riparian Landowners/Lake Association Members – Public awareness of Watershed and all pollutants, but specifically sediment, nutrients, high temperature, pathogens, and pesticides
- Landowners in Upper Maple River Watershed – Public awareness of Watershed and all pollutants
- Upper Maple River Monitoring Committee – Sediment
- Natural Resource Managers and Planners – Sediment
- Local Agricultural Producers and Owners - Sediment, nutrients, pathogens, high temperature, and pesticides
- Clinton County Private Landowners – Sediment
- Local Governmental Officials and Policy Makers – Sediment, nutrients, high temperature, pathogens
- Certified Commercial Fertilizer Applicators – Nutrients
- Fertilizer Applicators – Nutrients
- Golf Courses/Campgrounds – Nutrients
- Greenhouse and Nursery Operators – Nutrients
- Woodlot Owners – Nutrients
- Dairy Farms - Nutrients

Characterizing each target audience is an important part of implementing an I&E strategy. Collecting demographic information will help define the socio-economic structure of each target audience. Information on existing knowledge of Watershed issues, current attitudes and beliefs, and existing communications channels will also be relevant, and should be determined before initiating an education campaign. This information will ensure that appropriate messages are reaching the designated target audiences using effective formats and distribution methods.

Appropriate information about the Project will be provided to the full range of the target audiences. They will be invited and encouraged to participate throughout the Project.

## 7.3 DEVELOPING MESSAGES

Messages intended for target audiences range from broad to specific, depending on the character of the audience. Each target audience must have a clear understanding of the problems being addressed by the Project and how the Project affects them before any behavioral changes are to take place. The known pollutants in the Watershed are sediment, nutrients, pathogens, high temperature, and. Members of the I&E Committee developed the following messages, as noted in Appendix 17 - I&E Strategy:

- A watershed is an area of land that drains to a common point. You live in the Upper Maple River Watershed. You impact the watershed. Changes in land use may impact stream flows, creating water quality, stream stability, and flooding concerns.

- Human actions may increase sedimentation and adversely affect water quality. Sediment changes the flow capacity of the stream and impairs aquatic habitats.

- Human actions may increase nutrients in waterbodies and adversely affect water quality. Nutrient rich waters encourage excessive plant growth, deplete oxygen, and impair aquatic habitats.

- Human actions may increase the chances of *E. coli*/pathogen contamination in waterbodies. Bacterial contamination from agricultural runoff (over/improper application of manure), failing septic systems, and over population of waterfowl create unsafe water for human contact.

- Human actions may adversely impact the temperature of waterbodies. Lack of riparian vegetation and a dense drain network cause increased stream temperatures.

- Human actions may increase the amount of pesticides in waterbodies and adversely affect water quality. Harmful toxins can enter waterways through over or improper application of pesticides, and the lack of riparian buffer on lakes and streams.

## 7.4 SELECTING DELIVERY MECHANISMS AND ACTIVITIES

A mixture of activities and media formats are normally required to relay messages effectively to diverse audiences. The key is persistence. Repeating messages is the most effective way for people to remember the message.

Because the collective target audience is broad, multiple formats will be necessary to reach each audience and to reinforce messages over time. Formats should be phased in as each audience moves from awareness to education and finally to action. Initially, efforts should largely focus on media outlets and printed materials, to raise awareness and educate audiences on water quality issues. Formats that focus on solutions and actions should be developed as the audiences become more aware of the existing water quality concerns. These formats could include workshops, presentations, and other events.

Formats should be distributed through a variety of delivery mechanisms (Appendix 17 - I&E Strategy). One of the most effective means of distributing information is to piggyback with existing material distributions already received by the target audience. This approach helps to leverage resources, and materials are more likely to be seen by the audience since they are already familiar with the format. Some of the activities included in Appendix 17 are as follows:

- Use of project logo in communications
- Watershed signs at tillage demonstration sites in Clinton, Gratiot, and Shiawassee Counties
- Develop and distribute brochures and flyers

- Articles in local newspapers, county publications, Michigan State University Extension (MSUE) Office and U.S. Department of Agriculture (USDA) Service Center newsletters
- Displays for fairs, events (Conservation District Open House), and meetings
- Presentations at public, county, township, village, and city meetings
- Watershed tours of problem sites
- Community survey
- Volunteer water quality monitoring
- Storm Drain stenciling
- Comparison plots of BMPs on farmers' properties
- Encourage participation in Michigan Groundwater Stewardship Programs (MGSP), Conservation Reserve Enhancement Program (CREP), Continuous Conservation Reserve Program (CCRP), and Environmental Quality Incentives Program (EQIP)
- Present the Upper Maple River WMP
- One-on-one contact with individuals at informational gatherings
- Offer incentive payments to agricultural producers and owners for long-term enrollment in programs
- Advertise the local Clean Sweep days for farm pesticides, as well as household hazardous waste collection dates
- Trash cleanup
- Riparian tree planting

## 7.5 IMPLEMENTATION OF I&E STRATEGY

### 7.5.1 TASKS AND SCHEDULES

The implementation of the I&E Strategy follows three steps: (1) awareness; (2) education; and (3) action.

***Awareness***

General information about what a watershed is and providing examples of NPS pollution will increase awareness of target audiences about the issues. The public will be made aware that they live in a watershed and that their day-to-day activities can affect water quality. They will learn about the impacts that land use activities have on water quality, and general approaches to minimize these impacts. Awareness will be raised through signage, logos, brochures, and articles in local newspapers.

***Education***

The public will have opportunities for more in-depth education through a variety of opportunities, including public meetings, presentations, workshops, displays, tours, and articles. Many of these opportunities will allow the public to comment and respond to the findings of the Project. Open meetings and one-on-one contacts will provide further opportunity for the public to offer their opinions and concerns.

***Action***

Actions occur when audiences change behaviors and develop programs and events that influence and improve water quality. Such actions include participation in tree plantings, implementing BMPs to improve water quality, and making informed decisions on land use planning. Taking ownership for the solutions of water quality concerns provides a framework for sustainability and ensures the continuation of the Project's objectives.

The I&E Activities will be focused first on the critical areas in the Watershed, as identified in Table 4.3 Critical Areas for Restoration and Table 4.4 Priority Areas for Preservation and Protection. Sustainability for the I&E efforts will be developed throughout the Project, since the protection of the Watershed will be a long-term endeavor. The schedule for implementation is included in Appendix 17 - I&E Strategy.

### 7.5.2 POTENTIAL PARTNERS

Many groups and organizations are active within the Watershed and will provide support and assistance in educational efforts. The Steering Committee was formed to actively participate in the development of the WMP. At the Steering Committee meetings, community members have had an opportunity to give input and share ideas and concerns. Assistance for the I&E activities includes the Clinton County Conservation District (CCD); Shiawassee County Conservation District (SCD); Gratiot County Conservation District (GCD); Clinton County Drain Commissioner (CCDC); Shiawassee County Drain Commissioner (SCDC); Gratiot County Drain Commissioner; Township, City, and Village Officials; Michigan Department of Natural Resources and Environment (MDNRE); Mid-Michigan District Health Department; Shiawassee County Health Department (SCHD); Clinton County Road Commission (CCRC); Shiawassee County Road Commission (SCRC); Gratiot County Road Commission (GCRC); MSUE Office; Clinton County Regional Educational Service Agency (CCRESA); Shiawassee Regional Education Service District (SRESD); Gratiot-Isabella Regional Education Service District (GIRESD); Natural Resource Conservation Service (NRCS); U.S. Department of Agriculture Farm Service Agencies, Michigan Farm Bureau, Michigan Groundwater Stewardship Program; Great Lakes Commission; Friends of the Maple River (FOMR), Sporting and Environmental Groups; local newspapers; local businesses;

landowners/farmers; schools; and local residents. Appendix 17 - I&E Strategy lists the potential partners associated with the different I&E messages and objectives.

### 7.5.3 EVALUATION MEASURES

Evaluation of the education campaign provides a feedback mechanism for continuous improvement of the I&E Strategy. Evaluation tools are built into the strategy at the beginning to ensure that accurate feedback is generated.

In regard to specific I&E tasks, the purpose, theme, and objective (learning, behavioral, and emotional) of each delivery mechanism should be defined prior to implementation. An I&E worksheet template developed for completing such an assessment is provided on the last page of this chapter. This worksheet will help define each activity during its initial development and result in a more fine-tuned product that can be easily evaluated based on its initial purpose and objectives. Appendix 17 - I&E Strategy recommends evaluation methods to assess the success of each delivery mechanism, in accordance with the I&E worksheet.

Although evaluation of specific components within the I&E Strategy will occur continuously, the I&E Strategy will be periodically reviewed and adjusted as necessary. Questions that should be considered during implementation of the I&E Strategy are listed below.

- Are the planned activities being implemented according to the schedule?
- Is additional support needed?
- Are additional activities needed?
- Do some activities need to be modified or eliminated?
- Are the resources allocated sufficient to carry out the tasks?
- Are all of the target audiences being reached?
- What feedback has been received, and how does it affect the I&E strategy program?
- How do the BMP implementation activities correspond to the I&E strategy?

## INFORMATION AND EDUCATION ACTIVITY WORKSHEET TEMPLATE

**Activity:**_____

**Purpose of Activity:**

**Target Audience:**

**Learning Objectives (What do you want the target audience to learn from this activity?)**:

**Behavioral Objectives (What do you want the target audience to act on after this activity?)**:

**Emotional Objectives (What do you want the target audience to feel from this activity?)**:

**Distribution Method (e.g., workshop, flyer):**

**Date of Completion:**

**Budget:**

**Project Evaluation**

**Quantitative Evaluation:**

**Qualitative Evaluation:**

**Level of Success (After Implementation):**

# 8.0 METHODS OF MEASURING PROGRESS

Measures of success are essential to any project to evaluate and assess the achievements of the Project, and determine the benefits to water quality and the quality of life resulting from the implementation of the Best Management Practices (BMPs). The success of the Project toward meeting its goals of improving water quality and restoring the designated uses of the Upper Maple River Watershed (Watershed) depends on many factors, all of which need to be continuously evaluated. Establishing monitoring targets, against which observed measurements are compared, helps the Steering Committee determine whether progress is being made toward targets and ultimately the Watershed goals. The targets set are not enforceable, just a measure for the Steering Committee to use to gauge the implementation efforts. Section 8.1 describes measurements that can be taken to indicate overall water quality. Section 8.2 describes ongoing watershed monitoring efforts. Section 8.3 outlines watershed monitoring components to evaluate overall changes in watershed conditions. Section 8.4 outlines long-term subwatershed monitoring. Section 8.5 provides the evaluation framework to assess the success of the WMP implementation efforts.

## 8.1 INDICATORS OF OVERALL WATER QUALITY

### 8.1.1 MEASUREMENTS

Measurements are used in this evaluation to determine the level and rate of water quality improvements, focusing on areas of physical, chemical, and biological improvements. Methods of evaluation will be used to monitor the success of the project, both immediately following implementation and for continual monitoring of the water quality.

Measurements are defined by categories of indirect indicators and direct environmental indicators. Indirect indicators are measurements of practices and activities that could indicate water quality improvements but do not actually measure the water quality itself. For example, estimating the pollutant reductions achieved by a practice is stating that a certain amount of the pollutant will be prevented from entering the stream. Another indirect indicator would be the miles of filter strips installed as a percentage of the total miles of riparian areas without buffers. This percentage of installation could be compared to the goals of the Watershed and the success could be measured.

Direct environmental indicators would be measuring the quality of the water through scientific investigation. Sediment load reduction could be measured by total suspended sediment concentration, embeddedness, or pebble counts; and nutrient load reductions could be measured through chemical analysis of the water. Macroinvertebrate surveys are also direct environmental indicators of water quality, since some insects are very sensitive to changes in a stream's health.

Measurements will be used to determine whether the pollutant load reduction goals are being met. Pollutant reduction criteria have been established for the known and suspected pollutants of the Watershed as described below.

***Sediment***

The criteria for sediment evaluation would be reaching an informal target off 80 mg/L (milligrams per liter) for total suspended solids measured by local, county, or state laboratories, or wastewater treatment plants; more sites having sedimentation consistent with the soil types, as rated through the pebble count; implementation of BMPs on all identified nonpoint source (NPS) sites of sediment loading; and a measurable increase in the water quality and macroinvertebrate rating, as rated through the Surface Water Assessment Section Procedure No. 51 survey.

***Nutrients***

The criteria for nutrient evaluation would be a decrease in phosphorus and nitrogen exceedances compared to state recommendations (total maximum daily load [TMDL] assessment) and as measured by local, county, or state laboratories, or wastewater treatment plants, a decrease in nuisance algal growth, and implementation of BMPs on all identified NPS sites of nutrient loading. Nutrient reduction goals should align with the TMDLs that have been established for the watershed, with a total phosphorus goal of 0.06 mg/L.

