Munuscong River Watershed Management Plan

March 29, 2013

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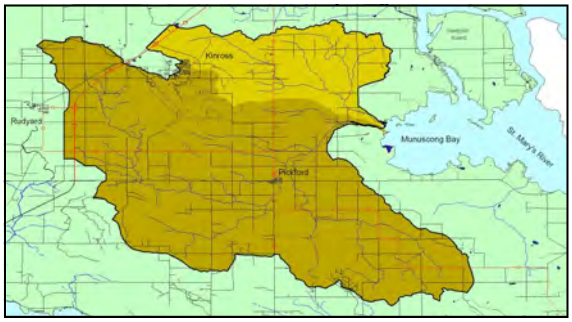
CHIPPEWA/LUCE/MACKINAC
CONSERVATION DISTRICT



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For the communities of Pickford Township, Kinross Charter Township, Bruce Township, Dafter Township, Rudyard Township, Raber Township, Marquette Township, and Clark Township.

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Chapter 1 Introduction

The Munuscong River watershed (MRW) is all of the land that drains into the Munuscong and Little Munuscong Rivers. The watershed includes all of the surface and groundwater within this area. Michigan's Eastern Upper Peninsula (EUP) depends upon water resources, including recreation and thriving fisheries. Unfortunately, poor land use management has influenced and continues to threaten these resources.

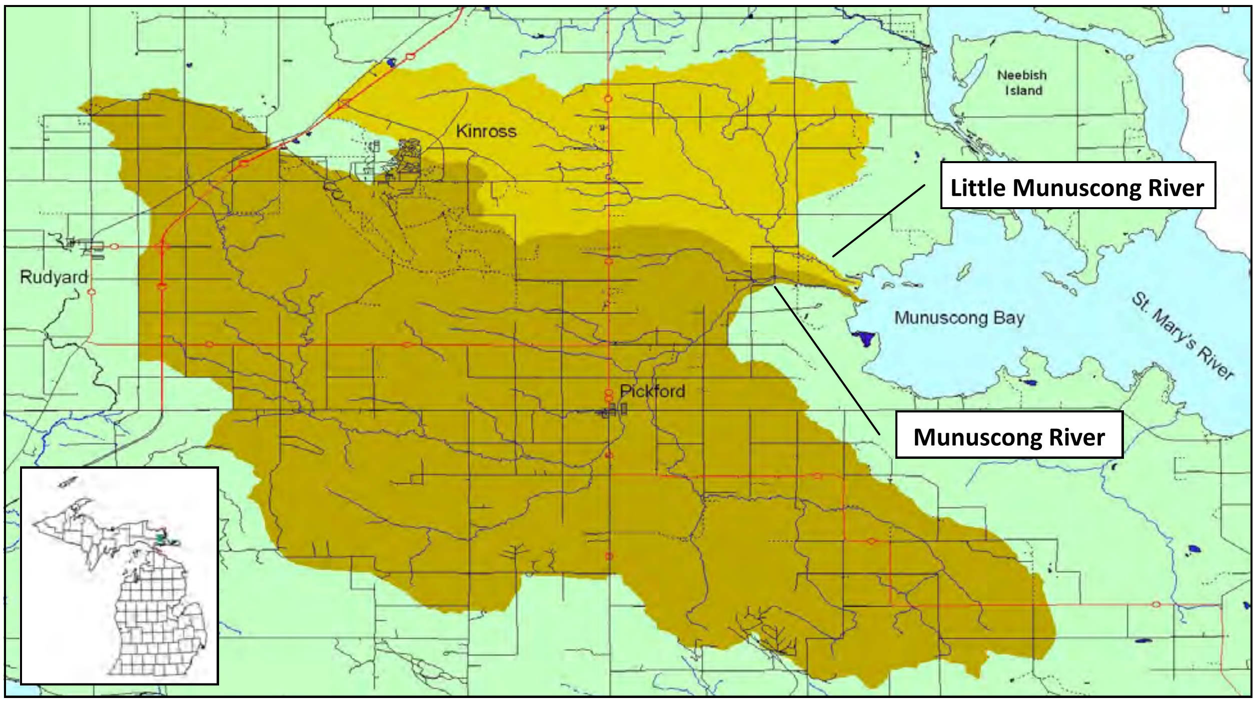


Figure 1.1 Munuscong River Watershed Area

The restoration, protection, and preservation of the MRW is a priority for the EUP community. The river helps support a thriving walleye, salmon, and perch fishery in the St. Mary's River, influencing a significant portion of the EUP economy. Both the Munuscong Lake and St. Mary's River are home to hundreds of seasonal residents, support a thriving boating recreational community, and sustain a significant Sault Area Tribe of Chippewa Indians subsistence fishery.

The Munuscong River Watershed Management Plan is a guide to help the Eastern Upper Peninsula community and other stakeholders, including local units of government, non-profit organizations, and local residents, protect water quality and aquatic resources. It can provide a recipe of Best Management Practices (BMPs) and land use planning recommendations to correct current water quality problems and to protect water quality into the future.

Implementation of the plan will require township, county, and regional stakeholders to work together across political boundaries.

Chapters 2 and 3 of the management plan provide background information into the watershed characteristics and community background within the watershed. Chapter 4 outlines the role governmental units play in protecting water quality with the use of regulations and an invested interest in the water quality within the region. Chapter 5 details the natural features within the watershed.

The watershed management planning process is outlined within Chapter 6. This chapter also provides an overview of the extensive inventory of road and stream crossings and agricultural facilities located along streams within the watershed.

Chapter 7 discusses the importance of protecting and restoring designated uses to protect water quality in the watershed. All of the major streams within the watershed were evaluated to provide an assessment of their condition.

Chapter 8 prioritizes the areas, pollutants and sources impacting water quality within the watershed. Chapter 9 offers goals for the improvement of the watershed and Chapter 10 outlines tasks and timelines to achieve the goals set.

Designated Uses

All surface waters of Michigan are designated for and shall be protected for all of the following uses:

1. Agriculture
2. Industrial Water Supply
3. Public Water Supply at the point of intake
4. Navigation
5. Warm/Coldwater Fishery
6. Other indigenous aquatic life and wildlife
7. Partial body contact recreation
8. Total body contact recreation (5/1-10/1)

Lastly, Chapter 11 outlines a process to evaluate the watershed plan, implementation progress, and achievement of milestones that have all been outlined within the plan.

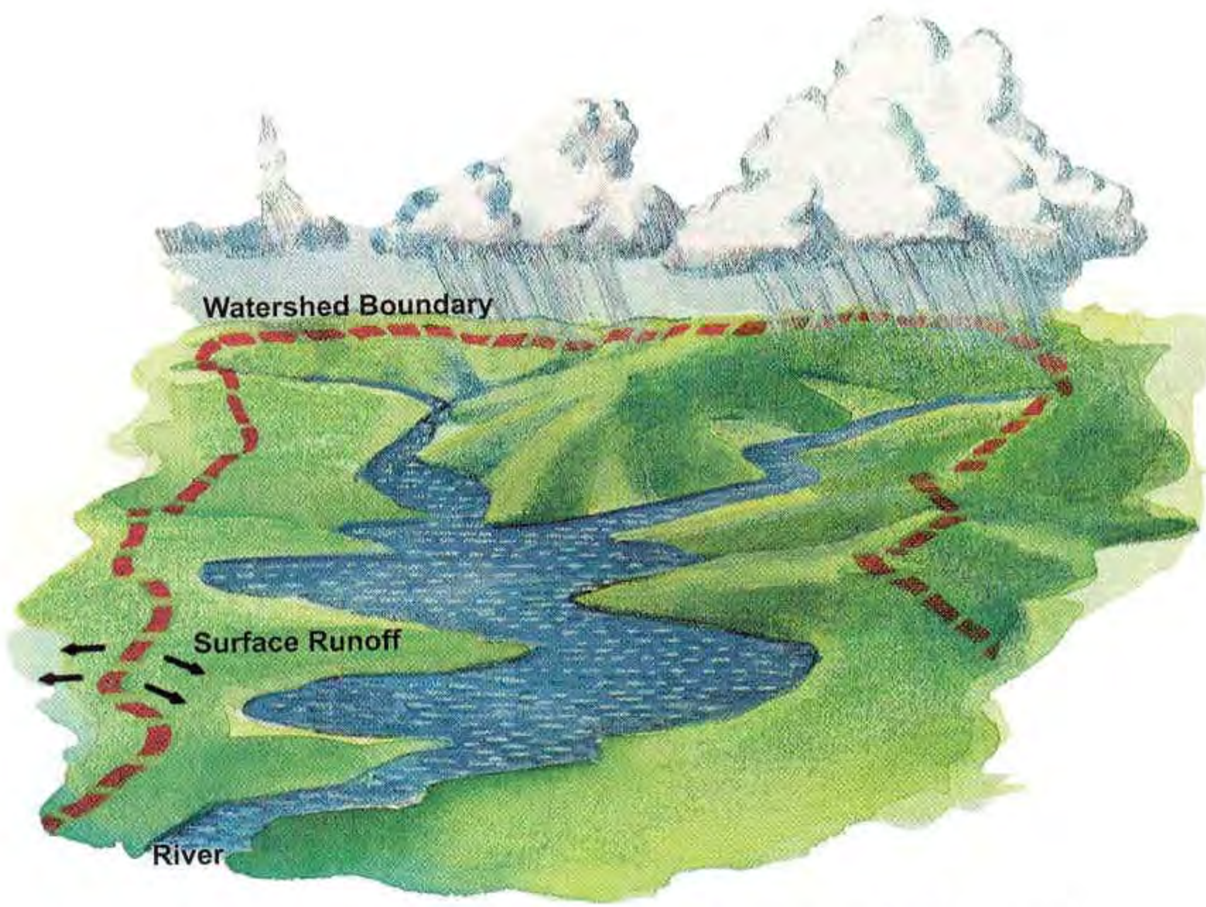
The ultimate goal of the Munuscong River Watershed Project is to restore and maintain water quality to the level that it meets the *Designated Uses* for water as set by the State of Michigan as set by the Michigan's Environmental Protection Act (P.A. 451 of 1994, Part 31, Chapter 1)

This management plan was created as part of the MRW planning project, which was funded with a Clean Water Act Section 319 grant administered by the Michigan Department of Environmental Quality (MDEQ), Nonpoint Source Program. The Chippewa/Luce/Mackinac Conservation District in collaboration with several partners was awarded the grant in January of 2010. Development of the Munuscong River Watershed Management Plan relied heavily on local stakeholder input and agency support, as well as professional services and other partnerships.

Chapter 2 Description of Watershed Characteristics

2.1 General Landscape

Imagine a typical landscape with hills, valleys, rivers, wetlands, as well as development like houses, parking lots, etc. that you find all across America. The characteristics of our water quality begin with our first experience with water as rainfall and/or snow falling to the landscape. Right away, that precipitation either percolates into the soil to recharge groundwater, or it evaporates, or it takes the path of least resistance downhill as runoff and collects at common low points, usually lakes, ponds, rivers, and wetlands. Each landscape can be delineated into watersheds based on the low point which creates the water body with the runoff water collected from all the land surrounding it. The water body is defined by these common low points.



A watershed is an area of land that drains to a common body of water.

Figure 2.1 — Watershed

The Munuscong River watershed is all of the land draining into the Munuscong and Little Munuscong Rivers (Figure 2.2).

The collective Munuscong River watershed consists of two separate watersheds: the 187 square mile Munuscong River watershed and the 46 square mile Little Munuscong River watershed.

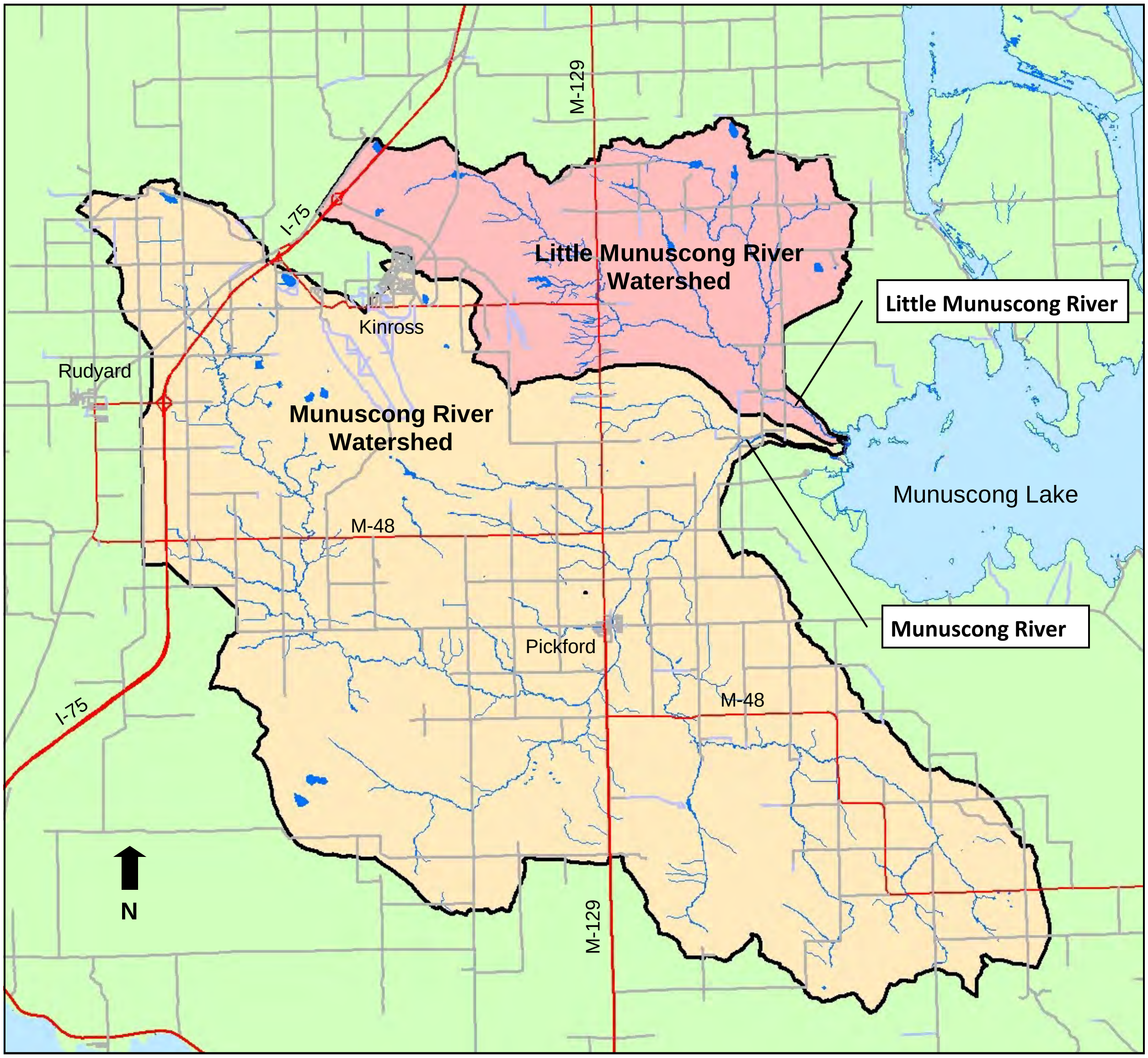


Figure 2.2 — Little Munuscong and Munuscong Watershed Area

The Munuscong and Little Munuscong flow eastward through the Michigan's eastern upper peninsula before out-letting to Munuscong Lake and the St. Mary's River, east of the town of Pickford. Land use and cover is comprised of wetland (40%), agriculture (28%), upland forest (23%), open field (5%), and urban (3%).

2.2 Subwatersheds

The Munuscong River and the Little Munuscong River are sub-basins within the St. Mary's River watershed (8-digit Hydrologic Unit Code (HUC) 04070001). The two sub-basins are defined as the Little Munuscong River (10-digit Hydrologic Unit Code 0407000101) and the Munuscong River (10-digit Hydrologic Code 0407000102).

The two sub-basins are further divided into nine subwatersheds (Figure 2.3). These subwatersheds include a number of small creeks that drain into the Munuscong and Little Munuscong Rivers. These include School Creek, Taylor Creek, Fletcher Creek, Hannah Creek, Demoreux Creek, Parker Creek, and Rapson Creek. The map below shows the last three digits of the 12-digit Hydrologic Code for each sub-watershed. See Table 2.1 for subwatershed identification (ID) key and descriptions.

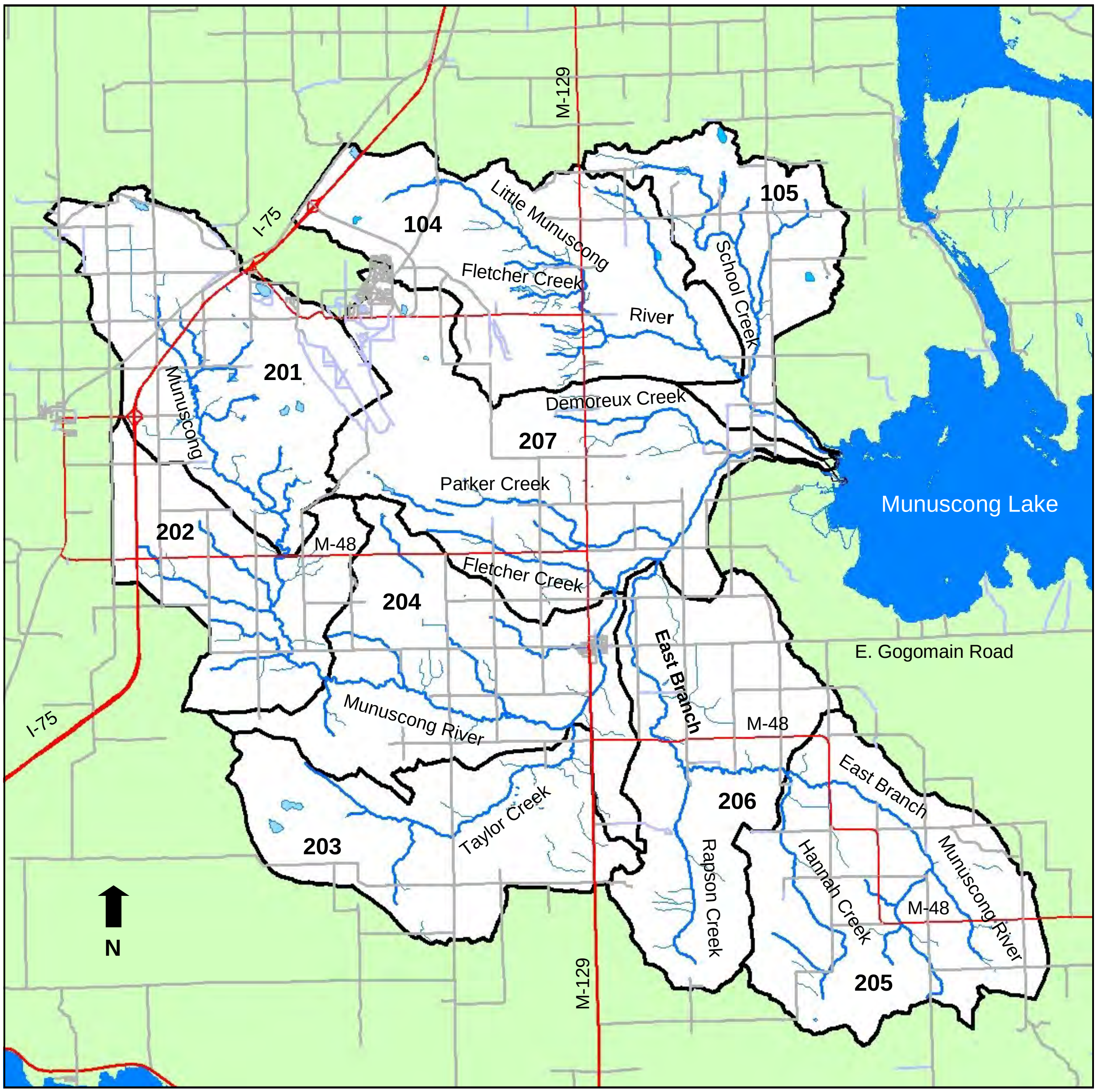


Figure 2.3 Subwatersheds

Table 2.1 provides a breakdown of the acres within each of the nine subwatersheds. The Munuscong River HUC area is 119,798 acres. The Little Munuscong River HUC area is 29,303 acres. The total combined acres is 149,101.

Munuscong River	**Watershed ID**	**Total Acres**
Headwaters Munuscong River	040700010201	17,749
Upper Munuscong River	040700010202	11,261
Taylor Creek	040700010203	14,883.8
Middle Munuscong River	040700010204	17,516.1
Hannah Creek	040700010205	18,504.7
East Branch Munuscong River	040700010206	16,837.1
Lower Munuscong River	040700010207	23,046.1
Munuscong Sub-total		119,797.8
Little Munuscong River		
Headwaters Little Munuscong River	040700010104	19,103.2
Little Munuscong River	040700010105	10,199.6
Little Munuscong Sub-total		29,302.8
Total Watershed		**149,100.6**

Table 2.1 Subwatershed Area

The Munuscong and Little Munuscong Rivers outlet to Munuscong Lake. The collective Munuscong River watershed is in Chippewa and Mackinac Counties.

The subwatersheds are fed by an average of 32 inches of annual precipitation. The watershed is also inundated with scattered artesian wells that contribute to the area's characteristic, excessively turbid creeks and rivers.

2.3 Hydrology of the Watershed

The Hydrologic Studies and Dam Safety Unit (HSDSU) of the Michigan Department of Environmental Quality completed a hydrologic study of the Munuscong River watershed and the Little Munuscong River watershed to better understand the watersheds' hydrologic characteristics. This study was completed in January 31, 2011 to support the preparation of this watershed management plan.

The watersheds' hydrologic characteristics were evaluated to help determine the watersheds' critical areas and to provide a basis for storm water management ordinances to protect streams from increased erosion. This information has been used to help determine which locations are most appropriate for wetland restoration and other best management practices (BMPs) presented later in this management plan.

2.3.1 Hydrologic Study—Sub-basins

The hydrologic study further divided the nine subwatersheds into 22 sub-basins (Figure 2.4). Areas identified as non-contributing have no surface outlet for stormwater runoff as determined by nested depression contours.

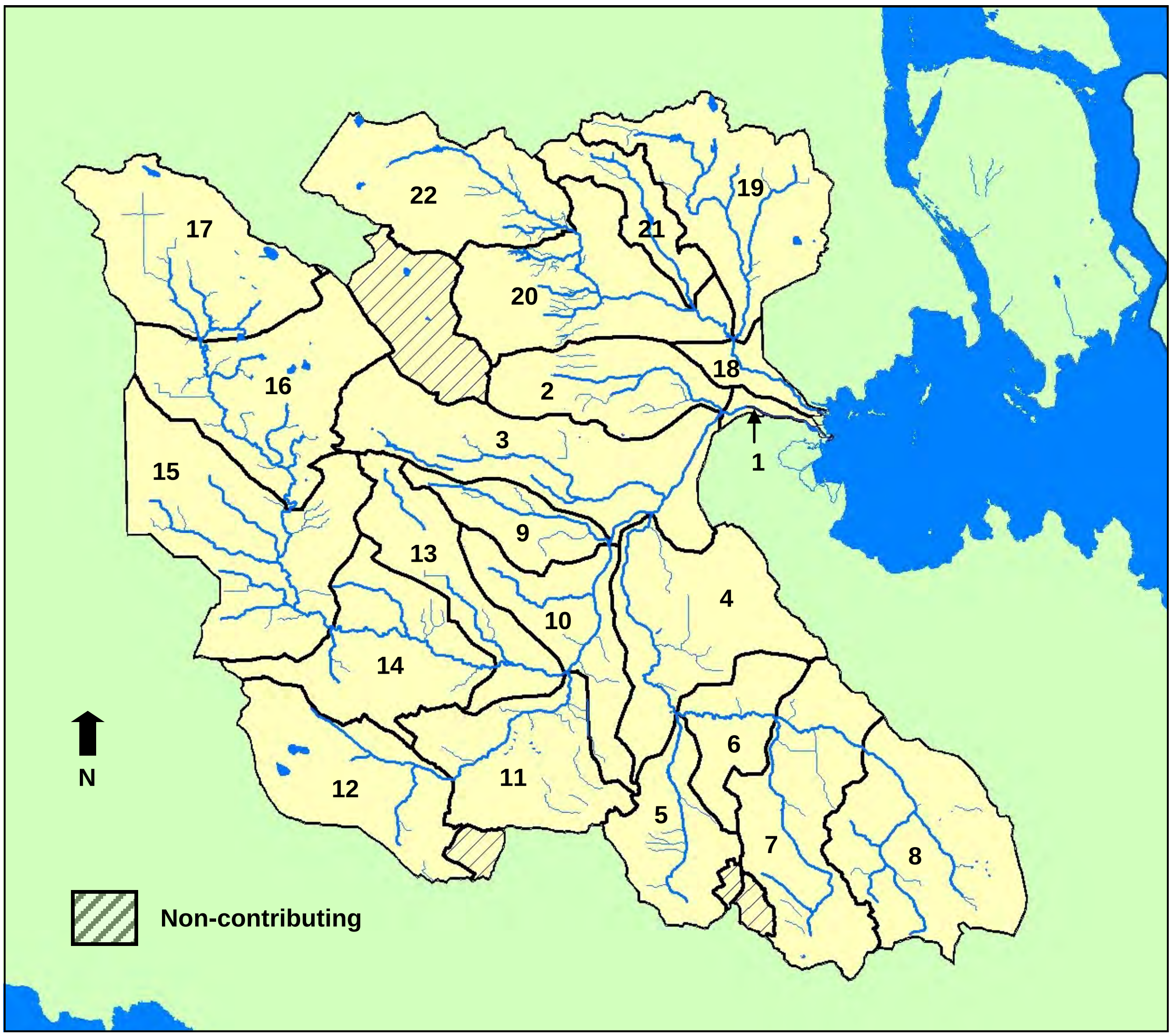


Figure 2.4 Hydrologic Study Subbasins

The collective Munuscong River watershed is 233 square miles. Table 2.2 provides a breakdown of the size of each of the 22 study sub-basin areas.

Subbasin	Description	Area (sq. mi.)
1	Munuscong River to mouth	0.9
2	Demoreux Creek to mouth	8.1
3	Munuscong River to Demoreux Creek	15.9
4	East Branch Munuscong River to mouth	13.2
5	Rapson Creek to mouth	7.4
6	East Branch Munuscong River to Rapson Creek	5.4
7	East Branch Munuscong River to below Hannah Creek	13.3
8	East Branch Munuscong River to South Reynolds Road	14.8
9	Fletcher Creek to mouth	4.7
10	Munuscong River to Fletcher Creek	8.1
11	Taylor Creek to mouth	10.7
12	Taylor Creek to Three Mile Road	11.5
13	Munuscong River to Taylor Creek	8.1
14	Munuscong River to Rutledge Road	11.2
15	Munuscong River to unnamed tributary	17.6
16	Tributary to Munuscong River to M-48	14.1
17	Tributary to Munuscong River to below unnamed tributary	13.5
18	Little Munuscong River to mouth	2.3
19	School Creek to mouth	13.6
20	Tributary to Little Munuscong River to School Creek	13.1
21	Tributary to Little Munuscong River to mouth	4.6
22	Little Munuscong River to Sixteen Mile Road	12.1
	Non-contributing	8.8
	Total area (square miles)	233

Table 2.2 Collective Munuscong River Watershed Sub-basin Identification

2.3.2 Hydrologic Study—Stream Order Analysis

Stream order is a numbering sequence that starts when two first order, or headwater, streams join, forming a second order stream. Two second order streams converging form a third order, and so on. Streams of lower order joining a higher order stream do not change the order of the higher, as shown in Figure 2.5. Stream order provides a comparison of the size and potential power of streams (MDEQ).

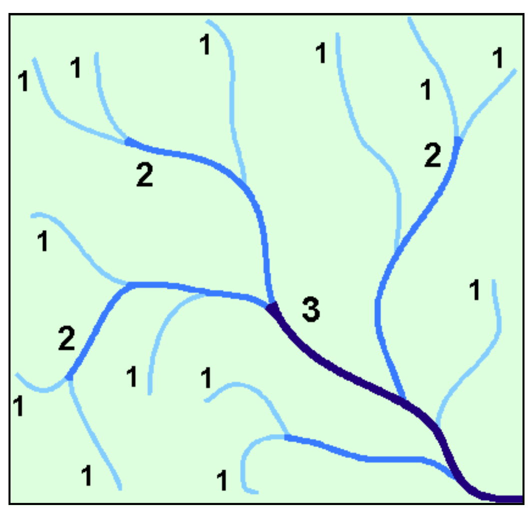


Figure 2.5 Stream Order

Map Source: HSDSU MDEQ

The Munuscong River is a fifth order river at its outlet with first through fourth order tributaries (Figure 2.6), including School, Demoreux, Fletcher, Taylor, Hannah, Rapson, and Parker Creeks. The Little Munuscong River is a fourth order river at its outlet with first through third order tributaries.

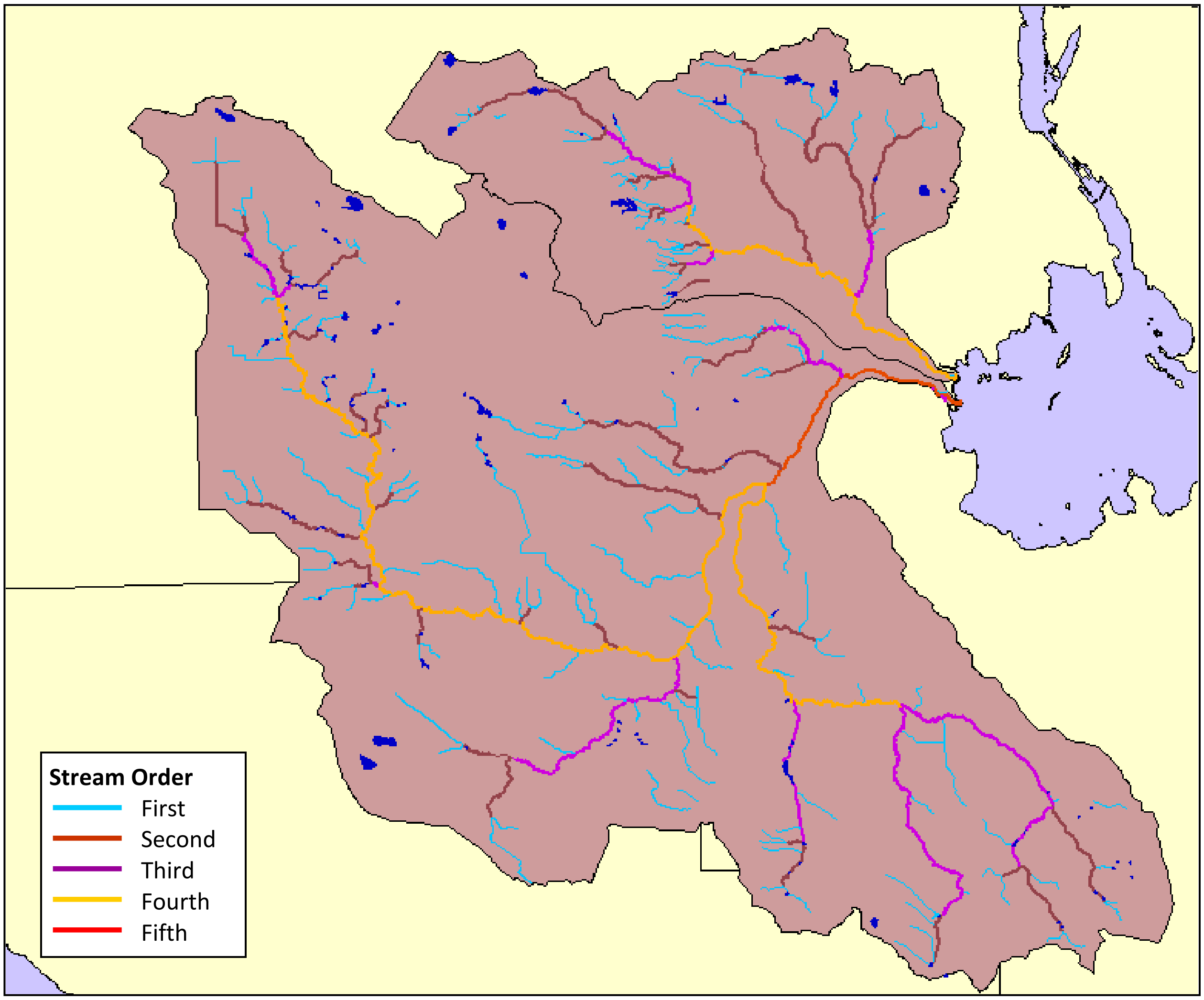


Figure 2.6 Munuscong Watershed Stream Order

Map Source: HSDSU MDEQ

2.3.3 Hydrologic Study—Stream Temperature Analysis

The Munuscong River and Little Munuscong River watersheds have predominately warm and cool stream reaches, with two cold tributaries, which is consistent with other watersheds in the eastern upper peninsula (Figure 2.7).

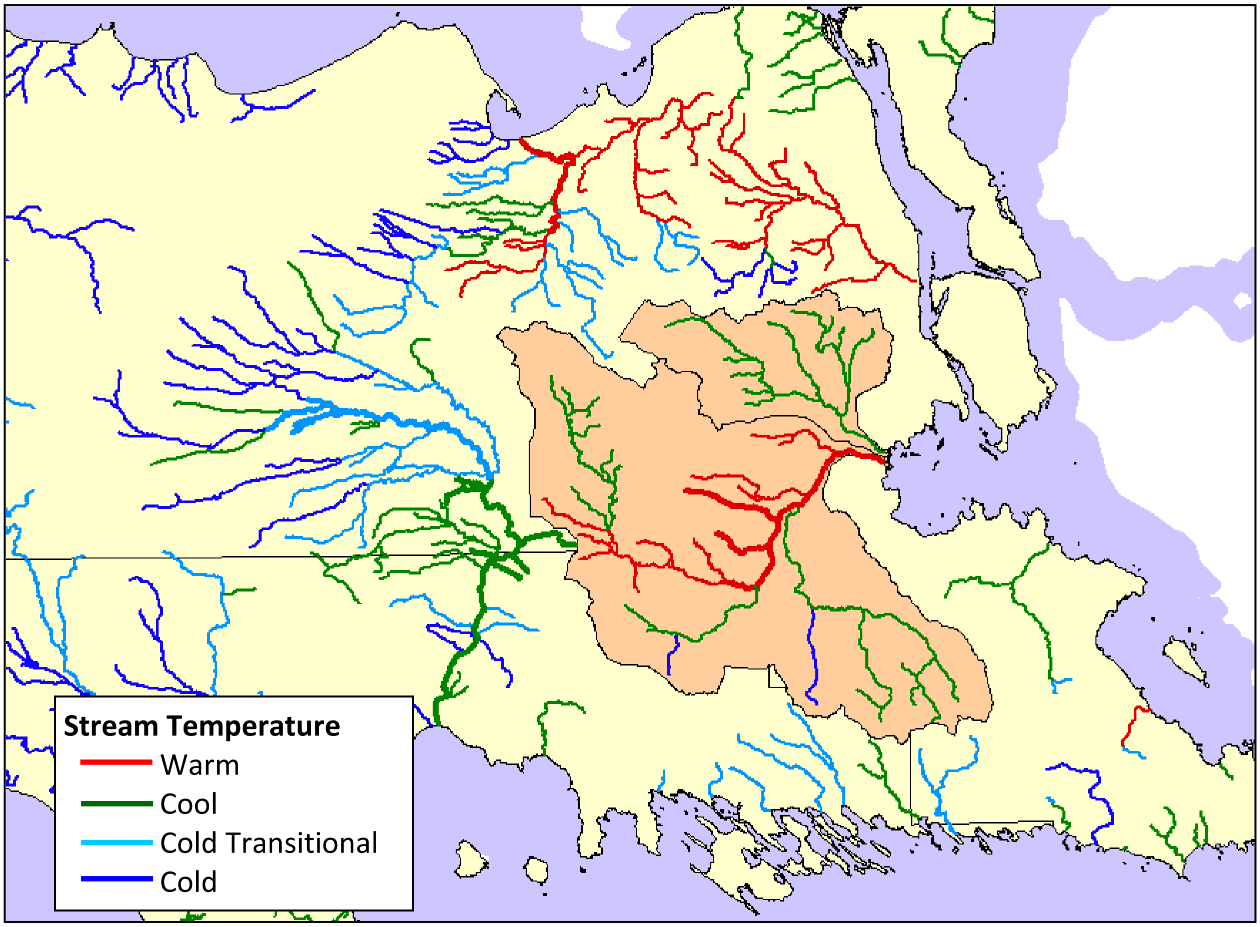


Figure 2.7 Munuscong Stream Temperatures

Map Source: HSDSU MDEQ

Colder water tributaries are generally associated with a good supply of ground water-fed base-flow, which helps keep stream flows and temperatures steady. These tributaries are considered high quality trout streams (Figure 2.8) (HSDSU).

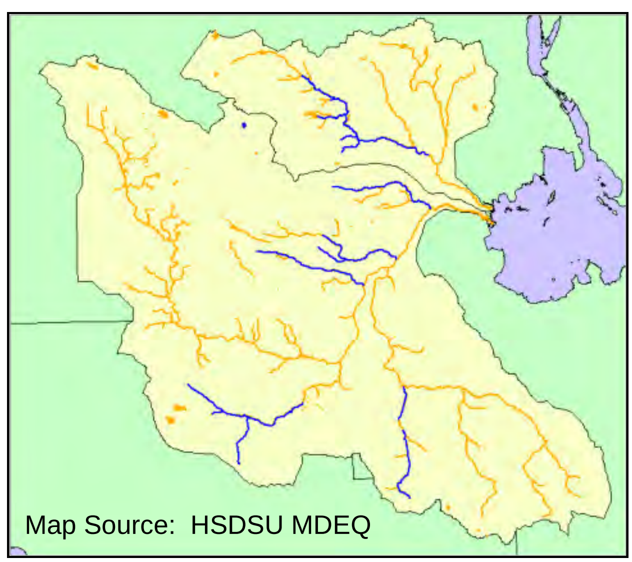


Figure 2.8 Munuscong Trout Streams

2.3.4 Hydrologic Study—Hydrologic Soil Groups

Hydrologic soil groups, or hydrogroups, are grouped according to the infiltration of water when they are thoroughly wet and receive precipitation from long-duration storms as described in Table 2.3. The hydrologic soils map for the Munuscong River watershed is shown in Figure 2.9. Where soil is given a dual hydrogroup classification, A/D for example, the soil type selected for calculating runoff curve is based on land cover. In these cases, the soil type is specified as D for natural covers, or alternate classification (A, B, or C) for developed land covers (such as football fields, neighborhoods, or parking areas). (HSDSU MDEQ)

Hydrologic Soil Group	Infiltration Rate when thoroughly wet	Description
A	High	• Sand • Gravel
B	Moderate	• Moderately fine textured to moderately course textured soil
C	Slow	• Moderately fine textured to fine textured soils • Soils with a soil layer that impedes downward movement or water
D	Very Slow	• Clays • Soils with a clay layer near the surface • Soils with a permanent high water table

Table 2.3 Soil Hydrogroups

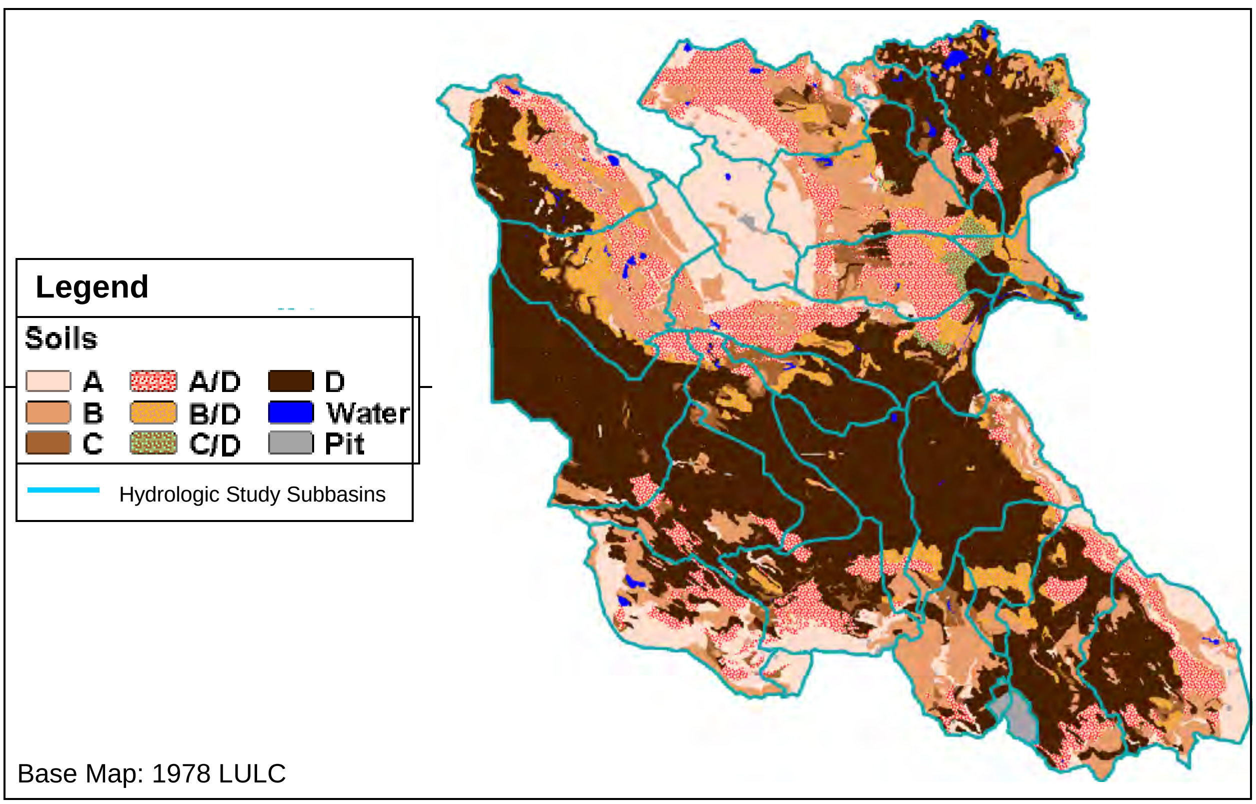


Figure 2.9 Hydrologic Soils Map for Munuscong Watershed Map Source: HSDSU MDEQ

Most of the Munuscong River watershed is made up of Group D soils. These soils are defined as poorly drained soils. These soils are one of the indicators of wetlands. Many have been drained for building or agricultural purposes, despite being poorly suited for those purposes, especially for septic fields.

The septic systems installed in areas with unsuitable soils are prone to failure, which can lead to nutrient and bacteria pollution of groundwater and surface water (SWMPC). In fact, failing on-site disposal systems (OSDS) near surface waters in the Munuscong River watershed are suspected of being a significant source of bacteria and pathogen pollution contributing to the watershed not supporting partial and total body contact recreation (MDEQ 2011 Integrated Report).

2.3.5 Hydrologic Study—Hydrologic Critical Areas

Watershed planning identifies critical areas to focus technical and financial resources on the area contributing a disproportionate share of pollutants. The "Munuscong River Watershed Hydrologic Study" prepared by the MDEQ, provided a ranking of critical areas based solely on hydrologic selection criteria: a) runoff volume per sub-basin area; b) runoff volume increase per sub-basin area; c) peak flood flow yield per sub-basin area; and d) peak flood flow yield change per sub-basin area. The selection criteria and scores used in the Hydrologic Study are shown in Table 2.4. Percent imperiousness was not used because all sub-basins are less than ten percent.

Runoff volume per area and peak flow yield, calculated from 1978 land cover, highlight those sub-basins contributing the most runoff or are the most hydrologically responsive. Changes in runoff volume per area and peak flow yield, calculated from 1800 to 1978, highlight those sub-basins that have experienced the most hydrologic change. The results are shown in Table 2.5 and Figure 2.10.