***Pathogens and bacteria***

The criteria for evaluating *E. coli* will be based on whether Water Quality Standards (WQS) are exceeded for partial and total body contact recreation, an elimination of all identified *E. coli* contributing sources, such as failing septic systems, and attaining designated uses.

***High Temperature***

To support the warmwater fish species of Maple River and its tributaries, instream temperature should meet the MDNRE requirement for "warmwater fishery use," which means the ability of a waterbody to support a balanced, integrated, adaptive community of fish species which thrive in relatively warm water, including any of the following: bass, pike, walleye, and panfish.

***Pesticides***

The criteria for pesticide evaluation will be based on implementing BMPs on areas where containment facilities are constructed. Pesticides will be prevented from reaching surface water by using proper application methods and amounts, and the use of filter and buffer strips.

## 8.2 ONGOING WATERSHED MONITORING EFFORTS

Ongoing monitoring activities within the Watershed have been conducted, for the most part, by the Michigan Department of Natural Resources and Environment (MDNRE). The information collected by the MDNRE in the past serves as the basis for developing the environmental monitoring component for this Watershed Management Plan (WMP). Particular attention of future monitoring should be given to established TMDL reaches (Appendix 9). Table 8.1 lists current water quality monitoring programs in the Watershed.

## 8.3 ENVIRONMENTAL MONITORING COMPONENT

### 8.3.1 BIOLOGICAL AND PHYSICAL HABITAT MONITORING

Metrics from the P51 physical habitat methods should be used to assess the amount of sediment present in the stream and the condition of the riparian corridor. Specifically, Metric 2 – Embeddedness and Metric 4 – Sediment Deposition are good measures of the amount of fine sediment present on the stream bottom. Care should be taken, however, to note the difference between a coarse bed stream covered with fine sediment, and a sand bed stream which is inherently composed of fine sediment. Another simple method useful for quantifying substrate composition, and degree of sedimentation, is the Wolman (1954) pebble count (http://relicensing.pcwa.net/documents/Library/PCWA-L-161.pdf). Relative to the riparian corridor, P51 Metrics 9 – Vegetative Protection and 10 – Riparian Vegetative Zone Width should be estimated.

For assessment of macroinvertebrate communities, collection and analysis pursuant to methods described in P51 are useful for documenting change over time at established sites. More basic methods, such as those described by MiCorps, may be more appropriate for volunteer efforts. Sites sampled as part of this planning project should continue to be monitored. Biological sampling is especially useful to document community changes following installation of BMPs. The MDNRE currently conducts this monitoring every five years, so all additional efforts should be coordinated with the MDNRE to avoid duplicate sampling.

Similar to erosion monitoring, biological and physical habitat monitoring should begin immediately on critical sites, or other sites of interest. Baseline information will be useful and necessary for measuring improvements related to installation of BMPs.

**Table 8.1 - Water Quality Monitoring and Evaluation for the Watershed**

| Organization | Monitoring Site(s) | Parameter Target | Type of Analysis | Protocol | Status | Frequency | Test Agent |
|---|---|---|---|---|---|---|---|
| CCD; FOMR; MDNRE | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | Sedimentation | Streambed assessment | GLEAS P51 (Substrate metrics) ; Wolman (1954) | Data collected at various locations in 2008 (MDEQ and FTC&H) | annual; MDEQ every five years, next event 2013 | Biologist/ Consultant |
| CCD; FOMR; MDNRE | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | Macroinvertebrate Communities | Macroinvertebrate survey | GLEAS P51; MICORP | Data collected at various locations in 2008 (MDEQ and FTC&H) | annual; MDEQ every five years, next event 2013 | Biologist/ Consultant |
| CCD; FOMR; MDNRE | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | Streambank Erosion | Erosional assessment | BEHI/Bank pins | Unknown | Annual | Stream morphologist/ Consultant |
| CCD; FOMR; MDNRE | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | Excessive Nutrients (Phosphorus) | Water chemistry | Standard Methods | Data collected at various locations in 2008 (MDEQ and CCD) | Annual; MDEQ every five years, next event 2013 | MDEQ approved lab |
| CCD; FOMR; MDNRE | All lakes in watershed | Pathogen Contamination (*E-coli*) | Presence of coliform bacteria | Standard Methods (IDEXX Colilert®) | Rainbow Lake (since 1998) | Annual, 3 times/year in summer | MDEQ approved lab |
| CCD; FOMR; MDNRE | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | High Temperature | Thermometer readings | Handheld meter; data loggers | Unknown | Continual; or weekly in summer | Volunteers / Watershed stakeholders |
| Experts | Otter Ck; Peet Ck; Ferdon Ck; Bradley Drain, Hayworth Ck; TMDL waters; others | Unstable Hydrology | Flow measurements and computer modeling | Pygmy meters, HEC RAS Model | Unknown | Annual | Engineer |

CCD – Clinton County Conservation District
BEHI – Bank Erosion Hazard Index
FOMR – Friends of the Maple River
GLEAS – Great Lakes and Environmental Assessment Section
MDEQ – Michigan Department of Environmental Quality
MDNRE – Michigan Department of Natural Resources and Environment

### 8.3.2 EROSION ASSESSMENTS

Erosion assessments using Bank Erosion Hazard Index (BEHI), or another universally accepted method, should be conducted at a number of sites that were identified during compilation of this WMP. Results of the assessments will aid in identifying further critical areas for BMP implementation. The following sites were identified as requiring additional assessment work:

- Baker Creek subwatershed
  - Devereaux Drain at Mead Road west of Hollister (Sections 14 and 15; Duplain Township; Clinton County)
  - Shiawassee No. 1 Drain at Mead east of Hollister (Sections 13 and 24; Duplain Township; Clinton County
  - Bigford Drain at Hollister and French Roads (Sections 24, 25, and 26; Duplain Township; Clinton County)
- Coon Creek – Bear Creek subwatershed
  - Krouse Road (Section 23; Middlebury Township; Shiawassee County)
- Niles Drain – Bear Creek subwatershed
  - Erosion and flooding along Bear Creek
- Stevens Drain subwatershed
  - Maple River at Wilson and on Shepardsville, just north of Maple Rapids Road (Section 3; Duplain Township; Clinton County)
  - Maple River near Faragher Road (Section 4; Ovid Township; Clinton County)
  - Thomas Drain, north of Elsie on Hollister Road (Section 11; Duplain Township; Clinton County)
- Doty Brook subwatershed
  - Upton Drain at Williams Road (Section 3; Bingham Township; Clinton County)
  - St. Johns Big Ditch at Livingston Road (Section 32; Greenbush Township; Clinton County)
  - Moore and Perrin Drain at Livingston Road (Section 32; Greenbush Township; Clinton County)
- Little Maple River subwatershed
  - Shepard Ext. Drain at Shepardsville Road (Sections 15 and 16; Ovid Township; Clinton County)
- Ovid – Maple River subwatershed
  - Maple River at Warren Road (Section 21; Middlebury Township; Shiawassee County)
  - Wait No. 2 Drain at Krouse Road (Sections 23 and 26; Middlebury Township; Shiawassee County)
  - Wait No. 2 Drain at Hammond and Shaftsburg Roads (Sections 25 and 26; Middlebury Township; Shiawassee County)
- Maple River – Mainstem
  - Float the entire mainstem to document any additional erosion sites

### 8.3.3 EROSION MONITORING

Monitoring efforts should be undertaken as soon as possible to establish baseline conditions at several of the critical sites identified in this WMP. This baseline information will provide detailed measures of bank erosion prior to project implementation, which can later be used to calculate load reductions from installed BMPs.

Erosion monitoring, using “bank pins” or a similar method, should be conducted at a representative sample of erosion sites identified in this WMP. One of the best ways to quantify bank erosion is to measure it directly in the field. A four-foot rod is driven horizontally into an eroded streambank, flush with the surface, and the amount of exposed pin is measured over time. Results are useful for making accurate predictions of annual erosion, and when combined with other measurements, annual sediment loading. These results can be used for a number of purposes, including inclusion in grant applications for funding of implementation projects. A detailed description of the use of bank pins can be found on the internet at: http://www.dnr.state.wi.us/waterways/factsheets/Bank_pin_form.pdf

Since many funding opportunities will be largely based upon showing measureable instream improvements, baseline information should begin to be collected immediately at high priority sites, or other sites of interest, that may be candidates for short-term implementation projects. Examples include critical sites (see Chapter 4 and Figure 8 in this WMP) on:

- Peet Creek (TMDL)
- Bradley Drain
- Ferdon Creek downstream of Dean Road (TMDL)
- Otter Creek
- South Fork of Hayworth Creek
- Pine Creek

### 8.3.4 PATHOGENS

Permitted waste dischargers currently monitor for coliform bacteria as specified in their permits. Recommendations for future monitoring include *E. coli* monitoring by the MDNRE as part of the watershed-wide biological survey every five years and the subsequent monitoring as required by the TMDL; monitoring by the Friends of Maple River (FOMR) at outlets of each subwatershed with possible molecular source tracking methods if sources are unable to be detected through visual observation; and monitoring by municipalities and the health department where septic system failures are suspected.

### 8.3.5 TEMPERATURE MONITORING

High water temperature has the potential to have negative impacts on fish and macroinvertebrate communities. Water temperatures should be monitored to ensure that values are within standards set for warmwater streams.

Continuously recording data loggers can be secured into a stream location and downloaded periodically (such as, HOBO Pro v2 [http://www.onsetcomp.com/products/data-loggers/u22-001]). Specific focus should be placed on stream reaches that lack riparian buffer or have recently been denuded of vegetation. Recommended sites are included in Table 8.1. Baseline information will be useful and necessary for measuring improvements related to installation of BMPs.

### 8.3.6 HYDROLOGIC MONITORING

Altered hydrology was identified in this WMP as being a cause of streambank erosion. Hydrologic/Hydraulic monitoring would be useful for determining changes in flow over time, including effects of changing land use, direct channel impacts or water withdrawal. As well, the information gathered is useful in the design of stream restoration and streambank stabilization projects. This type of monitoring may have to be set up by a professional. MiCorps methods could also be utilized.

## 8.4 LONG-TERM SUBWATERSHED MONITORING

### 8.4.1 WATER QUALITY MONITORING

Nutrients were identified in this WMP as being a high priority pollutant. As well, pesticides and pathogens and bacteria were identified as potential pollutants, based upon existing land uses. Water quality monitoring should be conducted to monitor water chemistry over time, as well as to aid in identification of specific sources and causes of pollution. While particular attention should be given to total phosphorus loading, nutrient testing parameters should be similar to those monitored by the MDNRE. Sites identified in Chapter 4 of this document as having suspected or potential loading impacts are a high priority for monitoring. Sites identified as having livestock access or livestock holding facilities adjacent to the channel should be monitored. The MDNRE currently conducts this monitoring every five years, so all additional efforts should be coordinated with the MDNRE to avoid duplicate sampling.

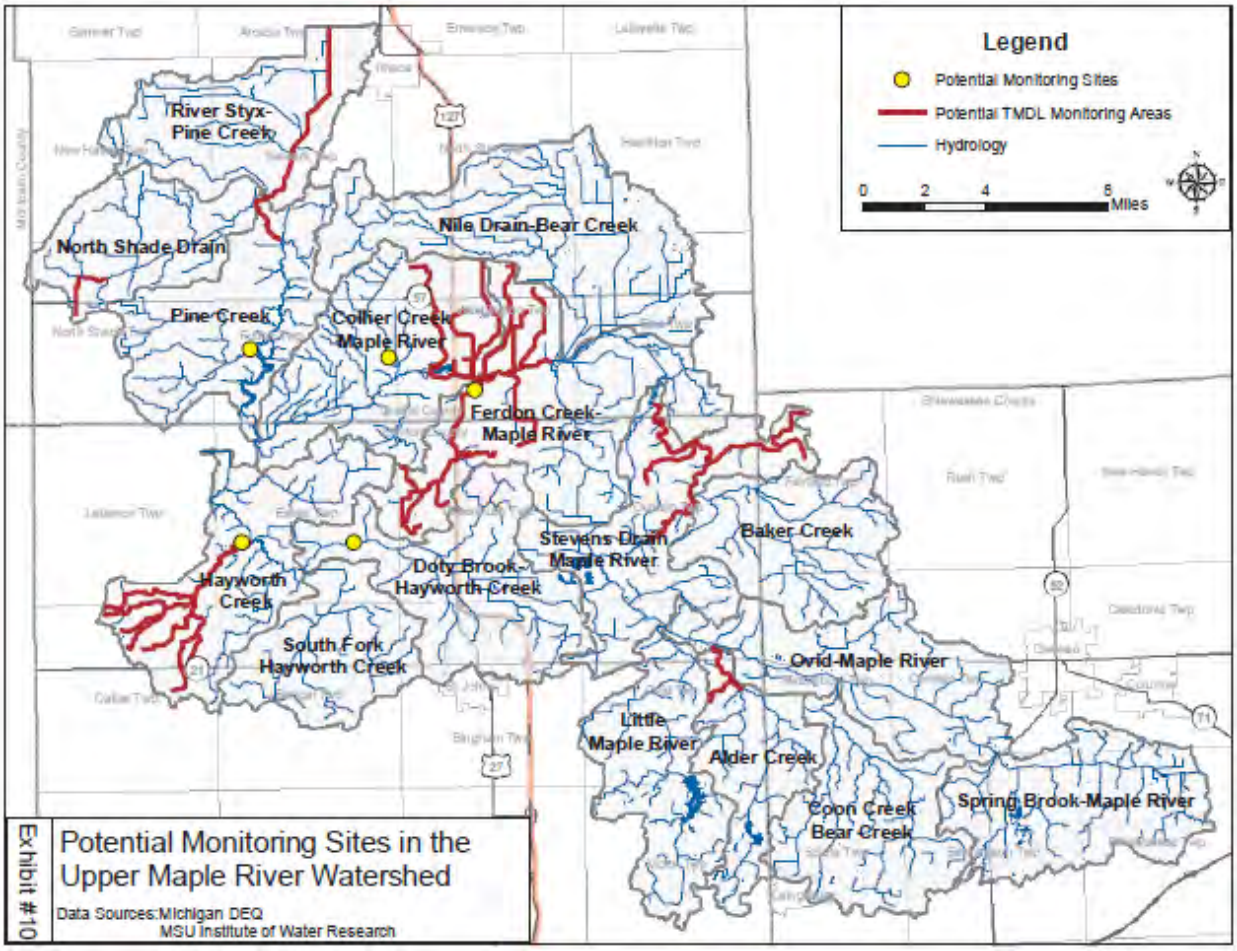
Water quality monitoring should also be conducted at all lakes within the Upper Maple River Watershed, to ensure that the designated uses of warmwater fishery, other indigenous wildlife, and partial and total body contact are being met. Standard lake monitoring methods should be employed, with particular attention given to phosphorus, nitrogen, and *E. coli* parameters.

All nutrient parameters must be tested using standard collection methods, chain of custody procedures, and an MDNRE-approved lab. Other water quality parameters, such as water temperature, dissolved oxygen, pH, and conductivity can be measured using hand-held meters, such as Hanna Instruments (HI98129) and YSI 550A.

### 8.4.2 SUBWATERSHED MONITORING

Permanent monitoring stations could be established near the outlet of each of the 16 subwatersheds to obtain continuous records of water quality over time. Nutrient parameters, total suspended solids, water temperature, embeddedness, and macroinvertebrate communities would be useful measures for monitoring larger-scale improvements to water quality, on a subwatershed scale. Data could be collected by permanent, continuously recording monitoring equipment or by periodic site visits by trained individuals. Potential sites for monitoring could include the downstream ends of TMDL reaches, specifically at the following sites (Exhibit 10, Figure 16):

- Pine Creek upstream of Grant Road (Section 33; Newark Township; Gratiot County)
- Peet Creek at Wacousta Road (Section 30; Essex Township; Clinton County)
- Ferdon Creek at Wilson Road (Section 33; Washington Township; Gratiot County)
- Collier Creek at Ranger Road (Section 20; Washington Township; Gratiot County)
- Maple River at US-127 (Section 28; Washington Township; Gratiot County)
- Maple River at Gratiot Road (Section 4; Duplain Township; Clinton County)
- Thomas Drain at Hollister Road (Section 35; Duplain Township; Clinton County)




## 8.5 EVALUATION FRAMEWORK

### 8.5.1 WMP EVALUATION CRITERIA

To evaluate the success of this WMP and to be able to keep it flexible for unknown future needs, the following evaluation strategy will be implemented.

***Step 1 - Developing Evaluation Questions with an Evaluation Team***

The Evaluation Team will identify the goals of the evaluation and generate a list of questions related to the evaluation criteria stated in Table 6.2 – Measurable Milestones and Section 8.4. The evaluation will look specifically at the progress toward improving water quality through the recommended actions. The Steering Committee is responsible for forming the Evaluation Team.

***Step 2 - Developing the Evaluation Approach and Tools***

Multiple tools will be used to evaluate the success of the implementation of the WMP. The first tool is a short bi-annual survey of the stakeholders, to be passed out and collected at meetings. The purpose of the survey will be to find out if publications are circulating correctly, if the group is still focused on the same goals, and if new information has surfaced requiring a change in the WMP.

Specific questions measuring the positive results of the WMP, such as implementation of BMP recommendations, water resource protection, watershed management planning, participation in workshops, and interest in water chemistry sampling, ensures a meaningful evaluation and will be developed to assist the evaluation team in focusing their efforts to what is working.

Another form of evaluation will be the project's ability to respond to needs voiced in public comments and incorporation of those needs into the I&E strategy.

***Step 3 - Collecting and Analyzing Data***

Data review will be specifically important, showing the restoration of impaired uses through the evaluation criteria identified in Section 8.3 or the protection of threatened uses, which will be used as an indicator of success. This WMP includes a well thought out evaluation plan to evaluate the effectiveness of the implementation strategies in addressing water quality goals. The evaluation techniques relate to the proposed activities in the Action Plan. The WMP would need to be revised if milestones are not being met as identified in Table 6.2 – Measured Milestones, if the Information and Education (I&E) components are not adequately meeting the evaluation criteria, as listed in Appendix 17 – I&E Strategy, if the pollution reductions are not being achieved, or progress is not being made toward meeting WQS. If additional watershed concerns are discovered, the milestones, actions, and commitments would also need to be updated. The evaluation criteria provide an indication of how BMPs can be assessed to evaluate success. Table 6.2 includes the measurable milestones for determining the success of the BMPs that are implemented.

The monitoring components included in Section 8.4 will be used to evaluate the effectiveness of the implementation efforts over time, and whether load reductions are being achieved and the TMDL goal of supporting other indigenous aquatic life and wildlife is being met.

The appropriate data collection and analysis method will depend on the use to be evaluated. An evaluation meeting will occur at the end of each Project year, and may involve meeting with individual members of the evaluation team or the team as a whole. This evaluation will contain both quantitative and qualitative results.

***Step 4 - Prepare Draft and Final Evaluation Summary***

An evaluation summary will be completed every year starting from the first year the evaluation team is formed and the WMP is approved by the MDNRE. Each year will build on previous years making one comprehensive report. The products of this evaluation strategy or evaluation tools include, but are not limited to, the tools (bi-annual surveys, additional I&E activities, and a review of water quality data), and comprehensive annual reports. The evaluation team will then determine if enough additional information

has been collected or water quality monitoring results have shown changes to require a revised WMP. The recommended date of the next revision is 2020.

Through this evaluation process, communities and agencies will be better informed about public response and the success of the Project, which improvements are necessary to the Project, and which BMPs need to continue as part of the Project. The implementation of the WMP is assumed to have a positive impact on the water quality, even though some components (such as I&E) may not be directly tied to water quality measurements. The monitoring components listed in Table 8.1, however, are designed to directly evaluate changes in water quality.

# 9.0 SUSTAINABILITY

The recommendations in this Watershed Management Plan (WMP) are options that can be voluntarily implemented to achieve water quality goals. It will be important to sustain the voluntary implementation of the WMP's recommendations to ensure that water quality conditions in the Upper Maple River Watershed (Watershed) are protected and improved, thereby avoiding the need for state regulations and mandates and further degradation. Success of the WMP depends on sustainable support from local governments, citizens, landowners, and businesses. Each of these communities has distinct needs that will require different strategies. However, to remain committed to a common water quality goal will require the coordination of all these groups.

## 9.1 EXISTING STRUCTURE

Currently, committees are in charge of various aspects of the Project, with the common goal of educating the public regarding the wise use of the watershed through the development of a WMP. The vision for the Watershed is to implement the WMP. Current committees include a Steering Committee, Information & Education (I&E) Committee, Monitoring Committee, Policy Committee, and WMP Review Committee. Appendix 1 contains more information on the responsibilities of each committee.

## 9.2 LOCAL PARTNERS

Many groups and organizations are active within the Watershed and will provide support and assistance in implementing the WMP. Local partners currently involved in the development of the WMP include the Conservation Districts; Friends of the Maple River (FOMR); County Drain Commissioners; Township, City, and Village Officials; Michigan Department of Natural Resource and Environment (MDNRE); Mid-Michigan District Health Department; Shiawassee County Health Department (SCHD); County Road Commissions; Michigan State University Extension (MSUE) Office; Clinton County Regional Educational Service Agency (CCRESA); Natural Resource Conservation Service (NRCS); Farm Service Agencies; Michigan Farm Bureau; Michigan Groundwater Stewardship Program; local newspapers; landowners/farmers; and local residents.

Prior to the Watershed Project, organizations have participated in watershed management without the use of a comprehensive WMP. Their efforts include development of planning and zoning ordinances, environmental education, and land conservation. The coordination of these efforts would build a stronger coalition to improve the Watershed and surrounding areas.

## 9.3 WATERSHED ORGANIZATION

Coordination between existing efforts could take place in a watershed organization involving the existing Steering, Monitoring, I&E, and Policy Committees and representatives from local governments, business,

CCRESA, and community development agencies and organizations. The organizational structure that develops from these stakeholders would provide a venue for the stakeholders to discuss their current activities and needs, as well as ideas for implementing the WMP. A watershed organization with tax-exempt status could be eligible for grant funding to implement recommendations in the WMP. Full-time or part-time staff could be housed at the Clinton County Conservation District.

Instead of a watershed organization, the Friends of the Maple River and the Friends of the Looking Glass River may be able to share resources, so implementing the recommendations outlined in the WMP are more manageable and efficient.

## 9.4 FUTURE ROLES AND RESPONSIBILITIES

Various organizations/entities have been assigned responsibility for maintaining key aspects of the WMP. Table 9.1 lists the tasks and entities responsible for maintaining/completing those tasks in the future.

## 9.5 OPPORTUNITIES AND FUNDING SOURCES FOR IMPLEMENTATION

### 9.5.1 FEDERAL OR STATE

Typically, WMP implementation is funded through federal and state grants. Because these grant sources are highly competitive, they cannot be relied upon for consistent funding.

#### 9.5.1.1 U.S. DEPARTMENT OF AGRICULTURE

The U.S. Department of Agriculture (USDA) Farm Services Agency (FSA) and the NRCS provide technical and financial assistance to landowners to address resource concerns of soil, water, air, plants, and animals. The agencies offer cost-share opportunities through many federal programs and coordinate with state and local programs to maximize benefits. More information can be obtained at http://www.mi.nrcs.usda.gov/.

**Table 9.1 – Future Tasks and Responsibilities**

| Task | Potential Partners |
|---|---|
| Facilitate committees and meetings. Coordinate information with other counties in the Watershed. | Clinton Conservation District, Friends of the Maple River, County Drain Commissioners |
| Collect additional data and update the WMP with new data | Conservation Districts, Friends of the Maple River |
| Keep in regular contact with the Michigan Department of Natural Resources and Environment (MDNRE) (regulatory aspect) in regards to total maximum daily loads (TMDLs), etc., in the Watershed | Conservation Districts, Friends of the Maple River |
| Coordinate implementation of the Action Plan (overall coordination). Coordinate partners (road commissions, drain commissioners, NRCS, etc.) so they report information in a usable format (create new forms for partner to use, etc.). when structural and vegetative practices are installed | Clinton Conservation District, Friends of the Maple River, County Drain Commissioners, County Road Commissions, County Health Departments |
| Coordinate implementation of the Action Plan (overall coordination). Coordinate partners (townships, city, county officials) so they report information about changes in managerial practices and new ordinances which affect water quality | Clinton Conservation District, Friends of the Maple River |
| Implement the I&E Strategy | Clinton Conservation District, Friends of the Maple River, Clinton County Regional Educational Service Agency, County Health Departments |
| Implement the future monitoring plan. | Clinton Conservation District, Friends of the Maple River, Consultants, County Health Departments |
| Update the WMP | Clinton Conservation District, Friends of the Maple River, Consultants |

## 9.5.2 LOCAL

### 9.5.2.1 CLINTON, GRATIOT, AND SHIAWASSEE CONSERVATION DISTRICTS

Technical Support can often be provided through the utilization of the Michigan Groundwater Stewardship Program (MGSP). An MGSP Technician will provide or recommend educational, technical, and financial assistance to agricultural producers and residents to identify and reduce groundwater contamination risks. This program, funded through the purchases of nitrogen fertilizers and pesticides, encourages individuals to take voluntary, proactive steps to protect Michigan's water quality. MGSP is also the gateway into the Michigan Agriculture Environmental Assurance Program (MAEAP) helping agricultural producers who participate in the MGSP become MAEAP Verified.