Condition	Standard	Score
Runoff Volume per Area 1978 Land Cover	• Less than 0.432 inches • 0.433 — 0.590 inches • 0.591— 0.770 inches • Over 0.770 inches	0 3 7 10
Runoff Volume Increase per Area, 1800 to 1978 Land Cover	• Less than 0.053 inches • 0.054 inches — 0.139 inches • 0.140 — 0.257 inches • Over 0.257 inches	0 3 7 10
Peak Flood Flow Yield 1978	• Less than 0.012 • 0.013 — 0.016 • 0.017— 0.033 • Over 0.033	0 3 7 10
Peak Flood Flow Yield Change 1800 to 1978	• Less than 45.9 percent • 46.0 — 96.7 percent • 96.8 — 217 percent • Over 217 percent	0 3 7 10

Table 2.4 Critical Area Scoring Source: HSDSU MDEQ

The watershed management plan uses these results with other criteria to help determine which locations are most appropriate for wetland restoration and other best management practices (BMPs). (HSDSU MDEQ)

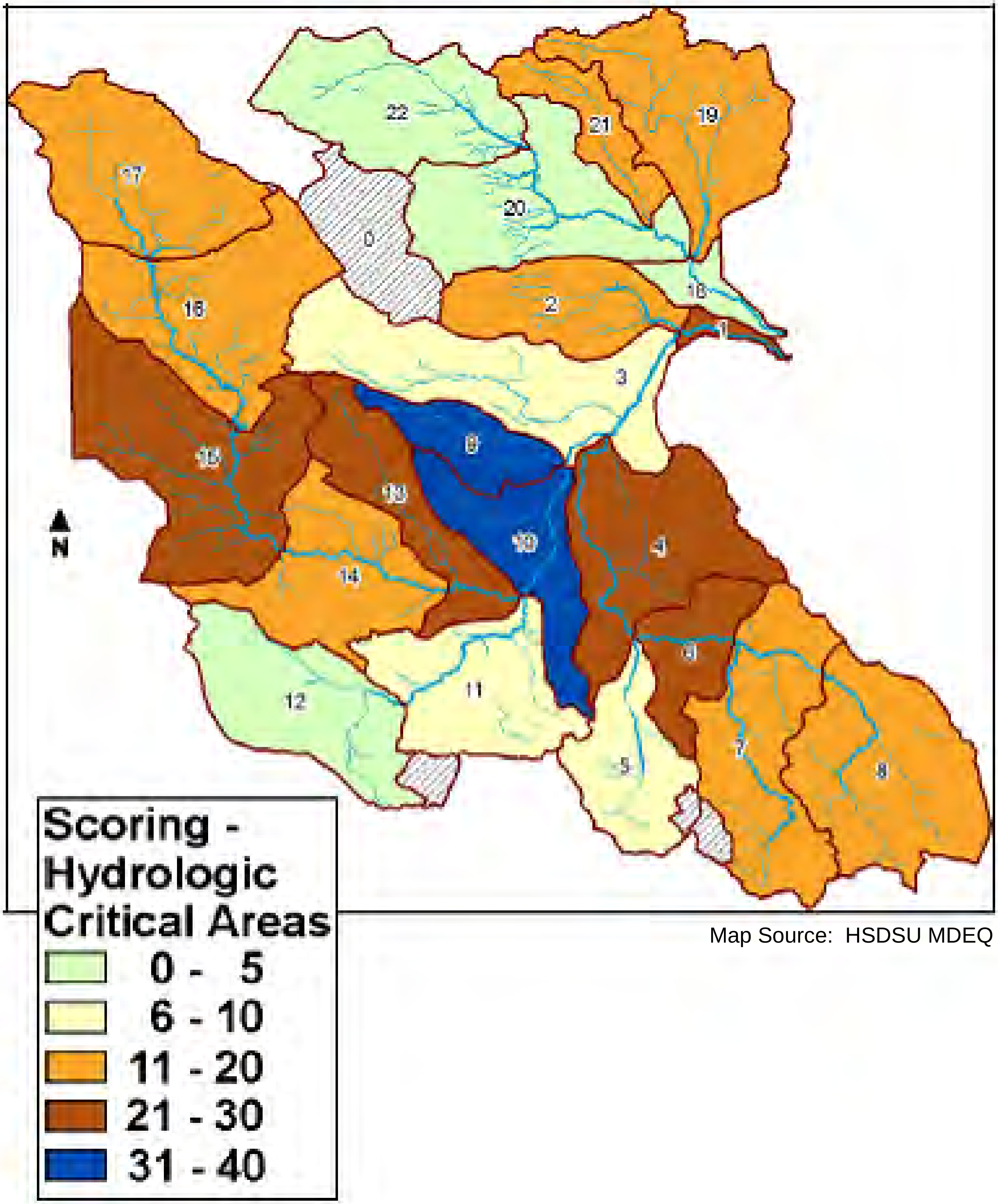
	Subbasin	Runoff Volume, 1978	Runoff Volume Change, 1800 to 1978	Peak Flow Yield, 1978	Peak Flow Yield Change, 1800 to 1978	Total Score
1	Munuscong River to mouth	10	10	7	0	27
2	Demoreux Creek to mouth	3	3	3	3	12
3	Munuscong River to Demoreux Creek	3	3	0	3	9
4	East Branch Munuscong River to mouth	7	7	7	7	28
5	Rapson Creek to mouth	0	0	3	3	6
6	East Branch Munuscong River to Rapson Creek	7	7	7	3	24
7	East Branch Munuscong River to below Hannah Creek	3	3	3	7	16
8	East Branch Munuscong River to South Reynolds Road	3	3	3	3	12
9	Fletcher Creek to Mouth	10	10	10	10	40
10	Munuscong River to Fletcher Creek	10	10	7	10	37
11	Taylor Creek to Mouth	3	0	3	3	9
12	Taylor Creek to Three Mile Road	0	0	0	0	0
13	Munuscong River to Taylor Creek	7	7	3	7	24
14	Munuscong River to Rutledge Road	7	3	3	7	20
15	Munuscong River to Unnamed Tributary	10	10	3	7	30
16	Tributary to Munuscong River to M-48	7	7	0	3	17
17	Tributary to Munuscong River to below unnamed tributary	3	3	7	3	16
18	Little Munuscong River to mouth	3	0	0	0	3
19	School Creek to mouth	7	3	3	3	16
20	Tributary to Little Munuscong River to School Creek	0	0	0	0	0
21	Tributary to Little Munuscong River to mouth	3	3	7	3	16
22	Little Munuscong River to Sixteen Mile Road	0	0	0	0	0

Table 2.5 Sub-basin Critical Area Scores Source: HSDSU MDEQ

The total scores in Table 2.5 are highlighted to match with colors used on Figure 2.10.

The sub-basin areas with the highest hydrologic concern are:

Sub-basin 9	Fletcher Creek to mouth	Score: 40
Sub-basin 10	Munuscong River to Fletcher Creek	Score: 37
Sub-basin 15	Munuscong River to unnamed tributary	Score: 30
Sub-basin 4	East Branch Munuscong River to mouth	Score: 28
Sub-basin 1	Munuscong River to mouth	Score: 27
Sub-basin 6	East Branch Munuscong to Rapson Creek	Score: 24
Sub-basin 13	Munuscong River to Taylor Creek	Score: 24



Map Source: HSDSU MDEQ

Figure 2.10 Hydrologic Critical Areas

2.4 Climate

The Munuscong River Watershed is located within the interior of the eastern upper peninsula, well away from many of the climate effects of Lake Superior to the north. Total annual precipitation in the area is approximately 31.9 inches including approximately 99 inches of snowfall (Chippewa County Soil Survey). In contrast, total annual precipitation is 34.75 inches at Whitefish Point to the north, immediately adjacent to Lake Superior, with 129.2 inches of snow fall.

According to the Michigan Department of Agriculture, Environmental Division, Climatology Program, the average winter temperature in the MRW was 16.4 degrees F and the average summer temperature was 62.5 degrees F from 1951 to 1980 (Chippewa County Soil Survey 1992).

2.5 Geology, Hydrology and Soils

Glacial activity has influenced virtually all of Michigan's topography and hydrology. Through repeated advances of continental ice sheets, glaciers have eroded pre-existing rock and soils and re-deposited these materials as sediments as ice retreats. Cycles of this melting and retreating have taken place for thousands of years.

Glacial materials were deposited as sands, gravels, silts and clays, as well as various mixtures, and can vary in thickness. These glacial deposits and their associated landforms provide a foundation for the hydrology, soil types and land cover that exist today (SWMPC 2008).

The MRW began as the bottomlands of glacial lakes Algonquin and Nippising (Fig 2.11). Dry now for some 10,000 years, the watershed community still is feeling the effects of those glacial formations. The thick, impermeable clay lake bottom still presents obstacles for land use, especially agriculture and urban development (CLMCD RWA 2008).

Most of the watershed is relatively flat and largely lowland. Surface characteristics of the watershed include headwaters atop what is considered a series of ancient beach ridges and swales, many miles from the present Great Lakes shorelines.

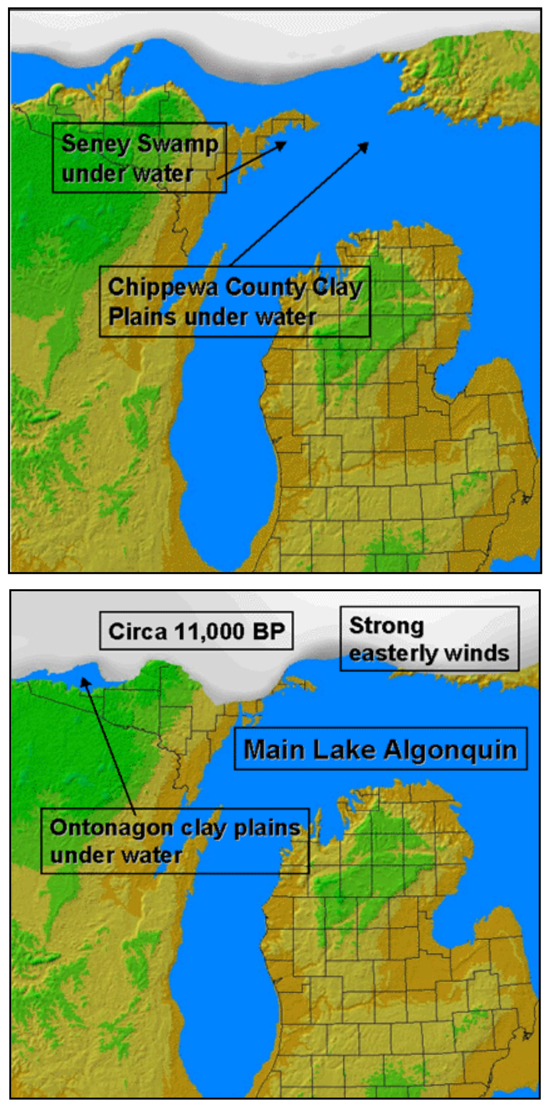


Figure 2.11 Glacial Activity

This ridge is prominently shown in Figure 2.12 forming the boundary of the watershed. This ridge, although not overly high in elevation, descends into what is called the Rudyard Clay Lake Plains. This area exhibits a generally flat to gently rolling landscape. Unfortunately, a few inches of elevation change, typical during development, can greatly alter drainage conditions.

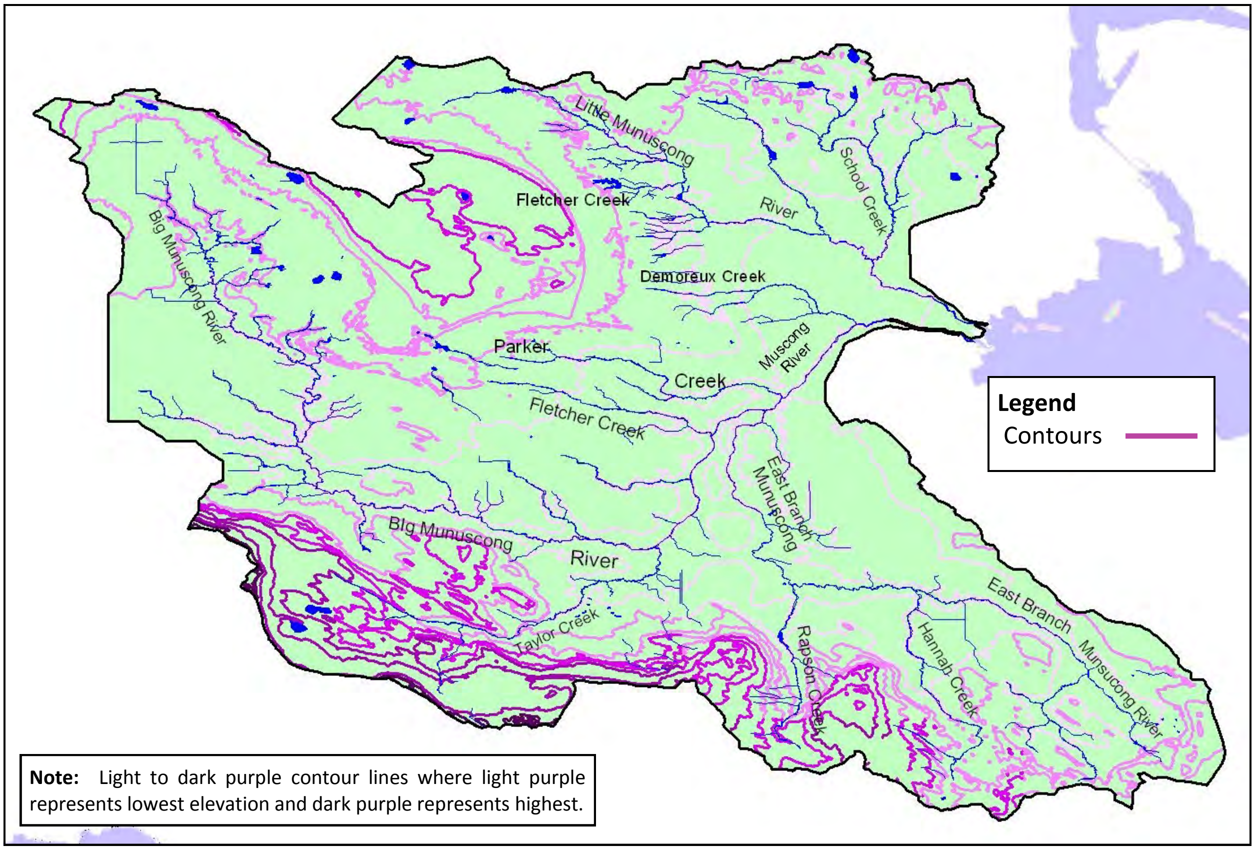


Figure 2.12 Topography

The highest elevation ranges from 1,000 foot above sea level at the southern border of the watershed to 850 feet along the northern border. While the lowest elevation is around 600 feet above sea level, with a majority of the watershed between 750 and 650 feet above sea level (USGS 2005).

2.6 Soils

Soils of a watershed influence all land uses and ultimately determine the characteristics of its natural resources. The National Cooperative Soil Survey publishes soil surveys for each county within the U.S. These soil surveys contain predictions of soil behavior for selected land uses, and also highlight limitations and hazards inherent in the soil, general improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

The soil surveys are designed for many different users. Planners, community officials, engineers, developers, builders, etc., use the surveys to help plan land use, select sites for construction, and identify special practices needed to ensure proper performance (SWMPC).

Almost the entire project area is within the *Rudyard Clay Lake Plain,* a broad, ancient glacial lake bed and dolomite. Above that lies thick, lacustrine clay (material formed at the bottom of a lake or along the shore), except for small areas of sand lake plain near the center of the watershed and cobbly loam near the south east end of the watershed.

On the southwestern edge, level lakebed plains are interrupted by gently rolling plateaus, low rounded ridges, or lakeshore features such as remnant beach ridges, sand dunes, bluffs, or coastal marshes.

Soils in the vicinity of Munuscong Lake and the St. Mary's River are comprised of clays, loams, or sands that are very poorly drained. Much of the remaining watershed within the *Clay Lake Plain,* is the thick, poorly drained clays. The clay soils are mostly *Pickford-Rudyard-Ontonogan*. Sands are *Kalkaska-Rubicon* (CEMCD) (Figure 2.13).

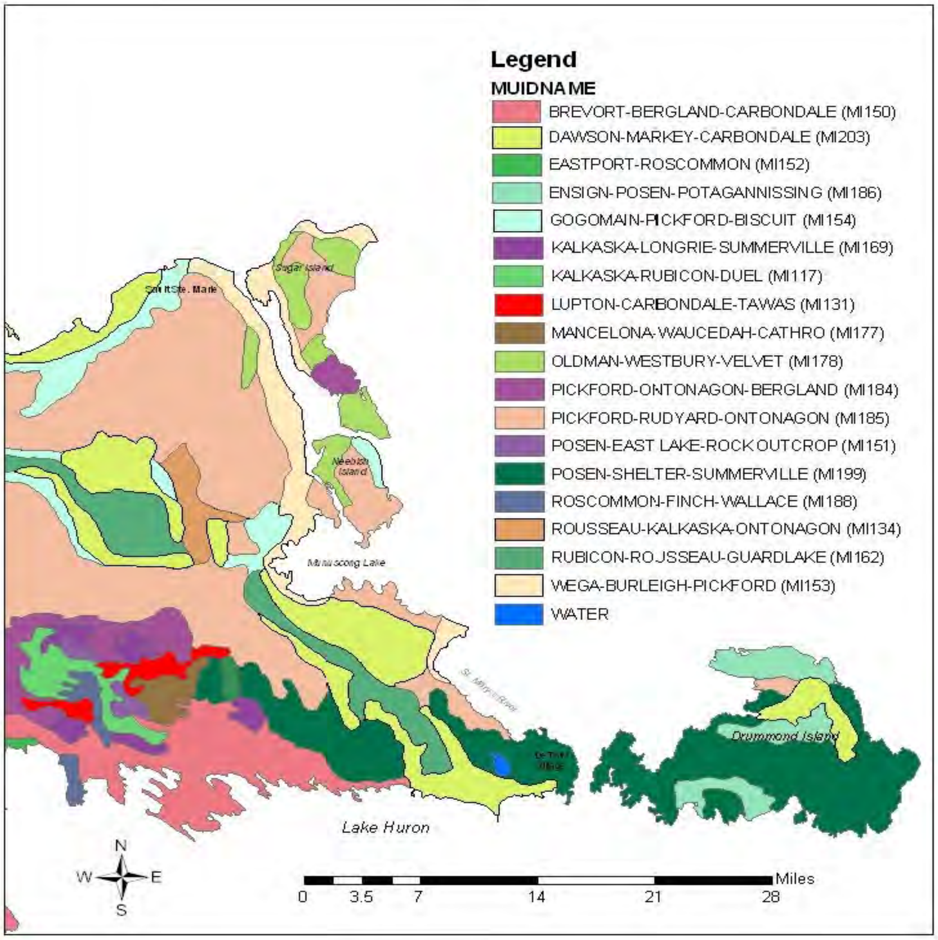


Figure 2.13 Soils

The dominant poorly drained soils in the Munuscong River watershed have been a limiting factor for agriculture and urban development options. Accompanying the thick clays of the *Rudyard Clay Lake Plain* is a relatively flat topography. Landowners have needed to install ditches to accelerate drainage and apply soil and gravel fill to raise developments above the flat, poorly draining landscape, mainly due to ponding.

In contrast, much of the historic landscape, now, is changing to more pre-settlement conditions. Much of it that was cleared for farming has been left to revert to herbaceous species, like speckled alder, willow, and red-osier dogwood. Remaining forest cover is dominated by species adaptable to the poorly drained soils, including red maple, balsam poplar, black spruce, tamarack, and northern white cedar (UPRCD).

2.7 Land Use and Land Cover

The Munuscong River watershed is characterized by a landscape composed of a broad, relatively flat clay lake plain bordered to the west by a well-defined forested slope that parallels the St. Mary's River.

Prior to European settlement, the Munuscong watershed was approximately 58 percent wetland (87,926 acres) and 40 percent upland forest (60,893 acres)(see Figure 2.14). The poorly drained interior of the watershed, supported hardwood/conifer swamps with balsam fir, balsam poplar, hemlock, northern white cedar, tamarack, trembling aspen, white pine, black spruce, and white spruce. Hemlock, white pine, sugar maple, elm, basswood, and birch stands coursed throughout the watershed along the sandy deposits and ancient beach ridges (UPRCD).

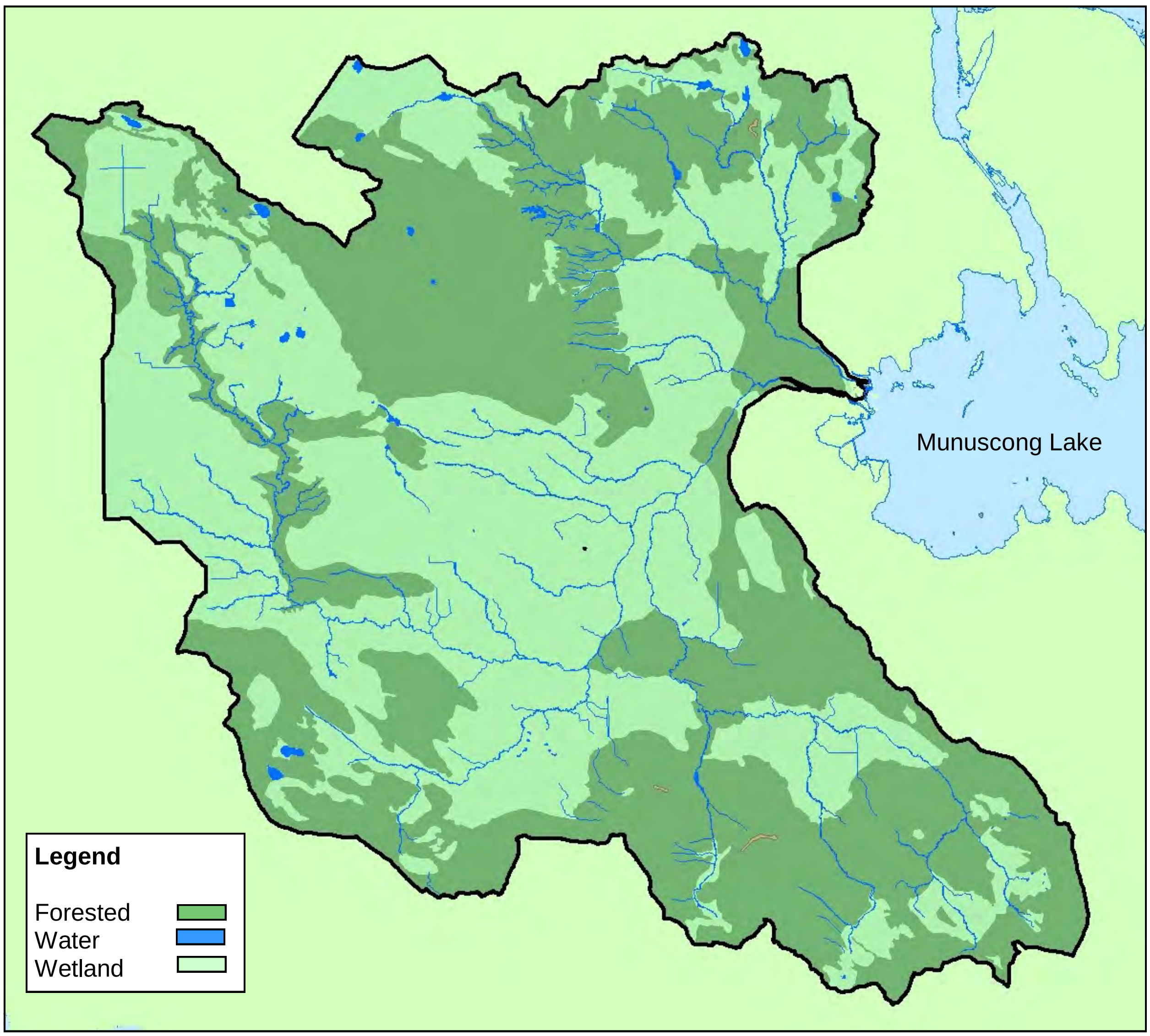


Figure 2.14 Land Use and Land Cover—Pre-European Settlement

Since the settlement of the area, thousands of acres of wetland have been drained and thousands of acres of forest have been harvested and cleared. Today, upland forest accounts for approximately 23 percent of the land use/land cover. Agriculture accounts for over 42,317 acres or 28% of the land with a mixture of hay and livestock farms (Figure 2.15 and Table 2.6). Timothy, trefoil, and clover are the primary crops which are grown for livestock forage.

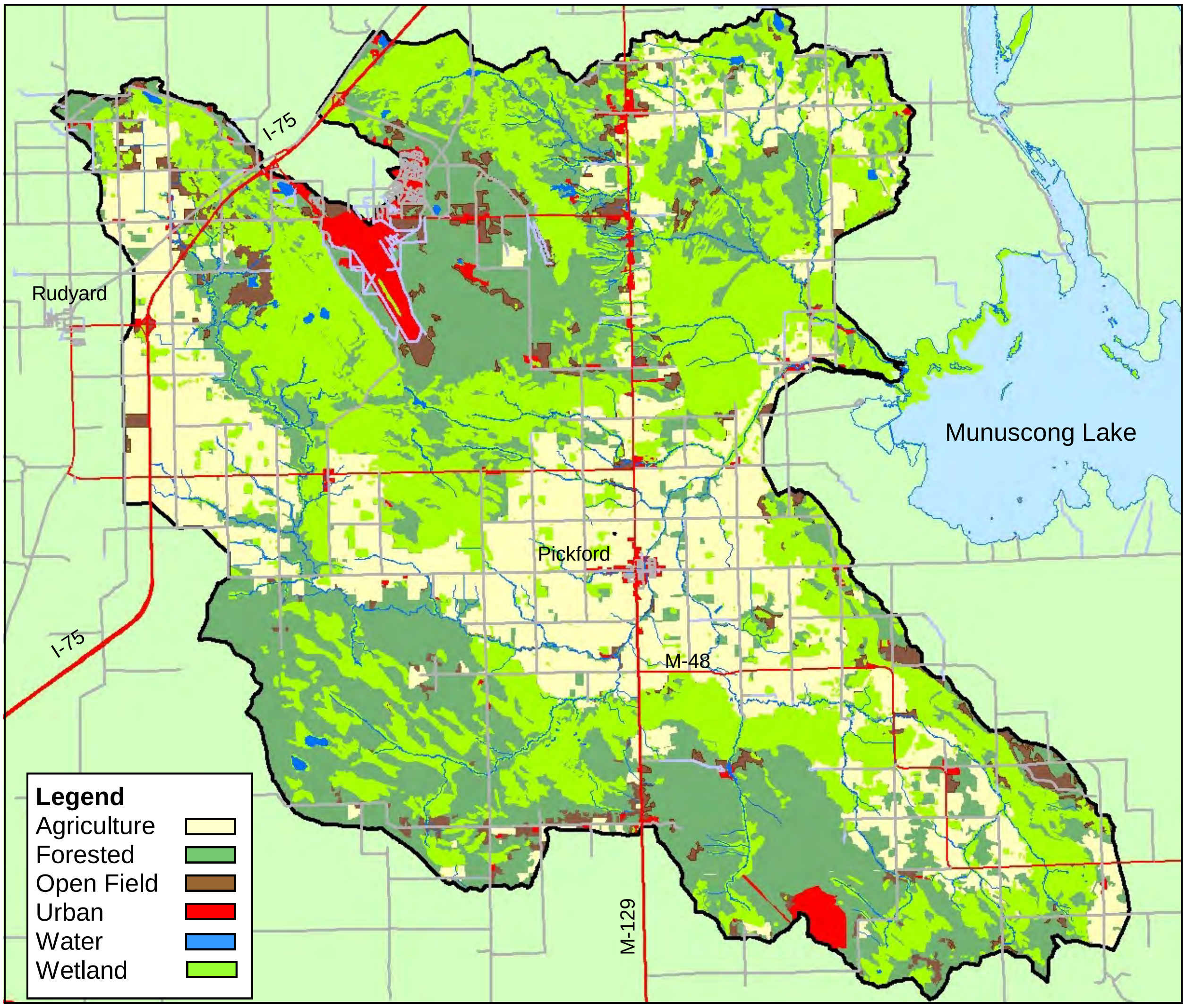


Figure 2.15 Land Use and Land Cover—1978 Base

Land Use	Pre-Settlement	Current	Gain/Loss
Wetland	87,926 acres (59%)	59,756 acres (40%)	-28,170
Upland Forest	60,893 acres (41%)	34,202 acres (23%)	-26,691
Agriculture	0	42,317 acres (28.2%)	+42,317
Urban	0	4,135 acres (3%)	+4,135
Open Field	0	8,409 acres (5.6%)	+8,409
Water	282 acres (0.002%)	282 acres (0.2%)	0
Total	149,101	149,101	0

Table 2.6 Land Use

Sources: LLWFA and MiGDL LULC

State and Federal Land ownership within the watershed is 31,856 acres or 21% of the land (Table 2.7)

State and Federal Land	**Acres**
Lake Superior State Forest	23,449
Munuscong Wildlife Management Area	7,928
State of Michigan	479
Total State and Federal Land	31,856

Table 2.7 State, Federal and Non-Public Land

The vast majority of the land is privately owned (Tables 2.8 and Figure 2.16). Large areas of state-owned lands include the Lake Superior State Forest. The majority of the developed land within the watershed is associated with the towns of Pickford and Kinross and limited amounts of waterfront residential properties scattered throughout the watershed.

Munuscong River Watershed	**Acres**	**Percent**
Private Land	117,244	79%
Public Land	31,856	21%
Total Land	149,101	100%

Table 2.8 Public and Private Land

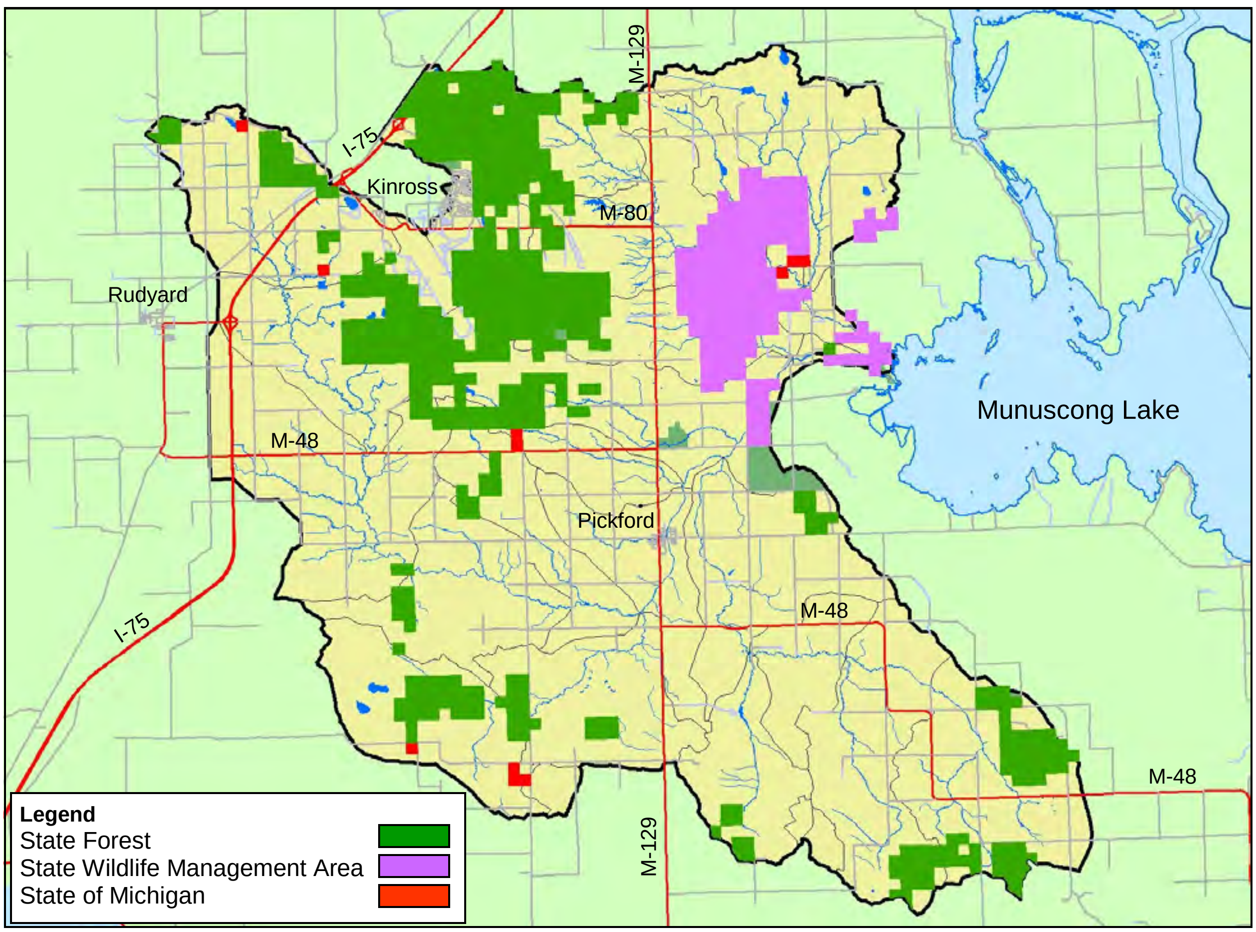


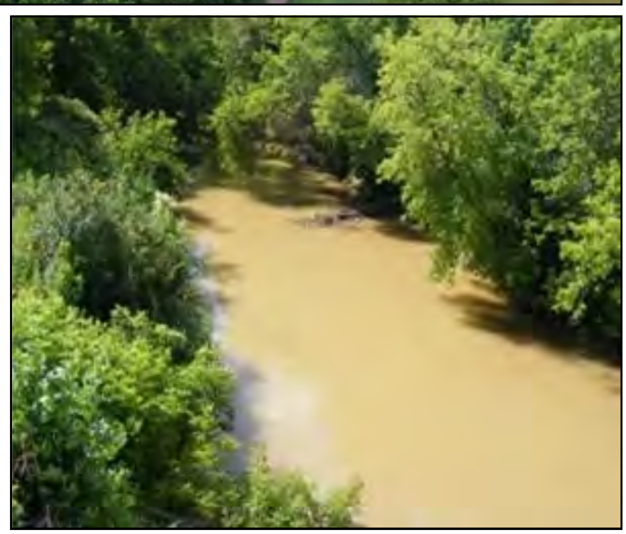
Figure 2.16 Public Lands

Chapter 3 Community Profile

3.1 History of the Area

The town of Pickford has always been grounded in natural resources. Founded through agriculture, the roots developed by the founding families are still strong and present today. Currently there are third generation farmers that can remember helping their grandfathers clear the land that they currently call home and make a living from the land. Unfortunately, this dependence upon natural resources has shown signs of degradation of our most important natural resource--clean water.

Figure 3.1 — Pickford Area



"Shortly after the Civil War, in the year 1877, James Clegg, John Crawford, and William Gough came to a wooded, remote valley called Munuscong and picked spots to make their homes. They returned to Canada and upon returning the next year, found that Charley Pickford had taken up residence on some of the land they had chosen.

Figure 3.2 - Main Street

Thus, Charley Pickford gave his name to what was a few years later a tiny cluster of frame buildings on a muddy street**.**

The Munuscong River was a main route for settlement. The Northern Belle was one of the two supply boats responsible for bringing early settlers to this section of the country, for she brought in needed supplies and persons who would otherwise have looked for another place to settle because transportation was indeed a problem. There were no roads, what trails there were had been slashed through virgin timber, passable only on foot or horseback. This left the principal traffic lane the water route, which challenge was answered by the Northern Belle. The way Pickford was built was exactly the way the rest of America was built - - by muscle, sweat, and tears. Founded based in the idea of clearing the land for it to be farmed, the history of the Pickford area was founded on an agricultural base as it is still to this day heavily dependent on agriculture." (Source: A History of Pickford Area Pioneer Families, Daniel Morrison, 1973.)

The "hay days" of the early 20th century in the Munuscong River watershed saw a multitude of successful farming operations with more concentration on high production than for natural resource protection. Farming started in the late 1800's and increased to its peak of close to 2,000 farms in the entire St. Mary's River in the early 20th century. Much of the Munuscong River watershed has marginal soils, so natural resource destruction began with conversion of land to agriculture by clearing forests and installing ditches.

Currently, there are 333 farms in the watershed area, with almost half of them being between 50 and 249 acres. 93% raise livestock, mostly horses and beef cattle. Primary crops are hay (70%) and oats (10%). 91% of farms produce less than $50,000 worth of agriculture products.

Hay production continues in the watershed, but to much less degree. Much of that land is turning fallow as aging farmers are retiring from the long struggle to make farming a profitable endeavor, where each spring, fields flood due to the heavy clay soils, as well as recent dry summers and skyrocketing fuel prices.

Cooperative landowners are realizing success implementing different conservation programs. All of this has spawned an increase in willingness of both farmers and other landowners in conservation programs (CLMCD 2007).

3.2 Governmental Units

In the Munuscong River Watershed, there are 13 governmental units, including portions of 2 counties (Chippewa and Mackinac), 8 townships, 1 village (Pickford), 1 city (Kincheloe/ Kinross), and 1 tribe (Sault Ste. Marie Tribe of Chippewa Indians) (Figure 3.3)

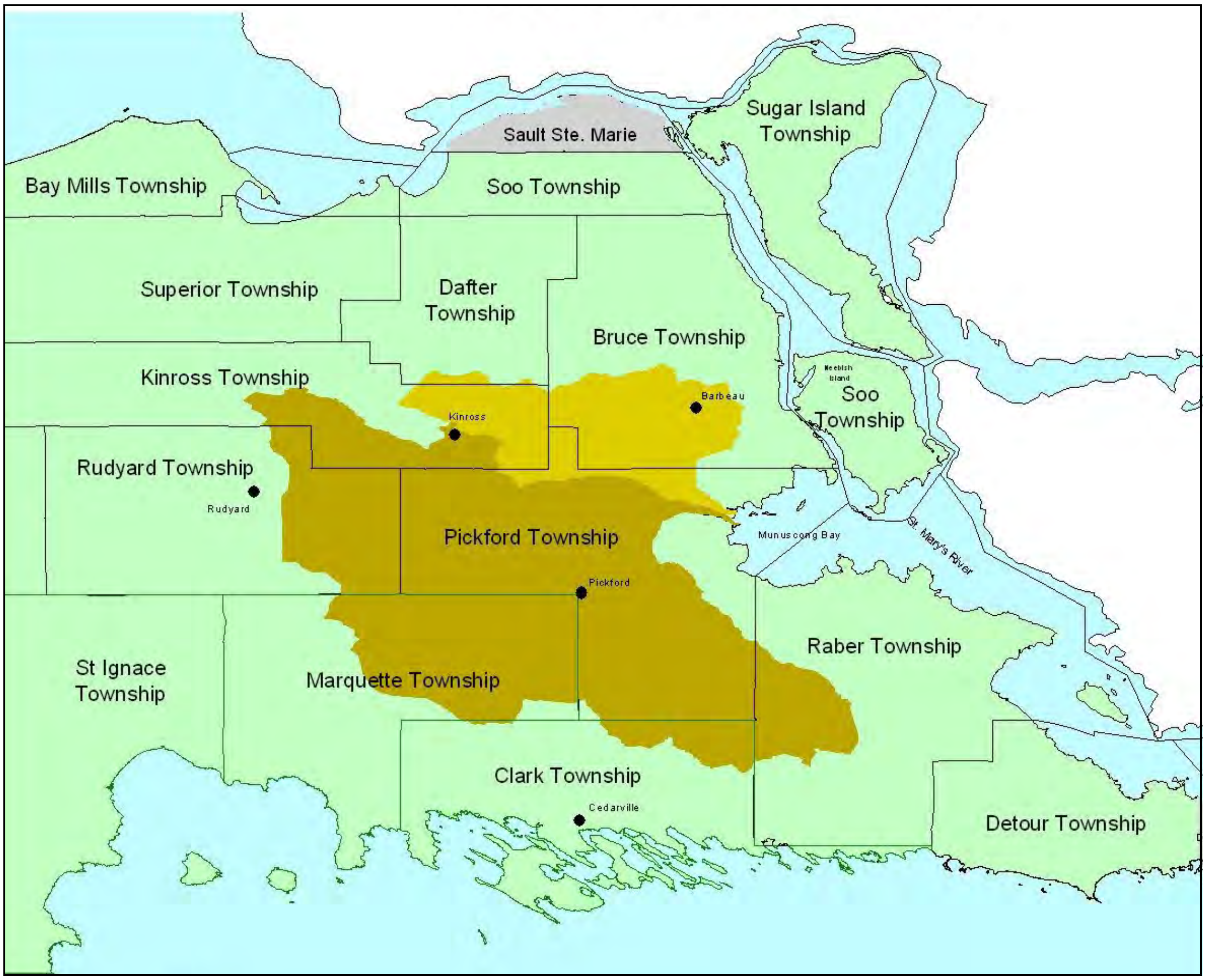


Figure 3.3 Local Jurisdictions

3.3 Demographics

Between the 2000 census and 2010 census, the population of Chippewa and Mackinac Counties changed by -0.2% and -6.9%,respectively.

	Population 2000	Population 2010	Percent Change
Chippewa County	**38,599**	**38,520**	**-0.2%**
Bruce Township	1,944	2,128	9.4%
Dafter Township	1,307	1,263	-3.3%
Kinross Charter Township	8,184	7,561	-7.6%
Pickford Township	1,588	1,595	0.4%
Raber Township	672	647	-3.7%
Rudyard Township	1,318	1,370	3.9%
Mackinac County	**11,943**	**11,113**	**-6.5%**
Clark Township	2,200	2,056	-6.5%
Marquette Township	659	603	-8.5%

Table 3.1 Population

The watershed is mainly rural, with the highest concentration of people in the Kincheloe area (Census Tract 9709—population 4,511) and Pickford Township (population 1,595). Population slowed in the watershed with the abandonment of the Kincheloe Air Force Base near Kinross in 1977. Population and economic growth have persisted in some part due to the establishment of the State of Michigan's Correctional Facilities in Kincheloe.

The Munuscong River watershed is home to approximately 3,833 residents. (EUPRPDC 2009). Table 3.1 provides a breakdown of population within the townships that are within or touch the boundary of the Munuscong watershed. Table 3.2 provides the number of occupied housing units with those townships.

2010 U.S. Census	Occupied Housing Units
Chippewa County	**14,329**
Bruce Township	853
Dafter Township	499
Kinross Charter Township	1,207
Pickford Township	643
Raber Township	303
Rudyard Township	516
Mackinac County	**5,024**
Clark Township	952
Marquette Township	257

Table 3.2 Housing Units—2010 U.S. Census

Population is widely dispersed around the watershed along shorelines of rivers and streams and along state and county roads. Figure 3.4 shows the water well locations in the eastern Upper Peninsula as of the year 2005.

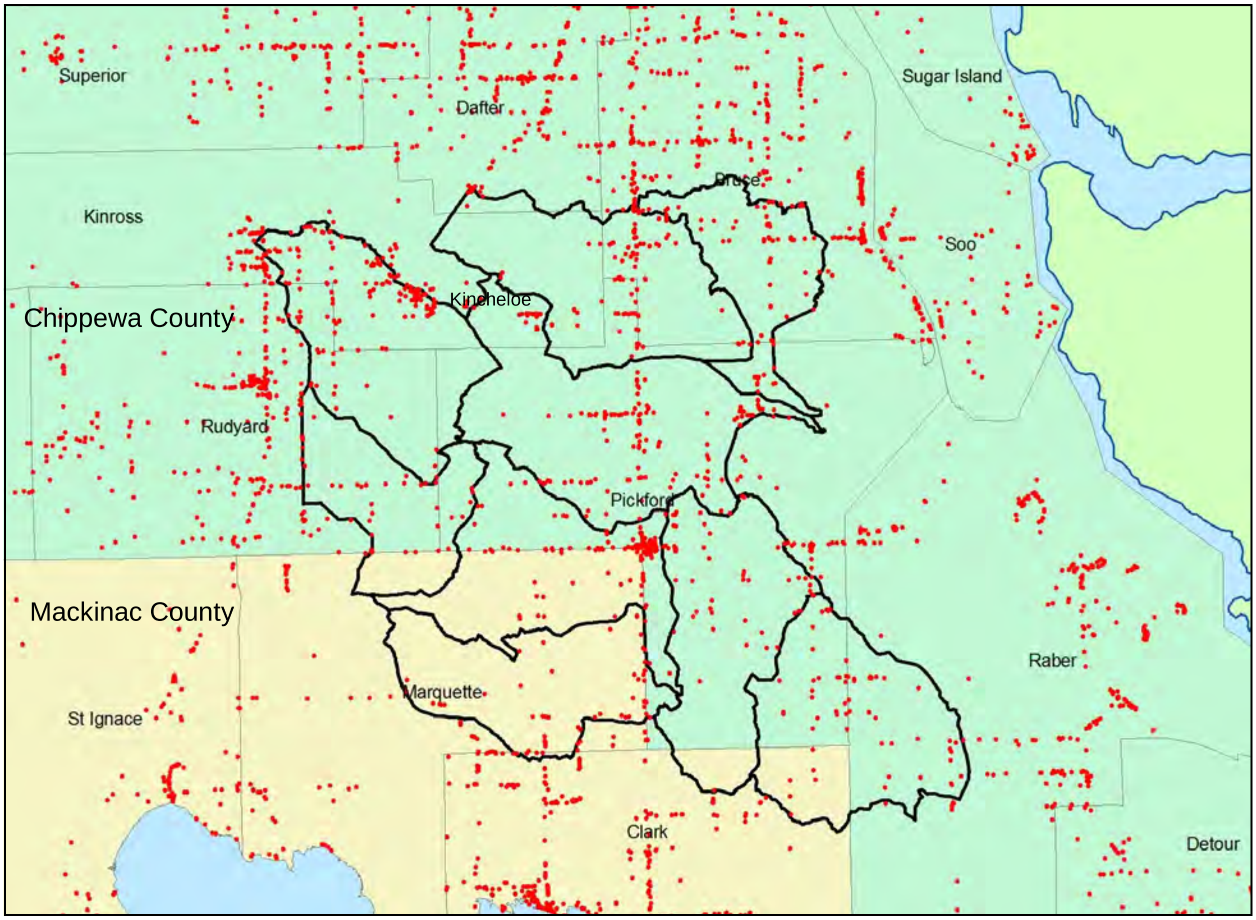


Figure 3.4 Population Distribution per Michigan Well Water Log

There are approximately 16 people per square mile in the watershed compared to 24.7 per square mile for the entire county, and 175 persons per square mile in the State of Michigan (MDTMB 2011). The median age of people in the watershed is 39.9 years, which is significantly older than the State of Michigan median age of 36.2 (EUPRPDC 2009). The racial make-up of the population in the watershed is relatively homogeneous. As a representative sample of the watershed, Pickford Township surveys showed 459 white, 92 American Indian, and 33 of another race or combination of races (EUPRPDC 2009).

The majority of the households (70.8%) in the watershed are married-couple families. The average household size for homeowner-occupied units is 2.66, and for renter-occupied units, 2.12. The average size of the homeowner-occupied unit decreased by 3.3 percent and by 16.9 percent for renter-occupied units from the 1990 Census.

Family households accounted for 475 of the 607 total households within the watershed; there were 132 nonfamily households in the watershed. The number of housing units has grown modestly over the decades and increases in single-family units has significantly outpaced any increases in multi-family structures (EUPRPDC 2009).

The unemployment rate in the watershed hovers around 11.5% compared to 10% for the rest of the State (MDTMB 2011).

Chapter 4 Resource Management

The responsibility of the management and protection of land, water, and natural resources falls on several levels of governmental units and their agencies. Local entities are obligated to comply with federal and state environmental statutes, county level ordinances and local ordinances. In the case of surface water protection, the federal and state laws generally provide a nation or statewide strategy for water quality protection though often leave gaps in protection efforts on the local level. These gaps in protection give county and local governmental units the opportunity to enact ordinances and standards that gives a more comprehensive water quality protection strategy.

4.1 Land Use and Water Quality

The way land is managed, patterns of land use in relation to natural resources, and especially the way water is managed on a site to support the land use, has a large impact on the quality of water and the ecology of lakes, rivers, streams and shore lands. The authority to regulate land use rests primarily with local governments, largely through master plans and zoning ordinances.

In addition, counties have the authority to enact ordinances that could affect the management of land. As a result, city, village, township and tribal governments have a significant role to play in protecting water resources. This role presents itself where federal and state statutes and county ordinances leave off.

It is essential to plan for land uses with respect to existing natural features, soils and drainage patterns to lessen the impacts to water quality, and also account for areas with current development has occurred. It is often forgotten that land use will not only affect the immediate area, but also alter the downstream areas within the watershed.

Four townships within the Munuscong watershed have developed Master Plans—Marquette, Pickford, Kinross, and Bruce Townships. Figure 4.1 represents current land use and land cover for Marquette Township and Pickford Township.

Most of the land in the Munuscong watershed is planned for agriculture and forest-recreation. Stakeholders need to be aware of appropriate development practices that can implemented to significantly improve water quality within the watershed. The negative impacts to water quality that commonly result directly from development activity and increased drainage to support land development can be minimized through the use of smart growth and low impact development techniques.

Figure 4.2 is a composite map of future land use in the watershed within the boundaries of Pickford and Marquette Township master plans. The future land use map is a vision that is supposed to guide future development. Figure 4.3 is Bruce Township's future land use map.

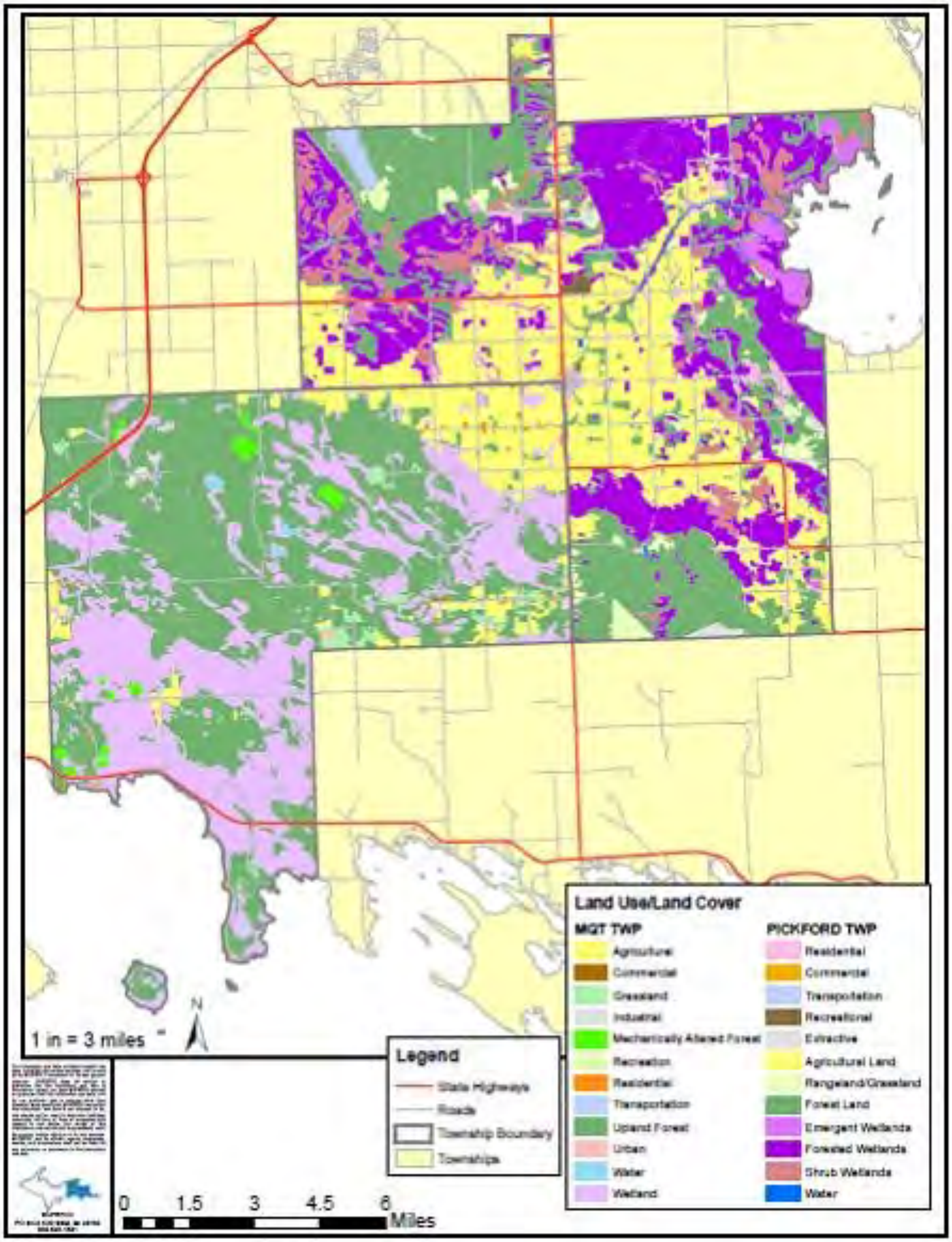


Figure 4.1 Current Land Use in Marquette and Pickford Townships

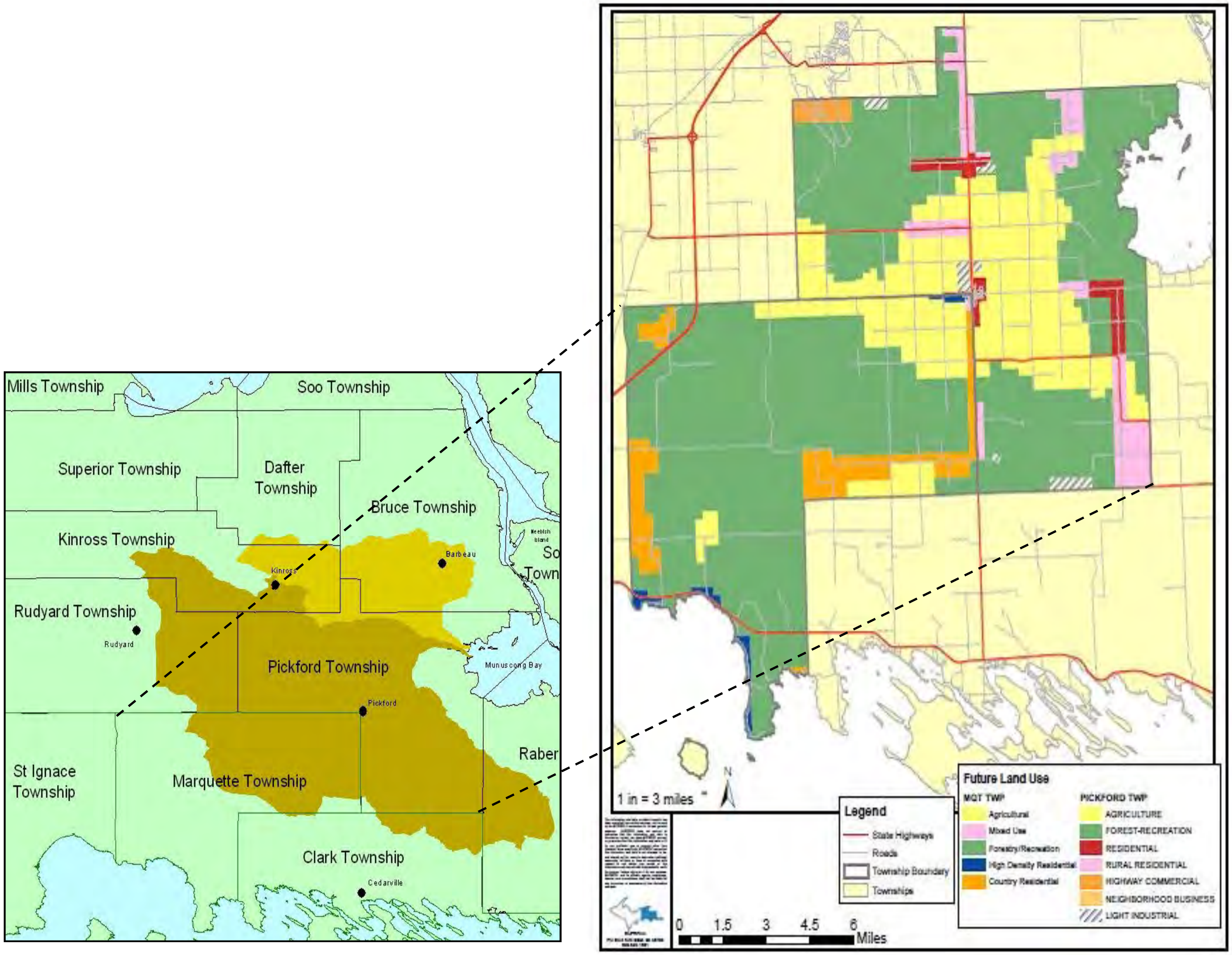


Figure 4.2 Future Land Use in Marquette and Pickford Townships

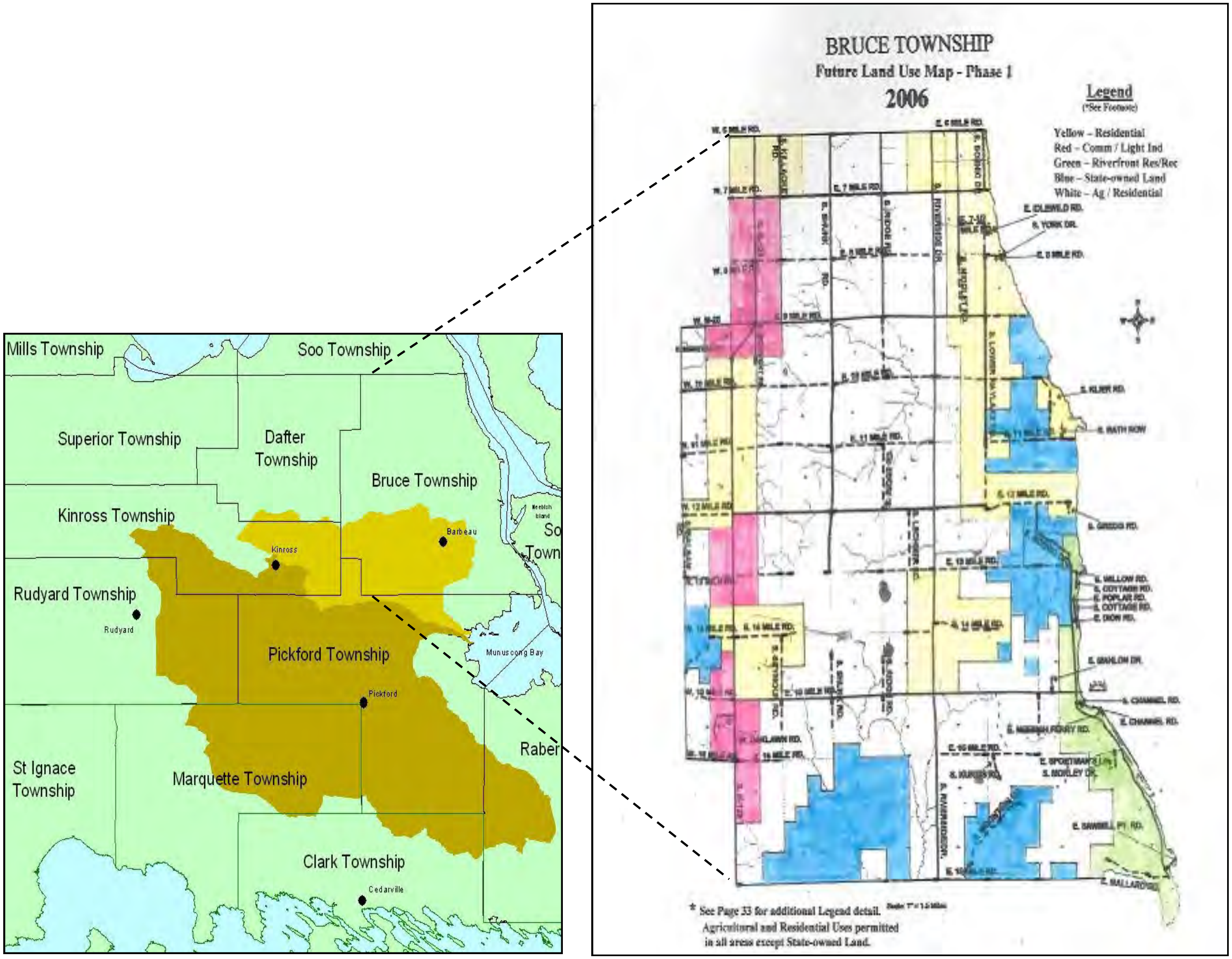


Figure 4.3 Future Land Use in Bruce Township

4.2 Roads and Water Quality

Road infrastructure is a land use that can have substantial impacts on the water quality within the watershed. Controlling roadway-related pollution during project planning, construction, and ongoing maintenance is important. For example, the stock piling of accumulated snow from heavy concentration areas and the salting and sanding of roads during the winter can be a major pollution concern. Sediment control at road and stream crossing is a major concern throughout the watershed.

Figure 4.4 shows the extent of the road system in the watershed. The Michigan Department of Transportation and the two County Road Commissions are responsible for the construction and maintenance of most roads in the Munuscong River watershed. However, the management of local roads is often shared with townships, cities and villages. Cities and villages may have their own road systems which they maintain but most of the local roads in the watershed are under the jurisdiction of the respective county. Road maintenance in the watershed is shared by the Michigan Department of Transportation, the Chippewa County Road Commission and the Mackinac County Road Commission.

Transportation Agency Contact Information

Michigan Department of Transportation
John Batchelder, Service Center Manager
Newberry Transportation Service Center
14113 M-28
Newberry, Michigan 49868
Phone: 906-293-5168

Chippewa County Road Commission
Robert Laitinen
3949 S. Mackinac Trail
Sault Ste. Marie, Michigan 49783
Phone: 906-635-5295

Mackinac County Road Commission
Dirk Heckman, Engineer/Manager
706 N. State Street
St. Ignace, Michigan 49781
Phone: 906-643-7333

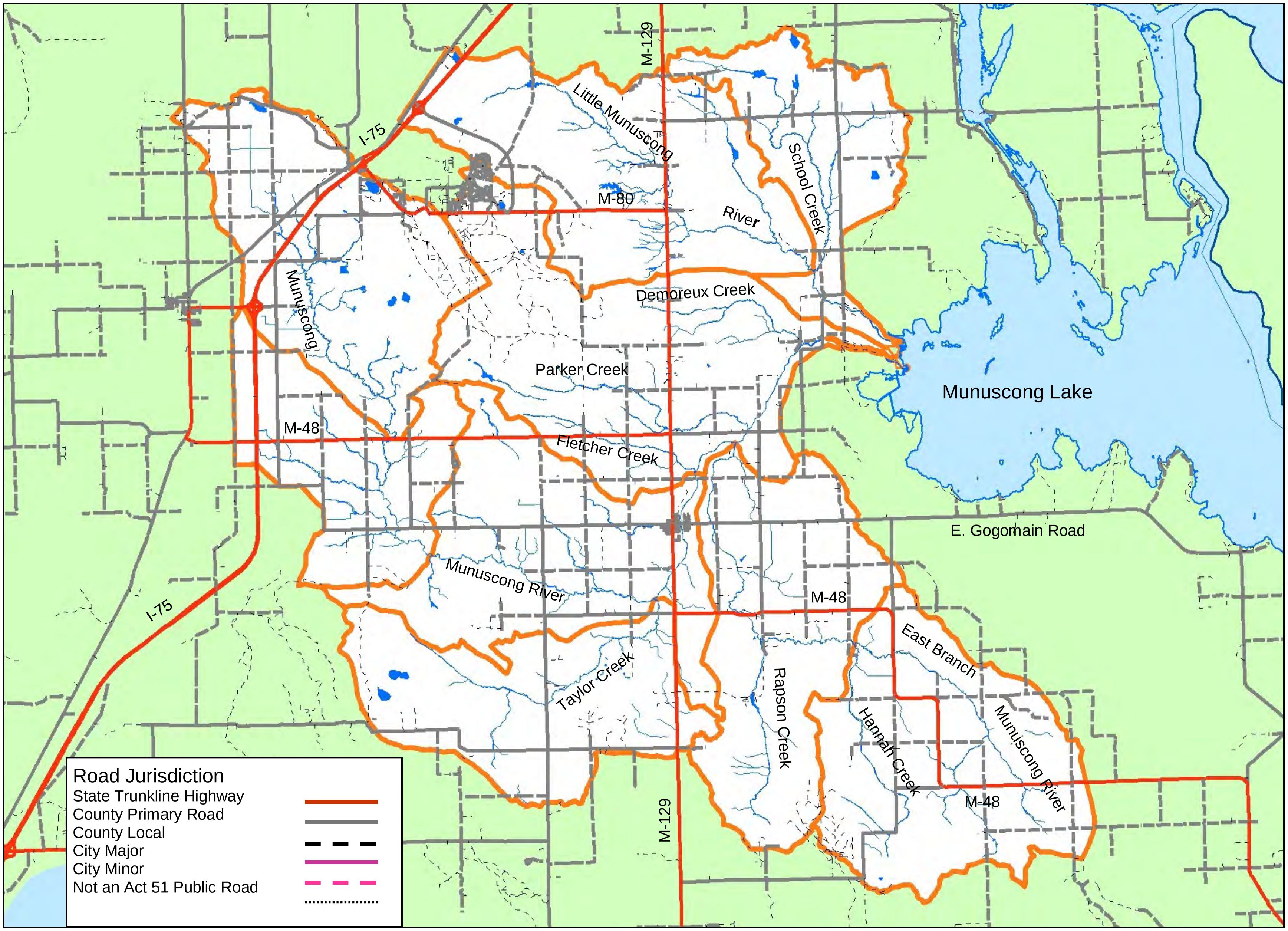


Figure 4.4 Road System

4.3 Area Organizations and State and Federal Departments

4.3.1 Munuscong River Watershed Association (MRWA)

The Munuscong River Watershed Association was formed in 1998 to protect and enhance the Munuscong River Watershed in Michigan's Upper Peninsula. In the summer of 1999 the MRWA sponsored a cleanup project at Stirlingville where sediment islands had formed due to the existence of old bridge pilings from the early 1900's. The MRWA in 1999 wrote a “Learn and Serve” grant for Pickford High School. This grant allowed us to build an environmental platform and purchase water quality testing equipment and weather monitoring equipment. The platform which is located on the banks of the Munuscong River will be used by over 400 students from high school to kindergarten.

In 2002 the Association identified a water trail from Pickford to the Munuscong Bay with signage and several "lunch and launch” sites for canoe and small boat travel. A brochure with map enables either a self-guided boat or car tour of the water trail. Future goals include highway signage to identify the boundaries of the watershed and sediment cleanup at the mouth of the Bay. During the Munuscong River Watershed Planning project a Michigan’s Volunteer River, Stream, and Creek Cleanup Program grant was received and conducted from Pickford High School downstream to the Pickford Township Park that removed 500 lbs of garbage, 500 lbs of metal, and 30 tires.

The Association has been an integral part to the management plan development through input and comments during the process. The Association is dedicated to helping with the implementation and continued work within the watershed and will be the integral part of keeping progress and programs pertinent.

4.3.2 Pickford High School Environmental Science Class

Environmental Science is a multidisciplinary field that draws from all the sciences, as well as other fields to help us understand the relationships between humans and the world in which we live. Environmental science is considered an applied science. It applies the pure sciences such as chemistry and biology to help achieve practical goals. The study of environmental science focuses on three main ideas:

1. Conservation and protection of natural resources
2. Environmental education and communication
3. Environmental research

The Environmental Science class has cooperated with the Munuscong River Watershed Association with annual water sampling within the watershed. This has given the students of the class some hands on experience with water quality sampling and increased their interest in further education and career opportunities in the field of water quality. The analysis has provided a benchmark of basic water quality conditions in the area over the past years.

4.3.3 Township Boards

Local and regional planning guidance and regulation are usually in the form of master plans, zoning, and ordinances. Master Plans represent a local governmental unit's vision for land use planning. Zoning and ordinances represent the manifestations of that vision in the form of the regulations to realize that vision. Zoning controls land development in a region and ordinances are related to site design and access. They are used to regulate permitted uses of the land (i.e. establishing lot sizes and setback requirements (from neighbors, roads, and water bodies).

Overall, ordinances are enacted to protect the use of a property and ensure the public's safety, health, and welfare. In terms of watershed management, zoning and ordinances can help the community manage activities on the land to protect the water bodies into which they drain (U'ren 2005). Within the MRW, township ordinances are lacking in the protection of water quality. Within the township master plans it is outlined in the goals and objectives to work towards the protection of the natural resources.

CLMCD reviewed the master plans for the Townships of Kinross, Pickford, and Marquette specifically looking for the goals and objectives towards the protection to water quality and natural resources. For example, Pickford Township has an ordinance that limits boat speed to a no-wake within the Lower Munuscong River. The master plans contained general concerns over environmental protection and look to further recognize natural resources as an important part of the economic base, and support the preservation of those resources. Objectives outlined within master plans are listed below.

4.3.3.a Pickford Township Master Plan Objectives

- Develop model ordinances to protect farmlands, forest lands, open spaces, clean air, groundwater, and surface water.
- Preserve scenic view-sheds and open spaces, especially along major roadways and shorelines.
- Effectively manage any conversion of farmland into other uses.
- Encourage practices that reduce pollution of air and water.
- Recognize the importance of prime hunting lands within the Township and encourage the preservation of those lands.
- Work cooperatively with the Munuscong River Watershed Association to preserve and enhance the quality of the Munuscong River.
- Support the development of a "walkable" community
- Encourage the formation of volunteer groups for beautification projects and supervising recreational facilities.

4.3.3.b Marquette Township Master Plan Objectives

- Work cooperatively with communities, agencies and organizations to develop studies and institute programs that address watershed, woodlands, wildfire, and ecosystem management.
- Develop ordinances to protect greenbelts, shorelines, farmlands, forestlands, groundwater, and surface water and encourage legislative adoption and cooperation amongst local units for the protection of these resources.

- Encourage county departments to effectively administer and enforce regulations such as soil erosion and sediment control and adopt needed ordinances such as storm water management
- Preserve scenic views and open space, especially along M-134 and the Lake Huron shoreline.
- Cooperate with the health department in conducting septic system educational programs regarding maintenance and management of systems.
- Support natural resource education and technical programs (such as Soil Conservation District, MSU Extension, and Regional Planning) that assist land owners, forestry and agriculture operators, businesses, and communities.
- Support studies that identify ways in which to protect critical habitats, water resources, scenic vistas, farmland, forestland, and other important ecological resources.
- Establish convenient year-round recycling in the Township to maintain the scenic character of our woodlands and extend the lifespan of the Region's landfill operations.
- Support control or eradication of invasive species in critical habitats, scenic vistas, and other important ecological resources.
- Support the development of a "walkable" community
- Encourage the formation of volunteer groups for beautification projects and supervising recreational facilities.
- Protect and develop scenic view corridors, overlook sites and vistas.

4.3.3.c Kinross Township Master Plan Objectives

- Stormwater Management—Implement storm water management principles that include the reduction of impervious surfaces with biofiltration methods
- Septic Inspection—Implement time-of-sale (or upon application for building permit) inspection program to identify failing septic systems and promote system improvements to protect surface and groundwater quality
- Waste Recovery—Continually improve waste recovery programs
- Wellhead Protection—Pursue continued implementation of the wellhead protection plans and ordinances
- "Green" Practices—Implement less environmentally destructive management practices in greening the community
    - A. Curtail the use of pesticides and herbicides in parks and greenspaces
    - B. Convert spaces between buildings from turf and grass to fruit trees, native plants, and more diversely vegetated areas and curtail mowing.
    - C. Preserve all prominent stands of trees within the community.
    - D. Utilize reinforced turf for a permeable, more environmentally friendly alternative for surface parking.
- Context Sensitive Development—Address sensitive environmental areas with context sensitive development.
    - A. Enact policies to restrict and control development in areas where there are steep slopes, wetlands, soil erosion possibilities, well-head protection areas, and shorelines.
    - B. Utilize incentives to provide open space easements, public access to water resources, and conservation easements.

C. Where major creeks, riparian habitat, and other sensitive environmental features intersect with approved development areas, site design should incorporate these features as open space amenities, avoiding the fencing, channelization, and piping of creeks.

D. Implement watershed protection measures

4.3.4 Chippewa Luce Mackinac Conservation District

(http://clmcd.org/)

In 2012, the Chippewa/East Mackinac Conservation District (CEMCD) and the Luce/West Mackinac Conservation District merged to from the Chippewa Luce Mackinac Conservation District (CLMCD). The CEMCD was established on May 23, 1949 and has provided 63 years of service to the landowners of Chippewa and Mackinac Counties. The District now includes all of Chippewa, Luce and Mackinac Counties.

The Conservation District mission is to assist with land use and management through education, community project, and services. The District has been fortunate to receive a number planning and implementation grants dealing with watersheds, water quality, soil protection, invasive plants and insects, and farming enhancements.

4.3.5 Eastern Upper Peninsula Regional Planning & Development

(http://www.eup-planning.org/)

The EUPRPDC is one of 14 agencies in the State of Michigan; established in 1968 as a multi-county organization to pool resources for the assistance of local governments in the Eastern Upper Peninsula. The agency assists EUP cities, townships and counties in the areas of grant writing, community surveys, land use planning, recreation planning, economic and community development, transportation, and building and maintaining geographic information.

A. **Transportation Planning**

Regional Planning staff assist local units of government & MDOT with transportation planning by coordinating and conducting planning activities, collecting traffic counts, and offering training and education materials and workshops.

B. **Geographic Information System (GIS)**

With a GIS, you can link information (attributes) to location data, such as people to addresses, buildings to parcels, or streets within a network. EUPRPDC assists EUP Counties, Townships, and communities with a variety of mapping needs. From developing maps for Master Plans and Recreation Plans to specialty projects like Zoning Districts and Addressing Maps.

C. **General Land Use Planning**

Regional Planning offers tools and technical assistance to local units of government to support land use decision-making in the Eastern Upper Peninsula. Master plans, recreation planning and grant writing, and community surveys are all part of the general planning services provided.

4.3.6 Michigan Nature Association (MNA)

What started as a small bird study group transformed into a state-wide land conservation organization. In 1951, Bertha A. Daubendiek and a few of her friends started a group to study birds. The group started out with a mission to protect ecological diversity and to educate people about Michigan's diverse wildlife. This mission was revised over time as the organization expanded its ideology to accommodate land acquisition and conservation.

> **Mission**: The purpose of the Michigan Nature Association is to acquire, protect and maintain natural areas that contain examples of Michigan endangered and threatened flora, fauna and other components of the natural environment, including habitat for fish, wildlife and plants of the state of Michigan and to carry on a program of natural history study and conservation education as permitted under the Michigan Nonprofit Corporation Act.

Sanctuaries within Munuscong River Watershed

A. Munuscong Bay
   20 Acres in Chippewa County

   Located in Raber township, Munuscong Bay is a class C sanctuary which are considered 'Sensitive Habitats' and should not be visited without a guide. This means that the sanctuary can only be visited with the assistance of an MNA guide.

B. Roach Point
   478.85 Acres in Chippewa County

   Roach Point is a truly wild nature sanctuary that protects the Roach Point peninsula. The point juts out into Munuscong Bay, between Lake Superior and Lake Huron, and is only accessible by boat or by trekking through acres of wetland. However, southern portions of the sanctuary can be accessed along Gogomain Road, and the experience is worth the trip.

   In 1981, Mason C. Schafer donated 141.1 acres on Roach Point to the MNA. With additional gifts and purchases, the sanctuary now totals almost 500 acres and includes parts of the bays on either side. The entire marsh occupying two bays was surveyed and sampled by the Michigan Natural Features Inventory in 1987 and was rated a good quality marsh, one of the best of the Great Lakes marshes visited. All but about 5% of the sanctuary was generously donated to MNA, including 23 acres donated in memory of Edward Bartlett Spaulding. Due to the foresight of these donors and by contributions made by visitors, the pristine Roach Point Peninsula and adjacent land to the south will be protected forever.

4.3.7 Binational Public Advisory Council

(http://www.lssu.edu/bpac/)

BPAC as it is commonly recognized, is a citizen's group organized in 1988 made up of members from Canada and the United States with the specific goal of informing the St. Mary's River (AOC) Remedial Action Plan (RAP) Team about public views and opinion regarding management and delisting of the St. Mary's as an AOC, and to assist with water use goals, planning methodology, technical data, preferred remedial options, problem identification, plan recommendations, and plan adoption. BPAC is dedicated to ensuring that the river water quality and the ecosystem are improved and protected for all users of the river. BPAC personnel strive toward community involvement in achieving a local volunteer base for water quality projects.

BPAC representatives participated in the Munuscong River Watershed Planning Project mainly through public outreach activities. The project's purpose, potential success, and relevance to BPAC mission was mentioned at BPAC monthly meetings in order to illustrate common goals with the St. Mary's RAP.

During the planning project, CEMCD called on BPAC for information and volunteer support for obtaining water quality information and providing public outreach for water quality projects. BPAC hosted the annual *Environmental Summit* each fall during the project, in part highlighting the Munuscong River Watershed project to interested attendees. The Munuscong River Watershed plan will utilize BPAC as a volunteer resource for implementing the watershed management plan.

4.3.8 Lake Superior State University Aquatic Research Laboratory

(http://www.lssu.edu/arl/index.php)

The mission of the Aquatic Research Laboratory (ARL) is to combine education and research on aquatic biota and their associated habitats within the Great Lakes basin to serve the academic, scientific, and public communities. The specific goals of the ARL are to:

- Provide scientific information to further advance our understanding of regional water bodies and issues of concern.
- Provide logistical and technical support for faculty and researchers from LSSU and other institutions engaged in freshwater research.
- Promote and conduct hands-on training for undergraduate students in freshwater science.
- Foster information transfer between scientists and local communities regarding water resources of the northern Great Lakes region.

Currently, the Atlantic salmon rearing program continues at the ARL, but activities have evolved and broadened to create additional educational, scientific, and outreach opportunities for LSSU biology students, scientific researchers, and the local community. Research at the ARL expanded into other areas of freshwater science including reproductive biology of fishes, ecological genetics, environmental chemistry, and ecological assessments. Research collaborations and external funding support have increased dramatically over the years.

Past project partners and funding agencies include National Science Foundation, Michigan Sea Grant, Great Lakes Fisheries Commission, US Forest Service, US Environmental Protection Agency, National Marine Fisheries Service, Canadian Forest Service, Fisheries and Oceans Canada, Michigan Department of Natural Resources, US Fish and Wildlife Service, Purdue University, Michigan State University, University of Michigan, and the University of Notre Dame. Non-governmental groups, such as sportsman's associations, and private donors also provide financial support. The ARL continues to represent a unique collaboration between academic, government, industrial, and community partners dedicated to the natural resources of the Upper Great Lakes region.

4.3.9 Lake Superior State University Environmental Analysis Laboratory

(http://www.lssu.edu/academics/stem/eal/)

The mission of LSSU Environmental Analysis Laboratory (EAL) is to provide professional analytical and research services, while engaging students in modern analytical techniques. The EAL is designed to help students prepare themselves for careers as scientists, technicians, and other professionals by creating an environment where students work with highly trained staff to engage in research, design experiments, and perform sample analysis.

The EAL is*:*

- Supervised by highly experienced Ph.D. chemists.
- Staffed in part by undergraduate chemistry and environmental science students.
- Provides "real world" working experience for LSSU science students.
- Provides funding for the maintenance of sophisticated analytical instruments that make our undergraduate chemistry program unique.
- Provides a service to the local community, as we offer the only environmental analytical laboratory in Michigan's Eastern Upper Peninsula.
- Provides unique customized analyses for customers from throughout the United States.

Benefits of Using the EAL:

Their skilled professional staff is committed to developing cost effective analytical methods making environmental research affordable. They play an integral role in environmental projects that are driven by private and local community environmental organizations, providing expertise in environmental science and health issues. Their state-of-the-art instrumentation provides chemical and biological analysis to state and federal agencies to ensure that regional monitoring and research needs are met.

4.3.10 Michigan Department of Environmental Quality (MDEQ)

Surface Water Assessment Section

The Surface Water Assessment Section (SWAS) oversees the protection of the quality of surface waters throughout the State of Michigan. To do this, SWAS develops standards for the protection of water quality and monitors water, sediments and aquatic life to ensure the viability of our aquatic ecosystems, that water quality standards are being met and that surface waters meet designated uses. As part of the five-year watershed monitoring cycle, staff from the Surface Water Assessment Section (SWAS) conducted qualitative biological assessments in 2010, 2005, and 2002 within the Munuscong River Watershed.

These surveys were conducted within the confines of the SWAS Procedure 51 (DNRE, 1990) with survey objectives including, but not limited to:

- Determine attainment status for the other indigenous aquatic life and wildlife designated uses of the watershed.
- Provide data to satisfy requirements of the biological trend monitoring program.
- Provide monitoring assistance to existing nonpoint source (NPS) activities and total maximum daily load development or other issues related to the Michigan 2006 Sections 303(d) and 305(b) Integrated Report (LeSage and Smith, 2008) in the watershed.
- Satisfy monitoring requests submitted by internal and external customers.
- Support Area of Concern related to beneficial use delisting decisions.

4.3.11 Natural Resource Conservation Service

The Farm Security and Rural Investment Act of 2008 (Farm Bill) represents the single most significant commitment of resources to implement conservation on private lands in the Nation's history. The legislation responds to a broad range of emerging natural resource challenges faced by farmers and ranchers and even more urban areas, including soil erosion, wetlands, and wildlife habitat. The U.S. Department of Agriculture's Natural Resource Conservation Service administers several Farm Bill programs in the watershed to protect wildlife habitat, wetlands, and riparian areas.

The *Wildlife Habitat Incentives Program* is a voluntary program that encourages creation of high quality wildlife habitats that support wildlife population of national, state, tribal, and local significance. Through WHIP, NRCS provides technical and financial assistance to landowners and others to develop upland, wetland, riparian and aquatic habitat areas on their property.

The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, waste, and related natural resource concerns on private lands in an environmentally beneficial and cost-effective manner. The program provides an opportunity for landowners to receive financial incentives to protect and enhance wetlands by retiring them from agriculture.

Total # of easements	33
Total acres in easement	3278.02
Average easement acreage	99.33
Largest Easement	461.2
Smallest Easement	14.4

Table 4.1 Wetland Reserve Program Easements in MRW as of 2010

Table 4.1 summarizes the WRP easements in the watershed as of 2010. These easements are on existing wetlands that were historically degraded by agricultural deforestation, ditching, and drainage. WRP purchases the development rights from the wetland land owner and restores and enhances hydrology through ditch plugs, establishing berms at downstream ends of drains, and establishing vegetation throughout the easement acreage.

Table 4.2 outlines the Farm Bill Programs that can help reduce non-point source pollution concerns from agricultural operations.

Program	**Resource Concern**	**Conservation Practice**	**Pollutant Addressed**
WHIP	Eroding Streambank	Rip Rap, Shrub Planting, Native Grass Planting	Sediment Habitat Loss Nutrients
	Livestock in Waterway	Livestock exclusion fence	Sediment Nutrients E. coli
	Wind Erosion	Riparian Buffer Forest Land Buffer	Sediment Nutrients
Continuous Conservation Reserve Program (CCRP) Conservation Reserve Enhancement Program (CREP)	Loss of Habitat Nutrient loading Field and Bank Erosion	Wetland Restoration Grassed Waterways Field Windbreaks Shallow areas Riparian Forest Buffer Native Grass Planting Sediment Retention Control Structure	Loss of Habitat Sediment Nutrients E. coli
WRP	Loss of Habitat Increased ditching/ drainage	Wetland Restoration	Loss of Habitat Water retention Flooding control

Table 4.2 Farm Bill Programs

4.4 Land and Water Use Permitting

4.4.1 Soil Erosion and Sediment Control (part 91 PA 451)

The Chippewa Luce Mackinac Conservation District continues to administer and enforce Part 91, Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act 1994 PA 451 as amended, which states, "*a landowner or designated agent who contracts for, allows or engages in an earth change in this state shall obtain a permit from the appropriate enforcing agency before commencing an earth change which disturbs 1 or more acres of land, or which is within 500 feet of the water's edge of a lake or stream.*"

The threat of area water quality degradation from excavation/construction sites has continued to be a priority for the Chippewa Luce Mackinac Conservation District to administer the SESC program for Chippewa County.

The District has qualified staff to administer the program and the pervading theme of the SESC program is consistent with the mission of the Conservation District and the Munuscong River Watershed Planning Project.

4.4.2 County Drain Commissioner

The county drain commissioner is a public official charged with:

- Administering Michigan laws related to flood protection, storm water management, and soil erosion.
- Build and maintain many millions of dollars worth of infrastructure to serve the citizens.
- Approves drainage in new developments and subdivisions and maintains lake levels.

4.4.3 Army Corps of Engineers

The Army Corps of Engineers exercises jurisdiction for navigation on the Munuscong River (mouth upstream to the Munuscong State Forest boat launch) and the Little Munuscong River (upstream 1.0 mile from mouth). Section 10 of the Rivers and Harbors Act of 1899 prohibits the obstruction or alteration of navigable waters of the United States without a permit from the USACE.

Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into all waters of the United States, including wetlands, both adjacent and isolated, without a permit. The state of Michigan has assumed from the U.S. Environmental Protection Agency (USEPA), the authority to regulate the placement of fill material in waterways and wetlands under provisions of Section 404 g (1) of the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.). However, since Section 10 of the Rivers and Harbors Act does not provide for similar transfer to states, the USACE retains Section 404 jurisdiction within those waters that are navigable waters of the U.S. and their adjacent wetlands. The discharge of any fill materials must comply with state water quality standards consistent with Sections 301, 307, and 401 of the Clean Water Act. (http://michigan.gov/statelicensesearch/0,1607,7-180-24786_24818-244631--,00.html)

4.4.4 Michigan Department of Environmental Quality (MDEQ)

The Water Resource Division (WRD), MDEQ regulates activities where land and water interface. The following Parts of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended and Rules are administered by the WRD and permitted through an MDEQ/USACE Joint Permit Application.: Part 301, Inland Lakes and Streams; Part 303, Wetlands Protection; Part 325, Great Lakes Submerged Lakes, the Administrative Rules for Floodplains and Floodways under Part 31, Water Resources Protection; Part 323, Shorelands Protection and Management; and Part 353, Sand Dunes Protection and Management. The program oversees activities including dredging, filling, constructing or placing a structure on bottomlands, constructing or operating a marina, interfering with natural flow of water or connecting a ditch or canal to an inland lake or stream.

The MDEQ also administers the federal permit program which regulates Section 404 of the Clean Water Act (except in coastal areas where the United States Army Corps of Engineers retains this authority). Further information about all permits can be found at http://www.michigan.gov/deq/0,4561,7-135-3307_29692_24403-67376--,00.html

4.4.5 National Pollutant Discharge Elimination System
(http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3713-10197--,00.html)

The purpose of the program is to control the discharge of pollutants into surface waters by imposing effluent limitations to protect the environment. Perhaps the most notable goal of the Act was the elimination of discharge of pollutants into navigable waters by 1985. This goal was not realized, but remains a principle for establishing permit requirements.

The Act had an interim goal to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water" by July 1, 1983. This is more commonly known as the "fishable, swimmable" goal.

The first round of NPDES permits issued between 1972 and 1976 provided for control of a number of traditionally regulated pollutants, but focused on 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), pH, oil and grease, and some metals, by requiring the use of the Best Practicable Control Technology currently available (BPT). The 1977 amendments to the legislation, known as the Clean Water Act (CWA) of 1977, shifted emphasis from controlling conventional pollutants to controlling toxic discharges.

The enactment of the 1972 amendments marked a distinct change in the philosophy of water pollution in the United States. The amendments maintained the water quality-based controls, but also included technology-based control strategies. The treatment technology-based discharge standards are promulgated by the U.S. Environmental Protection Agency (EPA) and are based on the category of the facility. Dischargers are placed in categories based on industrial processes or on the type of wastewaters generated. As treatment technology improves, these federal standards are expected to become more restrictive in order to progress toward the goal of zero discharge. As permits expire they must be reissued with limits reflecting the most recent treatment technology standards. The Act also contains four important principles:

- The discharge of pollutants to navigable waters is not a right.
- A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged.
- Wastewater must be treated with the best treatment technology economically achievable - regardless of the condition of the receiving water.
- Effluent limits must be based on treatment technology performance, but more stringent limits may be imposed if the technology-based limits do not prevent violations of water quality standards in the receiving water.

An NPDES permit is valid for a maximum of five years. If the applicant continues to require NPDES permit coverage, it is necessary to reapply by April 1 of the year the permit will expire. This generally involves completing a new application form. This gives the appropriate authorities an opportunity to reevaluate operational and monitoring requirements and effluent limits.

Michigan has developed a strategy for scheduling permit reissuance known as the "5-Year Basin Plan." This is a timetable for reissuance of permits based on receiving water-bodies. A receiving water is the river, stream or lake that "receives" a particular discharge. It is ideal to simultaneously evaluate all permits allowing discharge to a particular receiving water or watershed. A complete cycle of reissuances occurs every 5 years, with approximately 20% of the permits being reissued each year. The "5-Year Basin Plan" was established with the objective of establishing the most efficient plan for water quality monitoring and permit reissuance.

Chapter 5 Natural Features

The natural features of the Munuscong River watershed provide many social and economic benefits to the regional community, including recreational opportunities, tourism, and general social well-being. The Munuscong River watershed has been altered and degraded by poor land use practices, but areas of high quality habitat and diverse native species remain.

The natural features provide ecosystem services that benefit humans, such as recharging groundwater, cleansing air, and filtering water. Protecting these remaining features will undoubtedly benefit water quality and the quality of life in the Munuscong River watershed.

5.1 Wetlands

Wetlands provide ecosystem functions like storing and cleansing water, slowly releasing water to support higher baseflows and stable stream channels, and providing wildlife habitat. The wetland resource base in the Munuscong River watershed has undergone significant disruption in the 135 years since the area was settled, losing approximately 32% of its total wetland area (MDEQ 2011). It is common belief that the result of these losses is reduced surface water quality and total loss of some fisheries. It is estimated that there were 87,926 acres (59% of watershed) of wetland in the Munuscong watershed prior to European settlement (Figure 5.1).

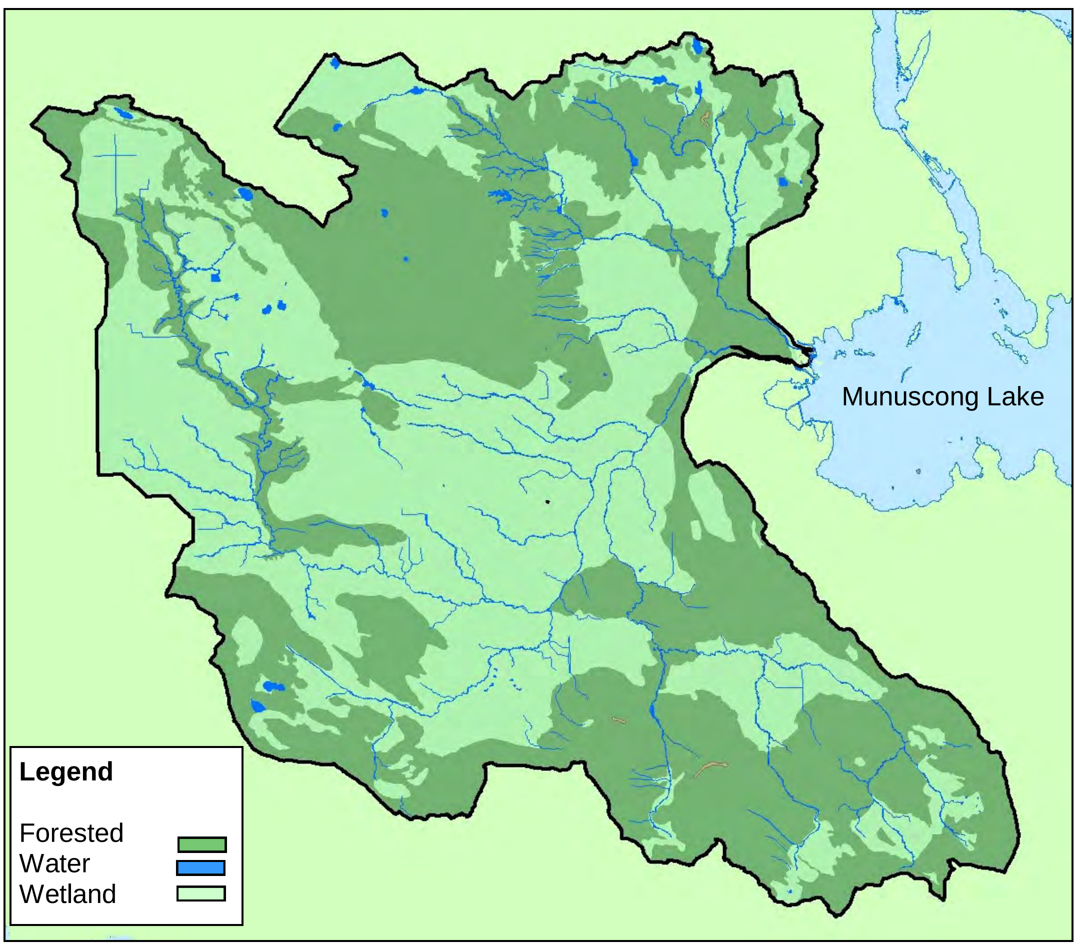


Figure 5.1 Pre-settlement Wetlands

The watershed itself has been extensively ditched since pre-settlement. This has resulted in the destruction, degradation, and vegetative conversion of many of the wetlands and waterways that originally existed. Forested wetlands have been the most affected, with clearing and drainage for agriculture responsible for most of the impact. Where these areas have been abandoned by agriculture, the land cover that is returning is dominated by emergent and scrub-shrub wetland (MCSSAG 2003).

A few large intact wetland complexes can be found in the watershed. One is located in the headwaters of the East Branch known as the Gogomain Swamp. These wetlands perform functions that help protect water quality and provide habitat for many species.

Wetlands are a significant factor in the health and existence of other natural resources of the state, such as inland lakes, ground water, fisheries, wildlife, and the Great Lakes.

Michigan's wetland statute recognizes the following benefits provided by wetlands:

- Flood and storm control by the hydrologic absorption and storage capacity of wetlands.
- Wildlife habitat by providing breeding, nesting, and feeding grounds and cover for many forms of wildlife, waterfowl, including migratory waterfowl, and rare, threatened, or endangered wildlife species.
- Protection of subsurface water resources and provision of valuable watersheds and recharging ground water supplies.
- Pollution treatment by serving as a biological and chemical oxidation basin.
- Erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
- Sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

These benefits, often referred to as wetland functions and values, play a vital role in recreation, tourism, and the economy in Michigan. According to a 1991 United States Fish and Wildlife Service Wetland Status and Trends report, over 50% of Michigan's original wetlands have been drained or filled, thereby making the protection of remaining wetlands that much more important (MDEQ 2011 web). Table 5.1 shows the loss in wetland acreage for the MRW.