#### 9.5.2.2 CLINTON, GRATIOT, AND SHIAWASSEE COUNTY DRAIN COMMISSIONERS

Public Act 40 of 1956 as amended, referred to as the "Drain Code", provides county Drain Commissioners with specific authority over drainageways including watercourses, which have been appropriately dedicated as a county drain. A Drain Commissioner's authority includes taking various actions to provide for flow within a drain, as well as implementation of measures that will purify the flow of water through the drain. All county drains have a designated drainage district area associated with them, which is comprised of the lands that contribute flow to the drain. Costs associated with appropriate activities on a county drain are specially assessed to owners of land within the drainage district. It is anticipated that certain recommendations in this WMP can be implemented under the Drain Code with special assessment of benefitting property owners.

#### 9.5.2.3 CLINTON, GRATIOT, AND SHIAWASSEE COUNTY ROAD COMMISSIONS

Gravel road stream crossings are often a source of nonpoint source pollution, including excessive sediment input. Any road stream crossing identified for improvements in the Watershed could be completed by the County Road Commissions in accordance with recommendations in this WMP.

#### 9.5.2.4 OTHER LOCAL OPPORTUNITIES

Self-sustaining funds from endowments and revenues generated by community services are a reliable approach to funding watershed implementation activities. Examples of these funding sources include, but are not limited to, the following:

- Membership dues
- Fund drives
- Charity events (e.g., angler competition, dinners, auctions)
- Educational services
- Government programs (e.g., storm water regulation administration, ordinance development, streambank stabilization, farm bill)

### 9.5.3 LONG TERM PLANNING/STRATEGY/PLAN MAINTENANCE

The WMP outlines the actions that stakeholders can take to continue the implementation of the WMP over the next 10 years. The following structure will ensure that the WMP will remain current and continue to improve in content.

- The Steering Committee will continue. Chaired by the Clinton County Conservation District, commitment has been made by FOMR, MDNRE, Gratiot County Conservation District, Clinton County Drain Commissioner, MSUE, and Fishbeck, Thompson, Carr & Huber, Inc. (consultants).

Additional members will be recruited from the NRCS, MDA, and U.S. Fish and Wildlife Service. A concerted effort will be made to recruit more members from the agriculture community, such as producers and recognized organizations and businesses that work to support agriculture.

- WMP progress and updates will be presented at the Friends of the Maple River annual meetings.

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Upper Maple River
Watershed Management Plan

June 2010
MDNRE Tracking Code #2007-0118

# Figures

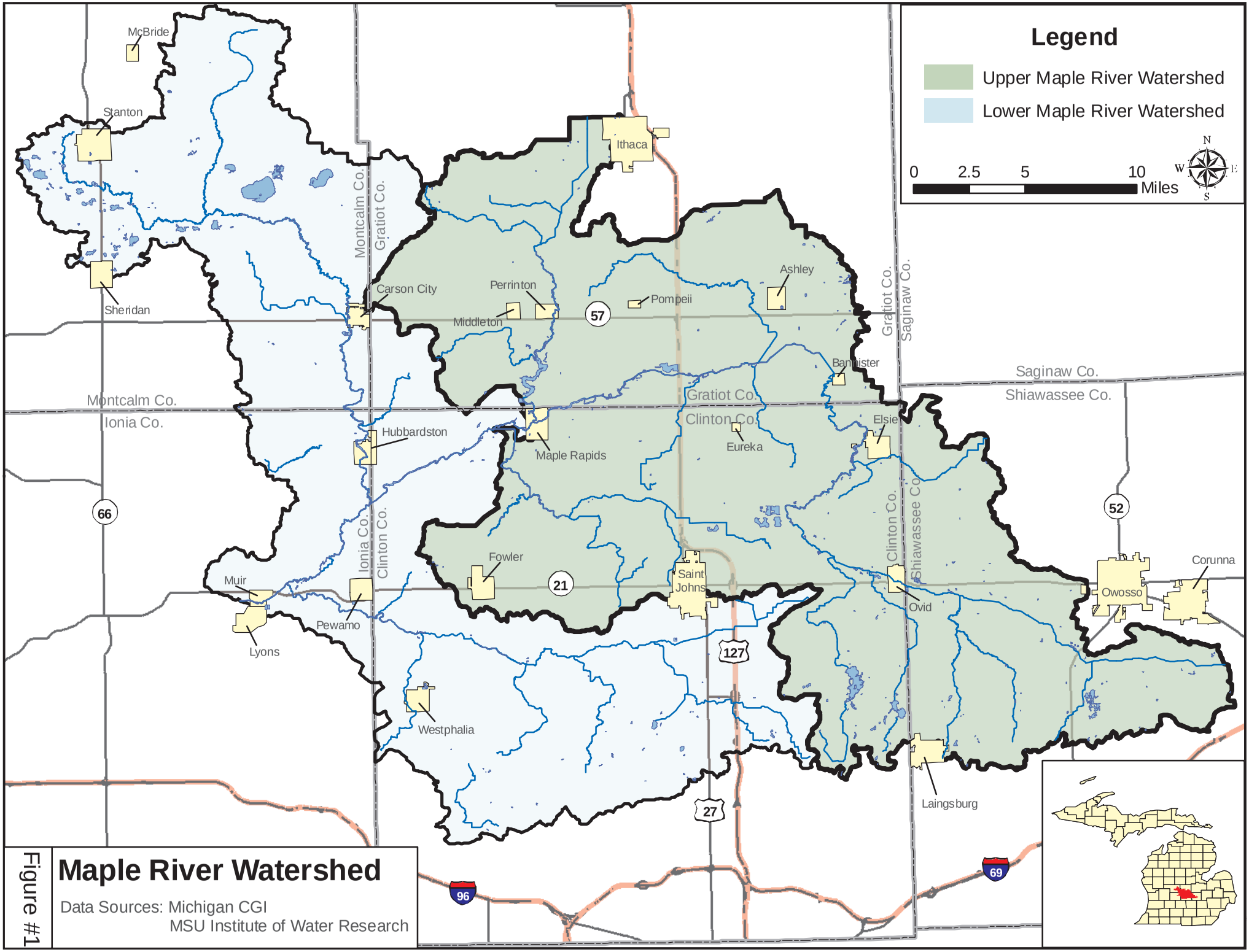


Figure #1

# Maple River Watershed

Data Sources: Michigan CGI
MSU Institute of Water Research

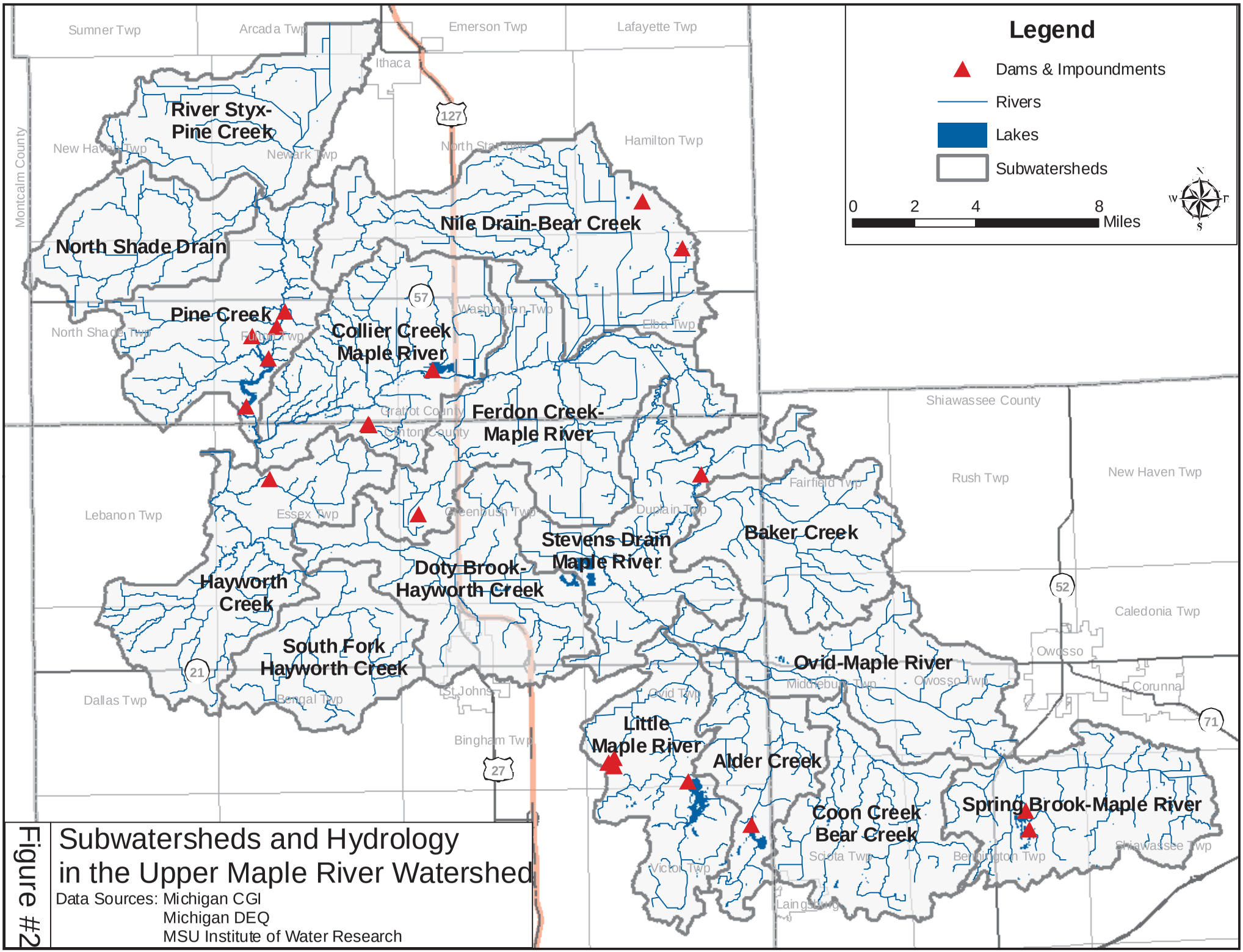


Figure #2

Subwatersheds and Hydrology in the Upper Maple River Watershed

Data Sources: Michigan CGI
Michigan DEQ
MSU Institute of Water Research

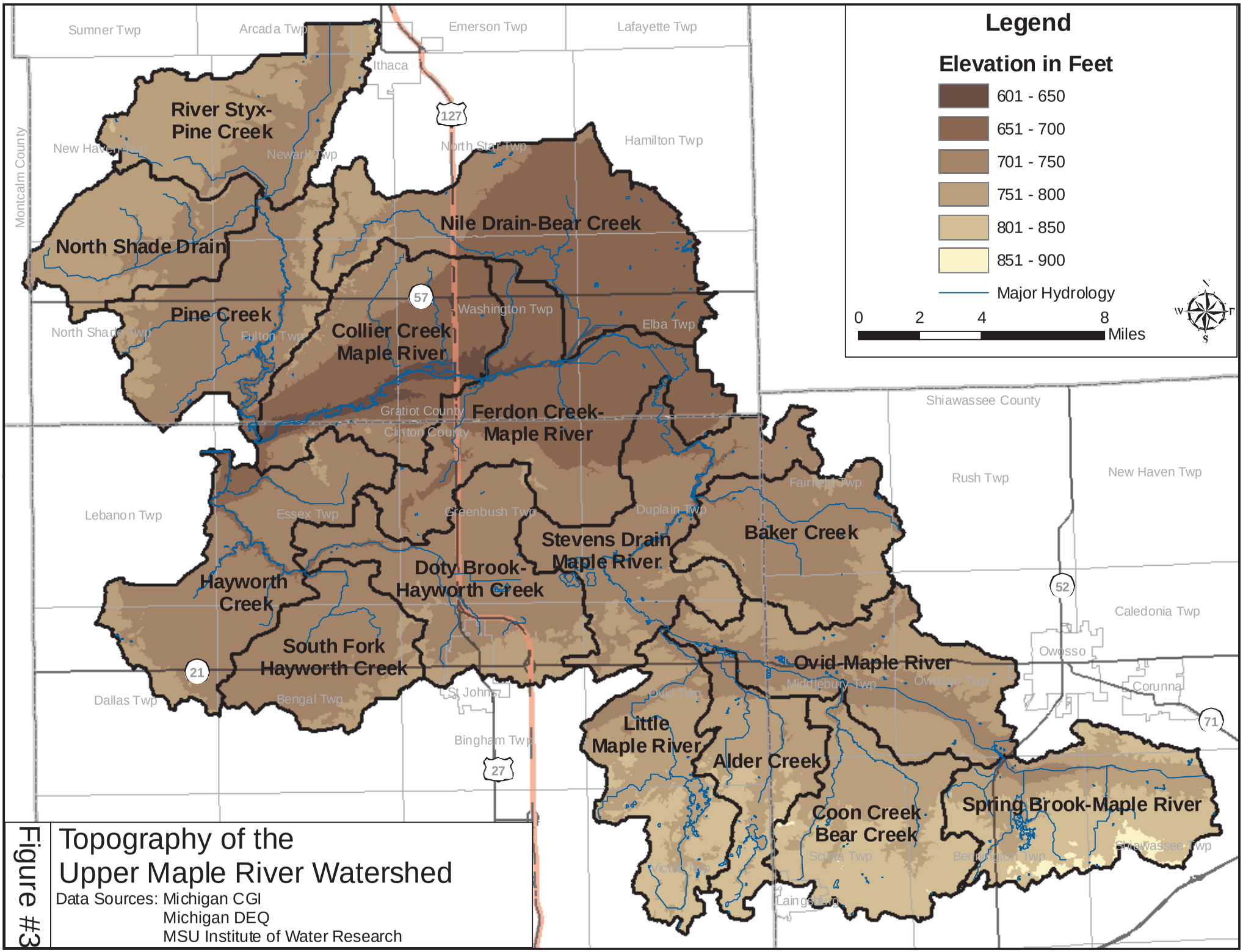


Figure #3

# Topography of the Upper Maple River Watershed

Data Sources: Michigan CGI
Michigan DEQ
MSU Institute of Water Research

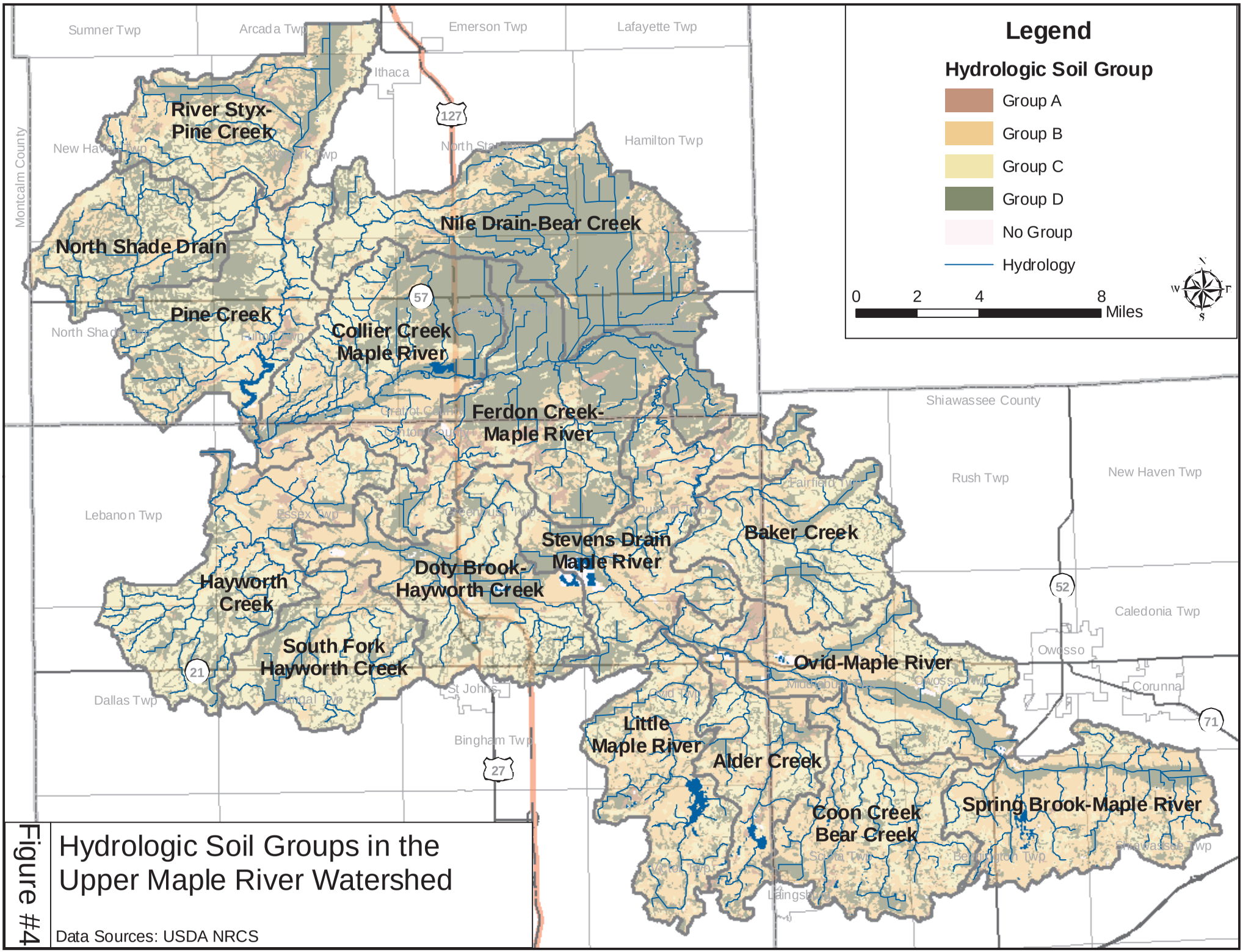


Figure #4

Hydrologic Soil Groups in the Upper Maple River Watershed

Data Sources: USDA NRCS

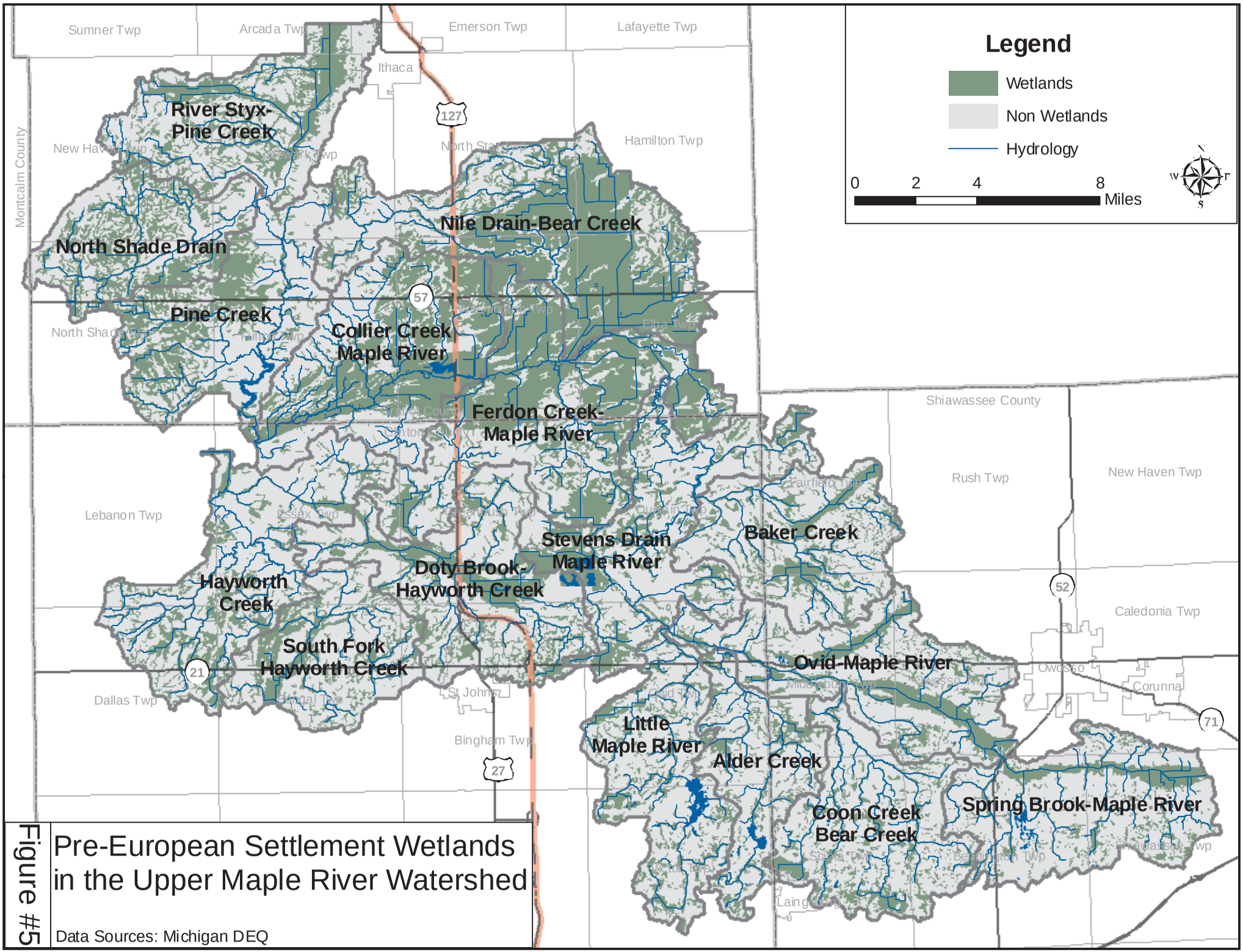


Figure #5

Pre-European Settlement Wetlands in the Upper Maple River Watershed