Munuscong River Watershed: Landscape Level Wetland Functional Assessment (MDEQ 2011)	
Presettlement Wetland Condition	**2005 Wetland Condition**
87,926 total acres of wetland	59,756 total acres of wetland
59% of watershed acreage	40% of watershed area
1016 Polygons (GIS graphic representation of contiguous, unfragmented wetland)	2,614 Polygons (GIS graphic representation of contiguous, unfragmented wetland)
Average wetland size-87 acres	Average wetland size-23 acres
68% of original wetland acreage remains 32% loss of total wetland resource Total acreage loss of 28,170 acres	

Table 5.1 Wetland Condition in the Watershed

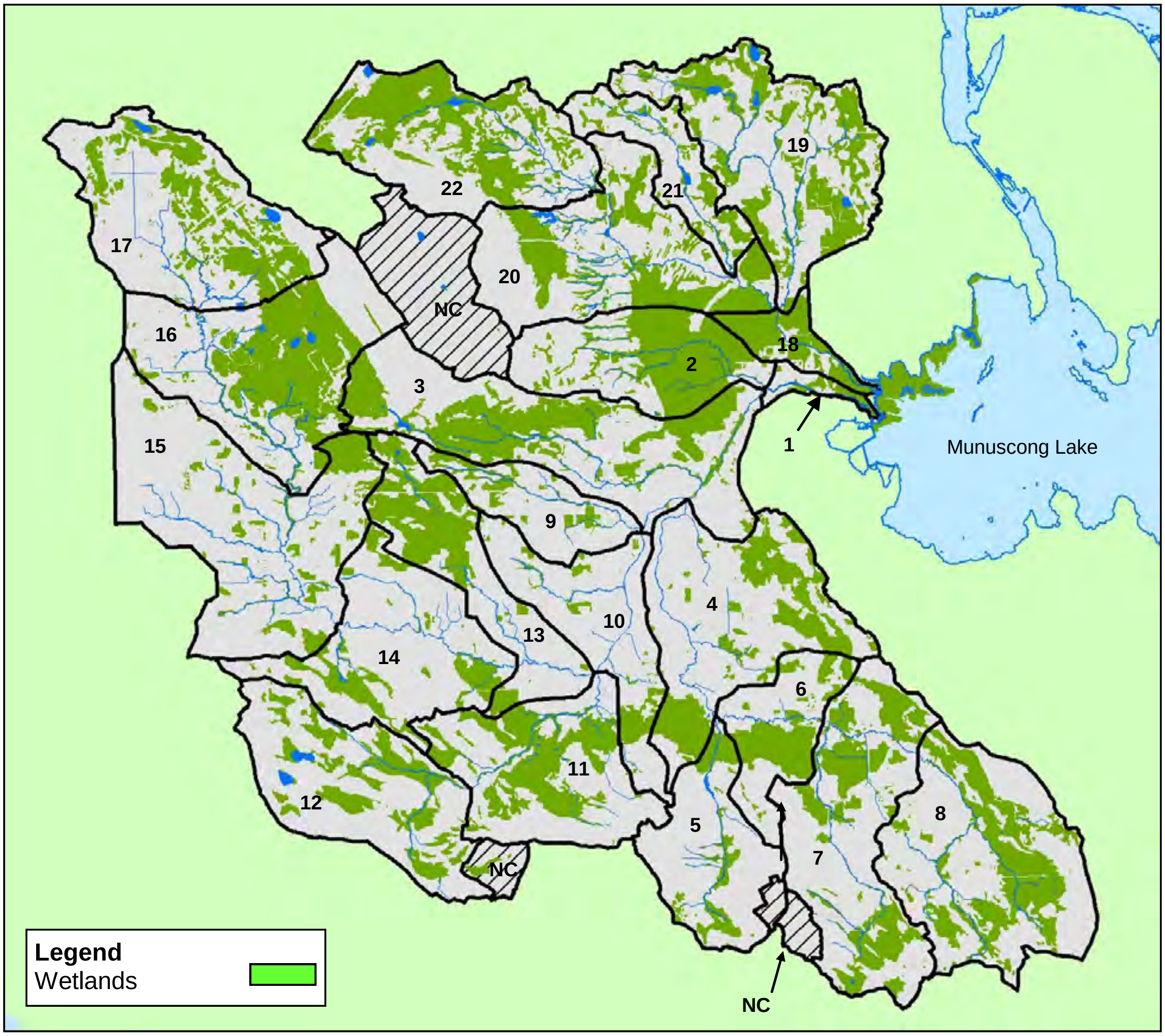


Figure 5.2 2005 NWI Wetlands

Per the 2005 National Wetlands Inventory there are 59,756 acres of wetland remaining in the collective Munuscong and Little Munuscong watershed.

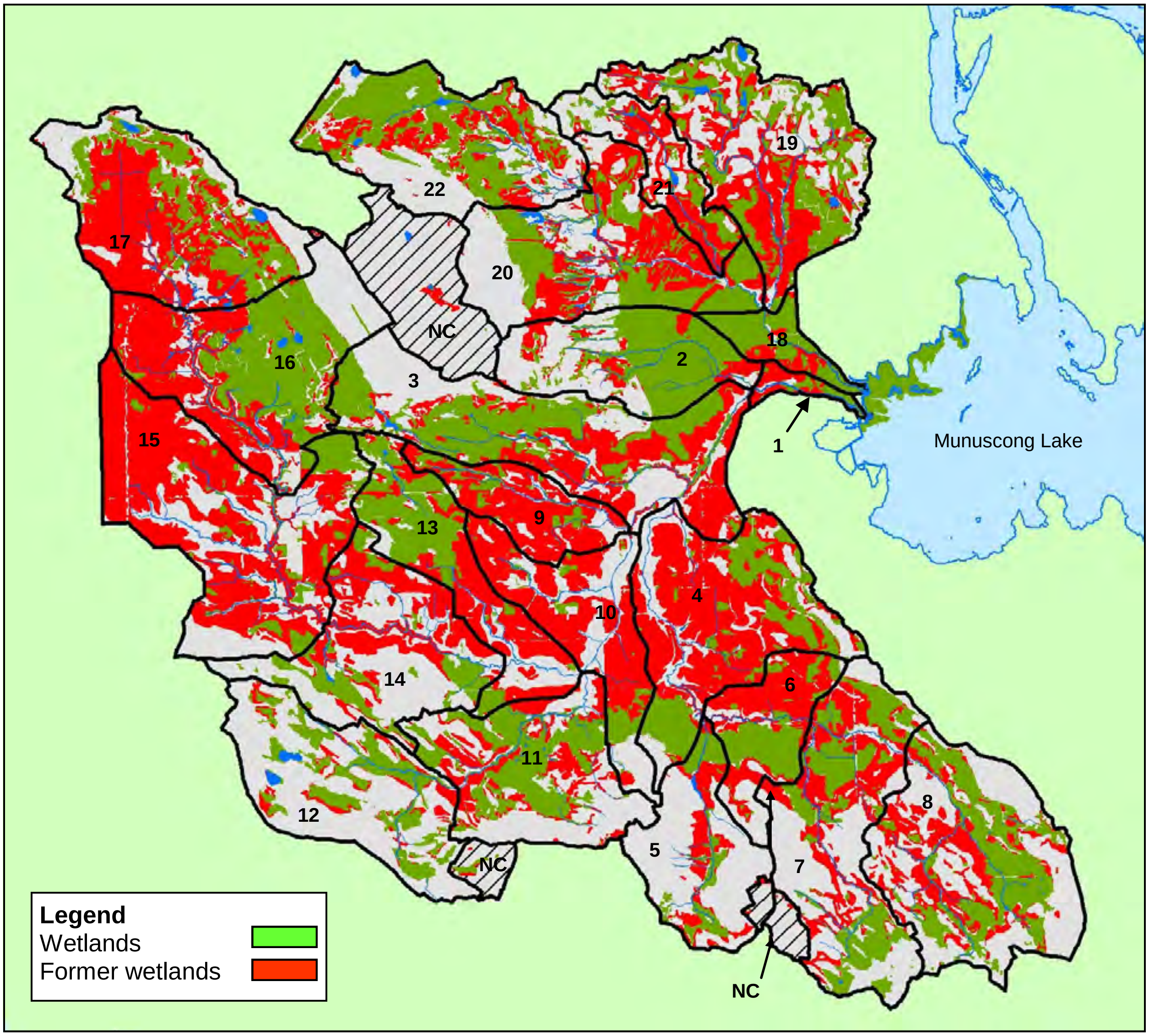


Figure 5.3 Wetland Loss

Source: LLWFA 2011

Per the MDEQ's Landscape Level Wetland Functional Analysis report, there have been 28,170 acres of wetland loss since pre-settlement days.

5.1.1 Landscape Level Wetland Functional Assessment

Watershed management planning is driving an interest in understanding the relationship between wetland loss and degraded surface water quality. In addition to quantifying wetland loss, there has been a strong push to interpret loss of wetland function on a landscape level, and to incorporate that information into watershed management.

The U.S. Fish and Wildlife Service (USFWS) has been conducting the National Wetlands Inventory (NWI) for over 25 years. The USFWS developed a technique to include additional information related to wetland function (i.e. landscape position, landform, and water flow path) to the National Wetland Inventory (NWI) database to characterize wetland function at a landscape level.

The Michigan Department of Environmental Quality (MDEQ) has been working since 2006 on refining and expanding the use of the Landscape Level Wetland Functional Assessment (LLWFA) across much of the state. The LLWFA incorporates digital data and geographic Information system (GIS) technology into the NWI database to perform various geospatial analyses. The database includes hydric soils, hydric soil complexes, land cover from the Michigan Resource Inventory System (MIRIS), base map features from Michigan Department of Geographic Information, pre-settlement wetlands from the Michigan Natural Features Inventory, and urban areas as mapped by the Michigan Department of Natural Resources.

This approach addresses both a current (2005) wetland inventory and a Pre-European Settlement inventory, to approximate change over time, and provide the best information possible on wetland status and trends from original condition thru today. With these tools we are better equipped to develop strategies to preserve or enhance our current wetland resources and plan for restoration of lost resources. Restoring lost wetland functionality shows great promise in addressing the systemic cause of much of the non-point source pollution occurring in the State.

In early 2012, the Michigan Department of Environmental Quality released the Landscape Level Wetland Functional Assessment (LLWFA) for the Munuscong River Watershed. The LLWFA provides a quantitative and qualitative assessment of the loss of wetland function in the watershed. Information provided in the LLWFA assisted in the development of wetland conservation and restoration strategies outlined in Chapter 10 of this management plan.

Figure 5.4 highlights "high potential" areas for wetland restoration in red and "medium potential" in yellow. The complete Landscape Level Watershed Assessment for the Munuscong Watershed can be found in Appendix L. Figure 5.4 includes delineation of the subbasins from the MDEQ hydrologic study discussed in Section 5.1.2.

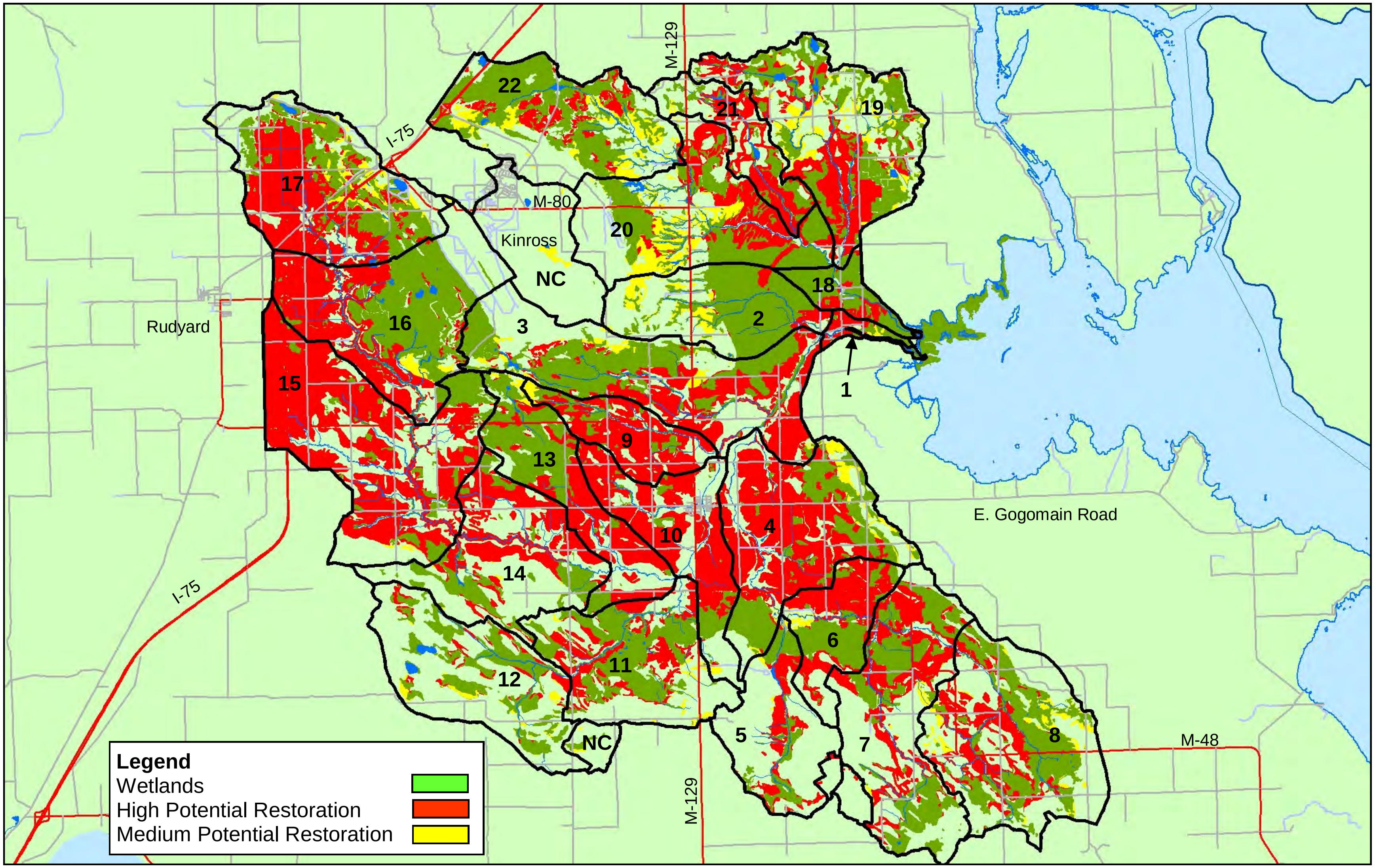


Figure 5.4 Potential Wetland Restoration Areas

5.1.2 Hydrologic Characteristics and Wetland Restoration

A recurring theme throughout the Munuscong Watershed management plan is the loss of critical wetlands and the impact on groundwater discharge, water quality, stream channel erosion, and fish and wildlife habitat.

In Chapter 2 of this document, the contents and results of the January 31, 2011 "Munuscong River Watershed Hydrologic Study" prepared by the Michigan Department of Environmental Quality were discussed in detail. The hydrologic study summarizes the critical areas that have experienced the most hydrologic change in Table 5.2.

	Subbasin	Runoff Volume, 1978	Runoff Volume Change, 1800 to 1978	Peak Flow Yield, 1978	Peak Flow Yield Change, 1800 to 1978	Total Score
1	Munuscong River to mouth	10	10	7	0	27
2	Demoreux Creek to mouth	3	3	3	3	12
3	Munuscong River to Demoreux Creek	3	3	0	3	9
4	East Branch Munuscong River to mouth	7	7	7	7	28
5	Rapson Creek to mouth	0	0	3	3	6
6	East Branch Munuscong River to Rapson Creek	7	7	7	3	24
7	East Branch Munuscong River to below Hannah Creek	3	3	3	7	16
8	East Branch Munuscong River to South Reynolds Road	3	3	3	3	12
9	Fletcher Creek to Mouth	10	10	10	10	40
10	Munuscong River to Fletcher Creek	10	10	7	10	37
11	Taylor Creek to Mouth	3	0	3	3	9
12	Taylor Creek to Three Mile Road	0	0	0	0	0
13	Munuscong River to Taylor Creek	7	7	3	7	24
14	Munuscong River to Rutledge Road	7	3	3	7	20
15	Munuscong River to Unnamed Tributary	10	10	3	7	30
16	Tributary to Munuscong River to M-48	7	7	0	3	17
17	Tributary to Munuscong River to below unnamed tributary	3	3	7	3	16
18	Little Munuscong River to mouth	3	0	0	0	3
19	School Creek to mouth	7	3	3	3	16
20	Tributary to Little Munuscong River to School Creek	0	0	0	0	0
21	Tributary to Little Munuscong River to mouth	3	3	7	3	16
22	Little Munuscong River to Sixteen Mile Road	0	0	0	0	0

Table 5.2 Subbasin Critical Area Scores

Figure 5.5 is a map of the subbasins from the hydrologic study with color coding to match the scores on the critical score column of Table 5.2

When comparing the critical area scores of the Hydrologic Study with the High Potential Wetland Restoration areas depicted in Figure 5.4, it is obvious that that Subbasins 15, 13, 9, 10, 4, and 6 are prime areas for potential wetland restoration work on private land such as the Wetland Reserve Program.

This mid-section area of the Munuscong River watershed has the highest potential for successful restoration work on private land resulting in the highest benefit for the collective watershed.

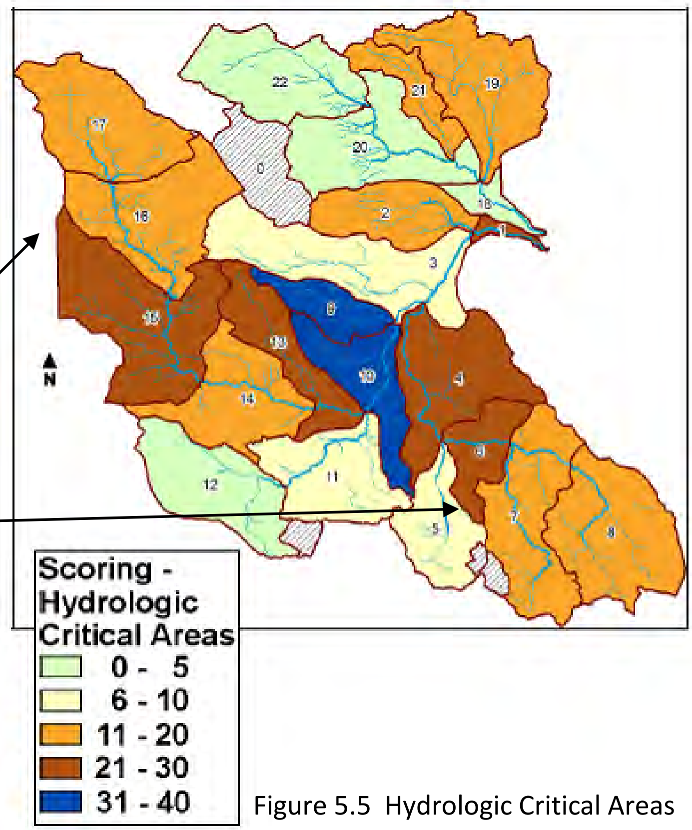


Figure 5.5 Hydrologic Critical Areas

The subbasin areas with the highest hydrologic concern are:

Subbasin 9	Fletcher Creek to mouth	Score: 40
Subbasin 10	Munuscong River to Fletcher Creek	Score: 37
Subbasin 15	Munuscong River to unnamed tributary	Score: 30
Subbasin 4	East Branch Munuscong River to mouth	Score: 28
Subbasin 1	Munuscong River to mouth	Score: 27
Subbasin 6	East Branch Munuscong to Rapson Creek	Score: 24
Subbasin 13	Munuscong River to Taylor Creek	Score: 24

Subbasins 17, 16, 19, 21, and 2 in the upper portion of the collective watershed are prime areas for development of coastal and inland wetland habitat restoration and protection activities due to the many acres of protected lands in this area (i.e. state land, federal land, nature conservancy land, etc.)

5.2 Public Lands—Conservation and Recreation

The "Munuscong River Watershed Hydrologic Study", prepared by the Michigan Department of Environmental Quality in 2011, presented a summary of public lands (federal, state, and local government-owned lands), private lands (The Nature Conservancy, Audubon, and local conservancies), and some conservation easements within the Munuscong River watershed. With the support of the United States Fish and Wildlife, Ducks Unlimited and the Nature Conservancy in Michigan, the MDEQ created a comprehensive GIS layer of Michigan's Conservation and Recreation Lands (CARL). CARL areas by management type are shown in Table 5.3.

Management Description	Area in Acres
Conservation	29,581
Recreation	267
Total	29,848

Table 5.3 Public Lands

Source: LLFWA MDEQ

The CARL layer is a valuable tool for planning and development of coastal and inland wetland habitat restoration and protection activities within existing public land. Figure 5.6 depicts the conservation and recreation lands for the Munuscong River watershed as of February 2008. The area of these lands is 29,848 acres, which is 20 percent of the watershed.

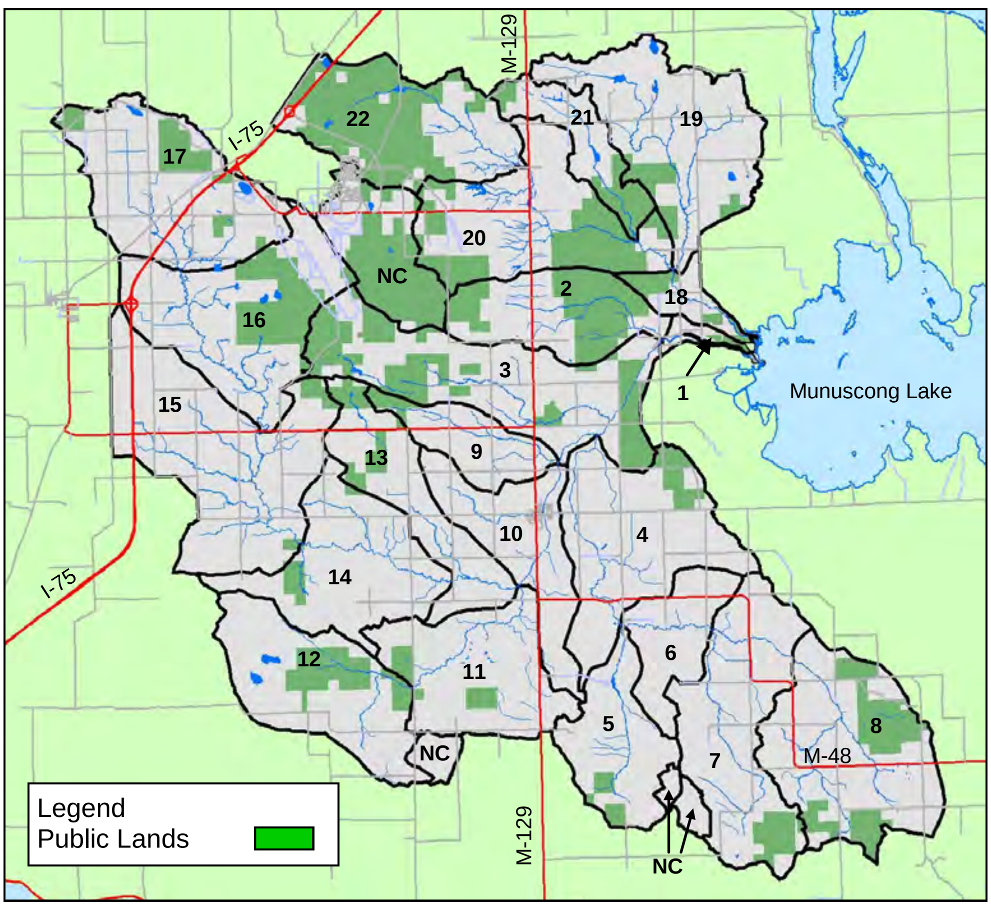


Figure 5.6 Public Lands

Table 5.4 breaks down the acreage of public and conservancy managed land for each of the 22 subbasins reported in the Hydrologic Study.

	Subbasin	CARL Area (acres)	CARL Area Percent of Subbasin
1	Munuscong River to the mouth	148	25.4%
2	Demoreux Creek to mouth	2,578	49.9%
3	Munuscong River to Demoreux	3,596	35.4%
4	East Branch Munuscong River to the mouth	610	7.2%
5	Rapson Creek to mouth	346	7.3%
6	East Branch Munuscong River to Rapson Creek		0.0%
7	East Branch Munuscong River to below Hannah Creek	668	7.8%
8	East Branch Munuscong River to South Reynolds Road	2,176	23.0%
9	Fletcher Creek to mouth	278	9.3%
10	Munuscong River to Fletcher Creek		0.0%
11	Taylor Creek to mouth	532	7.7%
12	Taylor Creek to Three Mile Road	1,372	18.7%
13	Munuscong River to Taylor Creek	716	13.9%
14	Munuscong River to Rutledge Road	349	4.9%
15	Munuscong River to unnamed tributary	313	2.8%
16	Tributary to Munuscong River to M-48	2,137	23.6%
17	Tributary to Munuscong River to below unnamed tributary	1,174	13.5%
18	Little Munuscong River to mouth	553	37.6%
19	School Creek to mouth	755	8.7%
20	Tributary to Little Munuscong River to School Creek	2,899	34.5%
21	Tributary to Little Munuscong River to mouth	1,007	34.2%
22	Little Munuscong River to Sixteen Mile Road	4,883	63.0%
	Non-Contributing	2,757	48.8%
	Total	29,848**	20.0%

Table 5.4 Public and Conservancy Lands—CARL Source: LLFWA MDEQ

**Note: The total acres reported earlier in this Management Plan for State and Federal Lands are reasonably close to those reported in the CARL GIS layer. That information was extracted from an earlier version of the State of Michigan geographic data files used in creating the CARL layer.

5.3 Rivers and Streams

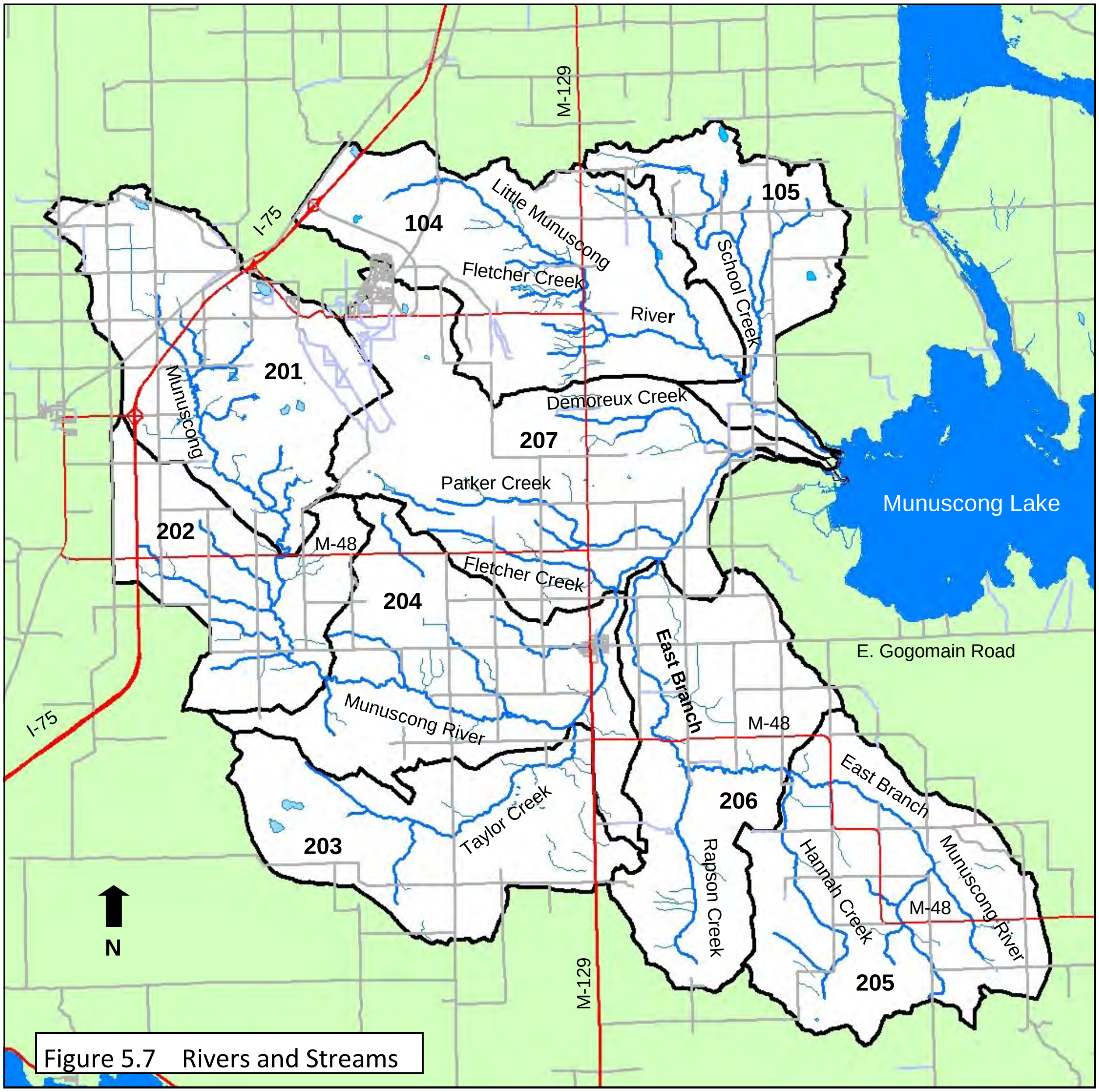


Figure 5.7 Rivers and Streams

Name	HUC ID	Length (km)	Length (miles)
Little Munuscong River	104, 105	21.482	13.348
Fletcher Creek (north)	104	1.944	1.208
School Creek	105	12.105	7.522
Big Munuscong River	207, 204, 202, 201	45.635	28.356
Demoreux Creek	207	7.031	4.369
Parker Creek	207	9.787	6.081
Fletcher Creek	207	7.161	4.450
Taylor Creek	203	10.929	6.791
E. Br. Munuscong River	206, 205	24.655	15.320
Rapson Creek	206	7.580	4.710
Hannah Creek	205	9.430	5.860
		157.739	98.014

Table 5.5 Rivers and Streams

5.4 Rare and Endangered Species

Figure 5.8 shows the probability of finding rare plants, animals, or plant communities in Pickford Township. This probability model was released by the Michigan Natural Features Inventory. The model is designed to help protect areas by directing development away from those areas with a high likelihood of encountering a sensitive species.

The model is based on the spatial extent of documented occurrences, the presence of potential habitat within the known extent of the occurrences, and the age of each occurrence. Table 5.4 lists endangered and threatened species in the St. Mary's watershed in the Pickford area. Species are listed as either Special Concern (SC) or Threatened (T).

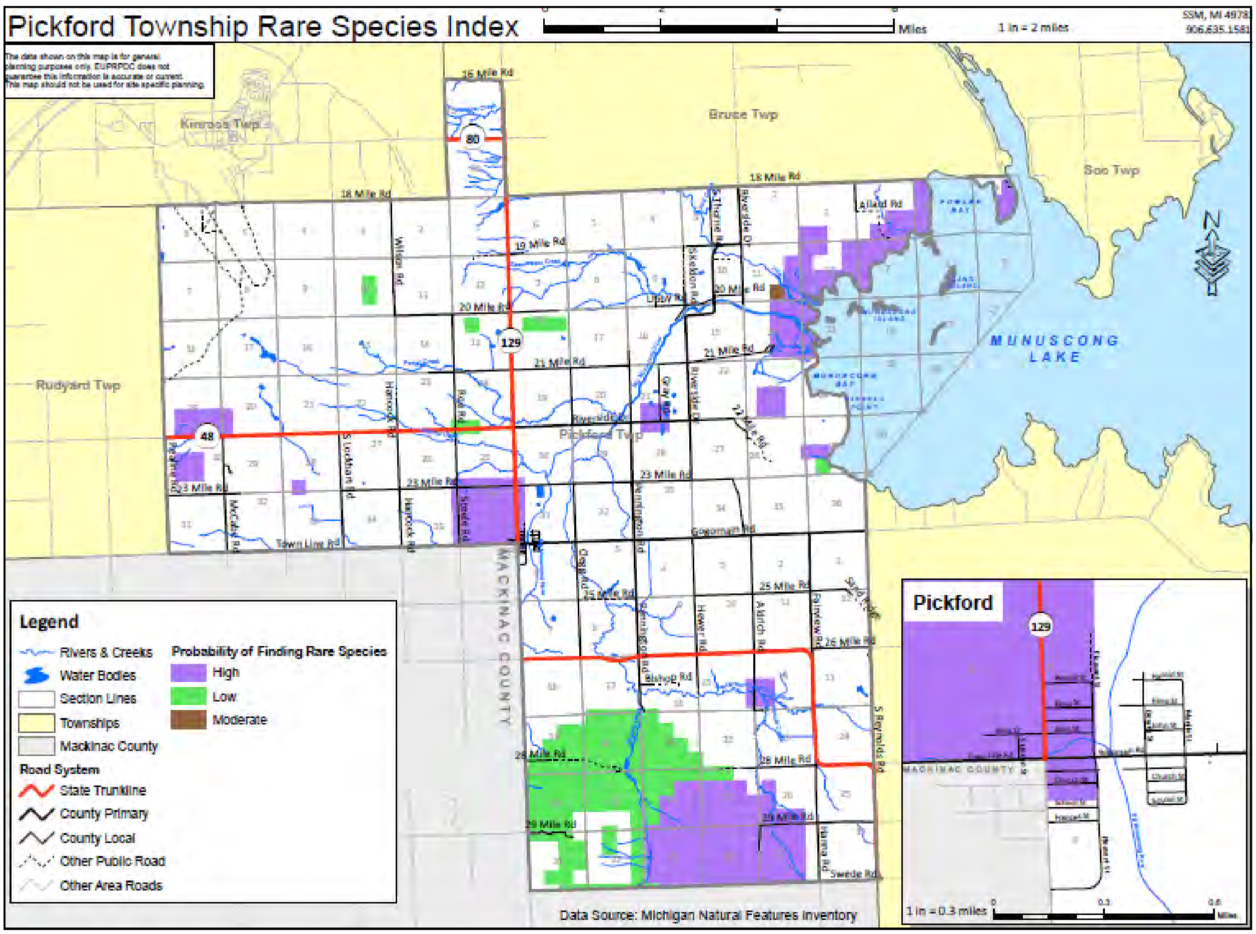


Figure 5.8 Pickford Township Rare Species Index

Recovering these species will require the restoration and protection of their habitats and natural systems. Key conservation areas of the Munuscong River watershed include critical habitat for plant and animal communities, such as wetlands, large forest tracts, springs, spawning areas; habitat for rare, threatened or endangered species, and native vegetation areas; the aquatic corridor, including floodplains, stream channels, springs and seeps, steep slopes, and riparian forests (MCSSAG 2003).

Table 5.6 lists endangered and threatened species in the Munuscong River watershed in the Pickford area. Species are listed as either Special Concern (SC) or Threatened (T).

Common Name	State Status
Grasshopper Sparrow	SC
American Bittern	SC
Marsh Wren	SC
Ashy Whitlow-grass	T
Osprey	T
Sharp-tailed Grouse	SC
Calypso or Fairy-slipper	T
Cisco or Lake Herring	T
Yellow Rail	T
Bald Eagle	T
Red-shouldered Hawk	T
Alaska Orchid	SC
Lapland Buttercup	T
Common Tern	T
Walking Fern	T
Green Spleenwort	T
Alternate-leaved Water-milfoil	SC

Source: Natural Features Inventory Watershed Data

Table 5.6 Endangered and Threatened Species in MRW

Chapter 6 Plan Development Process

The Munuscong River Watershed Management Plan was developed utilizing the best available data along with input from stakeholders. The planning process included:

- soliciting public input
- reviewing previous studies and reports
- conducting an inventory to identify problem sites and areas
- conducting research on topics of concern such as wetland functions, agricultural concerns and hydrology

6.1 Public Input

Public participation was relied upon during the planning process to solicit input on all stages of plan development. A large effort was conducted during the summer of 2010 to survey the residents of the watershed with a social survey. Respondents agreed that the water quality of the MRW is an important concern; that they support governmental efforts to maintain and improve water quality; and are willing to take action in their own lives to improve the situation. Further results from survey can be found in the Munuscong River Watershed Planning Survey report in Appendix F.

Results from public communication, meetings, and social survey were utilized to identify watershed concerns. During the planning process, several methods were used to engage stakeholders and solicit input. These methods included steering committee meetings, a web site with feedback opportunities, and email and personal communications to interested citizens and groups.

Steering committee participants were instrumental in identifying and commenting on designated uses, desired uses, pollutants, sources and causes of pollutants, priority or critical areas and in developing goals, objectives and an action plan. A list of steering committee participants can be found in Appendix B. Many partners were instrumental in providing information, completing modeling efforts, organizing and implementing the inventory and providing feedback on early versions of the plan.

The key governmental and non-profit partners included the Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Lake Superior State University, Sault Ste. Marie office of NRCS, Munuscong River Watershed Association, Eastern Upper Peninsula Regional Planning and Development, The Nature Conservancy, Chippewa Ottawa Resource Authority, and Pickford and Marquette Townships.

The internet was used throughout the plan development process. The MRW website contained information relating to the development of the plan. Along with email communication to keep stakeholders and steering committee participants informed and another opportunity to make comments relating to the watershed plan.

The media assisted in alerting watershed stakeholders and residents about the MRW Management Plan and encouraged them to comment on the draft plan either on-line, by phone or in person. In early 2012, CEMCD held an open house for stakeholders to review and comment on the plan. Local radio stations and newspapers announced the open house and several concerned citizens came to the open house to learn about the watershed and the management plan.

6.2 Stakeholder Concerns

Munuscong River watershed stakeholders have identified known or perceived impairments and problems within the MRW at Steering Committee meetings from 2010 to 2011 and in a public watershed forum held in March of 2010. Stakeholders expressed concerns about several issues in the MRW.

Key Areas of Local Concern

1. An issue that united the stakeholders was concern with elevated *E. coli* results from sampling within the watershed and surrounding region. The concern of elevated *E. coli* levels needs to be addressed on all levels of land use including residential on-site septic systems, township level septic treatment, and agricultural practices.
2. Another issue was soil erosion and sedimentation from agricultural lands, construction sites (residential and commercial), and road crossings; and the deposition of that sediment at the mouth of the Munuscong River which impacts navigation and recreational opportunities near the region. Munuscong River watershed impermeable soils are especially susceptible to increased erosion forces from characteristic accelerated runoff. Parker Creek is listed on the 303d list for sedimentation/siltation on the lower three miles.
3. Impaired navigation of the lower reaches of the Munuscong River from approximately Pickford easterly to the mouth and into the Munuscong Bay is a major concern of stakeholders. Excessive sedimentation, numerous bridge and log obstructions, and low water levels contribute to even small boat navigation within this corridor.
4. Fish populations and habitat within the watershed is another concern voiced by watershed stakeholders. Results from the social survey show the importance in eating fish caught locally and protecting fish habitat as important uses of the water. Local and regional natural resource departments have been using Munuscong River walleye as a brood source for walleye rearing and stocking.

A full list of stakeholder concerns have been compiled and organized by topic in Appendix C.

6.3 Previous Studies and Reports

Several studies and reports pertaining to the Munuscong River Watershed and region have previously been completed and were reviewed during the development of this management plan. Information contained in these reports provided background information, helped determine sampling locations, and assisted in prioritizing protection and management areas. A list of known studies and reports pertaining to the MRW are listed in the Appendix D.

6.4 Identifying Programs and Organizations

Several organization/state/federal programs are in place to help protect and enhance the waters and land of the state. A list was compiled of organizations and programs were compiled during the planning process, which is not all inclusive. Descriptions of organization and program goals or priorities are summarized in Chapter 4. These programs will be able to help implement and reach the goals of the Munuscong River Watershed Plan.

6.5 Watershed Inventory

6.5.1 Road and Stream Crossing Inventory

Road stream crossings are considered significant sources of sedimentation and pollutants and therefore can be extremely detrimental to the overall health of a stream. Road crossings can serve as barriers to the movement and dispersal of fish and other aquatic organisms by disrupting stream flow and structure of a stream.

Road stream crossing structures can become perched, creating a freefall condition, preventing some organisms from moving upstream. Crossing structures can change water velocity if the structure is undersized, narrowing the channel. At times culverts break the continuity of streams altering habitat. Culverts also lead to channelization by not allowing the stream to migrate across its natural floodplain leading to erosion and sedimentation.

Road stream crossings contribute a considerable amount of sediment. These alterations can strongly influence the downstream aquatic environments and overall health of a watershed. The Munuscong watershed has many issues with erosion and sedimentation and it is believed that impaired road stream crossings are a major contributor.

During the summer of 2010, employees of the CLMCD and a student from LSSU investigated the condition of road stream crossings and erosion taking place in the Munuscong River watershed. Nine creeks were accessed at 52 road crossings (Figure 6.1), with at least eight sites contributing over 53 tons sediment each year to area waters.

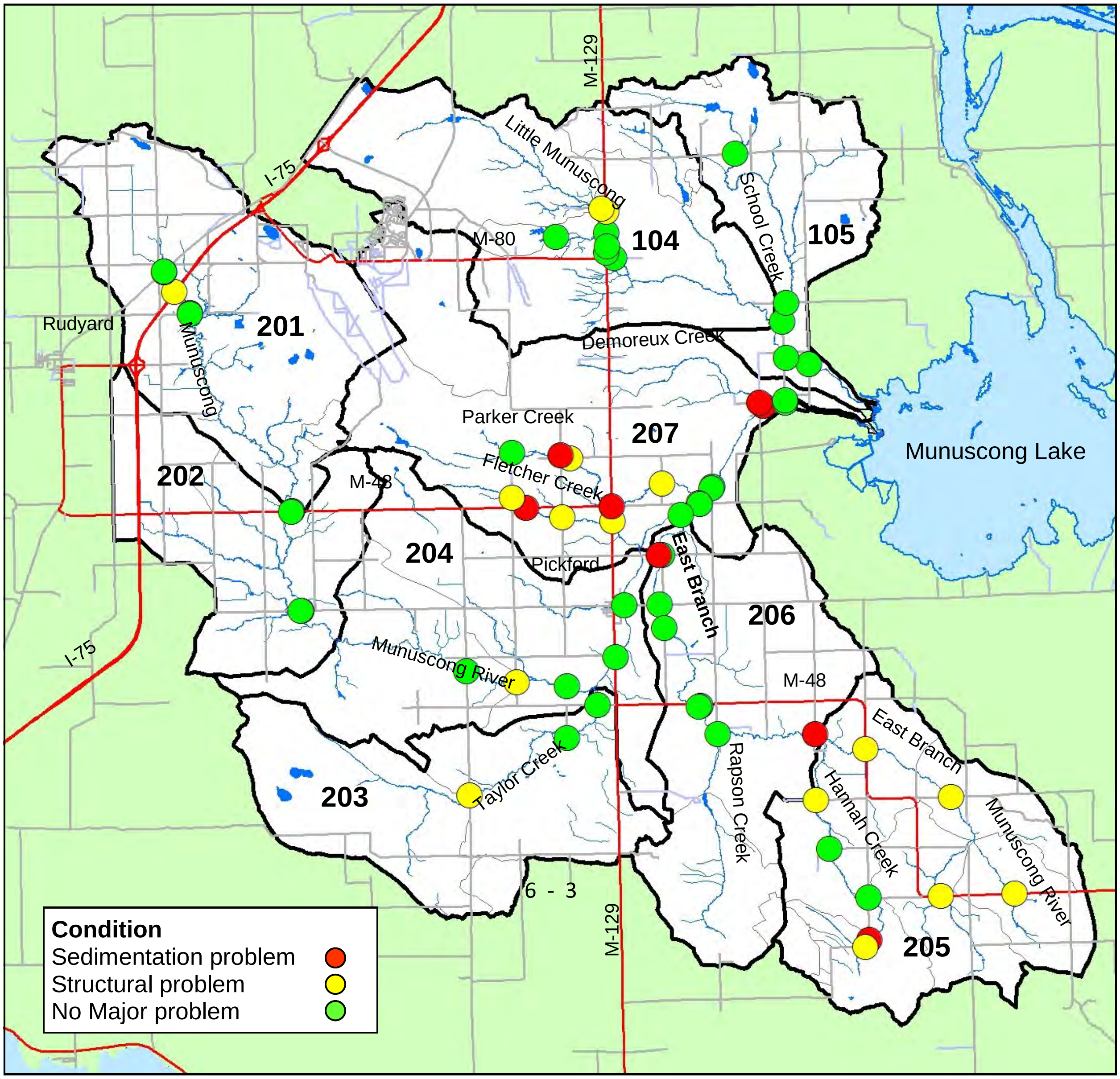


Figure 6.1—Road and Stream Crossing Condition Assessment

Table 6.1 shows some of the inventory sites that had critical values of sedimentation and/or structure issues. Many are not properly designed to facilitate the significant flood events characteristic of spring snow melt and significant rain events. During these events upstream flows are impounded, water rises over bankfull levels and the erosive forces erode stream banks and road embankments.

Road Stream Crossing Sites		Structure	Structure	Perch Height	Total Sediment	
Site ID	Stream Name	Plugged %	Crushed %	(feet)	(cu ft)/yr	tons/yr
DEM RSX 01	Desormeux Creek	50	5	na	144	8
DEM RSX 02	Desormeux Creek	0	0	3	27	2
EBMUN01	E. B. Munuscong	30	0	na	100	6
EBMUN07	E. B. Munuscong	0	0	na	84	5
EBMUN08	E. B. Munuscong	50	0	na		
EBMUN09	E. B. Munuscong	5	5	0.5		
EBMUN10	E. B. Munuscong	75	75	na		
EBMUN11	E. B. Munuscong	0	75	na		
FLES RSX 01	Fletcher Creek S	0	0	0.9		
FLES RSX 02	Fletcher Creek S	0	30	na		
FLES RSX 03	Fletcher Creek S	0	0	.5 Out	154	9
FLES RSX 04	Fletcher Creek S	0	40	1		
HANN 01	Hannah Creek	25	0			
HANN 04	Hannah Creek	0	0	na	57.6	3
HANN 05	Hannah Creek	5	5	0.5		
LIL MUNU RSX 06	Little Munuscong	100 (#2)	0	na		
LIL MUNU RSX 07	Little Munuscong	80	0	na		
MUNU RSX 03	Munuscong River	90	0	na		
MUNU RSX 08	Munuscong River	25	0	na		
MUNU RSX 10	Munuscong River	25	0	na		
MUNU RSX 13	Munuscong River	33	0	0.5		
MUNU RSX 14	Munuscong River	40 left, 100 Right	0			
PARK RSX 01	Parker Creek	0	80	na		
PARK RSX 02	Parker Creek	#2 is 100%	0	0	6	1
PARK RSX 03	Parker Creek	0	0	0.4		
PARK RSX 04	Parker Creek	35	0	0	540	19
TAY RSX 03	Taylor Creek	0	0	1.2		
Totals					1,112.6	53

Table 6.1 Road and Stream Crossing Sediment and Structural Concerns

Inventory of watershed crossings included federal, state, and local township government roads. Physical measurements were taken of each road crossing along with photographs of each site and can be found in Appendix E. There are a considerable amount of private crossings that are within the watershed that were not assessed during this inventory that pose similar environmental risk to the watershed.

6.5.2 Agricultural Inventory

Agricultural facilities within the watershed were inventoried to determine problem locations were farming operations may have a negative impact on water quality. The complete Agricultural Inventory can be found in Appendix G. The inventory addressed sites that are located along the river/stream corridor between road crossings.

Some areas were difficult to inventory due to lack of access to private property. Some landowners were hesitant to give permission to evaluate conditions on their property. Based on comments from landowners, there is a perception that personnel from regulatory agencies/organizations approach landowners to look around their facilities; and then later issue landowners violations for non-compliance.

There are areas that are large tracts of forested property with limited roads and trails to access the property. These areas when found were checked with aerial photography to try to determine if there was a potential for problem sites. There are numerous small farm operations/hobby farmers within the watershed that have limited resources to be able to address the problems seen with manure management, heavy use areas, and direct access to water courses.

Inventory calculations estimate that 75 sites are depositing approximately 3,530 tons of sediment, 4,055 pounds of phosphorus, and 8,109 pounds of nitrogen in area waters each year.

6.6 Watershed Research and Modeling

6.6.1 MDEQ Landscape Level Wetland Functional Assessment

Relatively new methods are 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 addition, a 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.

MDEQ’s 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. 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.

In 2011, the Michigan Department of Environmental Quality 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 wildlife habitat, or elimination of a nutrient sink.

In early 2012, the MDEQ released "The Munuscong River Watershed Landscape Level Wetland Functional Assessment" (LLWFA) report which compared the approximate wetland loss from pre-European settlement to the year 2005 in the collective watershed of the Little Munuscong and Munuscong Rivers.

According to the report, there are four types of wetlands within the watershed. These wetlands are Palustrine Emergent, Palustrine Forested, Palustrine Shrub-Scrub, and other Palustrine (ponds).

The report breaks down the trends within the subwatersheds and notes the existing size and number of wetlands in 2005 (most recent information) and compares them to the wetlands of the 1800's. The LLWFA report was useful during the watershed management planning project to focus efforts on watersheds with the most wetlands lost or fragmentation of wetlands. Results from the LLWFA in the Munuscong River Watershed can be found in Appendix L.

6.7 Water Quality Analysis

CLMCD partnered with Lake Superior State University (LSSU) faculty and students to survey chemical characteristics of area creeks to provide a snapshot or overview of the health of the sub watersheds located within the Munuscong River watershed, and their contribution of non-point pollution to the St. Mary's River (see Appendix I for the Quality Assurance Plan.)

Sampling locations were selected by consultation with LSSU faculty and MDEQ staff. Sites were based on accessibility, representation, known water quality problems, and correlated with current studies being done in the watershed (Table 6.2 and Figure 6). Sampling occurred during the summer of 2010 and spring 2011 and included dry and wet weather sampling events. Lake Superior State University's Environmental Analysis Laboratory assisted with inorganic chemistry analysis of the water and sediment samples.

Name	Description	Latitude	Longitude
Munuscong River 3	M-129 Bridge	46.142950°	-84.363281°
Munuscong River 2	22 Mile Rd	46.186445°	-84.326753°
Munuscong River	At S. Riverside Dr.	46.216217°	-84.290988°
Munuscong River 4	W Town line Rd	46.158341°	-84.493527°
E Branch Munuscong R	At Gogomain Rd	46.158153°	-84.344980°
E Branch Munuscong R 2	M-48	46.114824°	-84.260141°
Parker Creek 3	W 21 Mile Rd	46.201083°	-84.380281°
Parker Creek	Wynn Road	46.193364°	-84.342583°
Parker Creek 2	M-129	46.188528°	-84.363894°
Taylor Creek	Taylor Creek Road	46.129258°	-84.372057°
Taylor Creek 2	1 Mile Rd	46.122439°	-84.384364°
Taylor Creek 3	3 Mile Rd	46.100658°	-84.425172°
Little Munuscong River	Riverside Dr	46.228875°	-84.289711°
Little Munuscong River 2	17 Mile Rd near M-80	46.258792°	-84.360297°
Fletcher Creek	Mouth near M-129	46.266356°	-84.363625°
Rapson Creek	East Northwoods Road	46.103311°	-84.327483°
School Creek	18 Mile Road	46.244989°	-84.288722°
Hannah Creek	28 Mile Rd	46.100417°	-84.280964°
Demoreux Creek	S. Keldon Rd	46.216919°	-84.300983°
Fletcher Creek S	M-129 near O'Conners Auto Sales	46.180517°	-84.363819°

Table 6.2 — Sampling Locations

LSSU also assisted with habitat, macroinvertebrate, and bacteriological examination of the watershed. Additional work was conducted by an undergraduate student at LSSU for the completion of their required senior thesis which is attached in Appendix J.

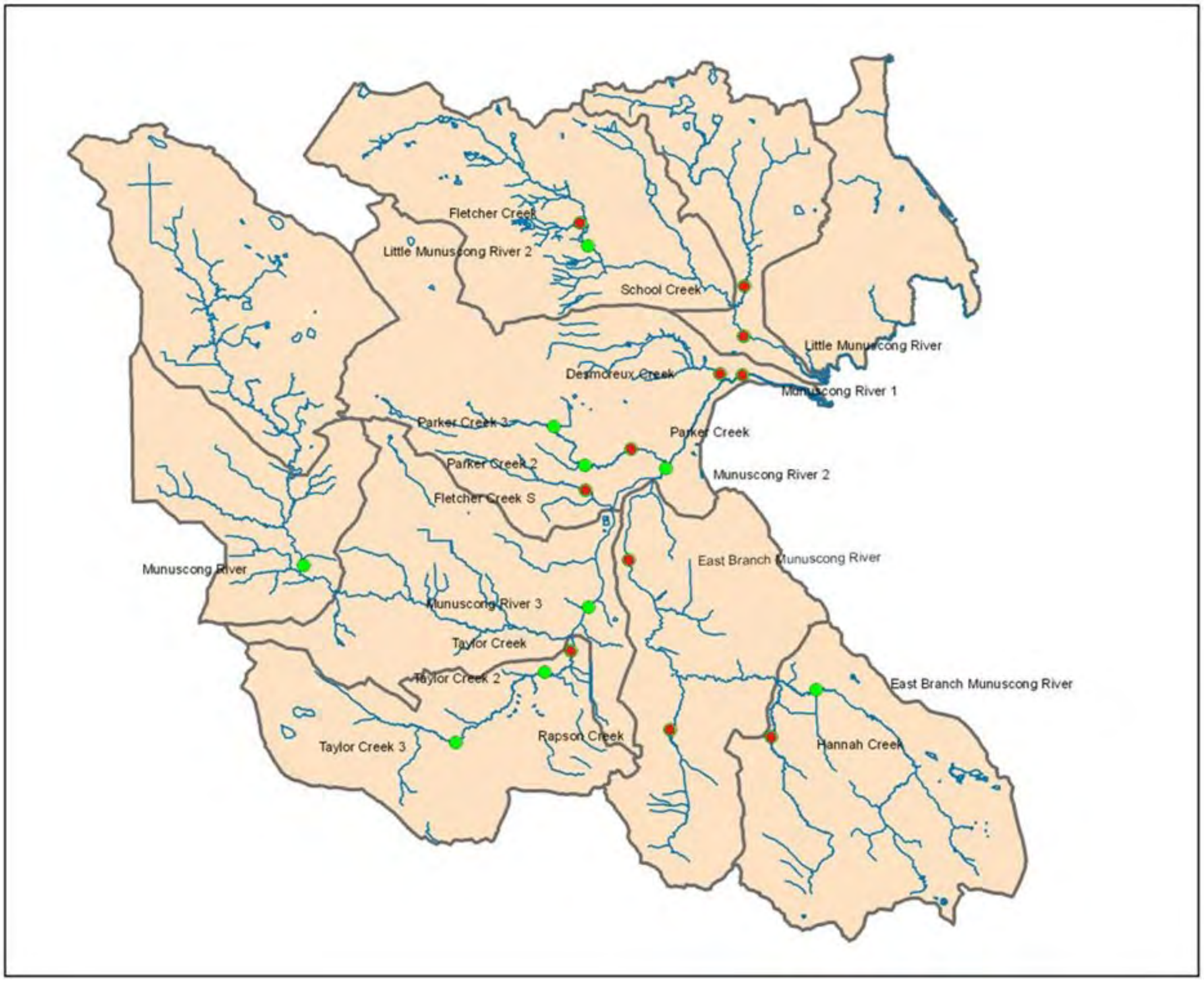


Figure 6.2 Physical, Chemical, and Biological Survey Sites

Note: Water samples were collected during both sampling events at all sites, while sediment samples were collected during the dry event at sites marked in red.

Simultaneously, *E. coli* sampling was conducted during the summer of 2010 on a weekly basis for determination if a Total Maximum Daily Load (TMDL) is needed for the waters due to *E. coli* levels. Section 303(d) of the Clean Water Act (CWA) requires Environmental Protection Agency and the Department of Environmental Quality to develop Total Maximum Daily Loads (TMDLs) for all pollutants violating or causing violation of applicable water quality standards for each impaired water body.

A TMDL determines the maximum amount of pollutant that a water body is capable of assimilating while continuing to meet the existing water quality standards. Such loads are established for all the point and nonpoint sources of pollution that cause the impairment at levels necessary to meet the applicable standards with consideration given to seasonal variations and a margin of safety.

TMDLs provide the framework that allows the State of Michigan to establish and implement pollution control and management plans with the ultimate goal indicated in Section 101(a)(2) of the CWA: "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable" (EPA, 1991a).

Ten water bodies located in Munuscong and Little Munuscong watersheds are listed on the state's 303(d) Impaired Waters List for non-attainment of the total body contact (TBC) and/or partial body contact (PBC) designated uses due to exceedance of the water quality standards for *Escherichia coli* (*E. coli*). The water bodies are:

- Little Munuscong River
- School Creek
- Munuscong River
- Taylor Creek
- Parker Creek
- Sanderson Creek (Fletchers Creek South)
- Hannah Creek
- Rapson Creek
- East Branch of the Munuscong River
- Demoreux Creek

E. coli bacteria are found in the lower intestines of warm blooded animals. Humans, livestock, birds, wildlife, and domestic pets can all act as vectors for the introduction of *E. coli* to a water body. Ingestion of and contact with water containing *E. coli* bacteria can cause gastrointestinal infections and other health problems in humans.

The full report of water sampling results can be found in Appendix M. The TMDL results will be covered in detail in Chapter 7, Water Quality Summary.

Sampling stations within the Munuscong River watershed were correlated between the two sampling projects to help evaluate site conditions. The St. Mary's River was identified as an area of concern by the International Joint Commission as a result of problems associated with phosphorus, bacteria, heavy metals, trace organics, contaminated sediments, fish consumption advisories, and impacted biota.

The St. Mary's is also listed in the state's integrated report as requiring a Total Maximum Daily Load for pathogens (rule 100), CSO's, fish consumption advisory, PCB's and Mercury-fish tissue, and *E. coli*. Survey design was based in part on detecting these pollutants.

6.8 Hydrological Study

As described earlier in Chapter 2, the Hydrologic Studies and Dam Safety Unit (HSDSU) of the Michigan Department of Natural Resources and Environment (DNRE) conducted a Munuscong River watershed hydrologic study to better understand the watershed's hydrologic characteristics. This study supported the NPS grant to the Chippewa Luce Mackinac Conservation District to update the watershed management plan.

According to MDNRE's Dave Fongers, the watershed's hydrologic characteristics were evaluated to help determine the watershed's critical areas and to provide a basis for storm water management ordinances to protect streams from increased erosion. Stakeholders may use this, along with other information, to decide which locations are the most appropriate for wetland restoration, storm water infiltration or detention, in-stream Best Management Practices (BMPs), or upland BMPs .

The watershed study has two scenarios corresponding to land cover in 1800 and 1978. Hydrologic modeling quantifies changes in storm water runoff from 1800 through 1978 due to land cover changes. The establishment of agricultural and urban land uses and the loss of wetlands are the most noticeable transitions during this period. Natural land covers remain the dominant land cover in the watershed.

This study focused on channel protection. For that purpose, the 50 percent chance (2-year) 24-hour storm is used in the hydrologic modeling. Flows which recur relatively frequently, every one to two years, have more effect over time on channel form than infrequent flood flows. Increased runoff has the potential to increase channel-forming peak flows, the duration of channel-forming flows, and the frequency of those flows.

Total runoff volume from a 2-year storm under average watershed conditions increased 30 percent from 1800 to 1978, with 20 of the 22 subbasins showing increases. From 1800 to 1978, 21 of the 22 subbasins contributed higher peak flows. These conclusions must be tempered by the observation that most of the watersheds' channel-forming flows likely occur in April, associated with snowmelt and frozen ground, not average watershed conditions. HSDSU expects that stream flow from snowmelt and rain-on-snow events would be less sensitive to differences in land cover than indicated in this hydrologic model.

A river or stream is affected by everything in its watershed. Watershed planning, however, must identify critical areas to focus limited technical and financial resources on the areas contributing a disproportionate share of the pollutants. Protecting the Munuscong and Little Munuscong Rivers and their tributaries from both higher flows and longer durations of channel-forming flows is important to prevent destabilizing stream channels (Fongers 2011).

This study divides the watershed into 22 subbasins, see Figure 6.3 and Table 6.3. Areas identified as non-contributing have no surface outlet for stormwater runoff as determined by two nested depression contours. The subbasin delineations are available on request from DNRE's Hydrologic Studies and Dam Safety Unit.

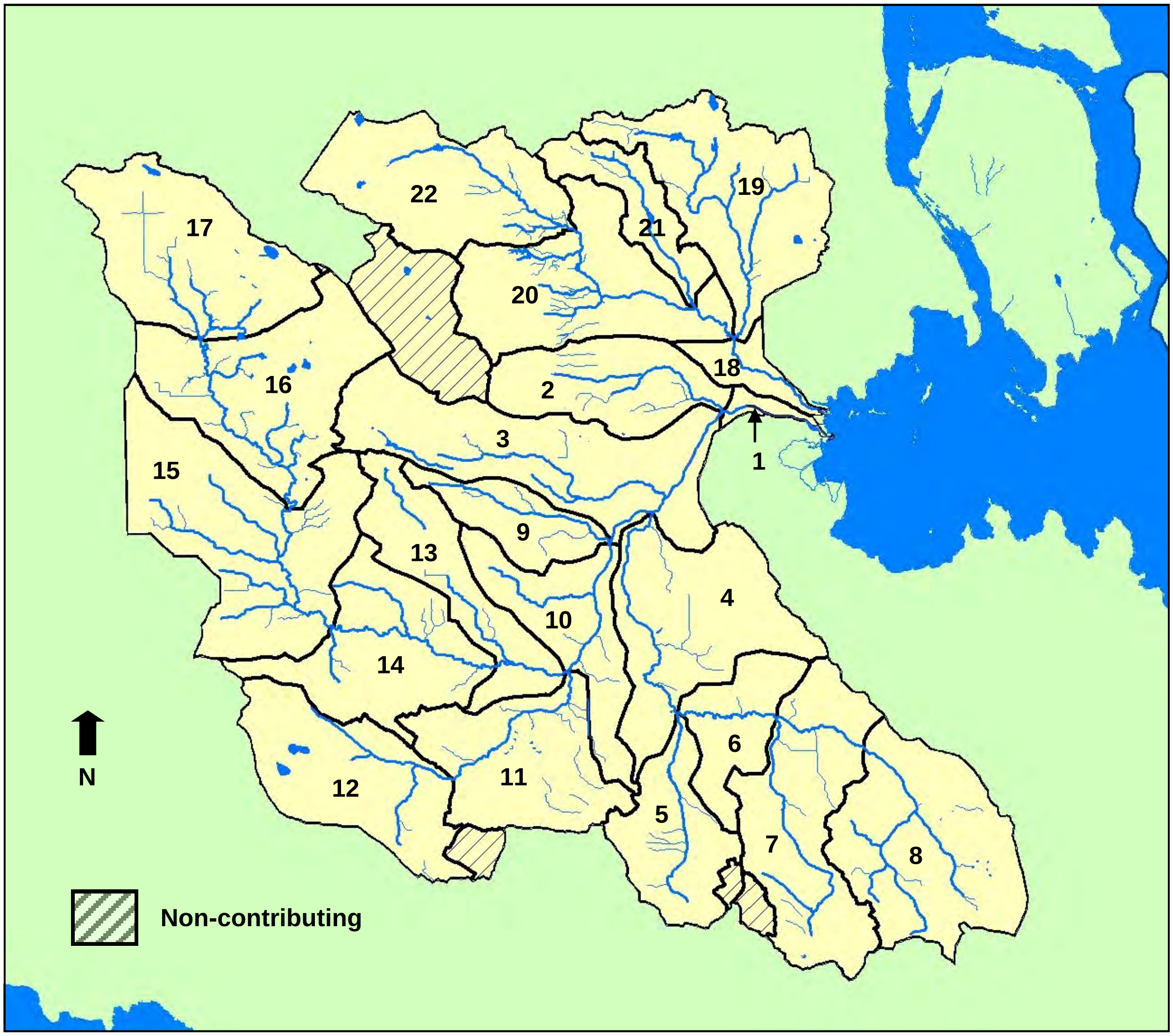


Figure 6.3 Hydrologic Study Subbasins

Subbasin	Description	Area (sq. mi.)
1	Munuscong River to mouth	0.9
2	Demoreux Creek to mouth	8.1
3	Munuscong River to Demoreux Creek	15.9
4	East Branch Munuscong River to mouth	13.2
5	Rapson Creek to mouth	7.4
6	East Branch Munuscong River to Rapson Creek	5.4
7	East Branch Munuscong River to below Hannah Creek	13.3
8	East Branch Munuscong River to South Reynolds Road	14.8
9	Fletcher Creek to mouth	4.7
10	Munuscong River to Fletcher Creek	8.1
11	Taylor Creek to mouth	10.7
12	Taylor Creek to Three Mile Road	11.5
13	Munuscong River to Taylor Creek	8.1
14	Munuscong River to Rutledge Road	11.2
15	Munuscong River to unnamed tributary	17.6
16	Tributary to Munuscong River to M-48	14.1
17	Tributary to Munuscong River to below unnamed tributary	13.5
18	Little Munuscong River to mouth	2.3
19	School Creek to mouth	13.6
20	Tributary to Little Munuscong River to School Creek	13.1
21	Tributary to Little Munuscong River to mouth	4.6
22	Little Munuscong River to Sixteen Mile Road	12.1
	Non-contributing	8.8
	Total area (square miles)	233

Table 6.3 Collective Munuscong River Watershed Subbasin Identification

Chapter 7 Water Quality Summary

7.1 Designated Uses

According to the Michigan Department of Environmental Quality (MDEQ), the primary criterion for water quality is whether the water body meets designated uses. Designated uses are recognized uses of water established by state and federal water quality programs. All surface waters of the State of Michigan are designated for and shall be protected for the uses listed in Table 7.1 (R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99). See Appendix A for general description of designated uses. A watershed management plan provides direction for protecting and restoring designated uses.

Designated Use	General Definition	Condition of Designated Use
Agriculture	Water supply for cropland irrigation and livestock watering	Designated use met
Industrial Water Supply	Water utilized in industrial processes	Designated use met
Public Water Supply	Public drinking water source	Designated use met
Navigation	Waters capable of being used for shipping, travel, or other transport by private, military, or commercial vessels	Designated use met but there is a local concern
Warm Water Fishery	Supports reproduction of warm water fish	Designated use met
Cold Water Fishery	Supports reproduction of cold water fish	Designated use met
Other indigenous Aquatic Life and Wildlife	Supports reproduction of indigenous animals, plants, and insects	Designated use impaired and of local concern
Partial Body Contact	Water quality standards are maintained for water skiing, canoeing, and wading	Designated use impaired (Bacteria/Pathogens (E. coli)) and of local concern
Total Body Contact	Water quality standards are maintained for swimming	Designated use impaired (Bacteria/Pathogens (E. coli)) and of local concern

Table 7.1 Designated Uses

7.2 General Water Quality Statement

Overall, the following designated uses are listed as "not supporting" in the MRW by the State of Michigan: Partial and Total Body Contact, Fish Consumption, and Other Indigenous Aquatic Life and Wildlife. The fish consumption designated use is included within the MRW for reference (040700010201-01 & 040700010204-01), but isn't directly targeted as a removal goal in this plan.

The designated uses of Agriculture, Industrial Water Supply and Navigation are being met throughout the watershed as assessed by the State of Michigan. There is local concern, however, concerning the navigation designated use at the lower reaches of Munuscong's mainstream, from approximately the town of Pickford down through the mouth and into Munuscong Bay. Excessive sedimentation, numerous bridge and log obstructions, and low water levels all have contributed to even small boat navigation within this section.

The State of Michigan considers Fish Consumption a designated use for all water bodies. For the Munuscong River, the Fish Consumption and Other Indigenous Aquatic Life and Wildlife designated use is considered non-attaining due to elevated levels of mercury in the water column (MDEQ Integrated Report).

7.3 Watershed Assessment

Within a watershed, water quality can vary greatly from one subwatershed to the next. An assessment of the watersheds and the individual water bodies within was completed for the collective Munuscong River watershed. Not all water bodies within the watershed were evaluated. Only water bodies with enough information to make a water quality statement were included.

The assessment includes: 1) which designated uses are threatened or impaired, 2) the reasons why the designated uses are being threatened or impaired, 3) the pollutants causing the threat or impairment, and 4) the sources of the pollutants and the causes related to those sources.

Several sources of information were used in this assessment, such as the MDEQ 2010 and 2012 Integrated Reports; MDEQ Hydrology Study; MDEQ Division staff input; MDEQ Biosurvey Reports; MRW Road Stream Crossing Inventory; MRW Agricultural Inventory; MDEQ Land-scape Level Wetland Functional Assessment; St. Mary's River Monitoring Project for TMDL Development; MDEQ Status and Trends Report; and the MDEQ Total Maximum Daily Load and Implementation Plan for *E.coli* in Sault Sainte Marie Area Tributaries (TMDL IP) (August 31, 2012); along with previous studies found in Appendix E.

The Clean Water Act (CWA) requires Michigan to prepare a biennial Integrated Report on the quality of its water resources as the principal means of conveying water quality protection/ monitoring information to the United States Environmental Protection Agency (USEPA) and the United States Congress. For each water body, the report classifies each designated use as: 1) fully supported, 2) not supported or 3) not assessed.

Designated uses other than fish consumption, which were considered not supported by the MDEQ in 2012, are identified in Table 7.2. Designated uses not supported because of a specific pollutant often require the development of a Total Maximum Daily Load (TMDL) which is noted in the Watershed Assessment Summary (Table 7.2) and the year the TMDL is scheduled to be developed.

Water Body	**State Status of Designated Uses Not Supporting**	**Pollutants (known(k) or suspected (s))**
Little Munuscong	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
School Creek	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
Munuscong River	Partial & Total Body Contact Other Indigenous Aquatic Life & Wildlife (**N**) Fish Consumption (**N**)	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli Toxins (Mercury in Water Column) (**K**) 2013 TMDL for Mercury in Water Column
Taylor Creek	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
Parker Creek	Partial & Total Body Contact Other Indigenous Aquatic Life & Wildlife	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli Sedimentation/Siltation (**K**) 2016 TMDL for Sedimentation/Siltation
Sanderson Creek (Fletchers Creek South)	Partial & Total Body Contact	Bacteria/Pathogens \(E. coli) (**K**) 2012 TMDL for E. coli
Hannah Creek	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
Rapson Creek	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
East Branch Munuscong River	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli
Demoreux Creek	Partial & Total Body Contact	Bacteria/Pathogens (E. coli) (**K**) 2012 TMDL for E. coli

Table 7.2 Watershed Assessment Summary

Figure 7.1 provides a water quality exceedance summary for the partial body contact daily maximum water quality standard of 1,000 CFU per 1,000 ml. Figure 7.2 provides a water quality exceedance summary for the total body contact daily maximum water quality standard of 300 CFU per 100 ml. These graphic representations were taken from the St. Mary's River Monitoring Project for TMDL Development Final Report which was used in the overall watershed assessment.

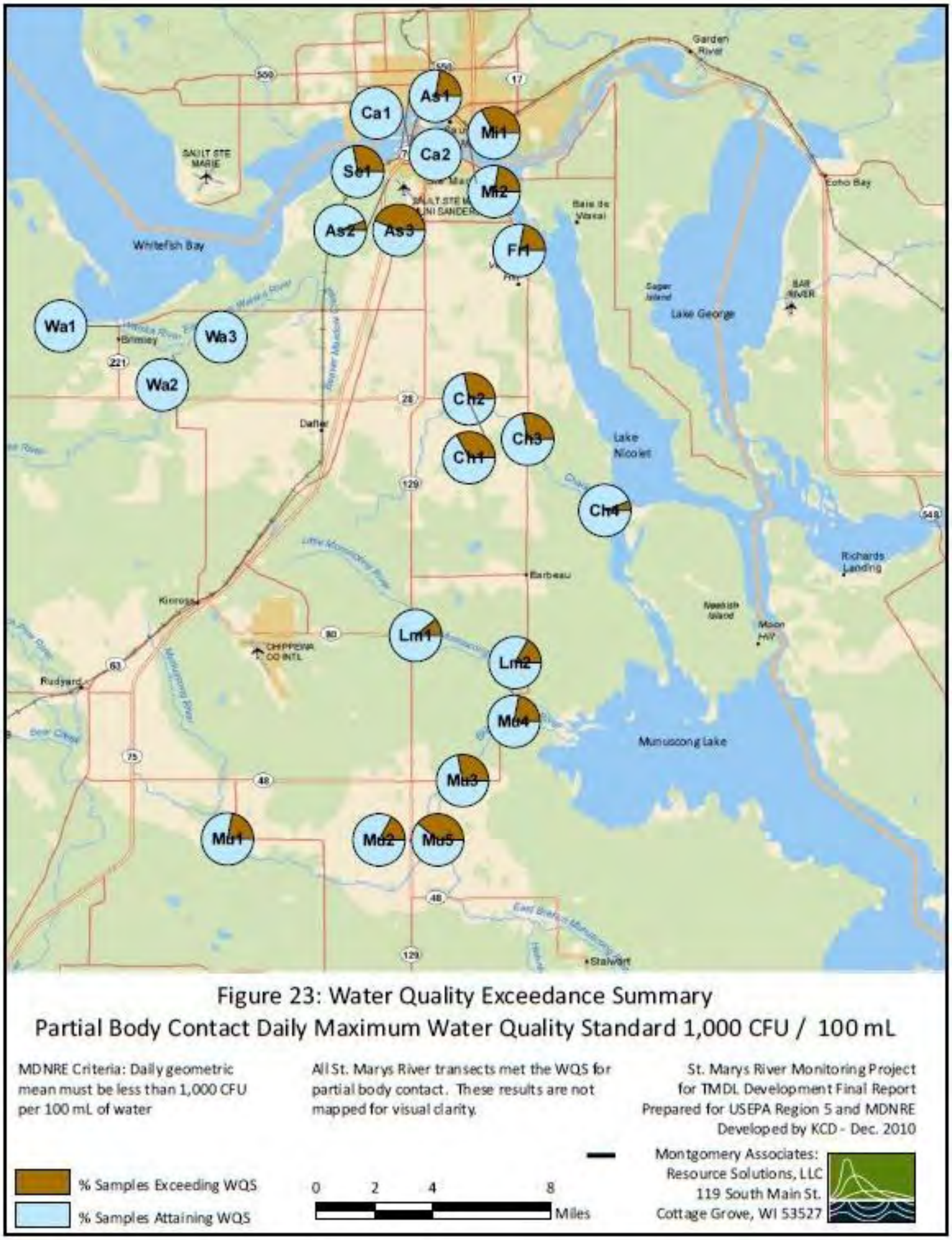


Figure 7.1 Water Quality Exceedance Summary for Partial Body Contact

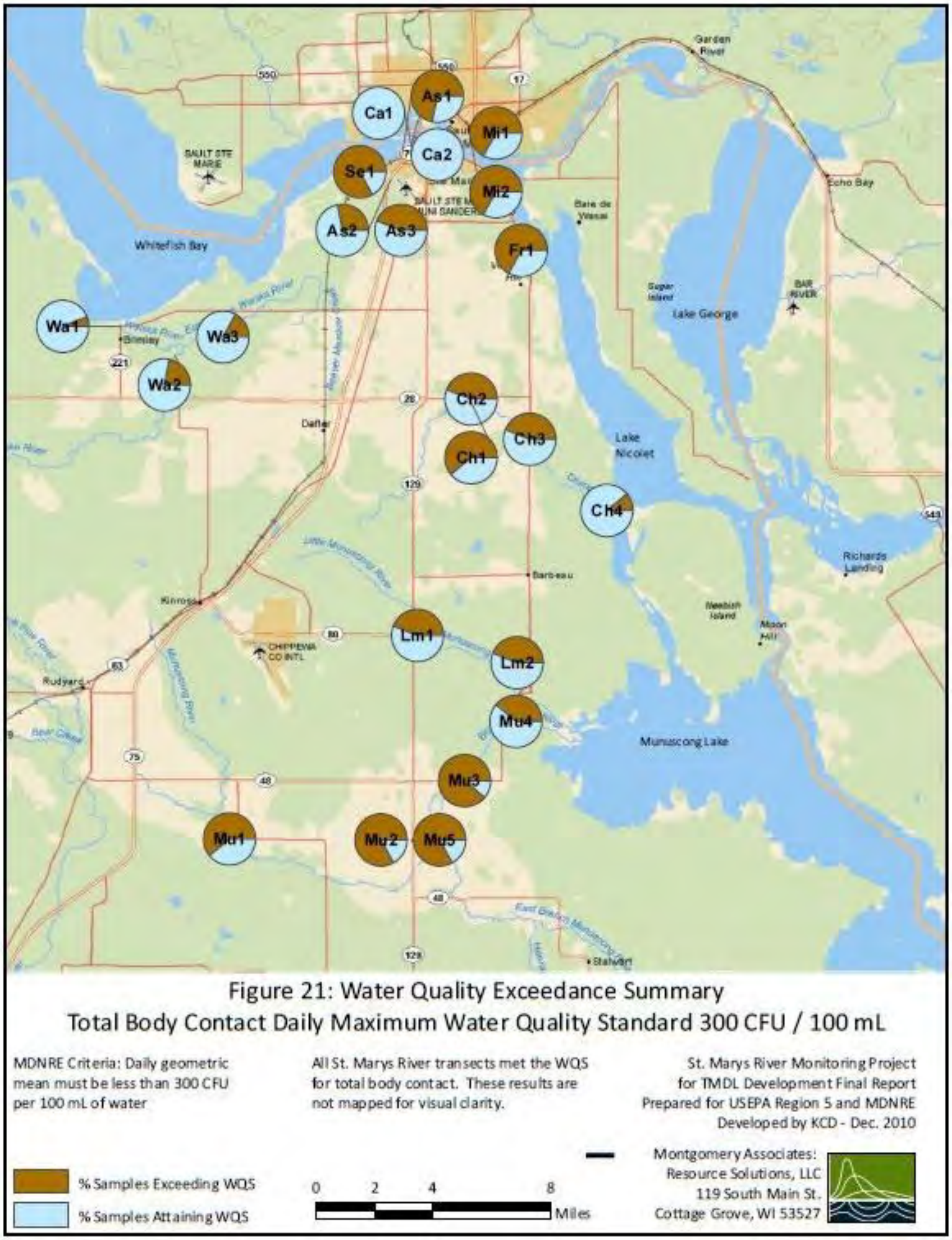


Figure 21: Water Quality Exceedance Summary
Total Body Contact Daily Maximum Water Quality Standard 300 CFU / 100 mL

Figure 7.2 Water Quality Exceedance Summary for Total Body Contact

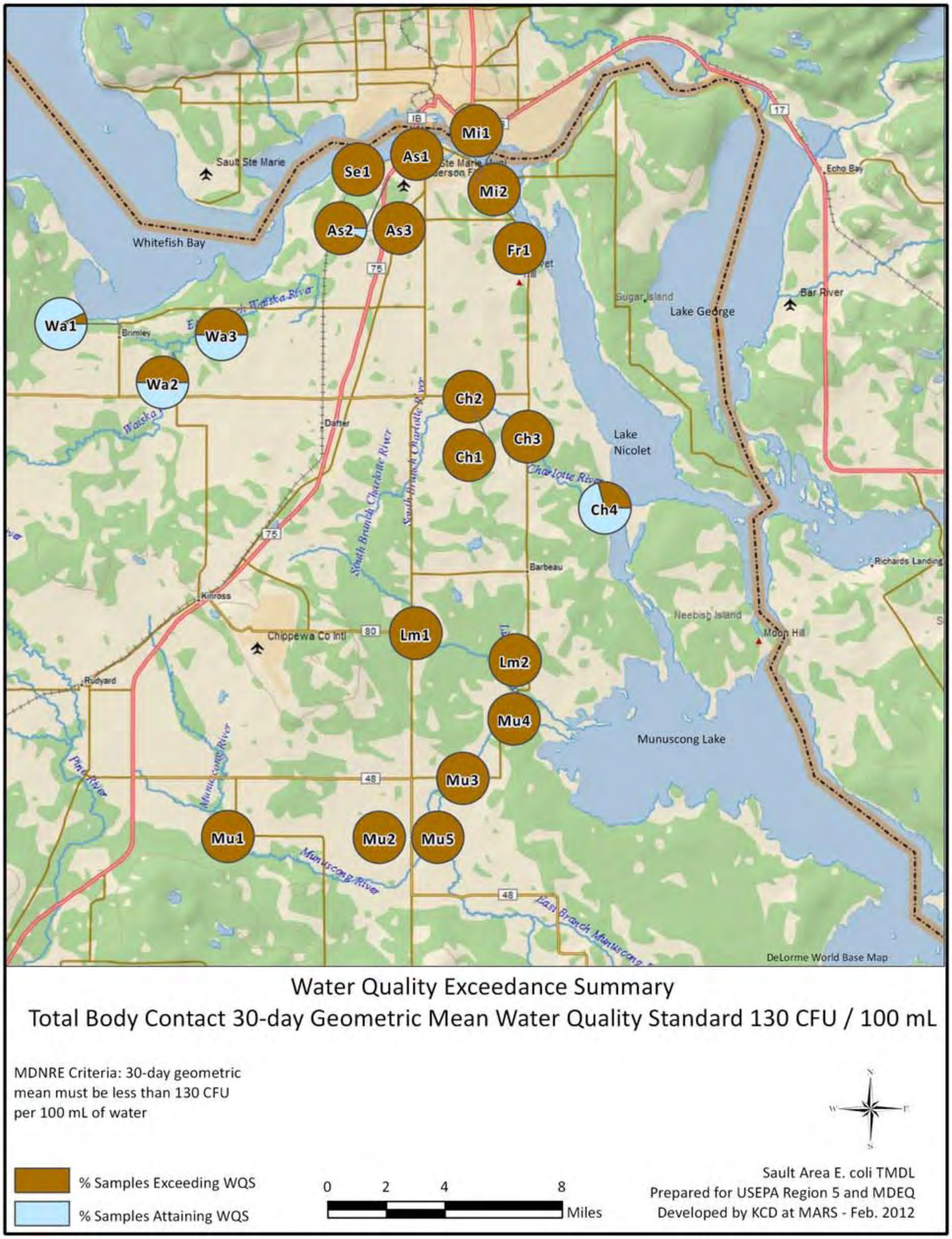


Figure 7.3 Total Body Contact 30-day Geometric Mean

7.3.1 *E. coli* Monitoring

E. coli samples were collected for 18 weeks of the 2010 total body contact recreation season at five (5) locations in the Munuscong River Watershed and two (2) locations in the Little Munuscong River watershed. Figure 7.1 and Figure 7.2 show the 2010 monitoring locations and associated watersheds. A description of the *E. coli* sample collection and analysis methods and results can be found in the St. Marys River Monitoring Project for TMDL Development Final Report (2010).

7.3.2 Bacterial Source Tracking (BST) Analysis

Bacterial Source Tracking (BST) sites are selected where elevated *E. coli* concentrations occurred in previous weeks. The BST tests were conducted only if the *E. coli* count of the concurrent sample was greater than 300 colony forming units per 100 milliliter (CFU/100mL) (although 750 CFU/100mL was preferred). Based on this approach, samples were taken at Mu5 (Munuscong River east of Pickford) and analyzed.

As reference, the proportion of human *Bacteroides* to total *Bacteroides* in untreated sewage from a major metropolitan area can range from 1 to 4%. The results are expressed in copy number (CN), which refers to the number of copies of the 16S Ribosomal Ribonucleic Acid (rRNA) gene that were detected. CN less than 100 is classified as background.

The tributary sample from the Munuscong River east of Pickford (Mu5) from 9/30/2010 was found to have high to moderate levels of human *Bacteroides.* (TMDL IP)

7.3.3 *E. coli* Monitoring in the Little Munuscong Watershed

The Little Munuscong Watershed includes two HUC-12 watersheds: the Little Munuscong River Headwaters (040700010104) and the Little Munuscong River (040700010105). (Figure 7.3) Monitoring site Lm1 is in the central part of the Little Munuscong River Headwaters Subwatershed, and monitoring site Lm2 is near the outlet of the Little Munuscong River Subwatershed. Land cover is similar in these subwatersheds, however there is more cropland and pasture, and less forest in the downstream subwatershed. Pastures occupy approximately 5% of the combined watersheds. Wooded buffers are common, but the northern headwaters of the Little Munuscong River watershed (HUC 040700010105) have substantial areas of pasture that lack wooded buffers.

Potential nonpoint sources of *E. coli* include failing, poorly designed or overflowing OSDS, illicit connections to surface water, runoff from active livestock pasture and the land-application of manure, manure stockpiling, livestock with direct access to streams or wetlands, wildlife and pets.

Some OSDS in the Little Munuscong River Watershed have been observed closer to streams than the 200-foot setback required by the Superior Environmental Health Code for lagoon systems, creating a higher potential risk of bacterial contamination of streams. (TMDL IP)

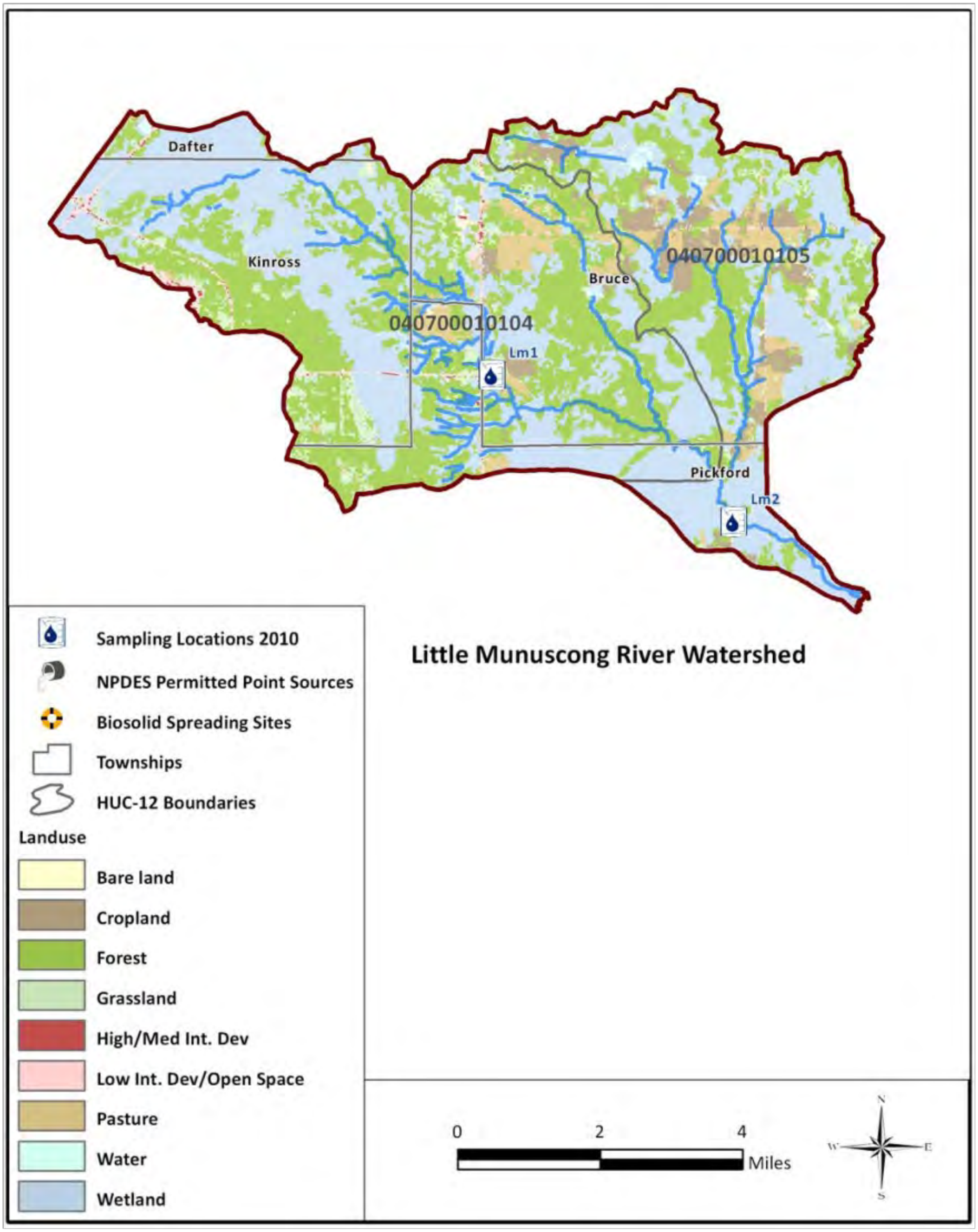


Figure 7.4 Little Munuscong River Watershed

Souce: (TMDL IP)

The load duration curves for Lm1 and Lm2 both show that exceedances of the total and partial body contact daily maximum WQS occurred most frequently during the lowest and highest flows. This indicates multiple sources of E. coli. Both sites are located very near OSDS lagoons, which may be worth inspecting to determine if they meet the Superior Environmental Health Code and are functioning properly. Higher flow bacteria loads may be driven by runoff carrying waste from livestock, wildlife and/or pets, and overflowing OSDS lagoons.

Horses were observed upstream of Lm1, and homes with dogs were observed near Lm2. Sites Lm1 and Lm2 had the 16th and 14th most frequent daily maximum WQS exceedances, respectively, out of the 21 sites in the TMDL watersheds monitored during 2010. The maximum daily geometric mean E. coli concentrations recorded in 2010 were 3,040 CFU/100 mL at Lm1 and 4,567 CFU/100 mL at Lm2.

Comparison of *E. coli* concentrations with daily precipitation shows that the highest concentrations in 2010 occurred both during rainfall events and during dry periods. It therefore appears that there are multiple bacteria sources that affect wet and dry weather. (TMDL IP)

7.3.4 *E. coli* Monitoring in the Munuscong River Watershed

The Munuscong River Watershed (Figure 7.4) is located approximately 25 miles south of Sault Ste. Marie. It occupies an area of nearly 120,000 acres and includes seven subwatersheds. The watershed is sparsely developed (4%), although it does include concentrated development at Pickford Township. Based on the 2010 U.S. Census, there is an estimated population of 11,068 persons occupying 3,565 housing units in the Munuscong River watershed. Of this population, an estimated 250 households are served by the Pickford WWSL, and an estimated 1,000 households are served by the Kinross WWTF. Thus, the estimated number of OSDS in the watershed is 2,300.

Forest and wetlands occupy 65% of the watershed, and pasture covers 19% of the watershed. *E. coli* samples were collected in 2010 from five locations, which all frequently exceeded the total and partial body contact daily maximum WQS. There are 10 permitted biosolids land applications sites originating from three waste water facilities: Kinross WWTP (MI0057776), St. Ignace WWTP (MI0020699), and Drummond Island Resort (MIG570215)

Potential non-point sources of *E. coli* include failing, poorly designed or overflowing OSDS, illicit connections to surface water, runoff from active livestock pasture and the land application of manure, manure stockpiling, livestock with direct access to streams or wetlands, wildlife, land application of biosolids, and pets.

Two NPDES permitted point source dischargers are located in the watershed: one WWSL and one industrial stormwater discharge. The Pickford WWSL is downstream of site Mu2 and approximately 2 miles upstream of site Mu3. (TMDL IP)

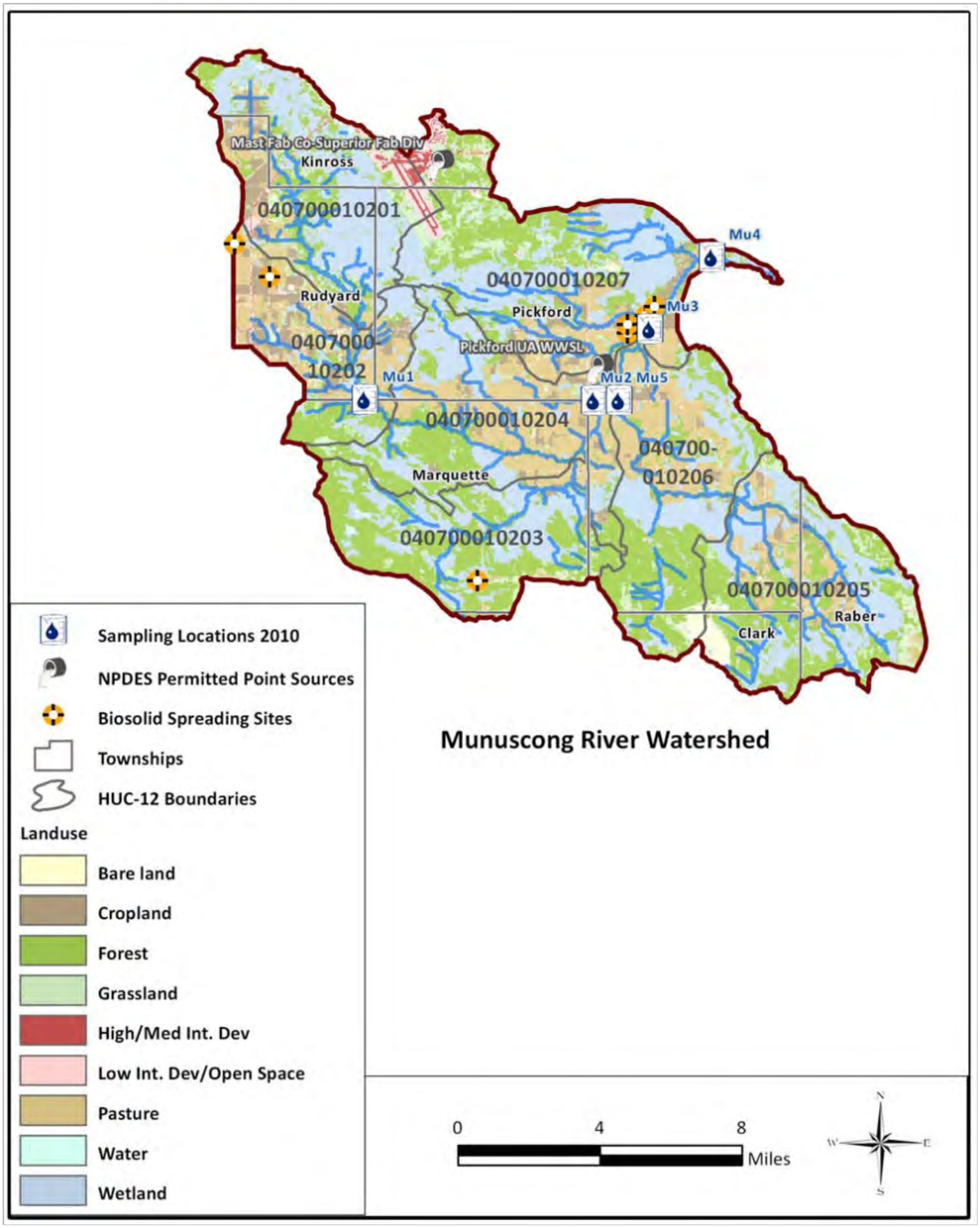


Figure 7.5 Munuscong River Watershed

Souce: (TMDL IP)

Monitoring site Mu1 is downstream of the Headwaters of the Munuscong River watershed (040700010201) and most of the Upper Munuscong River watershed (040700010202). The latter watershed includes two biosolids spreading sites for the St. Ignace WWTP. Compared to the entire Munuscong River Watershed, the Headwaters watershed has more development (8%) and less pasture (9%). The Upper Munuscong Watershed has little development (3%) but significant areas of cropland (21%) and pasture (33%). Wooded buffers are widespread in the Headwaters Watershed and less common in the heavily pastured Upper Munuscong Watershed (040700010202). The load duration curve for Mu1 indicates that the WQS are exceeded frequently for all but the lowest flows. This site had the 10th most frequent WQS exceedances of the 21 sites in the TMDL watersheds monitored in 2010, with a maximum daily geometric mean *E. coli* concentration of 18,396 CFU/100 mL.