Data Sources: Michigan DEQ

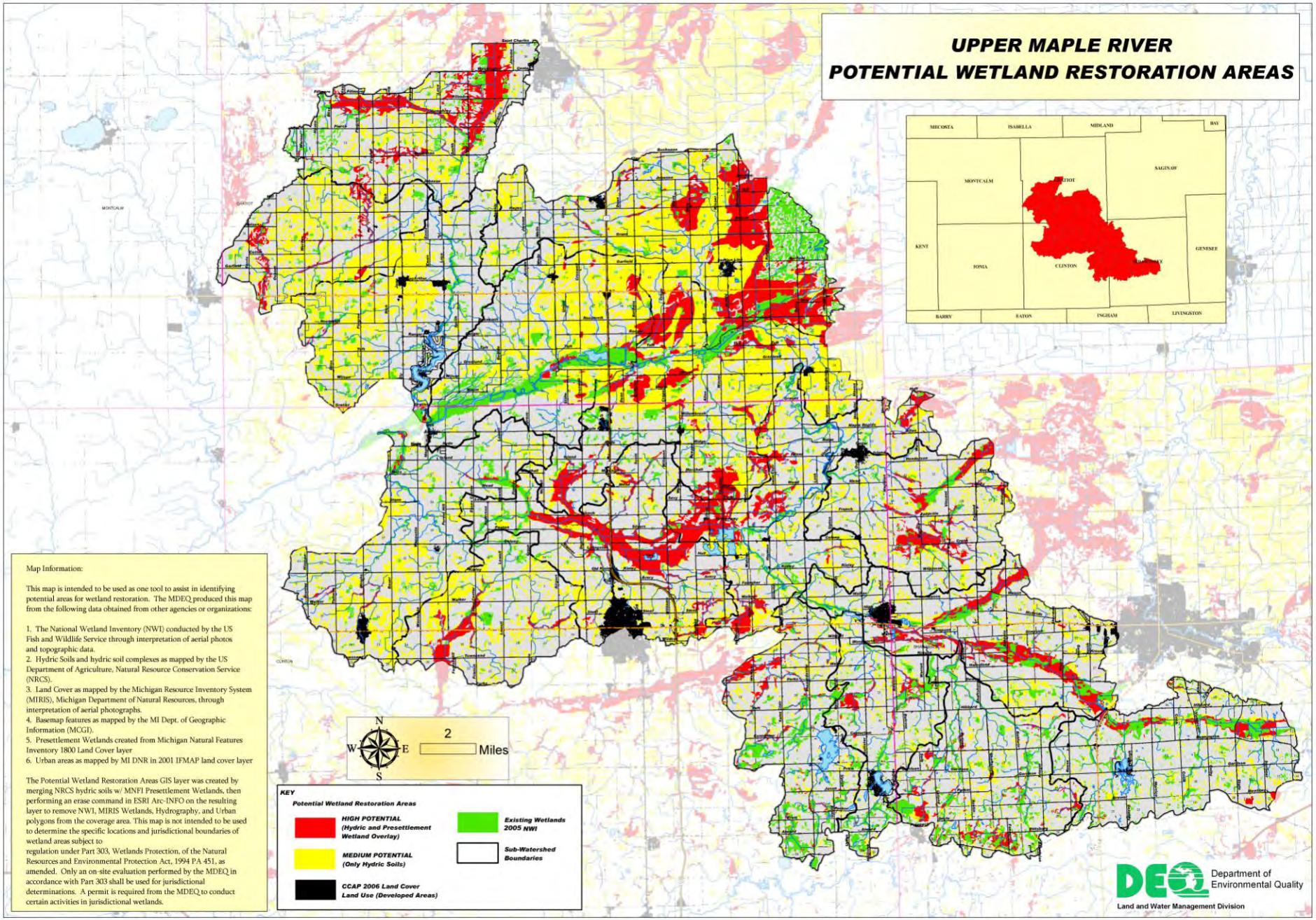


**Figure 6** **Upper Maple River Potential Wetland Restoration Areas**

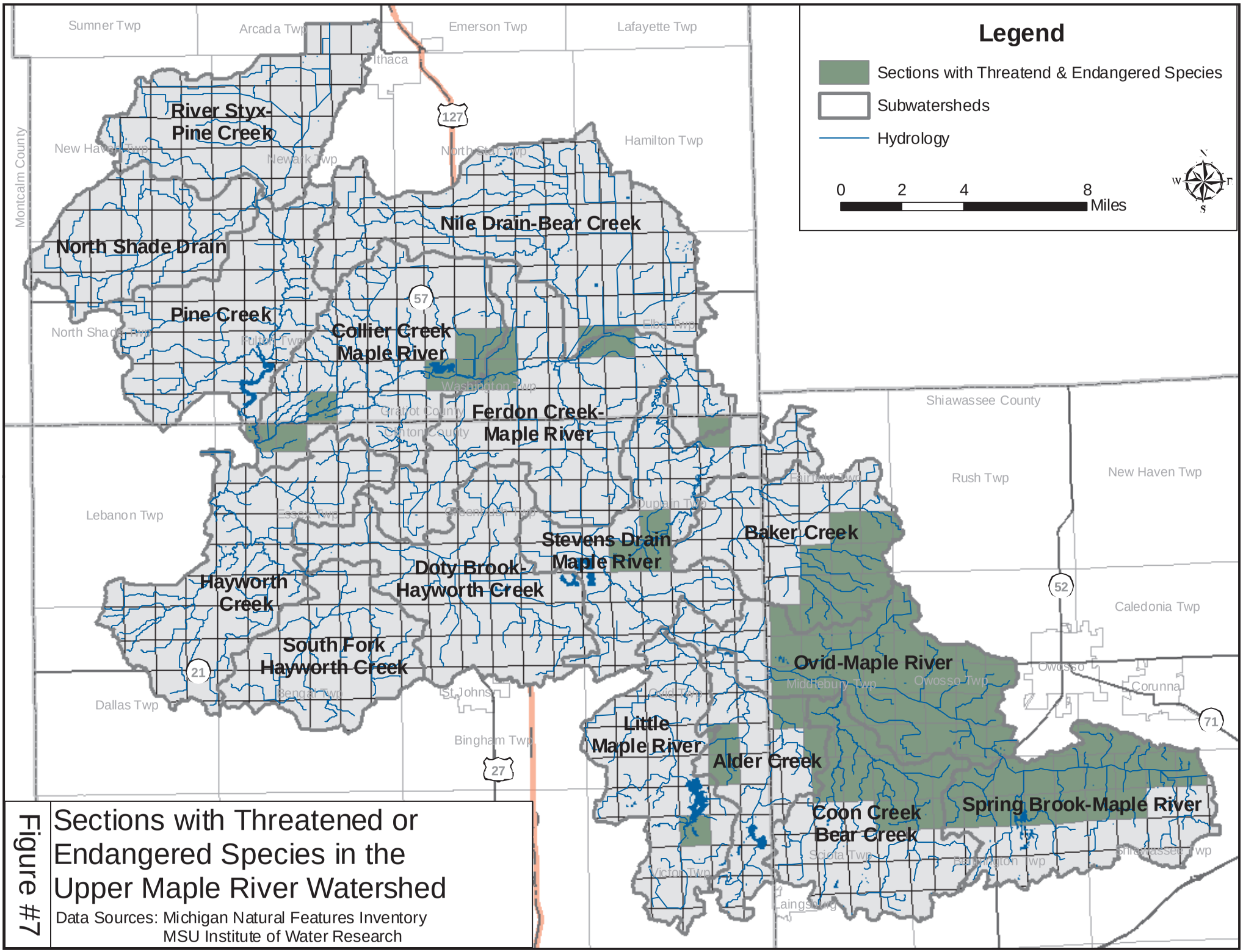


Figure #7

Sections with Threatened or Endangered Species in the Upper Maple River Watershed

Data Sources: Michigan Natural Features Inventory
MSU Institute of Water Research

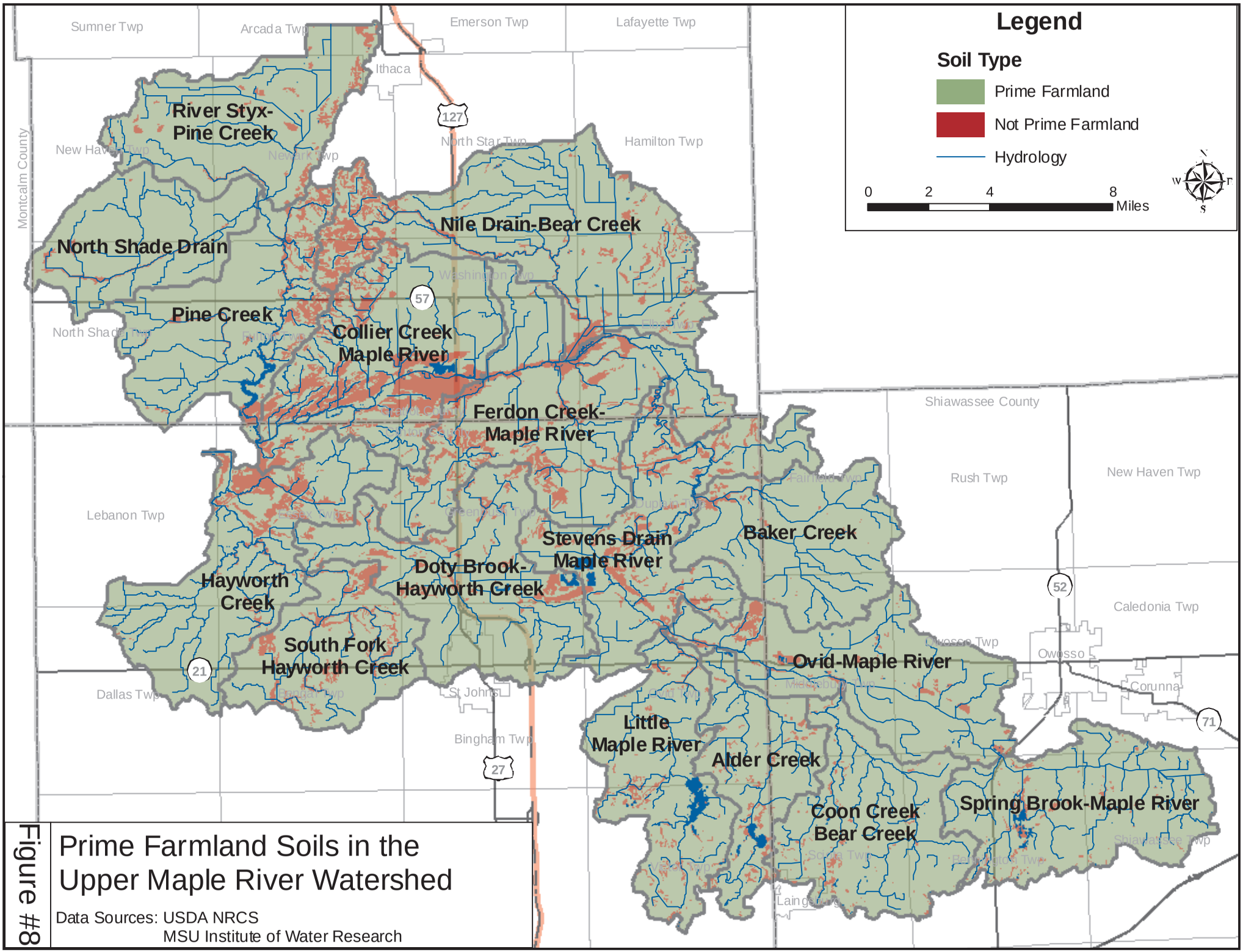


Figure #8

# Prime Farmland Soils in the Upper Maple River Watershed

Data Sources: USDA NRCS
MSU Institute of Water Research

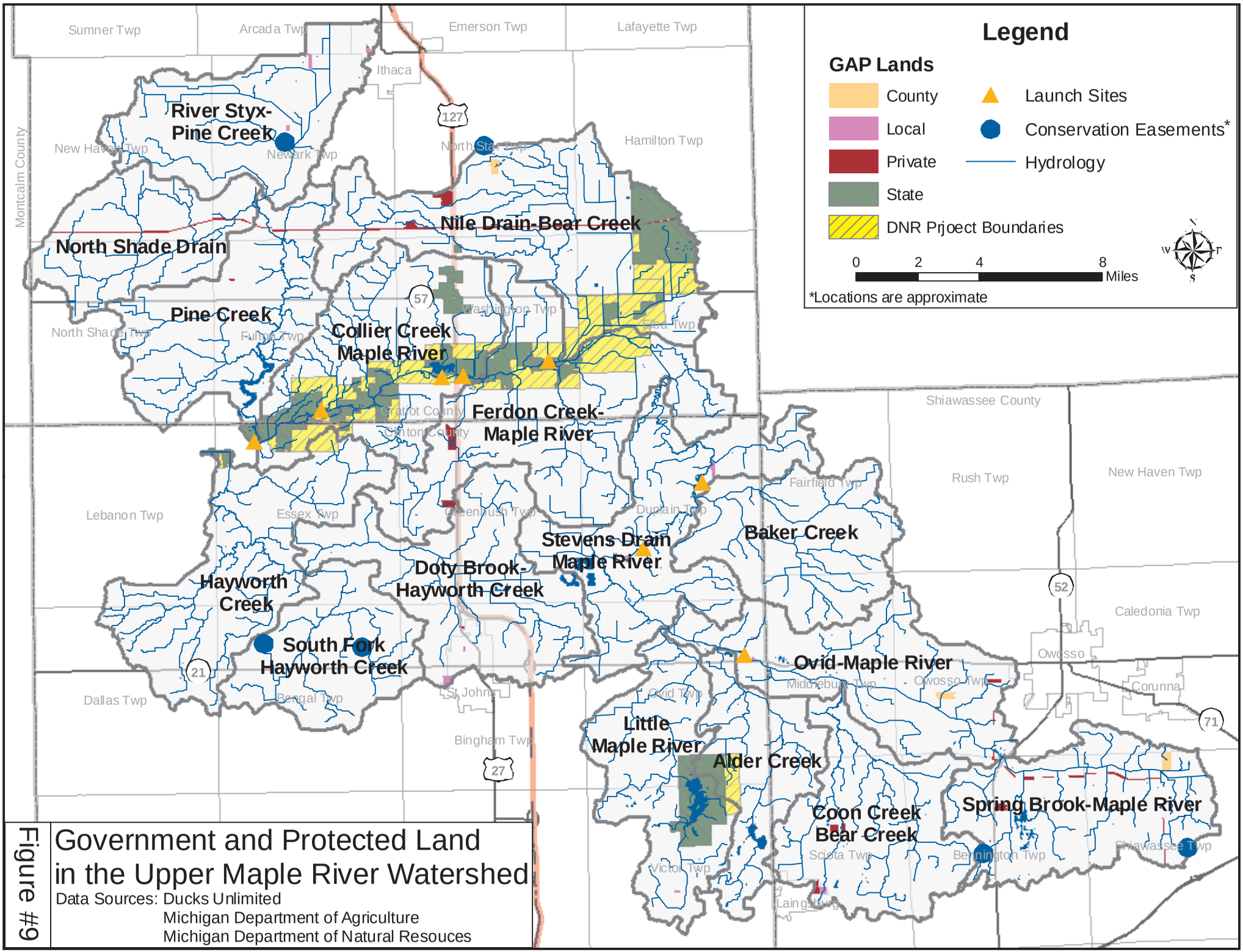


Figure #9

# Government and Protected Land in the Upper Maple River Watershed

Data Sources: Ducks Unlimited
Michigan Department of Agriculture
Michigan Department of Natural Resouces