The probable source of bacteria in wet weather runoff is livestock related, although pets, wildlife and biosolids land-application are other possible contributor. The highest *E. coli* concentrations at site Mu1 were recorded during higher flow conditions, indicating a significant wet weather source in the headwaters and upper Munuscong areas.

Monitoring site Mu2 is located in Pickford Township downstream of Mu1. In addition to the areas upstream of Mu1, the Taylor Creek and Middle Munuscong River subwatersheds (HUC 040700010203 and 040700010204, respectively) drain to Mu2. Three permitted biosolids spreading sites are located in the Taylor Creek Watershed near its southern divide; facilities producing these biosolids are the Kinross Township WWTP and the Drummond Island Resort. The Taylor Creek Watershed has very little development (1%), cropland (1%) or pasture (4%). In contrast, 35% of the Middle Munuscong River Watershed is pasture. Wooded buffers are common in the Taylor Creek Watershed and rare in the Middle Munuscong Watershed (040700010204). The load duration curve for Mu2 is very similar to that for Mu1, however WQS were more frequent at Mu2, which ranked 6th out of the 21 sites in terms of WQS exceedance frequency.

Additionally, exceedances of the daily maximum TBC water quality standard were much more common at low flows at site Mu2, indicating a constant source of *E. coli* contamination (such as livestock with direct stream access, illicit connections or failing OSDS). The maximum daily geometric mean *E. coli* concentration of 7,592 CFU/100 mL. Livestock, especially in the Middle Munuscong Watershed, and on-site waste water systems are the probable bacteria sources. It is possible that runoff from biosolids spreading sites also contributes to the bacteria load during wet weather. OSDS with lagoons are common in the watershed, and the failure of these systems is a probable source of bacteria during low flow and dry conditions.

Monitoring site Mu5 is located less than 1 mile east of Pickford on the East Branch of the Munuscong River. Two subwatersheds are upstream of Mu5: the Hannah Creek Watershed (HUC 040700010205) and the East Branch of the Munuscong River Watershed (HUC 040700010206), and these watersheds have significant pasture areas (14% and 27%, respectively). Significant portions of these pasture areas lack wooded buffers, especially in the East Branch subwatershed. Only 1% of these watersheds is developed, however numerous private OSDS are present near the creek less than 0.5 mile upstream of the monitoring location. (TMDL IP)

Monitoring site Mu5 had exceedances of both the total and partial body contact WQS in the full range of flow duration intervals. This site had the most frequent WQS exceedances of all of the 2010 monitoring sites, with a maximum daily geometric mean *E. coli* concentration of 14,930 CFU/100 mL.

The large areas of pasture without riparian buffers upstream of Mu5 suggests that the probable wet weather source is livestock related. Overflowing OSDS during heavy rains is also a potential wet weather bacteria source. Failing or poorly designed OSDS and illicit connections are the most likely source of bacteria at lower flows, and this is substantiated by the high proportion of human bacteria in the BST sample collected on September 30, 2010.

Monitoring sites Mu3 and Mu4 are located downstream of the three monitoring sites discussed above and are both in the Lower Munuscong River subwatershed (040700010207). A small upstream portion of this subwatershed drains to Mu3, and Mu4 is located near the watershed outlet and receives drainage from nearly the entire subwatershed. The Lower Munuscong River subwatershed has slightly more development (6%) than other portions of the Munuscong River Watershed, and it has 14 percent pasture. Many reaches in this watershed lack wooded buffers, especially in the southern half of the watershed. There are 5 permitted biosolids spreading sites in areas of the watershed that drain to each monitoring site: four for the Kinross WWTP and one for the Drummond Island Resort. The Munuscong Golf Club drains to Mu4, and many golf courses attract geese and other wildlife.

The load duration curve for Mu3 is similar to those for the monitoring sites discussed above and supports the same conclusion that livestock and private on-site waste water systems are the most probable bacteria sources. Site Mu3 had more frequent WQS exceedances than any site except Mu5, with a maximum daily geometric mean *E. coli* concentration of 10,255 CFU/100 mL.

Monitoring site Mu4 had fewer WQS exceedances, ranking 15th out of the 21 sites, with most exceedances occurring during mid-range to high flows. This indicates that OSDS may have less impact on this monitoring site than at the four upstream sites, although they remain a potential source. Wet-weather sources, such as run-off from livestock appear to be the major contributor of contamination to Mu4. The maximum daily geometric mean *E. coli* concentration at Mu4 in 2010 was 3,576 CFU/100 mL.

Comparison of *E. coli* concentrations with daily precipitation shows that the highest concentrations in 2010 occurred the day of or the day after rains of 1 inch or more, but that *E. coli* concentrations were typically well above the total body contact WQS during both wet and dry conditions. This indicates multiple bacteria sources. (TMDL IP)

7.3.5 Munuscong River Watershed Hydrologic Study

A Munuscong River watershed and Little Munuscong River watershed hydrologic study was conducted by the Hydrologic Studies and Dam Safety Unit (HSDSU) of the Michigan Department of Natural Resources and Environment (DNRE) to better understand the watersheds' hydrologic characteristics, to help determine the watersheds' critical areas and to provide a basis for stormwater management ordinances to protect streams from increased erosion. The study supported the NPS grant to the Chippewa Luce Mackinac Conservation District to establish the watershed management plan (Fongers 2011).

7.3.5.a Hydrologic Study Critical Areas/Recommendations

A number of critical areas were identified based solely on hydrologic criteria, including runoff volume per area and peak flow yield, contribution of the most runoff, the most hydrologically response, and changes in runoff volume per area/peak flow yield, between 1800 and 1978. For the watershed management plan, additional criteria should be used and these criteria may be modified (Fongers 2011).

The selection criteria used for this report are shown in Table 7.3. Percent imperviousness was not used, because all subbasins are less than ten percent. Runoff volume per area and peak flow yield, calculated from 1978 land cover, highlight those subbasins contributing the most runoff or are the most hydrologically responsive. Changes in runoff volume per area and peak flow yield, calculated from 1800 to 1978, highlight those subbasins that have experienced the most hydrologic change. The results are shown in Table 7.4. and Figure 7.3.

Condition	Standard	Score
Runoff Volume per Area 1978 Land Cover	• Less than 0.432 inches • 0.433 — 0.590 inches • 0.591— 0.770 inches • Over 0.770 inches	0 3 7 10
Runoff Volume Increase per Area, 1800 to 1978 Land Cover	• Less than 0.053 inches • 0.054 inches — 0.139 inches • 0.140 — 0.257 inches • Over 0.257 inches	0 3 7 10
Peak Flood Flow Yield 1978	• Less than 0.012 • 0.013 — 0.016 • 0.017— 0.033 • Over 0.033	0 3 7 10
Peak Flood Flow Yield Change 1800 to 1978	• Less than 45.9 percent • 46.0 — 96.7 percent • 96.8 — 217 percent • Over 217 percent	0 3 7 10

Table 7.3 – Critical Area Scoring

	Subbasin	Runoff Volume, 1978	Runoff Volume Change, 1800 to 1978	Peak Flow Yield, 1978	Peak Flow Yield Change, 1800 to 1978	Total Score
1	Munuscong River to mouth	10	10	7	0	27
2	Demoreux Creek to mouth	3	3	3	3	12
3	Munuscong River to Demoreux Creek	3	3	0	3	9
4	East Branch Munuscong River to mouth	7	7	7	7	28
5	Rapson Creek to mouth	0	0	3	3	6
6	East Branch Munuscong River to Rapson Creek	7	7	7	3	24
7	East Branch Munuscong River to below Hannah Creek	3	3	3	7	16
8	East Branch Munuscong River to South Reynolds Road	3	3	3	3	12
9	Fletcher Creek to Mouth	10	10	10	10	40
10	Munuscong River to Fletcher Creek	10	10	7	10	37
11	Taylor Creek to Mouth	3	0	3	3	9
12	Taylor Creek to Three Mile Road	0	0	0	0	0
13	Munuscong River to Taylor Creek	7	7	3	7	24
14	Munuscong River to Rutledge Road	7	3	3	7	20
15	Munuscong River to Unnamed Tributary	10	10	3	7	30
16	Tributary to Munuscong River to M-48	7	7	0	3	17
17	Tributary to Munuscong River to below unnamed tributary	3	3	7	3	16
18	Little Munuscong River to mouth	3	0	0	0	3
19	School Creek to mouth	7	3	3	3	16
20	Tributary to Little Munuscong River to School Creek	0	0	0	0	0
21	Tributary to Little Munuscong River to mouth	3	3	7	3	16
22	Little Munuscong River to Sixteen Mile Road	0	0	0	0	0

Table 7.4 – Subbasin Critical Area Scores (total scores highlighted with colors).

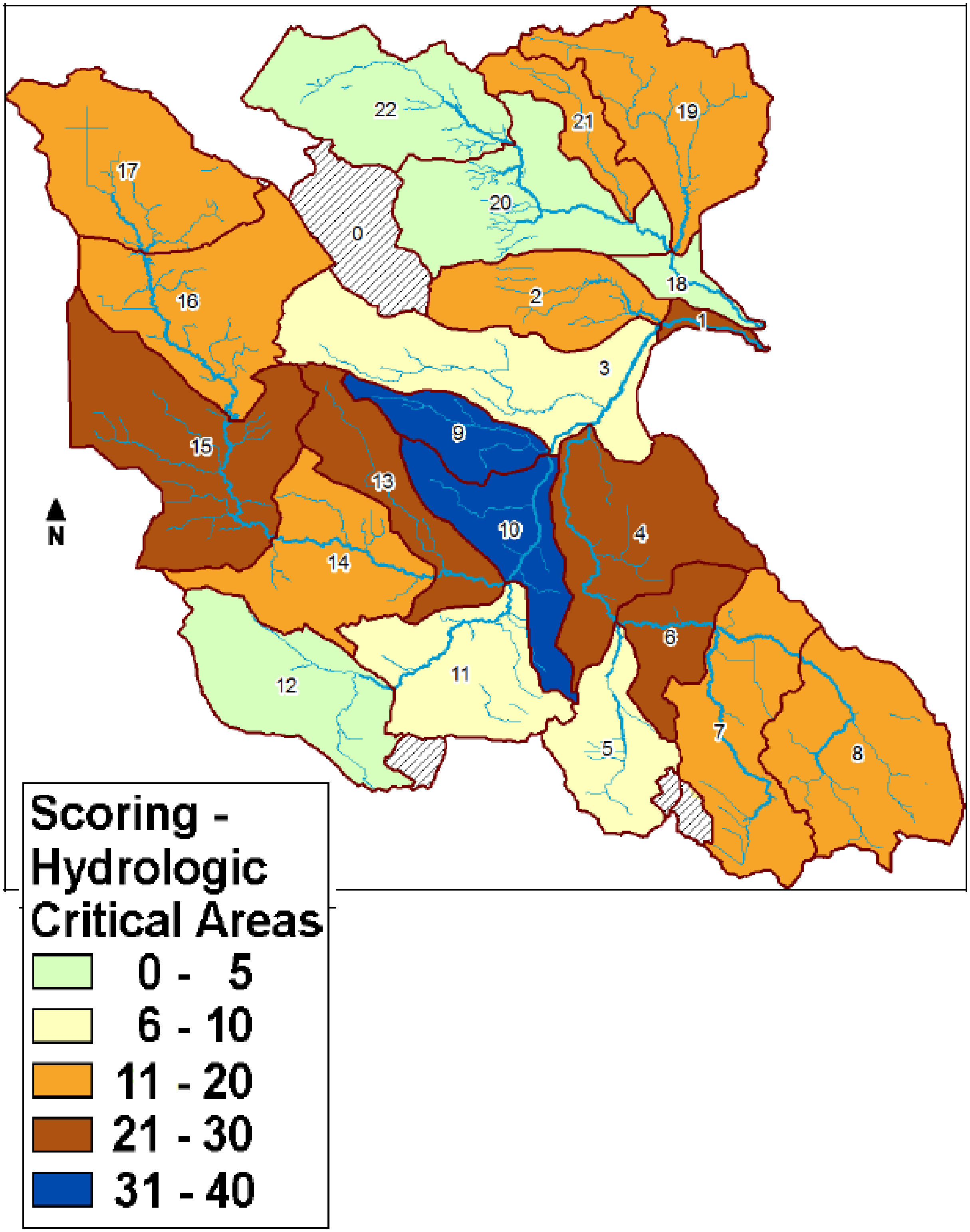


Figure 7.6 Hydrologic Critical Areas

7.4 Individual Water Body Assessment

7.4.1 Munuscong River

The Munuscong River is a 5^{th} order stream in the lower portions of the river after the confluence of the East Branch Munuscong River. Above that point it is a 4^{th} order stream. The Munuscong River flows into Munuscong Bay/Lake which is a bay within the St. Mary's River.

The summer stream temperature is considered warm for its entire length. The designated use of Total and Partial Body Contact Recreation are not supported due to *E. coli ,* and the designated uses of Other Indigenous Aquatic Life and Wildlife and Fish Consumption are not supporting due to Mercury in the water column.

The road stream crossing inventory, agriculture inventory, and state biological surveys of the river have concluded that there is a lack of habitat for macroinvertebrates; and, stream banks are void of vegetation and large woody debris well above the waterline. Issues with sedimentation and erosion are of concern, as well, with over 20 sites of erosion and five road stream crossings with structural problems.

Agricultural livestock operations are of special concern due to the common practice of locating spring and fall feeding operations near water bodies. The watershed's impermeable soils restrict infiltration of increased precipitation, coupled with riparian area sod destruction by concentrated livestock.

MDEQ's Hydrology Study determined that several subbasins along the mainstream are critical areas, exhibiting increased peak flow yield and runoff volume from 1800 to 1978 due in part to wetland alterations, along with the ditching of converted agricultural land for accelerated drainage. (see Hydrology Study table 7.3 and map 7.3)

7.4.2 Demoreux Creek

Demoreux Creek is a mostly a 3^{rd} order, designated trout stream. The creek flows through the small residential area known as Keldon. The Total and Partial Body Contact Recreational use is not supporting within the creek due to *E. coli*.

The watershed historically supported several cattle operations, though now hay production is the dominant land use. Consequently, *E. coli* sources may be residential. Comprehensive testing and evaluation of individual homes needs to be done. During inventorying it was found that there are two road stream sites causing significant erosion and having structural issues.

7.4.3 Parker Creek

Parker Creek is a 2nd order, designated trout stream of the Munuscong River. The designated uses of Total and Partial Body Contact Recreation, and Other Indigenous Aquatic Life and Wildlife are not supporting. The body contact recreation uses aren't being met due to *E. coli.* In addition, the aquatic life and wildlife use isn't being met due to sedimentation/siltation.

The headwaters of Parker Creek are mainly abandoned agricultural fields. The lower portion of Parker Creek has been highly modified due to the development of the land into a golf course and active farm operations on the adjacent lands. The land has been highly drained and ditched to increase the drainage of the adjacent lands for its desired use as a golf course and the typical furrows seen in the region for hay production. This has lead to the instability of stream banks, the lack of an active flood plain, incising of the stream channel, and lack of in stream habitat.

There are also three road stream crossings that are of concern within the watershed with structural or erosion problems.

7.4.4 Fletcher Creek (South) (Sanderson Creek)

This more southerly Fletcher Creek within this plan is known as Fletcher Creek South (a.k.a Sanderson Creek) due to a Fletcher Creek to the north, which is a tributary of the Little Munuscong River Watershed. This stream is a mostly a 2^{nd} order stream and one of several designated trout streams within the Munuscong River Watershed.

The designated uses of Total and Partial Body Contact Recreation are not being supported due to elevated *E. coli* levels. This stream runs through highly agricultural land. Through the local inventories there were four road stream crossing sites that have structural or erosion problems. Based on MDEQ's hydrolog analysis, Fletcher Creek's hydrology has been severely altered over the course of 178 years (1800 to 1978). Peak flow yield and runoff volume has increased dramatically over time. MDEQ's hydrological analysis lists alteration and loss of drainage-stabilizing wetlands as a primary cause.

7.4.5 Taylor Creek

Taylor Creek is a 3^{rd} order trout stream tributary to the Munuscong River. The designated uses of Total and Partial Body Contact Recreation are not being supported due to *E. coli* levels. Taylor Creek runs through a combination of forested land and agricultural operations, including one of the largest dairy operations in the region. Livestock grazing operations are having a significant influence on the creek. There is also approximately 6,500 linear feet of livestock access, causing 920 tons/year streambank erosion.

Within the agricultural operations on the stream there are issues with drop structures that are failing along with streambank erosion. Drop structures are designed to increase field drainage by funneling field drainage to the structure and dropping it through a pipe to a river. The farm operators are in the process of designing and replacing the structures with the aid of the Natural Resources Conservation Service (NRCS).

7.4.6 Fletcher Creek

Fletcher Creek is a small, 3rd order tributary to the Little Munuscong River. The Total and Partial Body Contact Recreation designated uses are not being met.

During the course of this project the creek was sampled for *E. coli* and results showed some elevated levels of *E. coli* but assessment was limited in amount of samples taken. This creek should be monitored more to determine if it is meeting the designated uses.

7.4.7 East Branch Munuscong River

East Branch Munuscong River is a 4th order, cool water tributary to the Munuscong River. The designated use of Total and Partial Body Contact Recreation are not being supported due to *E. coli*. State biological assessments determined that sites were meeting designated, but noted that macroinvertebrate and habitat ratings were on the lower end of acceptable, due in part to cattle access to the stream.

Local inventories found roughly 20 sites of road stream crossing sedimentation and structural issues, stream bank erosion, cattle access, heavy use areas, and areas with a lack of buffers on the stream edge. Local concern is that land use practices are threatening the designated uses within the watershed and without a change in practices further degradation will occur causing further impairments.

Within the headwaters of the river, segments have been channelized into the road ditches instead of allowing it to flow freely through the forested wetlands. MDEQ's Hydrology Study also determined the lower reaches to be critical areas due to significant changes in runoff volume and peak flow yields from 1800 to 1978.

7.4.8 Hannah Creek

Hannah Creek is a 3rd order stream and a cool water tributary to the East Branch Munuscong River. Hannah Creek starts as the headwaters of the East Branch Munuscong River and has retained 62% of wetlands. Total and Partial Body Contact Recreation are not supported due to *E. coli* levels within the stream.

Hannah Creek has had limited amount of state assessment for determination of the status of designated uses being met. However, local inventories found several livestock operations along the creek, possibly contributing to elevated E. coli levels. There is also cause for concern, hydrologically, as MDEQ's Hydrology Study determined that peak flow yield changed considerably from 1800 to 1978.

7.4.9 Little Munuscong River

The Little Munuscong River Watershed is completely separate from the Munuscong River watershed flowing in the Munuscong Bay/Lake just north of the Munuscong River. Though for this study the Little Munuscong River Watershed was combined with the Munuscong River Watershed due to similarities and being adjacent with each other. The Little Munuscong River is a cool water summer temperature river with the lower segment being a 4th order stream.

The middle segment is designated as a trout stream. The Total and Partial Body Contact Recreation designated uses are not being supported due to elevated *E. coli* levels.

Portions of the river have been redirected due to M-129, which may explain MDEQ's Hydrology Study peak flow yield numbers to be high. Over the course of the redirection the river has been able to regain some meander and natural flow and the old sections have remained as ponds and wetlands. There wasn't significant change in peak flow yield or runoff volume from 1800 to 1978, which may illustrate that natural restoration. There are two road stream crossings that have structural problems and six sites of stream bank erosion that were inventoried during the project.

7.4.10 School Creek

School Creek is a tributary to the Little Munuscong River as a cool summer stream temperature system. The lower portion of the creek is 3rd order with a couple tributaries of equal length as 2nd order streams. This creek is roughly 35% agricultural land within the watershed and 60% natural upland area.

The Total and Partial Body Contact Recreation designated uses are not being supported due to *E. coli* levels. Throughout the project inventories found sites of erosion, cattle access to the creek, and old dumping sites.

One site of high concern is directly downstream of 18 Mile Road. Work has been done on trying to stabilize the road edges with little success, allowing a lot of material to be washed into the stream and alter the flow of the creek and increasing streambank erosion at the site. In addition, MDEQ's Hydrology Study found that School Creek's runoff volume was considerable using 1978 land cover.

7.4.11 Rapson Creek

Rapson Creek is a 3rd order stream and a tributary to the East Branch Munuscong River. It is one of two cold water streams within the Munuscong River Watershed and one of several designated trout streams.

The designated uses of Total and Partial Body Contact Recreation are not being supported by being combined with a portion of the East Branch Munuscon River.

This stream has a limited amount of access to the stream. With a portion of the land owned by Northwood's Christian Camp and private property owners the majority of the Rapson Creek Watershed is forested with one farm operation near the mouth of the creek. The stream is damned historically from a logging operation that is now maintained to create a small lake/ large pond within the camp that is used for canoeing, swimming, and other activities.

Chapter 8 Prioritization - Areas, Pollutants, Sources

Priority areas were identified in the watershed based on lands that are contributing, or have the potential to contribute, a majority of the pollutants impacting water quality. By identifying priority areas, implementation can be targeted to the places where the most benefit can be achieved. Three different types of areas were prioritized in the Munuscong River watershed: a) rural management, b) urban management, and c) public lands. Pollutants and sources of pollutants were also prioritized for each of the three areas.

8.1 Rural Management Areas

The prioritization of rural management areas is based on significant water body impairments, land cover type, and problems identified through the inventory process, local concerns, and MDEQ staff. The Munuscong River watershed is prioritized into three categories for rural management as shown in Figure 8.1.

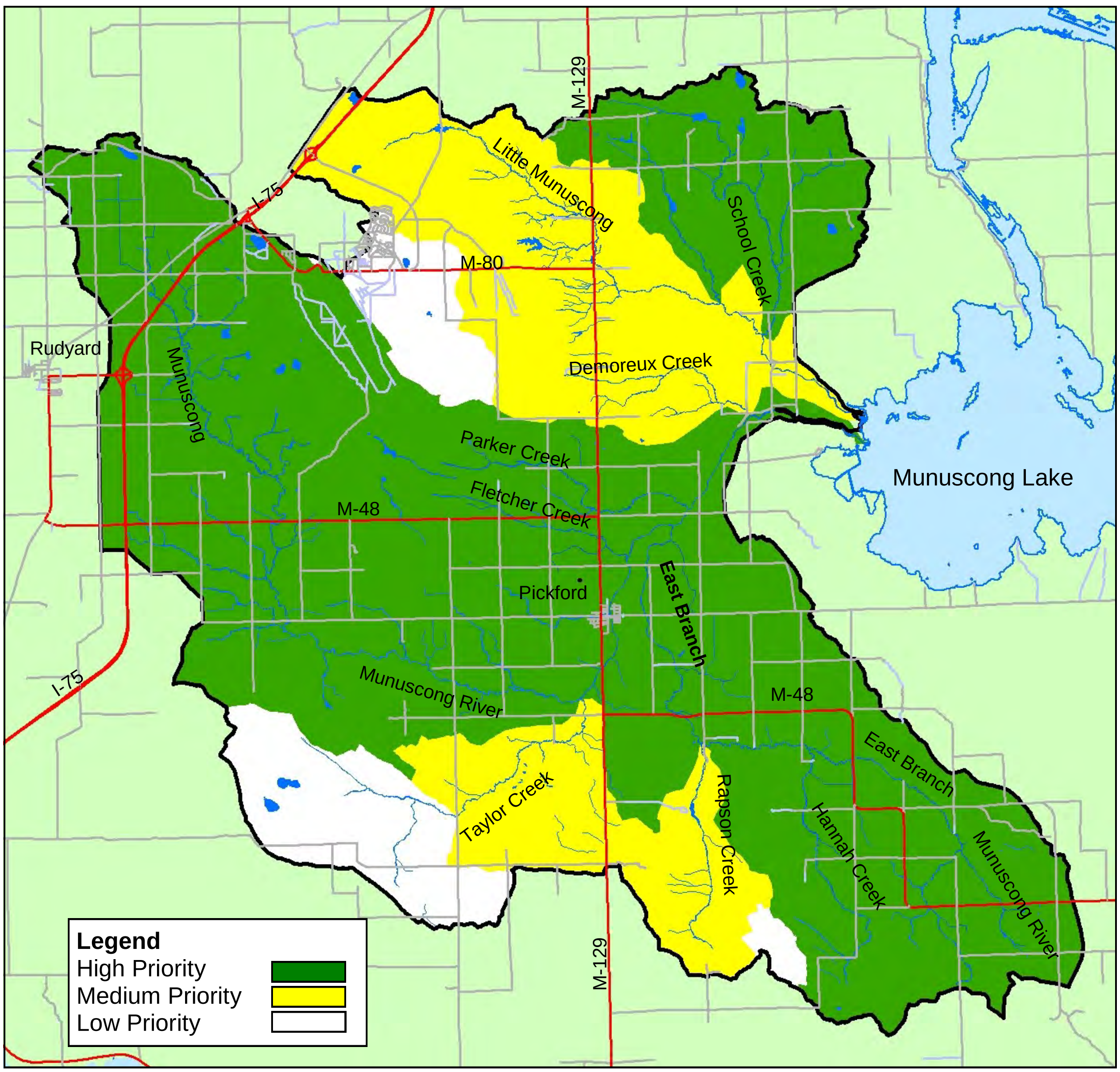


Figure 8.1 Rural Management Areas

The high priority rural management areas are the Munuscong River, East Branch Munuscong River, Parker Creek, and South Fletcher Creek subwatersheds. High priority status was given to these sub-watersheds because each one is not supporting at least one State designated use (MDEQ 2011 Integrated Report), all were critical areas with significant hydrological change according to MDEQ (2011 Hydrological Study), and all have high potential for wetland restoration as determined in MDEQ's Landscape Level Wetland Functional Assessment.

The medium priority rural management area generally covers those subwatersheds that still don't support at least one State designated use, but they contain less high potential wetland acreage, and they have experienced less hydrological change. Nonetheless, all these designations are at a landscape scale; consequently, there may be sites in each priority level that need immediate attention or can be delayed due to extenuating circumstances.

In the rural management areas, the prioritization of pollutants and sources is based on their suspected significance to impaired water quality in these areas.

In the rural management areas, the pollutants are prioritized as follows:

1. **Bacteria and pathogens** are highest priority because of its prevalence throughout the subwatershed and its impact on total and partial body contact recreation designated use. A TMDL Implementation Plan has been developed due to extremely high Escherichia coli (*E. coli*) levels.

2. **Sediment** is a known pollutant throughout the watershed, especially in the Parker Creek sub watershed. Predominate clay soils in this subwatershed are easily erodible from spring and fall plowed fields, livestock concentration areas, poorly designed and maintained gravel road crossings, and the Munuscong Municipal Golf Course. Next priority is given to this pollutant specifically for Parker Creek, since the creek is listed on MDEQ's integrated report as not attaining the other indigenous aquatic life and wildlife designated use.

3. **Peak Flow Yield and Runoff Volume** have increased significantly in several watersheds, which is manifested in increased river, stream, and creek "flashiness" over the last century according to MDEQ's Hydrology Study, warranting the next priority. This flashiness has the potential to impact channel morphology by destabilizing streambanks causing erosion.

4. **Temperature** is a concern in rural management areas because the removal of tree cover along coldwater streams and drains can lead to increased water temperature. Temperature is also impacted by altered hydrology from increased drainage efficiency, channelization, and soil compaction, because groundwater recharge is reduced.

5. **Nutrients** are a suspected pollutant in all of the rural management areas.

In the rural management areas, the pollutant sources are prioritized as follows:

1. **Livestock –** Highest priority concern is livestock access to surface water and concentrated feeding activity near surface water, resulting in poor manure and nutrient management and significant bacteria, sediment, and nutrient pollution. Wet weather runoff carrying livestock waste from pastures is a probable bacteria source in many watersheds, especially where fencing or vegetated buffers are lacking. Additionally, water testing in dry weather conditions with low water flows demonstrated exceedances of the daily maximum total body contact water quality standard indicating a constant source of *E. coli* contamination in areas where livestock have direct stream access.

2. **Septage waste –** OSDS appear to be a significant source of bacteria in the Little Munuscong River and Munuscong River Watersheds. The TMDL Implementation Plan of 2012 estimates that there are approximately 2,300 OSDS absorption systems in the Big Munuscong River watershed and 1,022 systems in the Little Munuscong River watershed. Although the population density is low, many of these systems are located near creeks and in soils not suited for standard OSDS adsorption systems which direct wastewater into the ground for further treatment. These poorly drained soils do not allow the downward percolation which provides both filtration and time for natural processes to treat the waste. These poorly functioning OSDS systems can be high and low flow contributors to the streams and creeks due their year around usage.

   Illicit connection of private waste water plumbing directly to surface water is another possible route for bacteria. Due to a predominance of soils poorly-suited for traditional OSDS adsorption fields, lagoons are frequently used as an alternative. OSDS lagoons function in place of an adsorption field, and are designed to allow evaporation and solar disinfection of liquid waste (TMDL 2012).

3. **Altered Hydrology** - Manipulation of wetlands, riparian areas, and forests has accelerated drainage of precipitation over the past 150 years, causing a negative change in hydrology, water temperature, and erosion.

4. **Stormwater runoff -** Unmanaged runoff from agricultural lands can carry sediment, nutrients, bacteria and pathogens directly to surface water.

8.2 Urban/Residential Management Areas

The prioritization of urban management areas is based on significant water body impairments, amount of urban land cover and problems identified through the inventory process, local concerns, and MDEQ staff. The MRW is prioritized into three categories for urban management — low, medium and high priority — as shown in Figure 8.2.

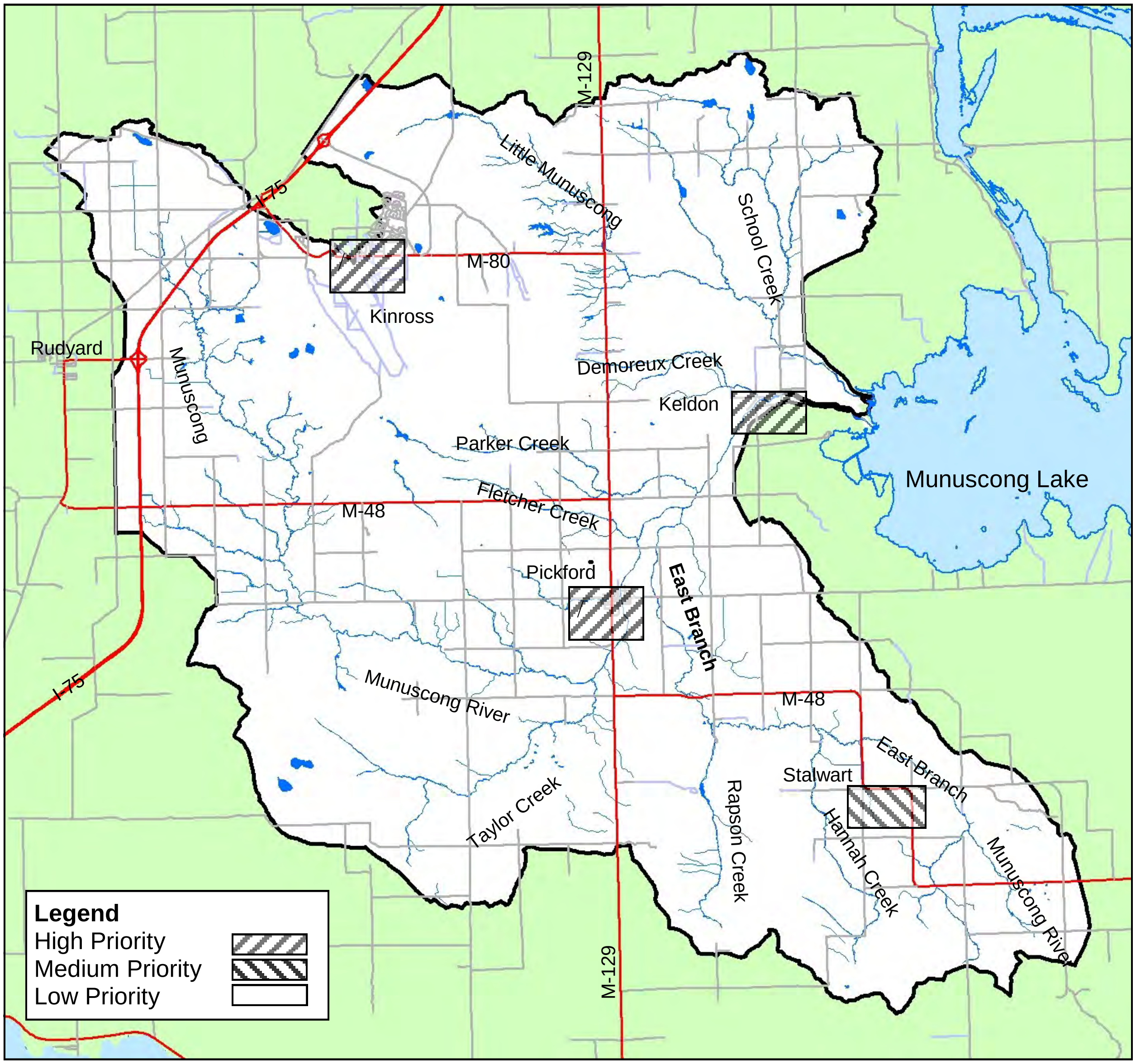


Figure 8.2 Urban Management Areas

The high priority urban management areas are within the areas known as Keldon and the town of Pickford. These areas have experienced the most human-induced perturbations to land cover and land use. In addition, human wastewater is collected and treated in municipal sanitary sewer systems in Pickford Township and Kinross Township. Other areas are served by private, on-site sanitary disposal systems (OSDS). Priority OSDS are located within 500' of surface water and are used to provide treatment of sanitary wastewater when a building is not connected to sanitary sewers.

Standard OSDS treat sewage by settling out solids, and allowing liquid waste to percolate downward in an adsorption field. This downward percolation provides both filtration and time for natural processes to treat the waste. Due to a predominance of soils poorly-suited for traditional OSDS adsorption fields, lagoons are frequently used as an alternative. OSDS lagoons function in place of an adsorption field, and are designed to allow evaporation and solar disinfection of liquid waste. In addition, wetlands in this area have been significantly altered to accommodate urban development, thus severely impacting hydrology, wildlife habitat, and pollution retention. Included in the high priority is the road infrastructure within the watershed.

Medium priority areas include the altered wetlands, new construction sites as they develop, and the area known as Stalwart. The high and medium priority areas are suspected to contain a majority of the urban related pollutant sources impairing or threatening water quality in the MRW. The remainder of the watershed is in a lower priority level for urban management efforts. However, since these designations are at a landscape scale, there may be places in the lower priority area that need attention to improve water quality in the watershed.

8.2.1 Urban Management Area Pollutants and Sources

In the urban management areas the prioritization of pollutants and sources is based on their suspected significance to impaired water quality in these areas.

In the urban management areas, the pollutants are prioritized as follows:

1. **Bacteria and pathogens** are known to be a problem within the watershed with elevated levels of *E. coli* with a TMDL scheduled for development for the watershed.
2. **Increased runoff volume and peak flow yield** have increased significantly in the area encompassing Pickford, the most urbanized watershed. MDEQ study documented increased river, stream, and creek "flashiness" over the last century.
3. **Temperature** is a concern as vegetation removal eliminates riparian shade. Increasing pavement and other impervious infrastructure exacerbates problems.
4. **Nutrients** are a suspected pollutant in urban storm water runoff
5. **Sediment** is a suspected pollutant from developed and construction areas, eroding stream banks, and road/stream crossings.

In the urban management areas, the pollutant sources are prioritized as follows:

1. **Septage waste**—Residential housing within the watershed is typically serviced by outdated and mismanaged septic systems. The TMDL Implementation plan estimates that there are 11,068 persons occupying 3,565 housing units in the Munuscong River watershed. Of this population, an estimated 250 households are served by the Pickford WWSL, and an estimated 1,000 households are served by the Kinross WWTF. Thus, the estimated number of OSDS in the watershed is 2,300. (TMDL IP)

   Two NPDES permitted point source dischargers are located in the watershed: one WWSL and one industrial stormwater discharge. Note that the outfall of the Kinross WWTF, which serves part of the Munuscong River watershed population, is located in the Waishkey River watershed.

Two reported SSOs for the Kinross WWTF occurred in 2005 and 2006. The 2005 event discharged 100 gallons of diluted raw sewage to a street in the Munuscong River Watershed due to a sewer pipe blockage. The 2006 event occurred at a secondary filter at the WWTF located in the Waishkey River Watershed. Two SSOs have been reported for the Pickford WWSL. The 2007 event was caused by a sanitary sewer break and discharged 1500 gallons of raw sewage to a ravine near a private residence. The 2008 event was caused by snowmelt that overwhelmed the system capacity and discharge 1200 gallons of diluted raw sewage to the Munuscong River. (TMDL IP)

2. **Stormwater runoff**—A majority of pollutants impairing or threatening designated uses in urban areas are found in storm water runoff, which largely results from impervious surfaces. Historically, much of the urban areas were wetlands, which detained and provided for indirect treatment of stormwater. Now, urban storm water carrying bacteria from pets, urban wildlife (including waterfowl) is a probable source of bacteria in urban watersheds during frequent, small runoff events that flush pollutants from impervious surfaces and from storm sewers. Probable dry and wet weather bacteria sources in urban areas are illicit connections of sanitary sewers to storm sewers and there is the potential for leaking sanitary sewer pipes. During wet weather, storm water may flush accumulated sanitary wastewater from illicit connections from storm sewers into surface water. NPDES discharges are considered a potential source of *E. coli* to surface waters; however, provisions and limitations contained within the permits are designed to achieve the WQS in the receiving water. If a permittee is in compliance with their permit, the contribution of E. coli to surface water is unlikely to cause an exceedance of the TBC or PBC WQS.

3. **Altered Hydrology**—Impervious surfaces and manipulation of wetlands in urban areas accelerate drainage, causing stream bank erosion, increased stream water temperature, and increased runoff volumes and peak flows.

4. **Road crossing structures** that are failing or improperly designed/installed cause in-stream changes in hydrology and erosion.

8.3 Public Land Management Areas

Public Lands Management Areas constitute those acres owned by the State of Michigan, the Federal Government, and various land conservancies. These areas are typically forested, protected from development, and remain in long term trust for the public's enjoyment. There is very little threat of human-influenced natural resource degradation, other than recreational activity. Nonetheless, the public utilizes these protection areas for their significant amount of natural land cover (habitat), intact wetland functions, and high quality water bodies. Therefore, the managing agencies should maintain the integrity of the natural resources through proactive land use planning and enforcement.

The Munuscong River Watershed public lands areas are prioritized into two categories (high priority and low priority) as shown in Figure 8.3.

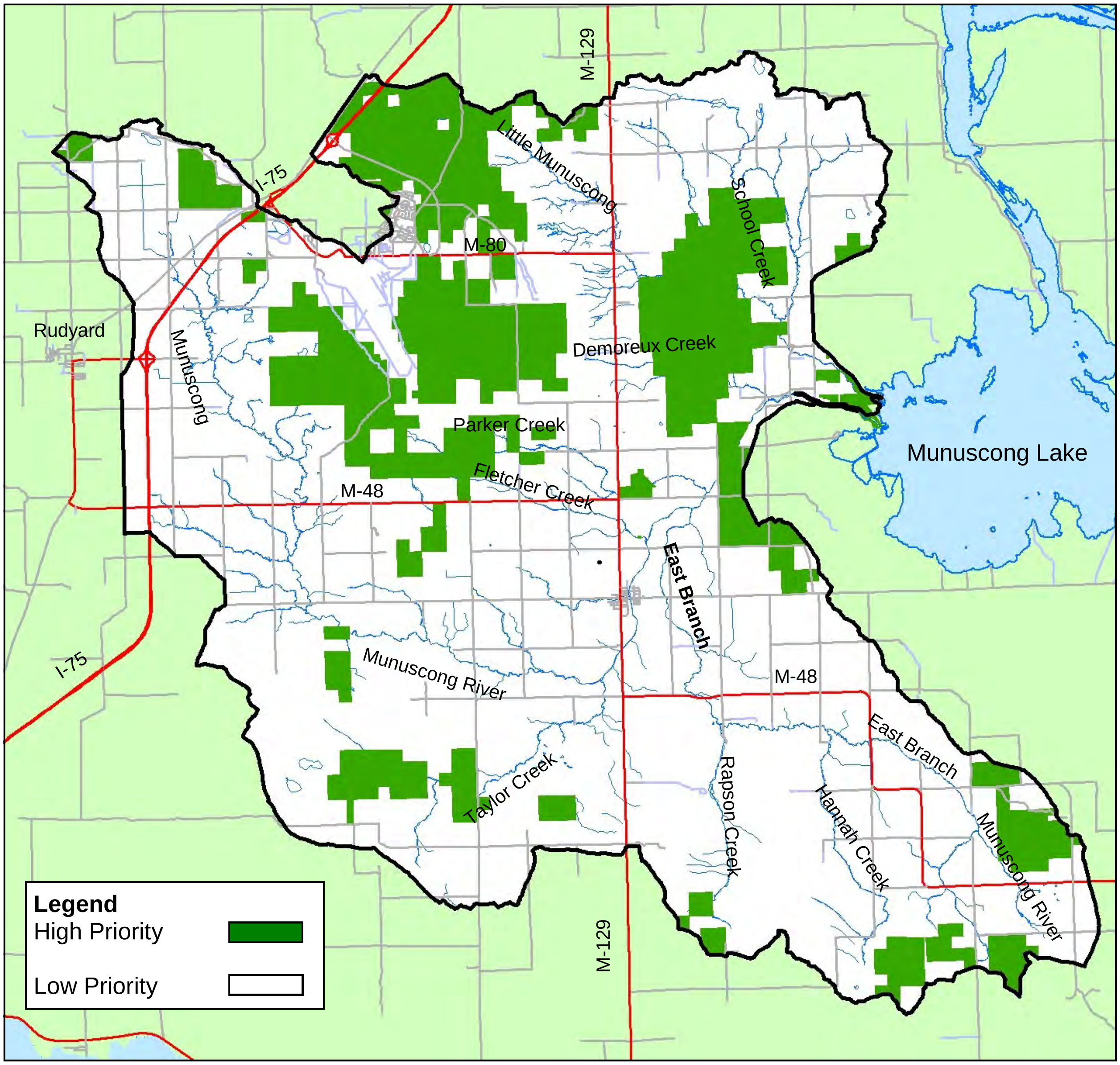


Figure 8.3 Public Land Management Areas

High priority public land areas are generally not sustaining various designated uses. These include the Little Munuscong River Watershed, the Munuscong River mouth upstream about two miles, Taylor Creek, Rapson Creek, and Hannah Creek. If not managed properly, the high priority areas have the potential to contribute pollutants, as well as disrupt hydrological patterns in the watershed.

The remainder of the watershed is lower in priority for protection efforts, but since these designations are at a landscape level, specific sites in the lower priority area may need just as much attention as the high priority areas for maintaining long-term water quality in the watershed.

8.3.1 Public Land Management Area Pollutants and Pollutant Sources

In the public land areas, the pollutants are prioritized as follows:

1. **Sediment** is a concern in public land areas. Inappropriate recreational activity, including but not limited to off road vehicles within 500’ of surface water, poses a threat of erosion and sedimentation to area water bodies.
2. **Peak Flow Yield and Runoff Volume** have increased significantly in several adjacent watersheds, which is manifested in increased river, stream, and creek “flashiness” over the last century according to MDEQ’s Hydrology Study.
3. **Bacteria and pathogens** are currently a known problem within the watershed.
4. **Nutrients** are currently a concern around lakes and urban areas. Nutrients are often attached to sediment.
5. **Temperature** is a concern because some coldwater streams are located on public land areas. Recreational removal of riparian buffers could cause the temperature of protection area streams to increase. Increased temperature could limit their ability to support coldwater fish.

In the public land areas, the pollutant sources are prioritized as follows:

1. **Recreational Use** – Vacationers, hunters, fisherman, etc. use public land areas and threaten impacts through activity within 500’ of surface waters, including concentrated foot traffic, ORV use, tree removal, etc.
2. **Altered Hydrology**—Manipulation of wetlands, riparian areas, and forests by pubic land managers to improve recreational use can accelerate drainage of precipitation, causing a negative change in hydrology, water temperature, and erosion. Increasing artificial drainage in any of these areas could alter hydrology and increase several of the aforementioned pollutants.
3. **Storm Water Runoff** – Several priority pollutants could be delivered to public land area water bodies by storm water runoff if improper drainage management, vegetation removal, and/or unregulated riparian activity increases in public land areas.

8.4 Problem Sites

Along with the priority areas, the inventories identified problem sites during the planning process that need attention. These sites included erosion sites, channelization, road stream crossing structural issues, direct livestock access to streams, and residential sites close to surface water (suspected of having failing on-site septic systems (OSS)). Specific problem sites (livestock, erosion, lack of buffer, road and stream, channelized, dump sites, and exposed sites) are identified in Figure 8.4 with more descriptions of sites within Appendix E. Figure 8.5 displays the critical areas of concern for on-site septic system failure due to unsuitable soils.

At the livestock access problem sites, the stream banks are eroding and most likely nutrients and bacteria/pathogens are entering the water bodies. Not all road stream crossing are directly causing erosion, but may be disrupting the natural flow regime having adverse affects surrounding the crossing.

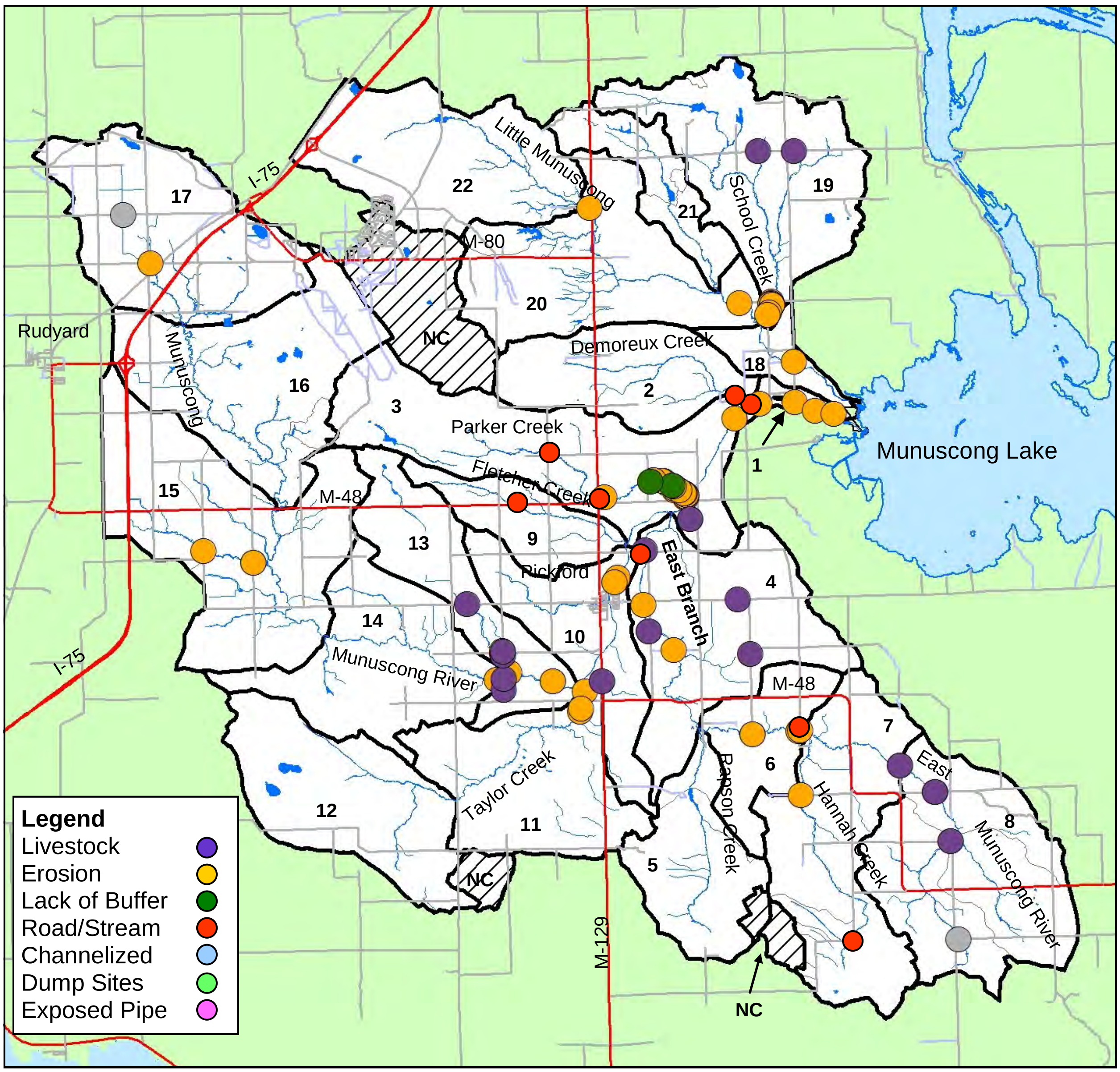


Figure 8.4 Problem Sites

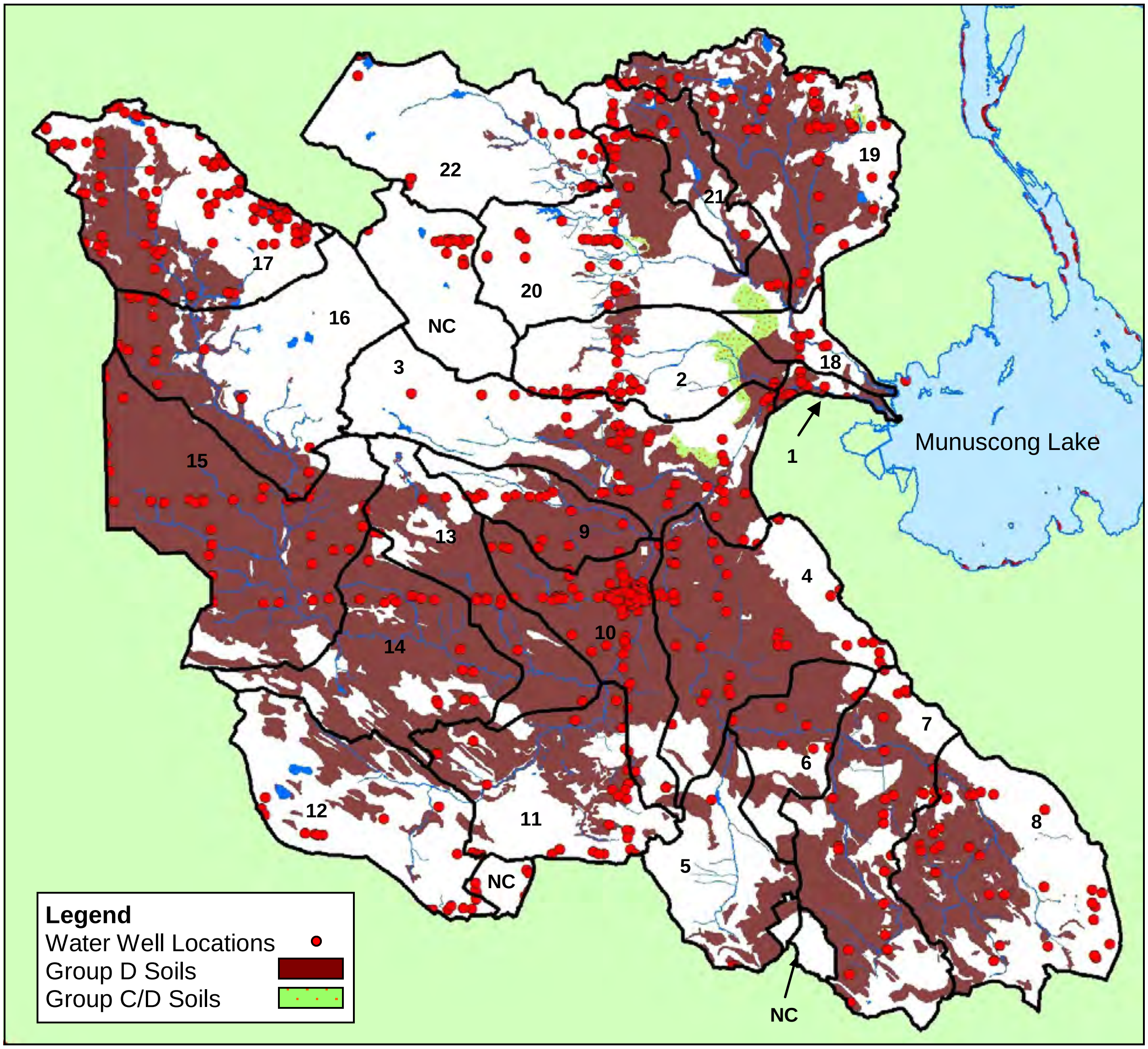


Figure 8.5 Soils Not Suitable for Traditional On-Site Septic Systems

Soils in the hydrologic soils group D and C/D have very slow infiltration rates and are considered not suitable for traditional septic tank and drainfield treatment systems. These poorly drained soils do not allow the downward percolation which provides both filtration and time for natural processes to treat the waste.

As explained earlier in this management plan, most of the shaded areas in Figure 8.5 were once wetlands that have been drained for residential and agricultural use. As demonstrated by the well water locations, this is also the area where most of the residential development has concentrated. Many of these rural residential locations have out-dated septic systems that are located near creeks and streams. These potential poorly functioning septic systems can be high and low flow contributors of bacteria and pathogens to the streams and creeks due their year around usage. Residential housing units in this critical area of concern will be the target of an extensive educational program described in the implementation and information and education strategies in Chapter 10 of this plan.

8.5 Pollutant/Source Reduction Targets

Measuring parameters to evaluate progress toward a goal requires the establishment of targets or evaluation criteria against which observed measurements are compared. These targets are not necessarily goals themselves, because some of them may not be realistically obtainable. However, the targets do define whether water quality standards, as set forth by the State of Michigan, are being achieved. The standards are scientifically-supported numbers that suggest measurements for achieving water quality, quantity, and biological parameters to support state designated uses such as partial or total body contact, and fisheries and wildlife. Using these scientifically based targets as targets for success will assist the watershed in deciding how to improve programs to reach both restoration and preservation goals and know when these goals have been achieved. These targets are listed in Table 8.1.

Priority Pollution/Source Summary			
Pollution Sites/Sources	# of Sites	Pollutant Load	Target Pollutant Load
Bacteria and Pathogens	• 10 sites not meeting State Designated Use for Full/ Partial Body Contact • Residential establishments within 500 feet of surface waters	Exceeds 300 cfu e. coli/100mL 4567 cfu/100 mL (LM) 3576 cfu/100 mL (M)	All sites meet designated uses < 300 cfu/100 mL (4267 cfu/100 mL reduction LM 93%) (3267 cfu/100 mL reduction M 92%)
Agricultural (Rural) Sites	75	3,530 tons sediment 8,109 nitrogen 4,055 phosphorus	25% reduction sediment, nitrogen, phosphorus
Road/Stream Crossings	8	53 tons sediment	25% reduction in sediment
Hydrology Alteration	7 sites with hydrological critical area scores > 24 (Fongers 2011)	Runoff Vol. >.77” Increase >.257” Peak Flow yield >.033” Increase>217%	Runoff Vol<.1285” Increase <.012 (2015) Peak Flow Yield <.012 Increase <45.9%

Table 8.1 Pollutant/Source Reduction Targets

Chapter 9 Goals and Objectives

Successful implementation of a watershed management plan is more likely to occur when the objectives are based on clearly defined goals. Goals can represent a long term vision and also serve as guideposts established to keep everyone moving in the same direction and assess progress. Objectives are more specific actions that need to occur to achieve the stated goal. The goals and objectives for the MRW address both water quality concerns and desired uses.

9.1 Goals for Designated Uses

The following two goals are related to restoring and protecting the designated uses of water bodies in the MRW. Objectives for these goals are listed in the Action Plan (Table 10.1 in Chapter 10) as tasks to be implemented.

1. Reduce pollutants threatening or impairing water quality in agricultural and urban management areas to meet designated uses.
2. Prevent or reduce pollutants threatening or impairing water quality by sufficiently preserving or managing protection areas to meet designated uses.

9.2 Goals for Desired Uses

In addition to the Designated Uses established by state and federal water quality programs, stakeholders identified several Desired Uses for the MRW. Desired uses are based on factors important to the watershed community. Desired uses may or may not have a direct impact on water quality. Table 9.1 lists the Desired Uses identified through the Munuscong River Watershed Social Survey (Appendix F), public meetings, and personal discussions with watershed stakeholders. The desired uses listed in Table 9.1 have a direct or indirect impact on water quality.

MRW Desired Use	**General Definition**
Groundwater resource protection	Protect groundwater recharge and aquifers from contamination and over drafting.
Intact habitat for native aquatic and terrestrial wildlife	Protect and enhance the habitats on which indigenous, threatened, and endangered species depend.
Operation of agricultural land	Maintain agricultural heritage of the area, but with the use of BMPs to protect natural features and water quality
Appropriate recreational use and infrastructure	Establish/maintain water and land use recreation within appropriate sections of the MRW where desired and feasible while protecting natural features. Support efforts of Beautification Committee in development of plan.
Watershed monitoring efforts	Continue partnership with Pickford High School and LSSU with water quality monitoring with expanded parameters and precision. Monitor for new dumping locations and cleanup of old dumping locations.
Coordinated development	Promote and achieve the environmental and economic benefits of planned communities through coordinated land use planning and low impact development
Watershed organization	Broaden and increase participation within the current organization to coordinate the implementation of the watershed management plan

Table 9.1 Desired Uses

The following goals were developed to address the desired uses identified by stakeholders. Objectives for these goals are listed below.

1. Protected groundwater resources

- Following the example of the Rudyard well-head protection program, develop and implement community well head protection programs
- Continue to close abandoned wells
- Work towards reducing the amount of flowing wells and rate of water entering the watershed through flowing wells.
- Determine current and future amount of groundwater withdrawal and its potential impacts
- Develop strategies to prevent increased impervious surfaces in high recharge areas and to restore areas with high recharge potential, as appropriate. Include strategies to improve and maintain natural hydrology, including the restoration, protection, and enhancement of wetlands and riparian areas.

2. Protected habitat for native aquatic and terrestrial wildlife

- Develop a community supported green infrastructure vision for the Munuscong River watershed that includes natural and working lands
- Assist conservation organizations, local governments and landowners to preserve and manage wildlife habitat
- Minimize modification of sensitive habitat areas such as stream corridors

3. Operation of Agricultural Lands

- Implement BMPs and approved practices within farm operations where there are cattle heavy use areas and stream access.
- Increase activity and verification within the Michigan Agriculture Environmental Assurance Program (MAEAP).

4. Improved recreation infrastructure along river while respecting natural feature

- Improve navigation opportunities in the Munuscong River mainstream. Consult with U.S. Army Corps of Engineers to maintain appropriate water depths and sediment loads throughout historical navigable reaches of Munuscong mainstream.
- Encourage coordinated recreation planning that promotes sustainable uses of natural resources and protects the unique natural features of MRW communities
- Incorporate bank stabilization efforts and BMPs at access sites to minimize the impact of foot traffic and erosion
- Educate private river users and land owners on the proper management of woody debris to improve navigability without impacting fish habitat or hydrology
- Build and maintain a trail/boardwalk system along appropriate sections of the river
- Remove litter and trash along banks
- Educate boaters and recreational users about limiting the movement of invasive species

5. **Continued/increased watershed monitoring efforts**

- Partner with MRWA, PHS, LSSU, MDEQ, tribal, and federal agencies to develop and implement a monitoring strategy to examine the current quality of the river as well as to monitor changes over time
- Coordinate volunteer road/stream crossing riparian surveys of public and private crossings to assess current conditions and monitor changes over time as well identify problem sites
- Develop a program for testing of private drinking water wells
- Encourage monitoring and potential regulation of commercial groundwater withdrawal
- Develop a program for testing of private drinking water wells
- Encourage monitoring and potential regulation of commercial groundwater withdrawal

6. **Coordinated land use planning in the MRW.**

- Review local plans, ordinances and regulations addressing storm water management, non-point source pollution and related water quality and natural resource issues
- Promote uniform set back requirements along lakes, streams, rivers and wetlands
- Develop model language for development standards and ordinances
- Develop resource maps for planning officials
- Gain local commitments to consider the watershed context in planning efforts and to recognize storm water planning early in site planning and evaluation
- Conduct technical workshops and provide technical assistance throughout the watershed regarding the importance of coordinated watershed and land use planning
- Develop a communication plan targeting county administrators, Township boards, planning commissioners, community development corporations, and neighborhoods about the importance of watershed and land use planning

7. **A sustainable organization to coordinate and implement the watershed management plan and to instill a sense of stewardship**

- Partner with the Chippewa/Luce/Mackinac Conservation District (CLMCD) and Les Cheneaux Islands Watershed Council to help build capacity and success in the Munuscong River Watershed Association and the implementation of the MRWMP
- Identify a funding strategy that includes membership, governmental units, foundations and business support
- Secure funding and implement the watershed management plan
- Develop a work plan for the organization

Chapter 10 Implementation Strategies

This chapter provides a management strategy to protect and improve water quality in the Munuscong River watershed. The management strategy prioritizes tasks to be implemented, identifies specific problem sites and lays out a detailed action plan for implementation. The strategy also includes an information and education plan and describes current efforts.

10.1 Action Plan for Priority Areas

The Action Plan (Table 10.1) is a table with implementation tasks organized into the three management areas (rural, urban, and public land) described in Chapter 8. Each project in the plan was evaluated with specific criteria and then ranked within each management area to ensure that future allocation of resources will address the most important pollutants and sources first.

Below is a list of structural, vegetative and managerial tasks to be implemented in the MRW by priority area. The priority areas are meant to target implementation efforts where the most benefit can be achieved. However, implementing these tasks in other parts of the watershed may be necessary to achieve long-term water quality improvement and protection. The priority areas are described in Chapter 8 and graphically represented on the management area maps (Figures 8.1, 8.2, and 8.3).

10.1.1 Rural Area Tasks

The following tasks should be focused in the high and medium priority rural management areas as depicted in Figure 8.1.

Tasks to begin within 1-5 years:

- Prevent/limit livestock access (fencing, crossings structures, alternative water sources)
- Increase activity within the MAEAP program
- Develop and implement manure management plans
- Restore riparian buffers and stabilize eroding stream banks
- Install agricultural BMPs (filter strips, no-till, cover crops, grassed waterways, etc)
- Utilize volunteers to inventory remaining sections of watershed under private ownership
- High priority wetlands for restoration and protection in the Munuscong River Watershed will be identified using MDEQ's Landscape Level Wetland Functional Assessment (LLWFA) *High Potential Wetland Restoration Areas*; the MDEQ's Hydrological Study *Subbasin Critical Areas* of the watershed, including that study's determination of hydrological soil groups (hydrological groups C, D, and C/D); and, current county (Chippewa and Mackinac) plat books to identify parcels containing these priority wetlands. The highest priority wetlands for both restoration and protection implementation efforts in these areas will be further refined as those that provide functions such as flood water storage, sediment retention, nutrient retention, and hydrological stability.
- Work with the Natural Resources Conservation Service to promote the Wetland Restoration Program and other Farm Bill wetland protection programs to landowners of high potential restoration distinction (MDEQ Landscape Level Watershed Assessment). Pursue cost share to implement restoration activity with willing landowners, and follow with implementation of restoration activity.

- Work with the Chippewa (CHD) and Mackinac County Health Departments (LMAS) to modify the Superior Environmental Health Code (SEHC) to require time-of-sale inspections at the time of property transfer, and reporting of existing septic systems (TMDL 2012)
- Conduct an audit of lagoon and conventional type OSDS to confirm that they are meeting the SEHC requirements; and utilize geographic informational systems (GIS) to map lagoon and conventional type OSDS (confirm presence within zone of 500' adjacent water bodies) and analyze for conformance with required surface water setbacks. After evaluation, utilize waste sniffing dog and other approved methods to conduct field inspection and system evaluations.
- Conduct a visual inspection, dry-weather testing, and dye testing of properties with suspected illicit discharges. Locate properties by analyzing maps and aerial photography, and walking length of stream. Perform E.coli with Bacterial Source Tracking (BST) sampling where suspected discharges/connections are located.
- Stakeholders will submit proposals for funding implementation activities and additional monitoring through Clean Michigan Initiative, Section 319 Clean Water Act, and other sources.
- Continue monitoring in TMDL watersheds, including additional sites, to provide detail on implementation effectiveness.

Tasks to begin within 6-10 years:

- Utilize soil testing to determine appropriate application rates for fertilizers and pesticides
- Continue work with NRCS to guide planning and implementation of priority wetland protection
- Inventory private road/stream crossings to assess alterations to hydrology, erosion issues, and fish passage obstacles. Organize data, prioritize sites, engineer BMP's and pursue funding to restore the failing crossings.

Tasks to begin within 11-15 years:

- Utilize integrated pest management
- Improve and/or enforce septage waste disposal regulations
- Continue wetland work with NRCS to restore wetlands that assist in stabilizing hydrology.
- Perform a follow-up hydrology study following MDEQ hydrology study model, including channel morphology, the update of watershed land cover data set, etc., to determine site specific cause of stream channel instability and suggest solutions.

10.1.2 Urban Area Tasks

The following tasks should be focused in the high and medium priority urban management areas as depicted in Figure 8.2.

Tasks to begin within 1-5 years:

- Locate illicit connections between waste water infrastructure and storm sewers by performing dry screening.
- Utilize storm water best management practices (road/parking lot sweeping, rain gardens, constructed wetlands, vegetated swales, snow removal, etc.)
- Utilize best management practices for road maintenance (such as alternative deicing methods
- Inventory private road/stream crossings to assess alterations to hydrology, erosion issues, and fish passage obstacles. Organize data, prioritize sites, engineer BMP's and pursue funding to restore the failing crossings.
- Work with the Chippewa (CHD) and Mackinac County Health Departments (LMAS) to modify the Superior Environmental Health Code (SEHC) to require time-of-sale inspections at the time of property transfer, and reporting of existing septic systems (TMDL 2012)
- High priority wetlands for restoration and protection in the Munuscong River Watershed will be identified using MDEQ's Landscape Level Wetland Functional Assessment (LLWFA) *High Potential Wetland Restoration Areas*; the MDEQ's Hydrological Study *Subbasin Critical Areas* of the watershed, including that study's determination of hydrological soil groups (hydrological groups C, D, and C/D); and, current county (Chippewa and Mackinac) plat books to identify parcels containing these priority wetlands. The highest priority wetlands for both restoration and protection implementation efforts in these areas will be further refined as those that provide functions such as flood water storage, sediment retention, nutrient retention, and hydrological stability.
- Work with the Natural Resources Conservation Service to promote the Wetland Restoration Program and other Farm Bill wetland protection programs to landowners of high potential restoration distinction (LLWFA, HS, HSG). Pursue cost share to implement restoration activity with willing landowners, and follow with implementation of restoration activity.
- Conduct an audit of lagoon and conventional type OSDS to confirm that they are meeting the SEHC requirements; and utilize geographic informational systems (GIS) to map lagoon and conventional type OSDS (confirm presence within zone of 500' adjacent water bodies) and analyze for conformance with required surface water setbacks. After evaluation, utilize waste sniffing dog and other approved methods to conduct field inspection and system evaluations.
- Evaluate urban municipal sewer systems for leaks and general condition using various inspection techniques, including camera inspections, smoke or dye testing, acoustic methods, electrical and electromagnetic methods, laser profiling, and flow metering.
- Conduct a visual inspection, dry-weather testing, and dye testing of urban areas with suspected illicit discharges. Locate properties by analyzing maps and aerial photography, and walking length of stream. Perform E.coli with Bacterial Source Tracking (BST) sampling where suspected discharges/connections are located.

Tasks to begin within 6-10 years:
- Enact stormwater and post construction control ordinances
- Identify and correct failing septic systems
- Identify and correct illicit connections or discharges to stormwater system

Tasks to begin within 11-15 years:
- Properly maintain, expand, and design municipal sewer system infrastructure

10.1.3 Public Land Management Area Tasks

The following tasks should be focused in the high priority protection areas as depicted in Figure 8.3.

Tasks to begin within 1-5 years:
- Enact/improve water quality protection related ordinances (see Chapter 4 of this plan for recommendations on ordinances)
- Inventory remaining road/stream crossings to assess alterations to hydrology, erosion issues, and fish passage obstacles. Organize data, prioritize sites, engineer BMP's and pursue funding to restore the failing crossings.
- Work with State, Federal, and Conservancy land managers in utilizing MDEQ Landscape Level Wetland Functional Assessment report (Groundwater influence, floodwater storage, stream flow maintenance, nutrient transformation, sediment/particulate retention, stream shading) (Appendix L), MDEQ's Hydrological Study Critical Areas, Natural Resource Conservation Service Wetland Restoration Program eligibility criteria, determine high priority wetland restoration sites on State, Federal, and Conservancy land, and work with partners to implement restoration through NRCS' Wetland Reserve Program, land conservancy easements, or through other partner recommendations.
- Establish, restore, and maintain riparian forest and/or vegetated buffers in order to shield riparian areas from recreational degradation.
- Develop and enact design and maintenance standards for road stream crossing
- Correct problem road/stream crossing sites (see Figure 6.1)

Tasks to begin within 6-10 years:
- Protect sensitive riparian zones and wetlands
- Work with State, Federal, and conservancies to develop land use management plans for long term protection of water quality and wildlife management.

Tasks to begin within 11-15 years:
- Evaluate land use management plans, condition of sensitive areas and implement restoration and/or protection activities to continue water quality and habitat protection

10.1.4 Tasks and Timelines

The Action Plan (Table 10.1) is a detailed, prioritized plan which addresses problem pollutants and their sources. The plan should serve as a starting point for effective implementation. The items in the plan should be reviewed annually and updated as conditions change in the watershed. Table 10.1 provides location information, the problem, pollutant reduction information, the recommended treatment (BMP), unit costs, total cost estimate for each task, and timeline.

Since resources will probably not be available to implement all of the tasks at once, the plan provides a suggested timeframe for beginning implementation of each task. The implementation timeframe was based on the ranking of pollutants and sources for each priority area in Chapter 8. The timeframe may be changed if resources or opportunities become available for earlier implementation.

10.1.5 Prioritization of Tasks

Prioritizing the tasks will allow resources to be allocated to the tasks that address the most important pollutants and sources first. CLMCD determined that bacteria/pathogens and their sources to be the highest priority. (Note: Bacterial Source Tracking (BST) will be implemented at all sites delineated as bacteria/pathogen sources). Subsequent priority was given to tasks addressing hydrological alterations, tasks within MDEQ's LLWFA most significant wetland loss, and those of local importance as determined in the Munuscong River Watershed Social Survey Report. In Table 10.1 "Action Plan" the following designations were used to indicate whether a project falls within the above categories:

B = Bacteria/pathogens are focus of the project activity
H = Project is within a critical hydrologic subbasin (Score between 21 and 40)
R = Project is within an area of high potential for wetland restoration
L = Project is considered high priority in watershed social survey

The designations are noted in the last column of the Action Plan titled "**PC**" which stands for "**P**riority **C**ategories".

Following Table 10.1 are maps providing locations of the tasks identified in the Action Plan. All Action Plan tasks are plotted on each of the following maps:

1) Rural Management Areas (Figure 10.1)
2) Urban Management Areas (Figure 10.2)
3) Public Land Management Areas (Figure 10.3)
4) High Potential Wetland Restoration Areas (Figure 10.4)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek

ACTION PLAN (Page 1 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
N/A	N/A	Munuscong & Little Munuscong River watershed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	OSDS audit; GIS aerial imagery assessment to confirm that they are meeting the SEHC requirements; and utilize geographic informational systems (GIS) to map lagoon and conventional type OSDS (confirm presence within zone of 500' adjacent water bodies) and analyze for conformance with required surface water setbacks. After evaluation, utilize waste sniffing dog and other approved methods to conduct field inspection and system evaluations.	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watershed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Work with the Chippewa (CHD) and Mackinac County Health Departments (LMAS) to modify the Superior Environmental Health Code (SEHC) to require time-of-sale inspections at the time of property transfer, and reporting of existing septic systems	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watershed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Conduct a visual inspection, dry-weather testing, and dye testing of properties with suspected illicit discharges. Locate properties by analyzing maps and aerial photography, and walking length of stream. Perform E.coli with Bacterial Source Tracking (BST) sampling where suspected discharges/connections are located.	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watershed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Continue monitoring in TMDL watersheds, including additional sites, to provide detail on implementation effectiveness.	$100,000	$100,000	2013-2017	BHRL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas **ACTION PLAN** (Page 2 of 15)	High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek Medium priority water bodies – Demoreux Creek and Little Munuscong River								
Site ID	**Latitude/ Longitude**	**Stream**	**Erosion type or Issue**	**Pollutant Reduction (S, P, and N)***	**BMP**	**Unit cost**	**Total**	**Timeline**	**PC**
N/A	N/A	Munuscong & Little Munuscong River watershed	Bacteria/ Pathogens; Hydrology; Wetlands; Local Issues	93% reduction in cfu/100mL samples; Restore 28,170 wetland acres	• High priority wetlands for restoration and protection in the Munuscong River Watershed will be identified using MDEQ's Landscape Level Wetland Functional Assessment (LLWFA) *High Potential Wetland Restoration Areas*; the MDEQ's Hydrological Study *Sub-basin Critical Areas* of the watershed, including that study's determination of hydrological soil groups (hydrological groups C, D, and C/D); and, current county (Chippewa and Mackinac) plat books to identify parcels containing these priority wetlands. The highest priority wetlands for both restoration and protection implementation efforts in these areas will be further refined as those that provide functions such as flood water storage, sediment retention, nutrient retention, and hydrological stability. • Work with the Natural Resources Conservation Service to promote the Wetland Restoration Program and other Farm Bill wetland protection programs to landowners of high potential restoration distinction (LLWFA, HS, HSG). Pursue cost share to implement restoration activity with willing landowners, and follow with implementation of restoration activity. • CLMCD staff will identify priority wetland sites and contact landowners.	$100,000	$100,000	2013-2017	BHRL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 3 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
500	46.13298 84.40478	Taylor Creek	Stream Bank Cattle Access	Sediment, Nutrients Bacteria,/Pathogens (44, 50, 100)	Prescribed grazing system Heavy use protection Lined streambank with rip rap; Bacterial Source Tracking	Fencing $2 per foot, Heavy use protection $10 per sq ft.; $2 per foot pipeline $2.95 per square foot	$49,000	2013-2017	BHRL
502	46.14303 84.40491	Taylor Creek	Stream Bank Cattle Access	Sediment, Nutrients, Bacteria/pathogens (140, 161, 322)	Prescribed grazing system Heavy use protection Lined streambank with rip rap; Bacterial Source Tracking	Fencing $2 per foot, Heavy use protection $10 per sq ft.; $2 per foot pipeline $58 per foot	$50,000	2013-2017	BHRL
503	46.14403 84.40499	Taylor Creek	Stream Bank Cattle Access	Sediment, Nutrients, Bacteria/pathogens (140, 161, 322)	Prescribed grazing system Heavy use protection Lined streambank with rip rap; Bacterial Source Tracking	Fencing $2 per foot, Heavy use protection $10 per sq ft.; $2 per foot pipeline $58 per foot	$50,000	2013-2017	BHRL
105	46.14916 84.34338	E. Br. Munuscong	Stream Bank, Heavy use area	Sediment, Nutrients, Bacteria/pathogens (62, 70, 142)	Heavy use protection, Prescribed grazing sys- tem; Bacterial Source Tracking	Heavy use protection $10 per sq. ft. Fencing $2 per foot Pipeline $2per foot Water system $62	$40,840	2013-2017	BHRL
26	46.14424 84.40503	Munuscong	Stream Bank	Sediment, Nutrients, Bacteria/pathogens (76, 88, 174)	Prescribed grazing system, streambank restoration with rip rap, tree revetments, fascines	Fencing $2/ft, $5,000 per water source, $2 per foot pipeline Streambank restoration $58 per foot	$75,000	2013-2017	BHRL
212	46.13488 84.36327	Munuscong	Stream Bank, Cattle access	Sediment, Nutrients, Bacteria/pathogens (14, 18, 34)	Prescribed grazing system, Heavy use protection, Crossing s Lined outlet with rip rap	Fencing $2 per foot, Heavy use protection $10 per sq ft, $2 per foot pipeline	$40,000	2013-2017	BHRL
97	46.15794 84.30568	E. Br. Munuscong	Cattle access to drainage	Sediment, Nutrients, Bacteria/pathogens	Prescribed grazing operation; Bacterial Source Tracking	Fencing $2/ft Pipeline $2per foot Water system $62	$15,000	2013-2017	BHR

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 4 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	**Latitude/ Longitude**	**Stream**	**Erosion type or Issue**	**Pollutant Reduction (S, P, and N)***	**BMP**	**Unit cost**	**Total**	**Timeline**	**PC**
87	46.14198 84.30089	E. Br. Munuscong	Cattle access: edge of drainage ditch	Sediment, Nutrients, Bacteria/pathogens	Prescribed grazing operation Bacterial Source Tracking	Fencing $2 per foot Pipeline $2per foot Water system $62	$10,000	2013-2017	BHR
96	46.15809 84.41937	Munuscong	Heavy use area	Sediment, Nutrients, Bacteria/pathogens	Heavy use protection, Prescribed grazing system; Bacterial Source Tracking	Heavy use protection $10 per sq. ft. Fencing $2 per foot Pipeline $2per foot Water system $62	$40,840	2013-2017	BHR
25	46.1435 84.40503	Munuscong	Stream Bank	Sediment, Nutrients, Bacteria/pathogens (1030, 1184, 2366)	Prescribed grazing system, streambank restoration with rip rap, tree revetments, fascines; Bacterial Source Tracking	Fencing $2 per foot, $5,000 per water source, $2 per foot pipeline Streambank restoration $58 per foot	$75,000	2013-2017	BHL
501	46.13620 84.40487	Taylor Creek	Stream Bank Cattle Access	Sediment, Nutrients, Bacteria/pathogens (88, 100, 200)	Prescribed grazing system Heavy use protection Streambank restoration; Bacterial Source Tracking	Fencing $2 per foot, Heavy use protection $10 per sq ft.; $2 per foot pipeline $58 per foot	$50,000	2013-2017	BHL
211	46.17296 84.34413	E. Br. Munuscong	Stream Bank	Sediment, Nutri- ents,Bacteria/ Pathogens (23, 27, 53)	Heavy use protection, Pre- scribed grazing system	Heavy use protection $10 per sq. ft. Fencing $2 per foot Pipeline $2per foot Water system $62	$40,840	2013-2017	BHL
24	46.13795 84.40232	Munuscong	Stream Bank	Sediment, Nutrients, Bacteria/Pathogens (48, 55, 111)	Prescribed grazing system. Lined waterway with riprap and geotextile	Fencing $2 per foot Pipeline $2per foot Water system $62 Streambank restoration $2.95 per sq. ft.	$26,225	2013-2017	BHL
92	46.0858 84.21839	E. Br. Munuscong	Cattle access and farm operation nearby stream, Stream Bank	Sediment, Nutrients, Bacteria/pathogens (1, 1, 3)	Prescribed grazing system; Bacterial Source Tracking	Fencing $2 per foot, $2 per foot pipeline, $100 water station	$22,000	2013-2017	BRL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 5 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
106	46.18164 84.32496	E. Br. Munuscong	Stream Bank, Cattle Heavy use area, Cattle access	Sediment, Nutrients, Bacteria/pathogens (582, 670, 1340)	Prescribed grazing system, Heavy use protection, Cross-ing structure	Fencing $2 per foot, Heavy use protection $10 per sq ft.; $2 per foot pipeline	$27,000	2013-2022	BRL
91	46.10039 84.22433	E. Br. Munuscong	Cattle access, Heavy use area, Manure storage with no protection	Sediment, Nutrients, Bacteria/pathogens	Heavy use protection, Prescribed grazing system; Bacterial Source Tracking	Heavy use protection $10 per sq. ft. Fencing $2 per foot Pipeline $2per foot Water system $62	$40,840	2013-2017	BR
99	46.2888 84.27804	School Creek	Cattle concentration within drainage to School Creek	Sediment, Nutrients, Bacteria/pathogens	Heavy use protection, Prescribed grazing system; Bacterial Source Tracking	Heavy use protection $10 per sq. ft.. Fencing $2 per foot Pipeline $2per foot Water system $62	$35,000	2013-2017	BR
21	46.13596 84.40527	Munuscong	Stream Bank	Sediment, Nutrients, Bacteria/Pathogens (189, 217, 433)	Prescribed grazing operation. Streambank Restoration with lined waterway or outlet. Rock rip rap with geotextile	Fencing $2 per foot Pipeline $2per foot Water system $62 Streambank Restoration $2.95 per sq. ft.	$63,800	2013-2017	BL
51	46.18924 84.32694	Parker Creek	Stream Bank	Sediment, Nutrients (5, 6, 12)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, Rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$80,885	2013-2017	RL
52	46.18936 84.32727	Parker Creek	Stream Bank	Sediment, Nutrients (4, 5, 10)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$80,885	2013-2017	RL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 6 of 16) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
50	46.18882 84.32647	Parker Creek	Private Stream Crossing	Sediment, altered hydrology	Remove crossing debris; restore area with rip rap, live fascines, tree revetments	$1000 debris $2.95 per sq. ft	$33,450	2013-2017	RL
53	46.19028 84.32932	Parker Creek	Stream Bank	Sediment, Nutrients (9, 11, 21)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$81,685	2013-2017	RL
56	46.1913 84.33159	Parker Creek	Stream Bank	Sediment, Nutrients (18, 20, 40)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$82,345	2013-2017	RL
59	46.19226 84.33437	Parker Creek	Stream Bank	Sediment, Nutrients (18, 20, 40)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1,000 per acre $2.95 per sq. ft.	$82,345	2013-2017	RL
60	46.193 84.33585	Parker Creek	Stream Bank	Sediment, Nutrients (53, 60, 121)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$88,850	2013-2017	RL
61	46.19305 84.33633	Parker Creek	Stream Bank	Sediment, Nutrients (21, 24, 48)	Wetland restoration, i.e. ditch plugs; Lined waterway or outlet, rip rap with geotextile	$1000 per acre $2.95 per sq. ft.	$83,540	2013-2017	RL
62	46.19333 84.33997	Parker Creek	Braided Channel for length of 75'	No visible erosion	Retain herbaceous riparian buffer and tree/shrub establishment	$326 per acre $369 per acre	$700	2013-2017	RL
63	46.19292 84.34119	Parker Creek	Stream Bank; lack of buffer	Sediment, Nutrients (2, 2, 5)	Retain herbaceous riparian buffer and tree/shrub establishment	$326 per acre $369 per acre	$700	2013-2017	RL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas ACTION PLAN (Page 7 of 15) High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
GC	46.1886 84.3609	Parker Creek	Stream Bank 1 1/4 mile segment Through golf course	Sediment, Nutrients (15, 17, 34)	Riparian herbaceous buffer, Filter strip (nutrients removed through cutting) Restore flow with adequate crossing	$326 per acre $369 per acre $1,113 per crossing	$9,035	2013-2017	RL
49	46.18836 84.32672	Parker Creek	Gully	Sediment, Nutrients (72, 83, 166)	Stabilize gully with lined waterway rock rip rap with geotextile	$2.95 per sq. ft.	$6,640	2013-2017	R
54	46.19028 84.33121	Parker Creek	Gully	Sediment, Nutrients (53, 60, 121)	Stabilize gully with lined waterway rock rip rap with geotextile	$2.95per sq. ft.	$8,850	2013-2017	R
55	46.19062 84.33137	Parker Creek	Gully	Sediment, Nutrients (39, 45, 91)	Stabilize gully with lined waterway rock rip rap with geotextile	$2.95 per sq. ft.	$6,785	2013-2017	R
57	46.19173 84.33224	Parker Creek	Lack of buffer	Sediment, Nutrients	Restore riparian buffer with shrubs, fascines, etc.	$1.00/ln ft.	$500	2013-2017	R
64	46.11832 84.3007	E. Br. Munuscong	Stream Bank	Sediment, Nutrients (4, 4, 8)	Streambank restoration	$58 per foot	$3,000	2018-2022	HRL
65	46.11932 84.28066	E. Br. Munuscong	Stream Bank	Sediment, Nutrients (21, 24, 48)	Streambank restoration with streambank riparian forest buffer	$58 per foot $898 per acre	$4,000	2018-2022	HRL
66	46.11895 84.2811	E. Br. Munuscong	Stream Bank	Sediment, Nutrients (8, 9, 18)	Streambank restoration with streambank tree/shrub Establishment	$58 per foot $898 per acre	$10,000	2018-2022	HRL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 8 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
86	46.14348 84.33307	E. Br. Munuscong	Stream Bank, Old RSX remnants	Sediment, Nutrients, Altered hydrology (16, 18, 37)	Remove old RSX remnants	$5,000 per removal	$5,000	2018-2022	HRL
86	46.14348 84.33307	E. Br. Munuscong	Stream Bank	Sediment, Nutrients (62, 70, 140)	Lined waterway or outlet; rock rip rap with geotextile	$2.95 per sq. ft.	$2,000	2018-2022	HRL
95	46.13512 84.38421	Munuscong	Snowmobile cross-ing: falling, debris, flow restriction	Sediment, Altered hydrology, Nutri-ents (12, 14, 30)	Replace crossing, Stabilize embankments, remove debris	$50,000 per bridge $2.95 per sq. ft to stabilize embankments	$53,540	2018-2022	HRL
82	46.17149 84.50917	Munuscong	Stream Bank	Sediment, Nutrients (30, 35, 69)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$10,000	2018-2022	HRL
85	46.17517 84.53003	Munuscong	Stream Bank	Sediment, Nutrients (42, 48, 97)	Lined waterway or outlet., Rock rip rap, with geotextile	$2.95 per sq. ft.	$8,850	2018-2022	HRL
95	46.13512 84.38421	Munuscong	Old dumping location	Debris	Removal of debris	$250-500	$500	2018-2022	HR
98	46.21522 84.27998	Munuscong	Gully	Sediment, Nutrients (50, 58, 116)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$10,000	2018-2022	HR
64	46.11832 84.3007	E. Br. Munuscong	Gully	Sediment, Nutrients (23, 27, 54)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$3,000	2018-2022	HR
101	46.21269 84.27135	Munuscong	Stream Bank	Sediment, Nutrients (5, 6, 11)	Streambank restoration	$58 foot.	$2,530	2018-2022	HL
213	46.15694 84.3452	E. Br. Munuscong	Old RSX remnants	Sediment, Altered hydrology	Stream Clean up	Volunteer Clean up $2,500 per garbage service	$2,500	2018-2022	HL
108	46.16498 84.35597	Munuscong	Stream Bank	Sediment, Nutrients (11, 13, 26)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$4,720	2018-2022	HL
9	46.21497 84.2945	Munuscong	Stream Bank	Sediment, Nutrients (3, 4, 7)	Removal of debris	$250-500	$500	2018-2022	HL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas ACTION PLAN (Page 9 of 15) High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
100	46.21161 84.26354	Munuscong	Stream Bank, Heavy use recreation area	Sediment, Nutrients (5, 6, 12)	Stabilize recreational access with lined waterway rock riprap with geotextile	$2.95 per sq. ft.	$1,475	2018-2022	HL
103	46.27402 84.56145	Munuscong	Channelized river	Altered hydrology, Sediment	Riparian herbaceous buffer; filter strip	$326 per acre	$1,379	2018-2022	RL
104	46.25963 84.5503	Munuscong	Stream Bank	Sediment, Nutrients (6, 6, 13)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$1,549	2018-2022	RL
47	46.18793 84.32673	Munuscong	Stream Bank	Sediment, Nutrients (7, 8, 17)	Remove large instream woody debris; stabilize streambanks with riprap with geotextile	Debris removal. $2,500 per site Streambank restora-tion $58 per foot.	$10,620	2018-2022	RL
210	46.1003 84.28084	Hannah Creek	Stream Bank	Sediment, Nutrients (11, 12, 24)	Streambank restoration with streambank riparian forest buffer	$58 per foot. $898 per acre	$10,000	2018-2022	RL
19	46.22725 84.27976	Little Munuscong	Stream Bank, Old road abutments	Sediment, Nutrients (38, 44, 78)	Remove large instream woody debris; reshape bank over abutments with geotextile and large riprap	Debris removal $,2500 per site Lined water-way or outlet; rock rip rap with geotextile $2.95 per sq. ft	$6,000	2018-2022	RL
72	46.24491 84.28874	School Creek	Stream Bank	Sediment, Nutrients (49, 56, 113)	Install lined waterway with rip rap and live fascines with tree revetments	$2.95 per sq. ft	$6,000	2018-2022	RL
81	46.27323 84.36461	Little Munuscong	Stream Bank	Sediment, Nutrients (34, 39, 77)	Streambank restoration	$58 per foot.	$27,000	2018-2022	RL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 10 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
72	46.24491 84.28874	School Creek	Stream Bank	Sediment, Nutrients (49, 56, 113)	Install lined waterway with rip rap and live fascines with tree revetments	$2.95 per sq. ft	$6,000	2018-2022	RL
73	46.24429 84.2888	School Creek	Stream Bank	Sediment, Nutrients (11, 12, 24)	Install lined waterway with rip rap and live fascines with tree revetments	$2.95 per sq. ft	$3,000	2018-2022	RL
74	46.24421 84.28904	School Creek	Stream Bank	Sediment, Nutrients (7, 8, 15)	Install lined waterway with rip rap and live fascines with tree revetments	$2.95 per sq. ft	$3000	2018-2022	RL
75	46.24403 84.28853	School Creek	Stream Bank	Sediment, Nutrients (241, 278, 553)	Install lined waterway with rip rap and live fascines with tree revetments	$2.95 per sq. ft	$40,500	2018-2022	RL
77	46.24169 84.2898	School Creek	Stream Bank	Sediment, Nutrients (12, 14, 28)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$3,000	2018-2022	RL
107	46.16372 84.35735	Munuscong	Gully, Left Side	Sediment, Nutrients (21, 24, 49)	Lined waterway or outlet. Rock rip/rap with geotextile	$2.95 per sq. ft.	$3,098	2023-2027	H
107	46.16372 84.35735	Munuscong	Gully, Right Side, pipe from twp park fields	Sediment, Nutrients (22, 25, 50)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$3,098	2023-2027	H
215	46.13595 84.40486	Munuscong	Gully	Sediment, Nutrients (156, 179, 359)	Lined waterway or outlet. Rock rip/rap, w/ geotextile	$2.95 per sq. ft.	$29,205	2023-2027	H
75	46.24403 84.28853	School Creek	Gully	Sediment, Nutrients (15, 17, 34)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$2,000	2023-2027	R
74	46.24421 84.28904	School Creek	Old dumping location	Debris	Removal of debris	$250-500	$250-$500	2023-2027	R

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
ACTION PLAN (Page 11 of 15) Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
75	46.24403 84.28853	School Creek	Gully	Sediment, Nutrients (30, 34, 68)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$4,500	2023-2027	R
89	46.11459 84.27759	Hannah Creek	Old dumping location	Debris	Removal of debris	$250-500	$500	2023-2027	R
71	46.24468 84.30202	School Creek	Old dumping location	Debris	Removal of debris	$250-500	$500	2023-2027	R
90	46.10833 84.23874	E. Br. Munuscong	Gully	Sediment, Nutrients (11, 13, 26)	Lined waterway or outlet. Rock rip rap w/ geotextile	$2.95 per sq. ft.	$2,000	2023-2027	R
102	46.1953 84.31551	Munuscong	Unknown pipe from ground with foundation nearby	Groundwater contamination	Cap well using groundwater program	$5,000 per well	$5,000	2023-2027	L
48	46.18812 84.32629	Munuscong	Streambank	Sediment, Nutrients (9, 11, 23)	Streambank Restoration	$58 per foot.	$5,800	2023-2027	L
93	46.05715 84.21583	E. Br. Munuscong	Channelized stream into ditch line: 2,100'	Altered hydrology, Sediment	Lined waterway or outlet. rock rip rap w/ geotextile	$2.95 per sq. ft.	$1,000	2023-2027	L
11	46.21095 84.3054	Munuscong	Stream Bank	Sediment, Nutrients (21, 24, 48)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$9,292.50	2023-2027	L
70	46.2447 84.30232	Little Munuscong	Stream Bank	Sediment, Nutrients (39, 45, 91)	Remove instream woody debris	Debris removal. $2,500 per site	$2,500	2023-2027	L