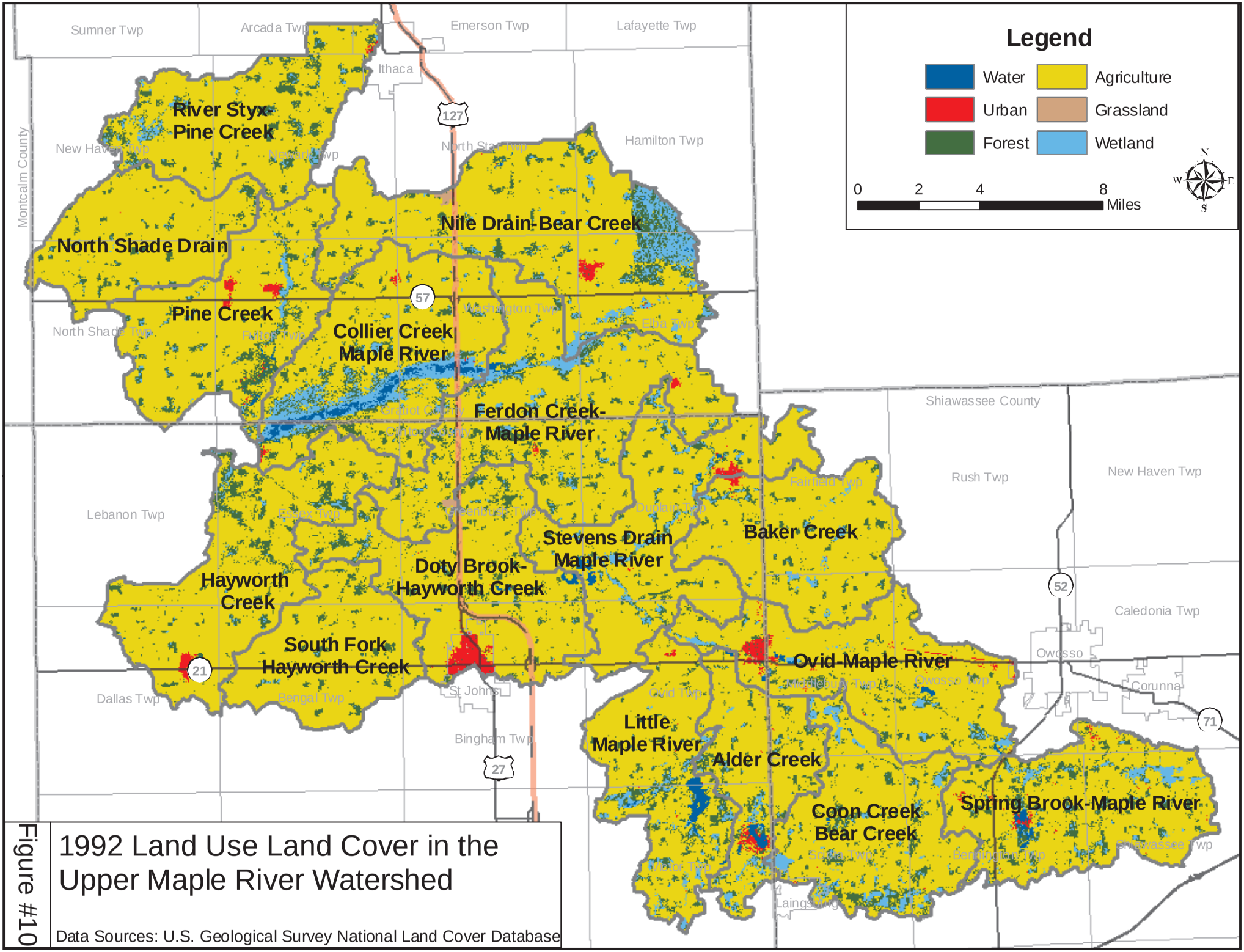


Figure #10

# 1992 Land Use Land Cover in the Upper Maple River Watershed

Data Sources: U.S. Geological Survey National Land Cover Database

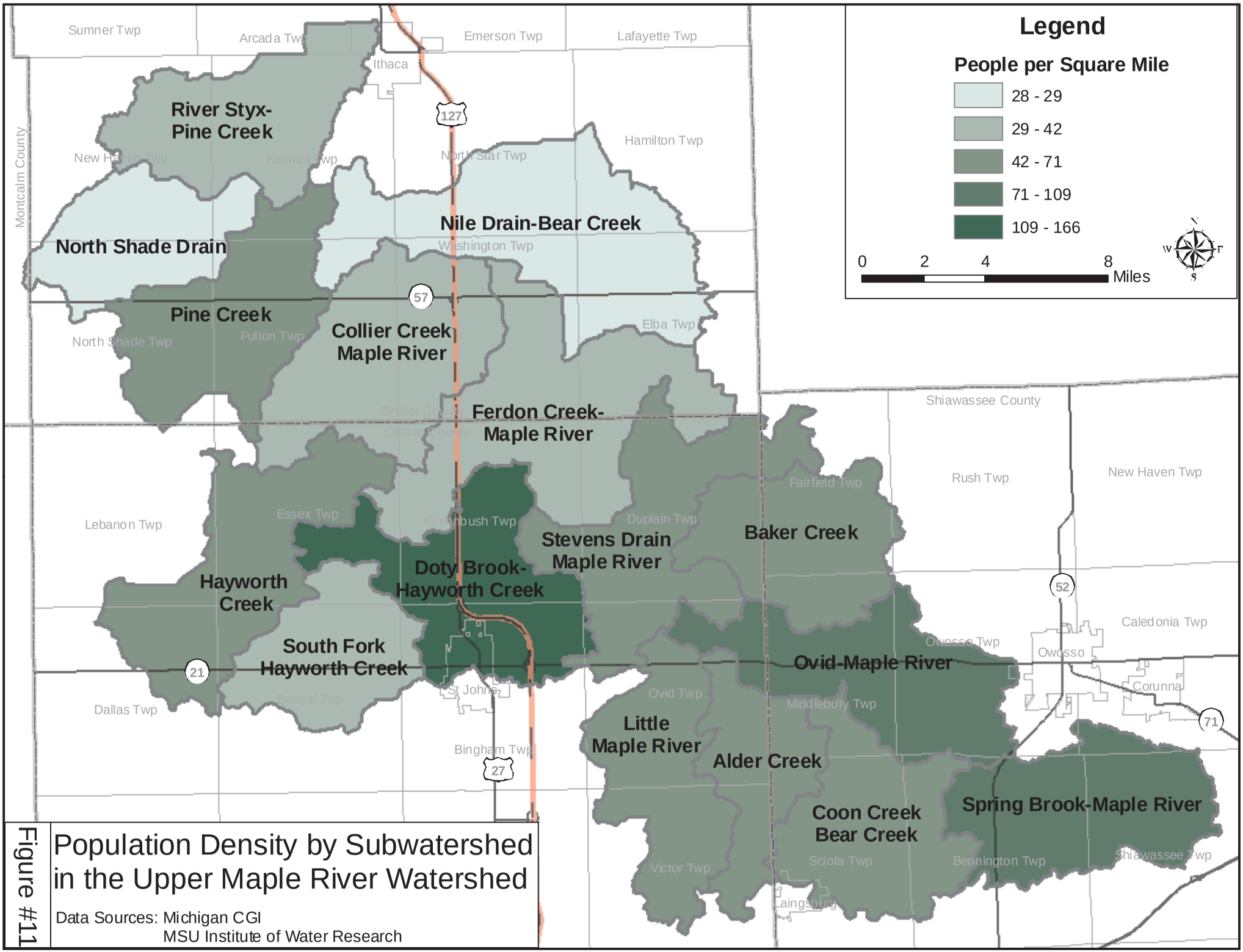


Figure #11

Population Density by Subwatershed in the Upper Maple River Watershed

Data Sources: Michigan CGI
MSU Institute of Water Research

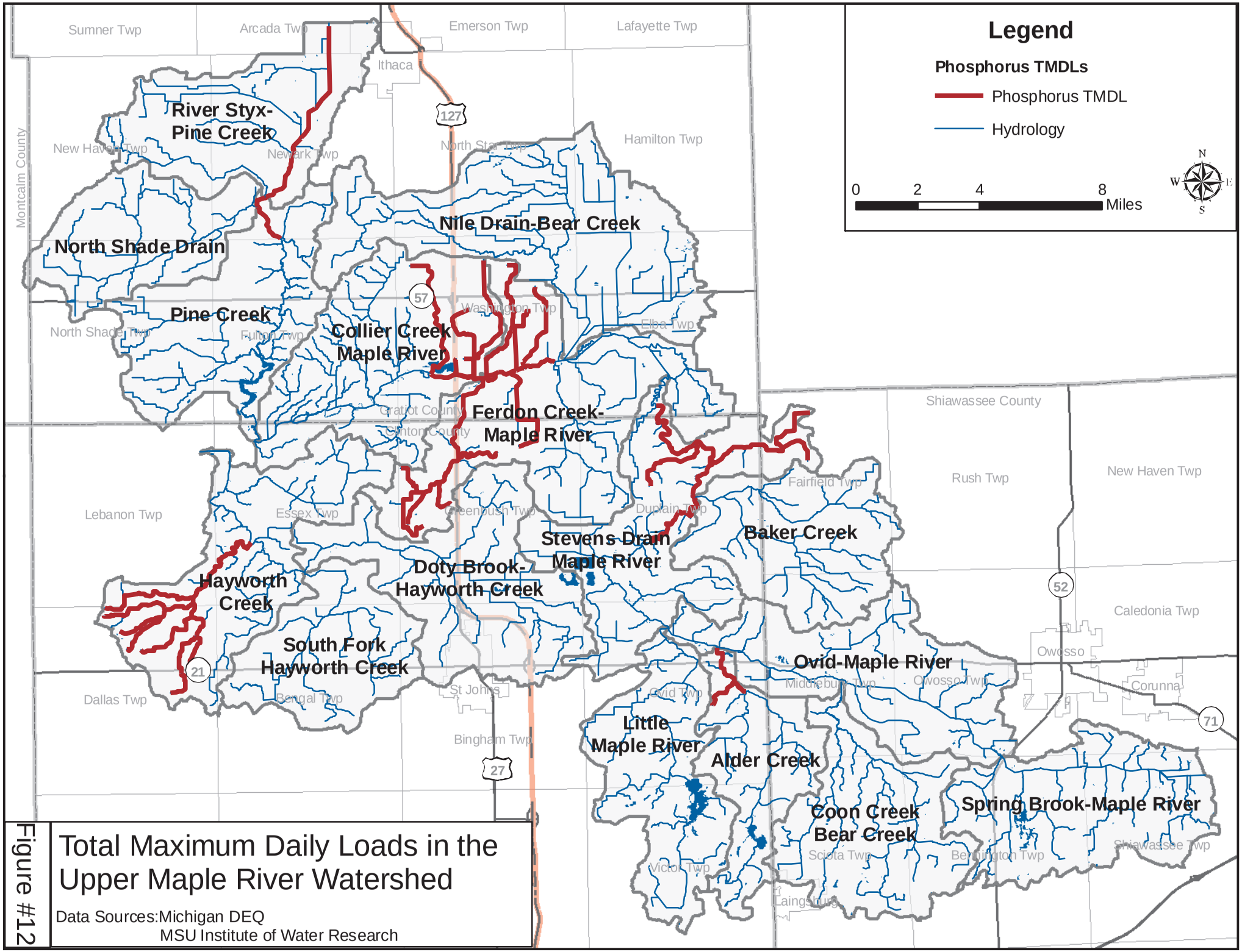


Figure #12

# Total Maximum Daily Loads in the Upper Maple River Watershed

Data Sources: Michigan DEQ
MSU Institute of Water Research

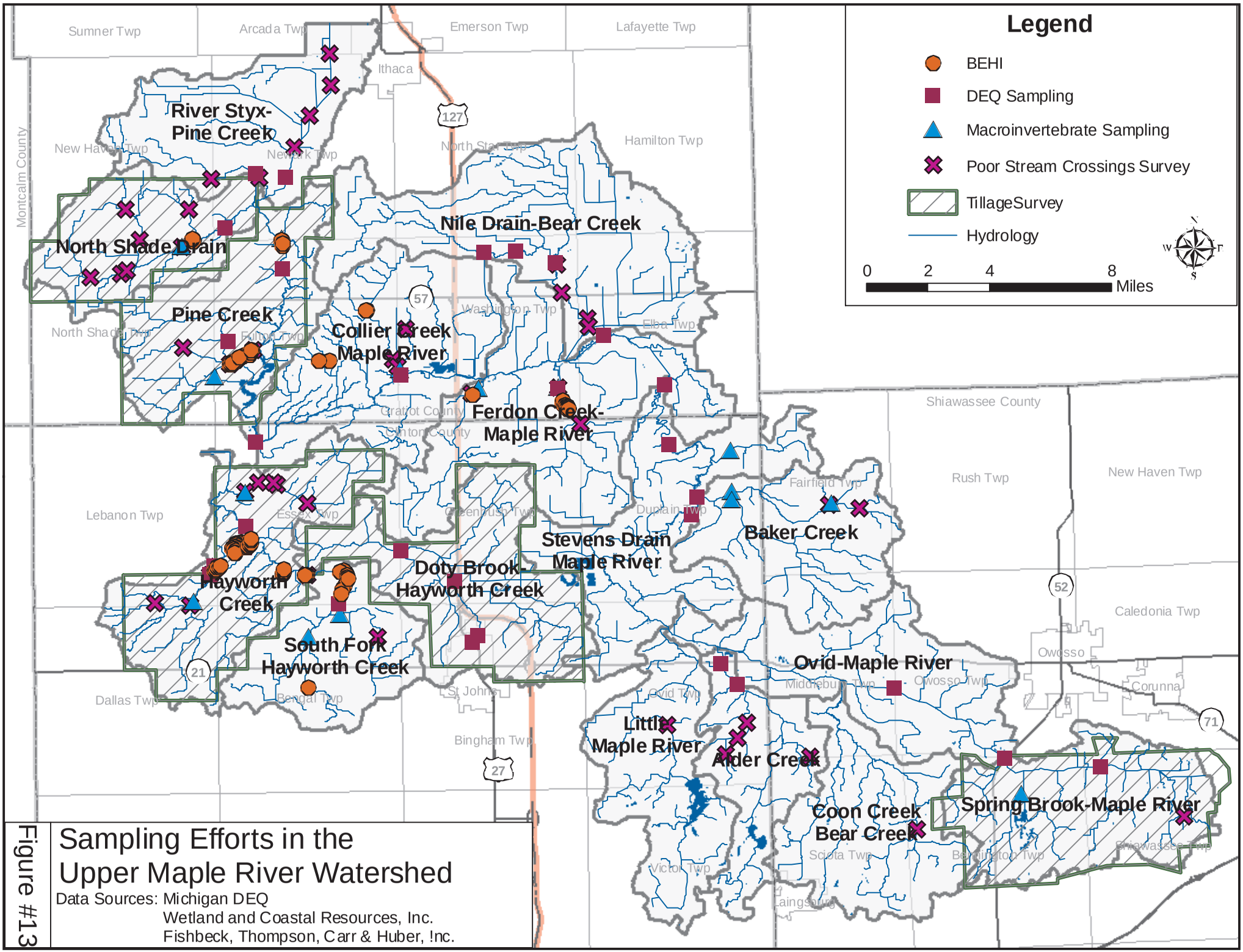


Figure #13

Sampling Efforts in the Upper Maple River Watershed

Data Sources: Michigan DEQ
Wetland and Coastal Resources, Inc.
Fishbeck, Thompson, Carr & Huber, !nc.

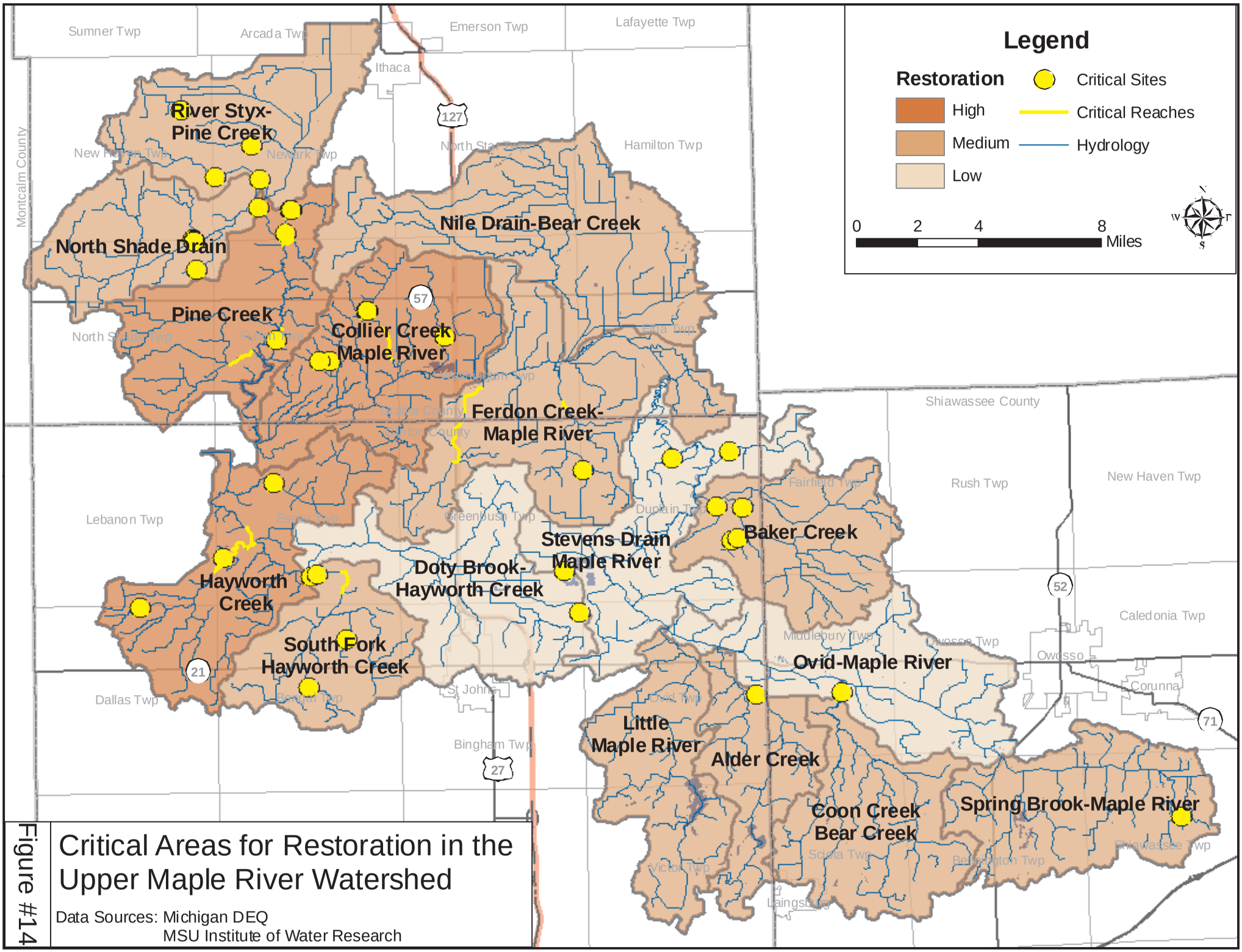


Figure #14

# Critical Areas for Restoration in the Upper Maple River Watershed

Data Sources: Michigan DEQ
MSU Institute of Water Research

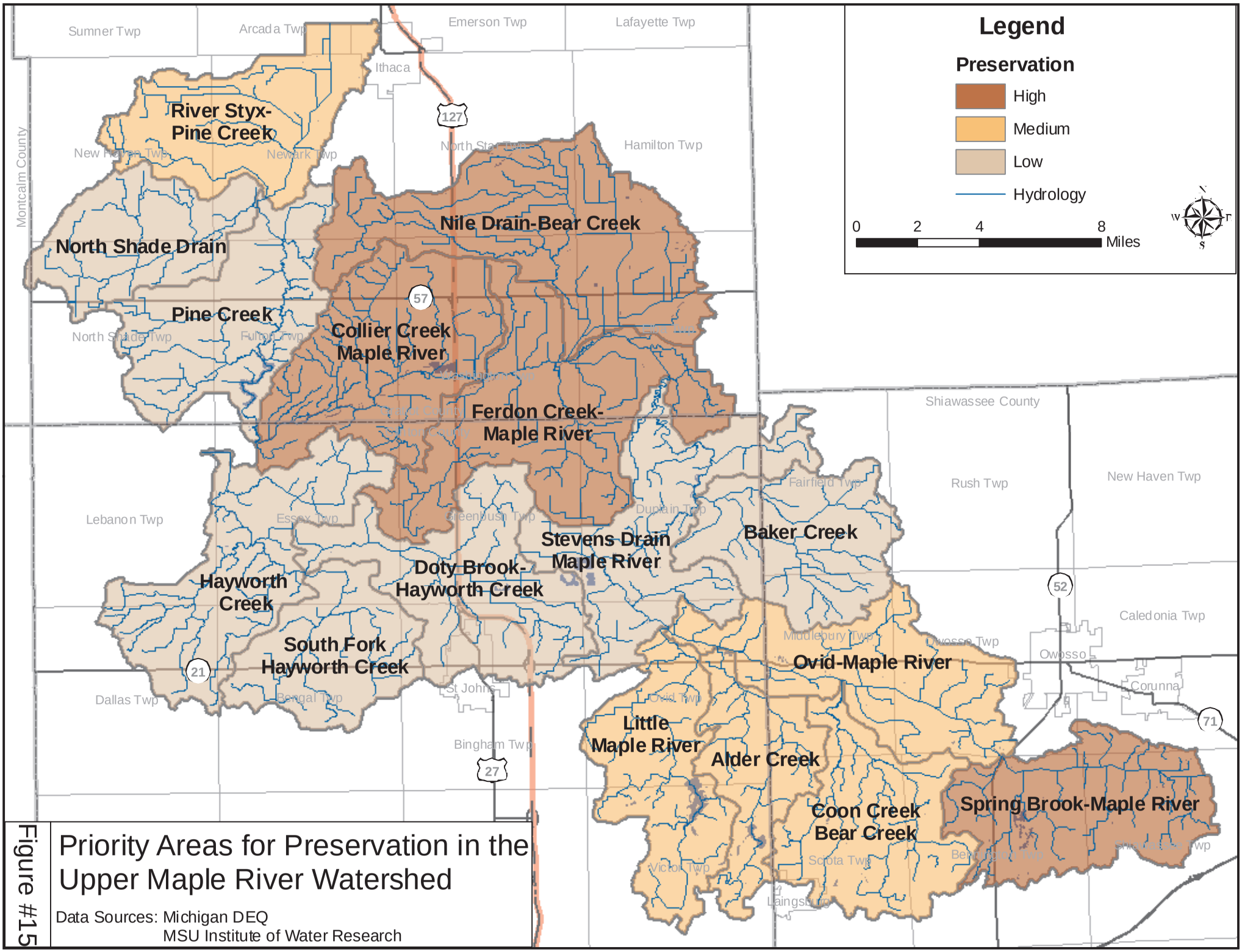


Figure #15

# Priority Areas for Preservation in the Upper Maple River Watershed

Data Sources: Michigan DEQ
MSU Institute of Water Research

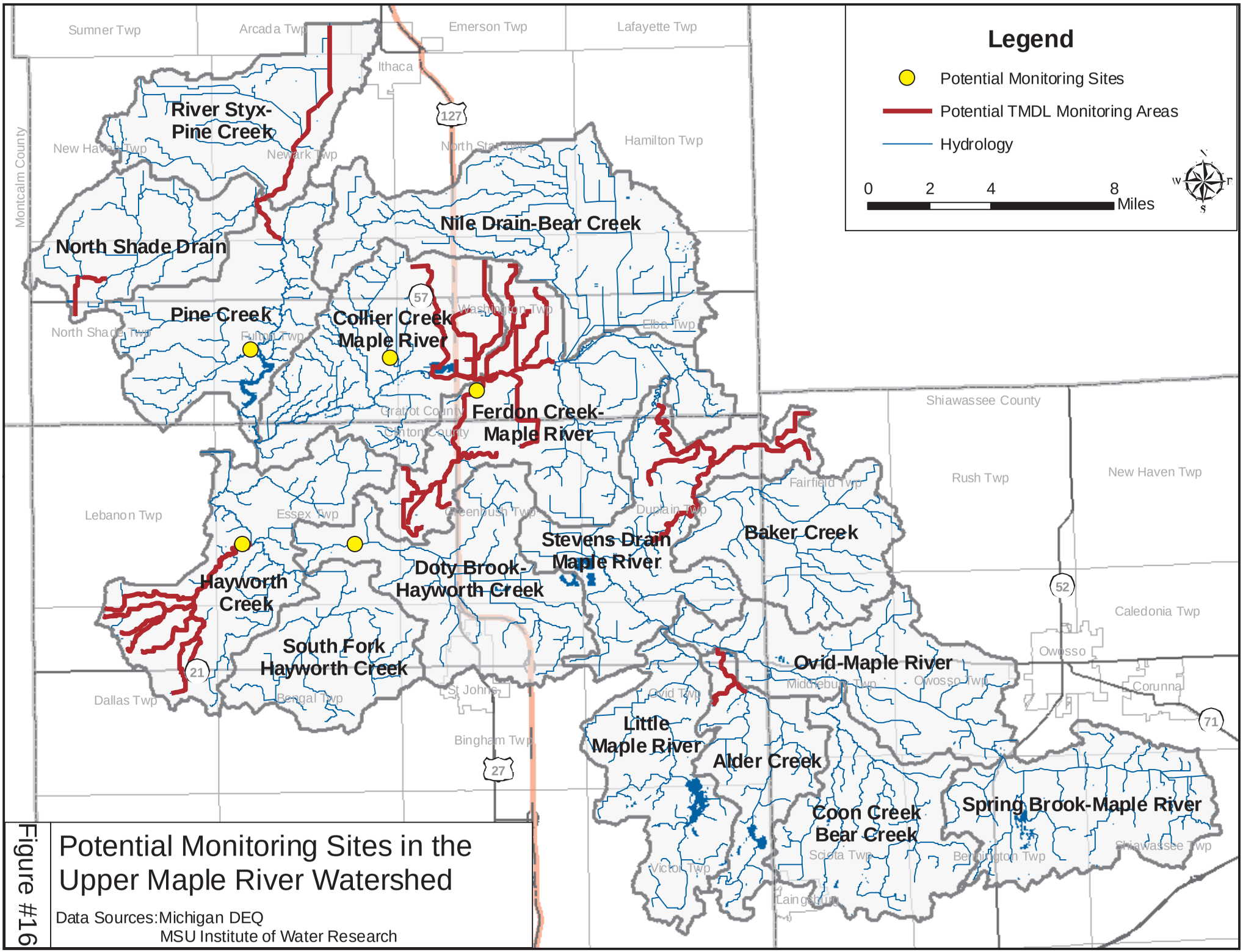


Figure #16

Potential Monitoring Sites in the Upper Maple River Watershed

Data Sources: Michigan DEQ
MSU Institute of Water Research