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Rural Management Areas ACTION PLAN (Page 12 of 15)

High priority water bodies – Munuscong and East Branch Munuscong Rivers, Parker , School, Lower Taylor, Hannah Creek
Medium priority water bodies – Demoreux Creek and Little Munuscong River

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
78	46.24089 84.29041	School Creek	Gully	Sediment, Nutrients (21, 24, 48)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$1,000	2023-2027	
23	46.13587 84.40767	Munuscong	Gully	Sediment, Nutrients (21, 24, 48)	Lined waterway or outlet. Rock rip/rap, w/ geotextile	$2.95 per sq. ft.	$2,655	2023-2027	
111	46.13202 84.37072	Taylor Creek	Gully	Sediment, Nutrients (4, 4, 8)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$1,000	2023-2027	
114	46.12611 84.37275	Taylor Creek	Gully	Sediment, Nutrients (30, 33, 66)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$2,000	2023-2027	
115	46.12687 84.37241	Taylor Creek	Gully	Sediment, Nutrients (70, 81, 161)	Lined waterway or outlet. Rock rip rap with geotextile	$2.95 per sq. ft.	$4,000	2023-2027	

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Urban Management Areas ACTION PLAN (Page 13 of 15)
High priority water bodies – area of Keldon, the towns of Pickford and Kinross (Kincheloe), and road infrastructure
Medium priority water bodies – area of Stalwart, and new construction sites

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
N/A	N/A	Munuscong & Little Munuscong River watedrshed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	OSDS audit; GIS aerial imagery assessment to confirm that they are meeting the SEHC requirements; and utilize geographic informational systems (GIS) to map lagoon and conventional type OSDS (confirm presence within zone of 500' adjacent water bodies) and analyze for conformance with required surface water setbacks. After evaluation, utilize waste sniffing dog and other approved methods to conduct field inspection and system evaluations.	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watedrshed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Work with the Chippewa (CHD) and Mackinac County Health Departments (LMAS) to modify the Superior Environmental Health Code (SEHC) to require time-of-sale inspections at the time of property transfer, and reporting of existing septic systems	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watedrshed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Conduct a visual inspection, dry-weather testing, and dye testing of properties with suspected illicit discharges. Locate properties by analyzing maps and aerial photography, and walking length of stream. Perform *E.coli* with Bacterial Source Tracking (BST) sampling where suspected discharges/connections are located.	$100,000	$100,000	2013-2017	BHRL
N/A	N/A	Munuscong & Little Munuscong River watedrshed	Bacteria/ Pathogens	93% reduction in cfu/100mL samples	Continue monitoring in TMDL watersheds, including additional sites, to provide detail on implementation effectiveness.	$100,000	$100,000	2013-2017	BHRL
TBD	TBD	Munuscong & Little Munuscong River watedrshed	Sediment/ Nutrients	TBD	Inventory private road/stream crossings to assess alterations to hydrology, erosion issues, and fish passage obstacles. Organize data, prioritize sites, engineer BMP's and pursue funding to restore the failing crossings.	$100,000	$100,000	2013-2017	HRL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10.1 — Urban Management Areas ACTION PLAN (Page 14 of 15) High priority water bodies – area of Keldon, the towns of Pickford and Kinross (Kincheloe), and road infrastructure
Medium priority water bodies – area of Stalwart, and new construction sites

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Timeline	PC
PRK RX 4	46.20205 84.38426	Parker Creek	Road/Stream Crossing	Sediment, Altered hydrology (19)	Restore failing crossing	$75,000/site	$75,000	2013-2017	RL
PRK RX 2	46.18695 84.36341	Parker Creek	Road/Stream Crossing	Sediment, Altered hydrology (1)	Restore failing crossing	$75,000/site	$75,000	2013-2017	RL
FLES RX 3	46.18690 84.39930	Fletcher Creek	Road/Stream Crossing	Sediment, Altered hydrology (9)	Restore failing crossing	$75,000/site	$75,000	2018-2022	HRL
DEM RX 1	46.21501 84.29920	Demoreux Creek	Road/Stream Crossing	Sediment, Altered hydrology (8)	Restore failing crossing	$75,000/site	$75,000	2018-2022	HRL
EBM RX 1	46.17236 84.34281	E. Br. Munuscong	Road/Stream Crossing	Sediment, Altered hydrology (6)	Restore failing crossing	$75,000/site	$75,000	2018-2022	HRL
EBM RX 7	46.11939 84.28066	E. Br. Munuscong	Road/Stream Crossing	Sediment, Altered hydrology (5)	Restore failing crossing	$75,000/site	$75,000	2018-2022	HRL
HAN RX 4	46.05935 84.25975	Hanna Creek	Road/Stream Crossing	Sediment, Altered hydrology (3)	Restore failing crossing	$75,000/site	$75,000	2023-2027	L
DEM RX 2	46.21596 84.30075	Demoreux Creek	Road/Stream Crossing	Sediment, Altered hydrology (2)	Restore failing crossing	$75,000/site	$75,000	2023-2027	L

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

Table 10. 1 — Protection Areas High priority waterbodies – Little Munuscong River, the Munuscong River and river mouth upstream 2 miles, **ACTION PLAN** (Page 15 of 15)

Site ID	Latitude/ Longitude	Stream	Erosion type or Issue	Pollutant Reduction (S, P, and N)*	BMP	Unit cost	Total	Time-line	PC
PA**	N/A	Munuscong & Little Munuscong Rivers	Erosion, Sediment, Altered Hydrology, Wetlands	TBD	Establish, restore, and maintain riparian forest and/or vegetated buffers in order to shield riparian areas from recreational degradation.	$100,000	$100,000	2013-2017	BHRL
PA**	N/A	Munuscong & Little Munuscong Rivers	Erosion, Sediment, Altered Hydology, Wetlands	TBD	Work with State, Federal, and Conservancy land managers to utilizing MDEQ Landscape Level Wetland Functional Assessment report (Groundwater influence, floodwater storage, streamflow maintenance, nutrient transformation, sediment/particulate retention, stream shading) (Appendix L), MDEQ's Hydrological Study Critical Areas, Natural Resource Conservation Service Wetland Restoration Program eligibility criteria, determine high priority wetland restoration sites on State, Federal, and Conservancy land, and work with partners to implement restoration through NRCS' Wetland Reserve Program, land conservancy easements, or through other partner recommendations.	$100,000	$100,000	2013-2017	HRL
PA**	N/A	Munuscong River	Sediment/ Altered Hydrology	TBD	Dredge Mouth of Munuscong River	$5 Million	$5 Million	2013-2017	HL
PA**	N/A	Munuscong & Little Munuscong Rivers	Erosion, Sediment, Altered Hydrology	TBD	Inventory remaining road/stream crossings to assess alterations to hydrology, erosion issues, and fish passage obstacles. Organize data, prioritize sites, engineer BMP's and pursue funding to restore the failing crossings.	$100,000	$100,000	2013-2017	HL

* Estimates of pollutant load reductions of: S—Sediment (tons per year); P—Phosphorus (pounds per year); N— Nitrogen (pounds per year)

** PA—Public Land Area

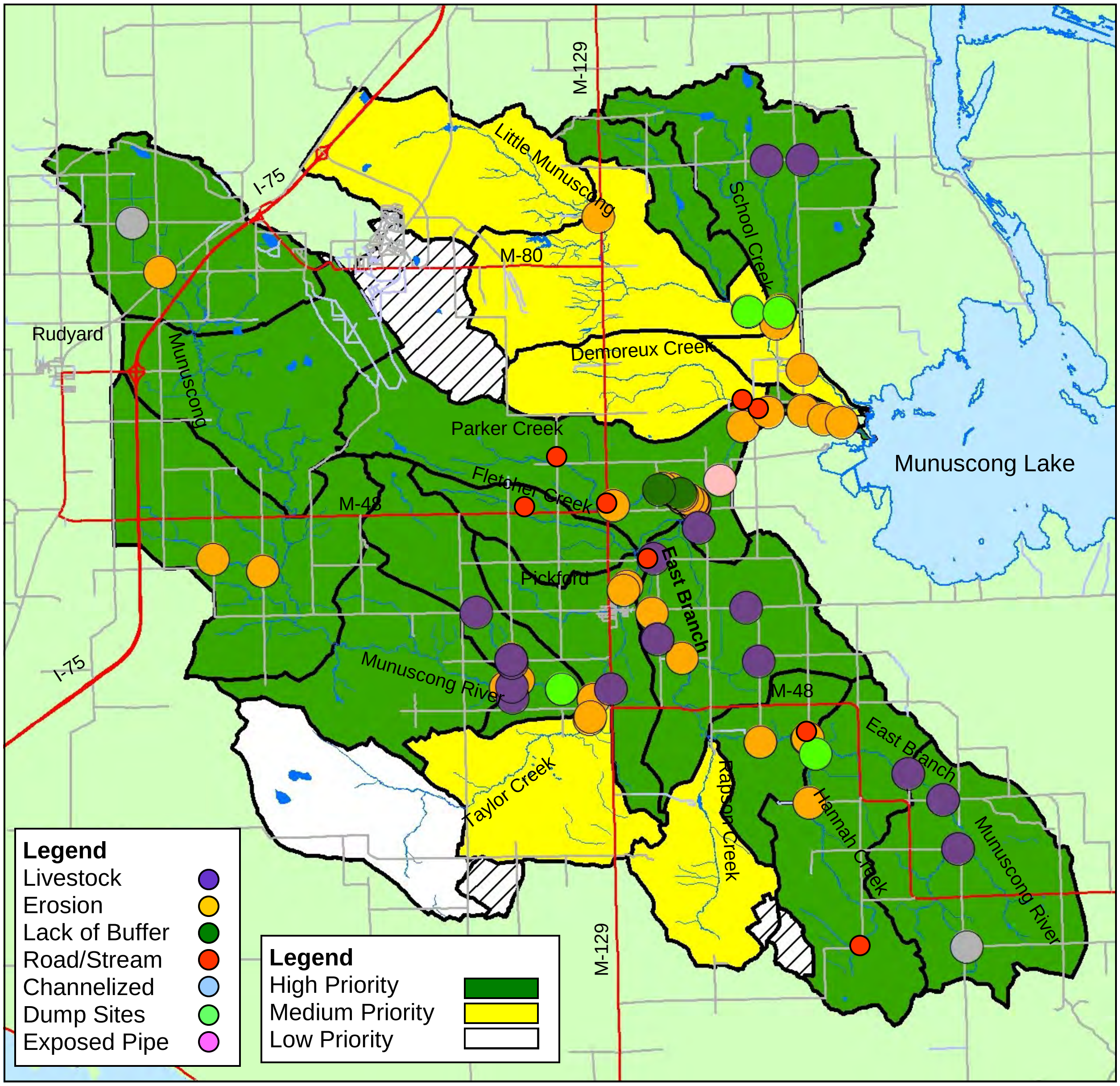


Figure 10.1 — Rural Management Areas With Action Plan Projects

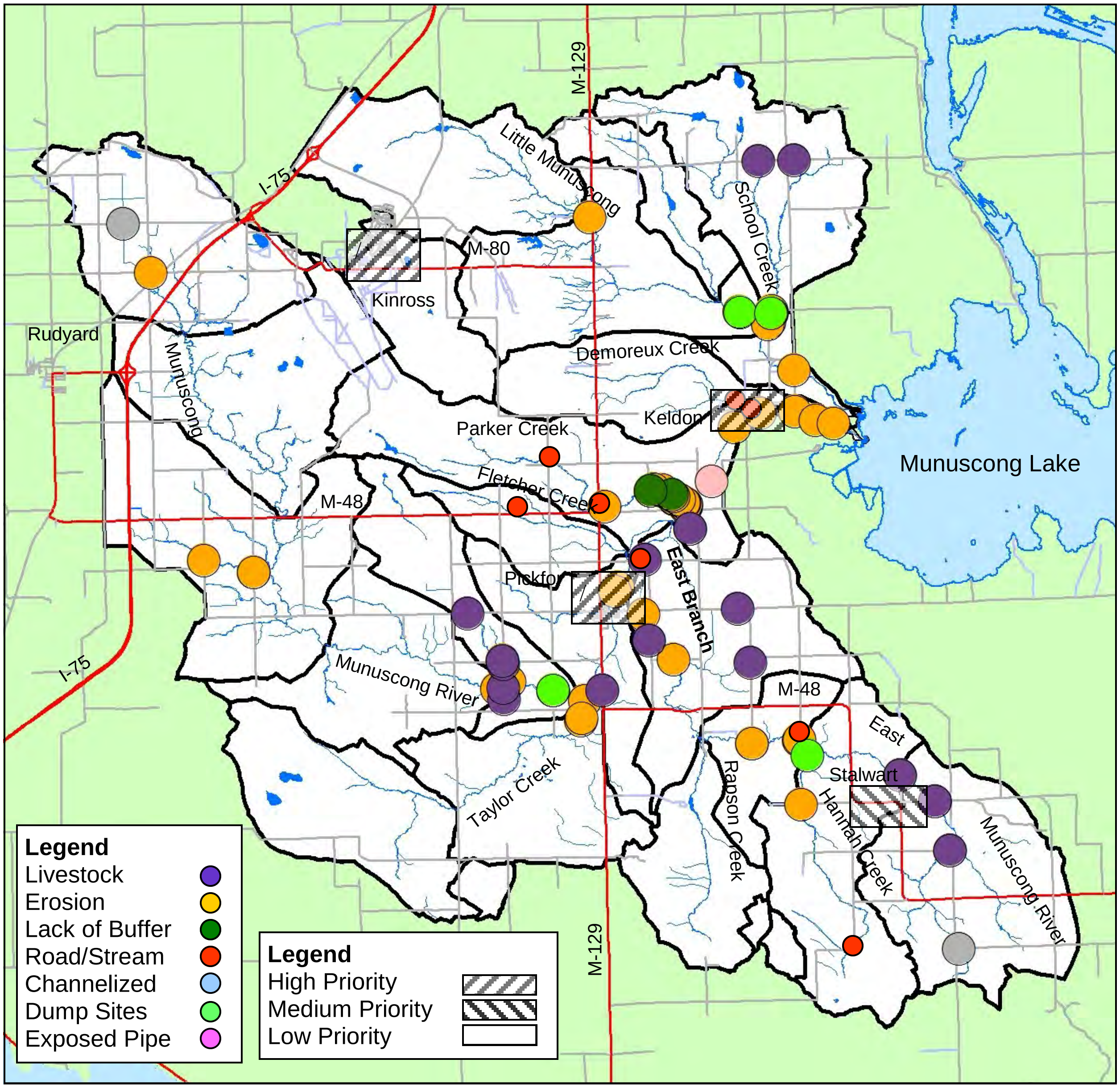


Figure 10.2— Urban Management Areas With Action Plan Projects

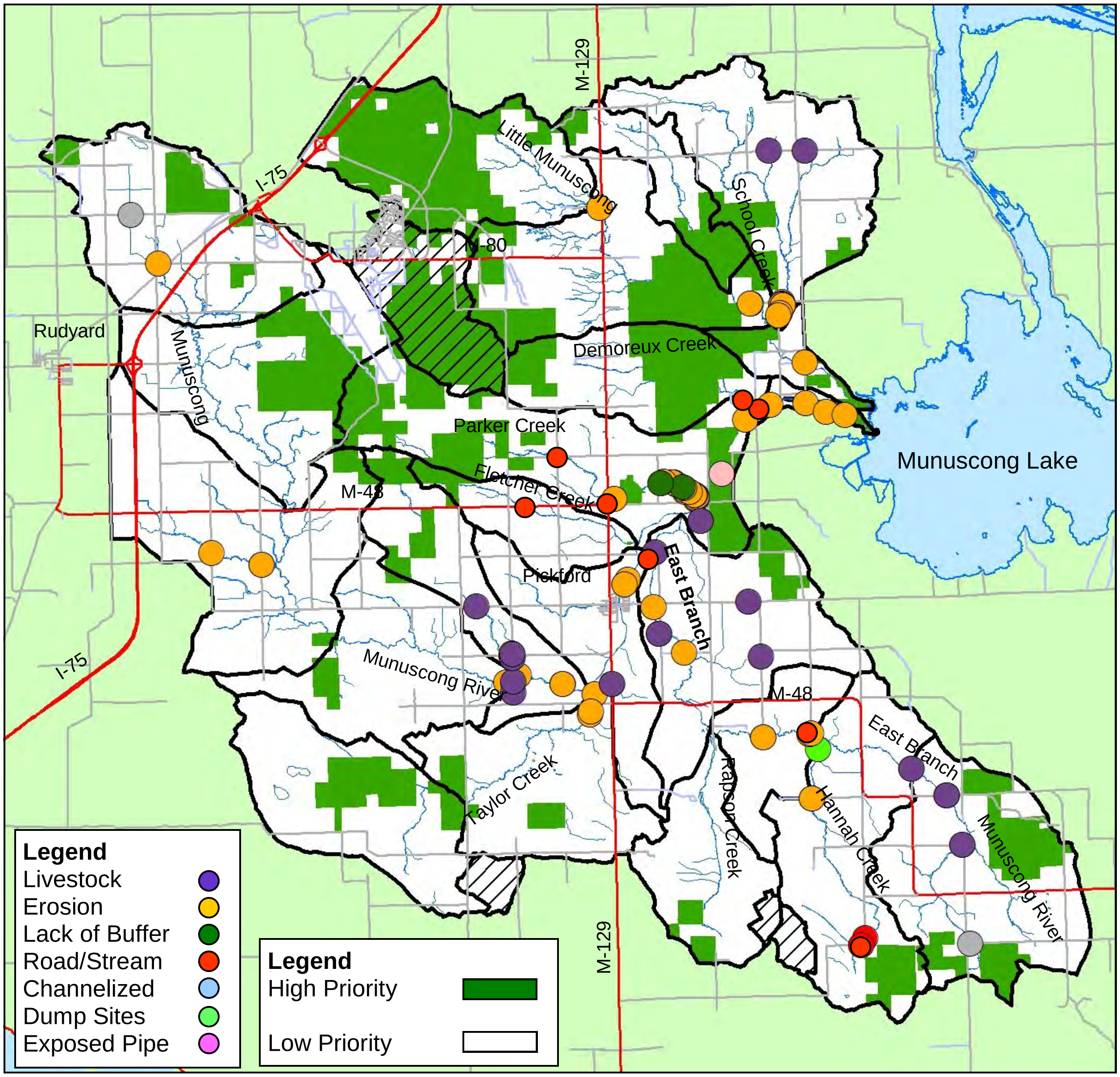


Figure 10.3 — Public Land Management Areas with Action Plan Projects

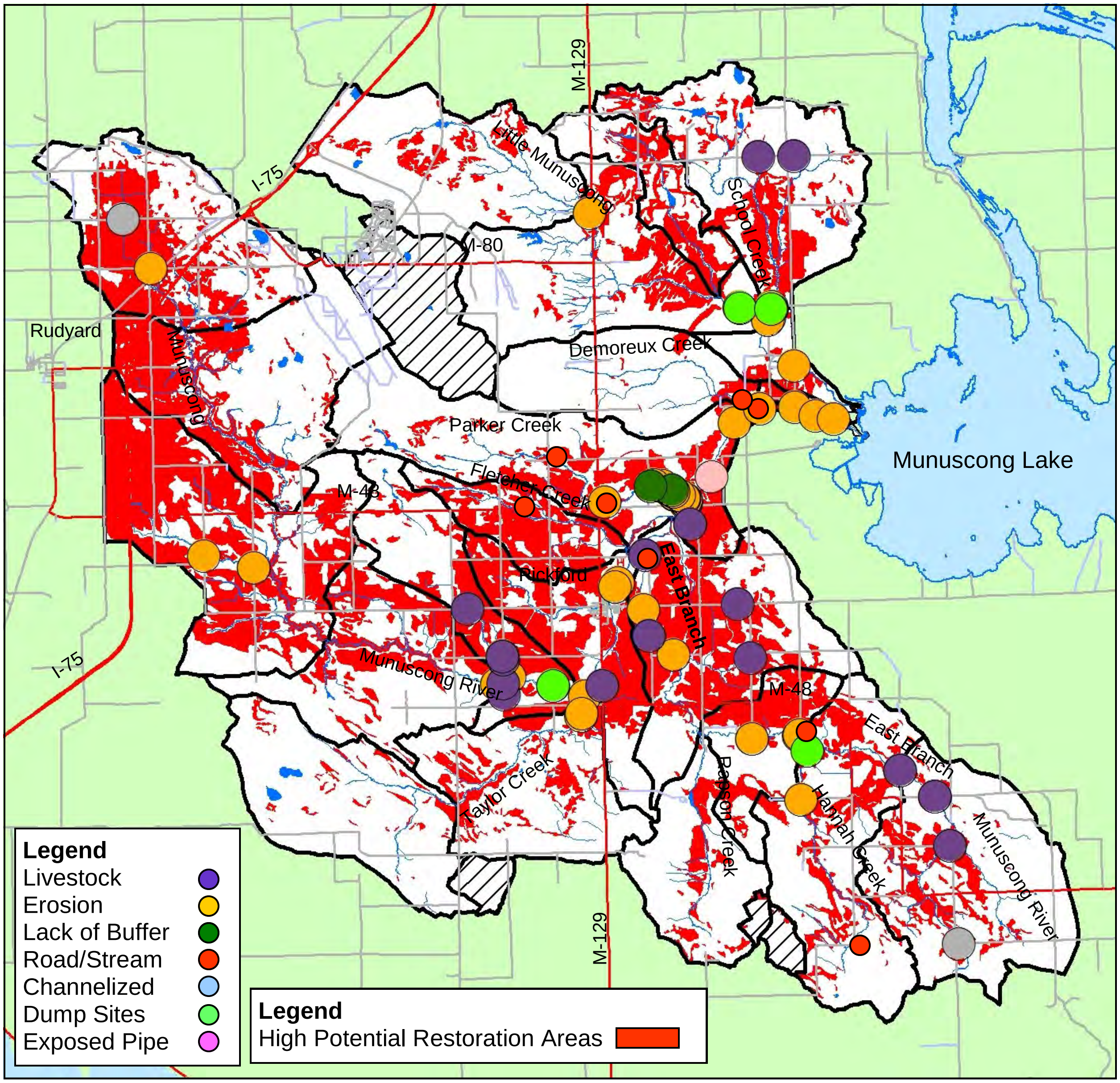


Figure 10.4 — High Potential Wetland Restoration Area With Action Plan Projects

10.2 Information and Education Strategy

The structural, vegetative and managerial tasks listed in the Action Plan (Table 10.1) are voluntary. Therefore, individuals, before they are motivated to action, will need to understand the watershed concerns and how their actions can play a role in protecting water quality. This Information and Education (I&E) strategy was developed to offer a strategy for informing and motivating responsible parties to implement the tasks listed Table 10.1. The I&E plan provides goals and outlines the relationship between target audiences, watershed issues and outreach activities.

The remedy for water quality concerns in the Munuscong River watershed rests within the local community. The purpose of the plan is to provide a framework to inform and motivate the various stakeholders, residents and other decision makers within the Munuscong River watershed to take appropriate actions to protect water quality. This working document will also provide a starting point for organizations within the watersheds looking to provide educational opportunities or outreach efforts.

10.2.1 Information & Education Goal

The I&E Plan (Table 10.2) will help to achieve the watershed management goals by increasing the involvement of the community in watershed protection efforts through awareness, education and action. The watershed community can become involved only if they are informed of the issues and are provided information and opportunities to participate.

The I&E Plan lists specific tasks to be completed. These tasks will increase the general awareness of watersheds and water quality issues for all audiences, educate target audiences on specific issues and motivate target audiences to implement practices to improve and protect water quality. These practices may include homeowner activities such as maintaining/ updating septic systems, installing a rain garden or maintaining stream buffers. Practices for governmental units or officials may include incorporating watershed protection language into master plans and zoning ordinances, reducing the amount of salt used for deicing and utilizing low impact development techniques on public property.

10.2.2 Target Audiences

The level of understanding of watershed concepts and management, the concerns, values and level of enthusiasm can all vary between different audience groups. Recognizing differences between groups of target audiences is critical to achieving success through education and outreach efforts.

Educational messages may need to be tailored to effectively reach different audiences. It is important to understand key motivators of each target audience to establish messages that will persuade them to adopt behaviors or practices to protect and improve water quality.

The Munuscong River Watershed community can be divided into the following general audiences so that specific I/E activities can be directed accordingly:

- **All –** The general public throughout the watershed.
- **Property Owners** – Includes all land owners within the watershed.
- **Riparian Landowners** – Due to their proximity to a specific water body, the education needs of riparian landowners are different.
- **Agricultural Landowners** – The second most land use within the watershed is agricultural at 28%. It is important that they are educated on proper handling and storage of waste and land use practices near riparian areas.
- **Business** – There is a fairly diverse mix of business and industry segments within the watershed. Tourism, retail, and other service industries dominate the mix along with manufacturing and construction.
- **Builders/Developers/Real Estate** – This group consists of all involved in the process of developing land including carpenters, excavators, and those promoting land sales and development. It will be critical to increase awareness in this sector to low impact development techniques.
- **Partner Organizations** – The Eastern Upper Peninsula boasts a knowledgeable list of watershed partner groups with a broad range of expertise and important ongoing protection, restoration and education programs. Providing ongoing learning opportunities to watershed partner organizations regarding current research, BMPs, emerging issues and trends is important to keep implementation work moving forward.
- **Elected and Appointed Officials –** Township, and county commissioners; planning commissions; zoning board of appeals; road commissioners; drain commissioners; etc.
- **Governmental Staff –** Planners, engineers, zoning administrators, etc.
- **Education** – Area educators and students, including K-12.
- **Recreational Users** – Includes any person that engages in recreational activities (snowmobiling, canoeing, fishing, hunting, bird watching, etc.)
- **Special Target Audiences** - In addition to the above, certain user groups such as sportsman, environmental groups, or smaller audience segments may be targeted for specific issues.

10.3 Watershed Issues

To begin formulating education and outreach strategies, it is important to identify the major issues, which need to be addressed to improve and protect water quality. The priority issues for the MRW are described below. Each of these issues relate back to the goals and actions in the Watershed Management Plan.

Each issue is tied to pollutants of concern in the watersheds. For each issue, the audience will need to not only understand the issue, but also the solutions or actions needed to protect or improve water quality. For each major issue, priority target audiences have been identified. The priority audiences were selected because of their influence or ability to take actions, which would improve or protect water quality.

10.3.1 Agricultural Runoff

Agricultural lands cover most of the area in the MRW, If not properly managed; runoff from agricultural lands can impact the watershed by delivering pollutants such as sediment and nutrients. Education efforts should seek to help audiences understand the impacts of agricultural runoff. A key concept is the need to reduce soil erosion from agricultural lands. It is also important to understand that soil particles also carry nutrients and chemicals to water bodies. There are many best management practices for addressing soil erosion from agricultural lands. Best management practices include rotational grazing plans, heavy use protection, filter strips, cover crops, grassed waterways, ditch naturalization and wetland restoration.

Small cattle operations and hobby farmers within the MRW are a major concern to the degradation of water quality. These operations have limited resources in the form of land to pasture cattle, access to watering facilities, proper manure management, and governmental aid to implement BMPs on their operations.

Another major concern is manure being applied to fields in the watershed especially fields with drain tiles, which connect to ditches and streams. For nutrients and bacteria and pathogens, agricultural best management practices include methane digesters, manure and/or nutrient management, restricting livestock access to water bodies, wetland restoration and soil testing. Cost share and technical assistance programs are available to assist agricultural landowners in implementing many of these practices.

Priority Target Audiences: Agricultural Landowners, Governmental staff
Major Pollutants of Concern: sediment, nutrients, bacteria and pathogens
Priority Area: MRW High and Medium Priority Agricultural Management Areas

10.3.2 Septage Waste

Septage waste is both an urban and rural issue. In more rural areas, failing or incorrectly installed septic systems impact water quality by adding excess nutrients, bacteria or other pollutants to the system. Within the urban area, illicit connections to stormwater or directly to the environment also increase nutrients, bacteria, or other pollutants to the system, this also bypasses the treatment system setup to treat waste.

Education activities should seek to educate audiences about the impacts of septic systems on water quality. Proper maintenance of septic systems is a key practice for homeowners. According to the social survey respondents 42% are currently having their septic system regularly serviced. Educational efforts should also target governmental units to encourage them to enact point of sale septic system inspection ordinances and to plan and zone for higher density development only in areas served by municipal sewer systems.

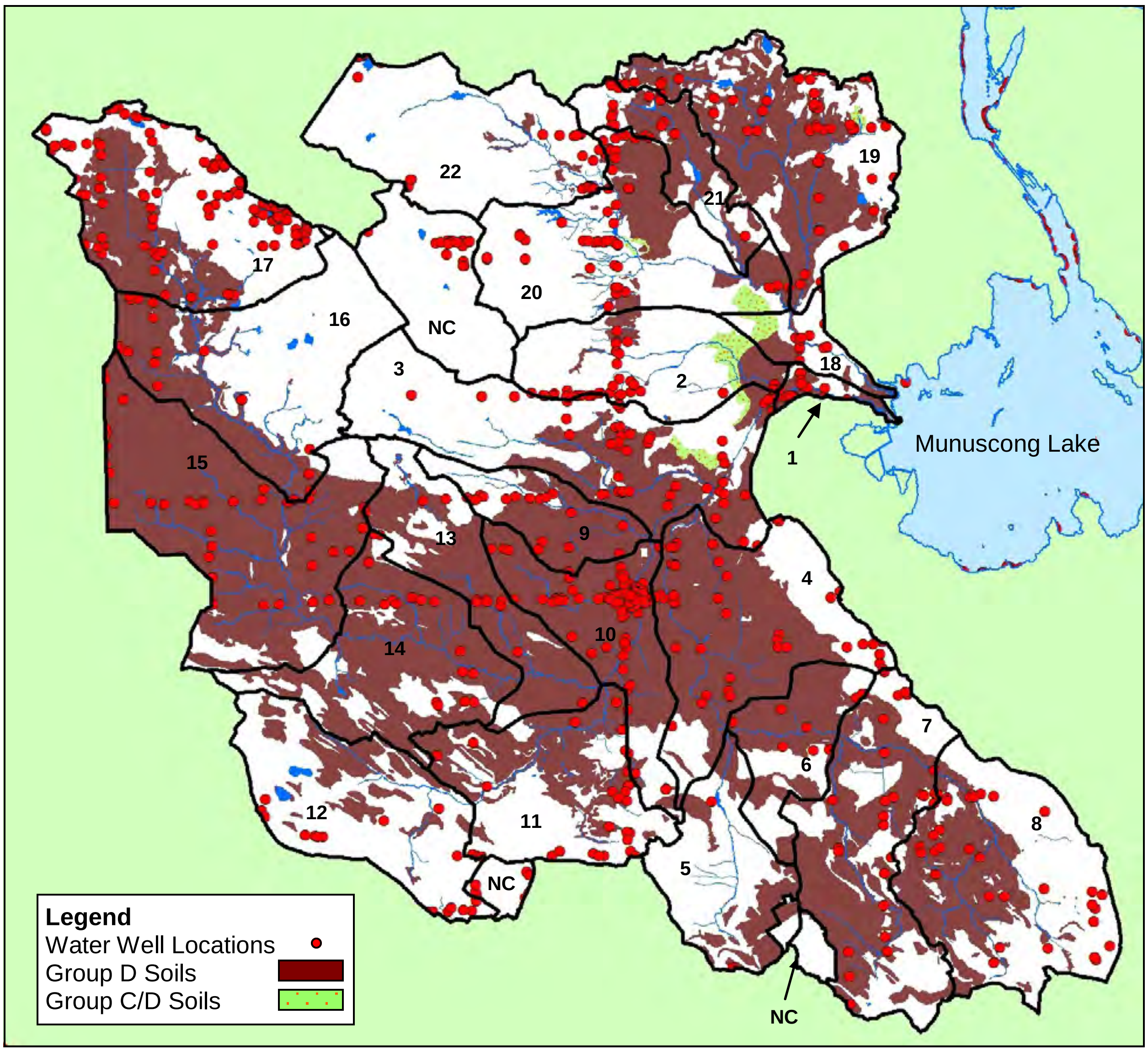


Figure 10.5 Critical Areas of Concern for Septic System I/E Activities

Figure 10.5 represents soils in the hydrologic soils group D and C/D which have very slow infiltration rates. These areas are considered not suitable for traditional septic tank and drainfield treatment systems. These poorly drained soils do not allow the downward percolation which provides both filtration and time for natural processes to treat the waste.

As demonstrated by the well water locations (red dots on Figure 10.5), this is also the area where most of the residential development has concentrated. Many of these rural residential locations have out-dated septic systems that are located near creeks and streams. These potential poorly functioning septic systems can be high and low flow contributors of bacteria and pathogens to the streams and creeks due their year around usage. Residential housing units in this critical area of concern will be the target of an extensive information and educational program that will include training in proper use and maintenance of septic systems and state-of-the-art improvement options to upgrade their systems to properly treat waste.

For urban areas, the proper operation and maintenance of municipal sewer infrastructure is necessary for protecting water quality. Municipalities must ensure that combined sewer overflow events and other untreated releases of septage waste do not impact water quality.

Educational efforts should target municipal officials and employees to encourage planning for adequate capacity, management, operation, and maintenance of sewer collection and treatment systems.

Priority Target Audiences: Governmental Officials and Employees, Property Owners, and Riparian Property Owners
Major Pollutants of Concern: bacteria and pathogens, nutrients
Priority Area: MRW High and Medium Priority Urban Management Areas and *E.coli* TMDL watersheds.

10.3.3 Land Use Change

Land use change can disrupt the natural hydrologic cycle in a watershed. Natural vegetation, such as forest cover, usually has high infiltration capacity and low runoff rates. Whereas, urbanized land cover has impervious areas (buildings, parking lots, roads) and networks of ditches, pipes and storm sewer, which augment natural drainage patterns. Impervious surfaces reduce infiltration and the recharge of groundwater while increasing the amount of runoff. Local governmental officials and builders/developers need to understand the water quality benefits of smart growth, low impact development, open space and farmland preservation and protection of wetlands, floodplains and riparian areas.

Current and past wetland loss in both urban and agricultural areas is a major concern. The loss of wetlands result in disrupted hydrology and degraded water quality. Further, many agricultural areas have been drained with extensive ditching to move water off the land quickly. While this helps with farm operations in these areas, water quality suffers.

The high flow amounts and velocity can cause increased streambank erosion and sediment delivery. Educational efforts should target natural resource planners and farmers to better understand the water quality benefits of ditch naturalization techniques and the need for wetland protection and restoration.

Priority Target Audiences: Farmers, Governmental Officials and Employees, Developers/ Builders/Engineers
Major Pollutant of Concern: Sediment
Priority Area: MRW High and Medium Priority Protection Areas, MRW High and Medium Agricultural Areas

10.3.4 Stormwater Runoff

Stormwater runoff is caused when rain, snowmelt or wind carries pollutants off the land and into water bodies. Education efforts should increase awareness of stormwater pollutants, sources and causes, especially the impacts of impervious (paved or built) surfaces and their role in delivering water and pollutants to water bodies. Everyday homeowner and business actions are often the source and cause of stormwater pollution. These activities include lawn care practices, household hazardous waste and oil disposal, pet waste disposal and car and equipment care. Spring snow melt within the MRW is of high concern because of local practices to pile snow directly within drainages and tributaries.

Local government activities impacting stormwater runoff include land use planning, road and parking lot maintenance and construction, lawn care practices, oversight of construction sites and identification and correction of illicit discharges and connections.

Educational efforts should target property owners and businesses about the many best practices that can decrease the amount of water and pollutants coming from their property. In addition, local governmental units can be encouraged to implement low impact development and smart growth techniques in their plans and zoning ordinances. Local governments can also be encouraged to enact regulations such as a stormwater ordinance. Educational efforts can also promote municipal operations and maintenance best practices, which are important for reducing polluted runoff. These include best practices for road and parking lot construction and maintenance, lawn care and vehicle maintenance.

Priority Target Audiences: Property Owners, Builders/Developers/Engineers, Businesses, Governmental Officials and Employees
Major Pollutants of Concern: Sediment, nutrients, bacteria and pathogens, temperature
Priority Area: MRW High and Medium Priority Urban Management Areas

10.3.5 Natural Resources Management and Preservation

Preserving land and managing natural resources is crucial for effective watershed management. Preservation and management of open space, wetlands, farmland and other natural features helps to reduce the amount of stormwater runoff entering water bodies, preserve natural ecosystems, endangered species as well as the services that the natural systems provide to us such as filtering drinking water and retaining storm water.

Invasive species, both aquatic and terrestrial; pose a threat to water quality and biodiversity in the MRW. Education efforts should focus on identification and control techniques as well as the prevention of additional invasive species. Education efforts should also encourage the use of native Michigan plants for landscaping, wildlife habitat and other uses.

Recreational activities can often have a negative impact on sensitive areas. In sensitive areas, there may be a need to limit recreational activities to ensure water quality and natural resources are protected. In addition, best management practices should be utilized to limit the impacts of recreational use on water and other natural resources. BMPs could include proper woody debris management for clearing rivers for navigation and installing and maintaining proper access sites to rivers and streams for fishing and canoeing.

Education efforts should instill a sense of understanding and appreciation for natural features. Property owners, developers and local governmental officials and employees need to be presented with options for preservation and management of natural resources. Educational efforts promoting smart growth, low impact and open space development and green infrastructure should target local government officials and employees and builders, developers and engineers.

Priority Target Audiences: Property Owners, Governmental Officials and Employees, Recreational Groups/Users, Developers/Builders/Engineers
Major Pollutants of Concern: Sediment, temperature
Priority Area: MRW High and Medium Priority Protection Areas

10.3.6 Watershed Awareness

The MRW has unique natural resources, but also has significant problems with water quality. Watershed residents need to understand that their everyday activities affect the quality of those resources; and, according to the social survey, 93% of respondents agreed that individual households have the potential to impact water quality.

Many residents may not be aware of the water quality issues within the watershed. Educational programs need to be introduced that will focus on priority pollutants and their sources and causes in each of the watersheds. Lastly, education efforts should, whenever possible, offer audiences solutions to improve and protect water quality.

One effective way to increase general watershed awareness is through recreational activities. These activities can help instill a sense of stewardship of the resources needed to enjoy the activities. Rivers, lakes and streams can provide many enjoyable recreational activities such as fishing, paddling, boating and swimming. It is important for recreational users to understand and appreciate the natural resources within the watershed and to gain a level of knowledge about the protection of those natural resources. Water trails and public access to water bodies can ensure that the public is offered an opportunity to enjoy and recreate on the water resources within the watersheds.

Priority Target Audiences: All, with focus on kids/students
Major Pollutants of Concern: Lack of buffers/riparian corridors, sediment, nutrients, bacteria and pathogens, and temperature
Priority Area: Entire watershed

Table 10.2 — I/E Plan (1 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Agricultural runoff and Land use change	Farmers	Distribute brochures/ flyers/fact sheets to farmers about advantages of implementing of BMPs, cost share programs, wetland protection and restoration, MEAEP	CLMCD	NRCS, CEMCD	Within one year (2 distributions/year)	Number of practices installed, amount of Farm Bill $'s spent within watershed, reduction in pollutants	$1,000 per distribution + 40 hours staff time per distribution
		Host a tour/field site visit at least every 2-3 years addressing cost share programs, agricultural runoff, BMPs, wetland protection and restoration/MEAEP	CLMCD, MSUE	NRCS, Farm Bureau	Current/On-going (One within 2-3 years)	Number of attendees	$3,000 + 160 hours staff time per farm tour
		Make one-on-one contact with farmers within priority areas to discuss BMPs, cost share programs, MAEAP verification	CLMCD	NRCS, MDA, Farm Bureau	Implement within one year and continued ongoing (3 MAEAP Verification farms within 4 years, 2 cost share programs targeting cattle access or manure management within two years)	Number of practices installed, amount of Farm Bill $'s spent in watershed, reduction in pollutants	1,500 hours staff time

Table 10.2 — I/E Plan (2 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Natural resource management and preservation	Recreation groups/users	Revamp the Munuscong River Historical Trail kiosks to include information about water quality and natural resources	MRWA	CLMCD, PHS	Within 4-5 years (Redesign all historical trail kiosks as replacement is needed)	Munuscong River Historical Trail kiosks completely replaced	$500 per kiosk
		Increase public access site and walking trails along the river	MRWA, LTG	CLMCD	Within 4-5 years (One access site within 3 years, one walking trail within 5 years)	Use of access site and trails; Implementation of trails and access sites	$5,000 per access site $200 per mile for water trail
		Develop and distribute one newsletter article per year	MRWA	CLMCD	Within one year, on-going (One article per year)	Number of readers (circulation of publication)	10 hours staff time per article
		Develop display board	MRWA	CLMCD	Within one year, on-going (use at three events per year)	Number of events displayed at	10 hours staff time to develop, + volunteers and staff time to man display
	Riparian landowners/ All landowners	Provide educational material through meetings/ presentations/direct mailing regarding voluntary conservation easements and other land protection measures	Little T, MRWA	CLMCD, MNA	Within 4-5 years, on-going (Township conservation easements established within 5 years)	Number of easements established	80 hours staff time

Table 10.2 — I/E Plan (3 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Land use change, Stormwater runoff	Builders/ Developers	Host workshop, seminar, and site tours to educate developers and contractors on proper stormwater and sediment management at construction sites	CLMCD	CCHD, LTG, MDEQ	Continued, on-going (Host one workshop per year)	Attendance at workshops	20 hours staff time
		Recommend design, construction, and maintenance of new and existing development in the watershed that utilizes BMPs	CLMCD	CCHD, LTG, MDEQ	Continued, on-going (Increased usage of BMPs in site design within two years)	Compliance with SESC permits	800 hours staff time
Land use change, stormwater runoff, and natural resource management and preservation	Government units and employees	Promote trainings being offered on water quality, land use planning, and LID	CLMCD, EUPRPDC	MSUE, MDEQ	Within 2-3 years (One training per year)	Increased use of LID techniques	20 hours staff time per training
		Produce and distribute brochures/flyers/fact sheets on land use and water quality, LID, green infrastructure	MRWA	CLMCD, MSUE, EUPRPDC	Within 2-3 years (Two pieces per year)	Increased use of LID practices	$500 per printing 40 hours staff time per piece
		Work one-on-one with planning commissions to improve plans and zoning ordinances for water quality protection ordinances, LID, and green infrastructure	CLMCD	EUPRPDC	Within 4-5 years, on-going (Two new/improved plans)	Number of improvement to plans and ordinances	300 hours staff time per plan or ordinance
		Host workshop to provide information on BMPs to establish at road stream crossings	CLMCD	MWRA, MDEQ, CCO, MDOT, CCRC, BMP vendors	Within 2-3 years, on-going (One workshop per year)	Number of road stream crossing replaced using BMPs	80 hours staff time per workshop
		Distribute brochures/flyers/ fact sheets about road construction maintenance best practices for water quality	CLMCD	MDEQ, MDOT, CCRC	Within 1-2 years (One piece per year)	Number of pieces distributed	$200 per distribution + 20 hours staff time

Table 10.2 — I/E Plan (4 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Land use change, stormwater runoff, and natural resource management and preservation	Builders/ Developers/ Real Estate/ New home/land owners	Develop a new homeowners package with information regarding water quality, watershed issues, lawn maintenance, green practices, natural habitats, LID, environmental laws	CLMCD	MRWA, LTG, MSUE, CCHD	Within 2-3 years, on-going (distribution to realtors/developers/ builders)	Number of packets distributed to new home/land owners	40 hours staff time
		Promote statewide LID manual and trainings	MRWA, CLMCD	EUPRPDC, MSUE	Within one year (One training/year)	Increased use of LID practices	20 hours staff time/training
		Host a watershed tour to showcase LID	CLMCD	MRWA, MSUE, EUPRPDC	Within 3-4 years (One tour every 2-3 years)	Attendance at tour and evaluations	100 hours staff time, + cost/person
	Property Owners	Print and distribute fact sheets, door hangs, about stormwater management, protecting water quality, and land protection	MRWA	LTG, CLMCD	Within 1-2 years (Three distributions per year)	Number distributed	$500 printing/ distribution 40 hours staff time
	Riparian Land Owners	Work with priority landowners to establish shoreline buffers	MRWA	CLMCD, MSUE, NRCS	Within 1-2 years (Contact with five land owners)	Number of land owners contacted Amount of buffers implemented	400 hours staff time
	Businesses	Develop promotions with landscaping and garden centers to provide educational brochures and workshops regarding native planting, green landscaping, and natural habitat	MRWA	MSUE, CLMCD	Within 1-2 years (Two workshops per year)	Attendance at workshop Number of businesses participating	100 hours staff time

Table 10.2 — I/E Plan (5 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Septage	Property Owners	Develop and distribute information (door hang tags, brochures, and flyers) about septic system maintenance	CLMCD	MRWA, CCHD, MDEQ	Within one year (Two distributions per year)	Number of pieces distributed	$300 per distribution + 30 hours staff time per distribution
	Riparian Land Owners	Meet one-on-one basis to discuss septic system maintenance	MRWA	CLMCD, CCHD	Within 2-3 years (contact within priority area per year)	Improved septic maintenance and reduced pollutants	200 hours staff time
	Government units and officials	Develop and distribute brochures/flyers/fact sheets about the impacts of failing septic systems and what local government can do	CCHD	CLMCD	Within 2-3 years (One distribution per three years	Increased num-ber of septic re-lated ordinances	$400 per distribution + 80 hours staff time
		Work one-on-one with planning commissions to improve plans and zoning ordinances relating to septic systems	CCHD	CLMCD, EUPRPDC	Within 2-3 years (One municipality per year)	Increased num-ber of septic re-lated ordinances	160 hours staff time
		Promote trainings about municipal sewer infrastructure planning and management	CCHD	CLMCD	Within 2-3 years (One training every 2years)	Number of officials and employees attending trainings	20 hours staff time

Table 10.2 — I/E Plan (6 of 6)

Issue	Priority Target Audience	Activity	Potential lead agency	Potential partners	Timeline (milestones)	Evaluation	Costs
Watershed Awareness	All	Maintain a website that makes watershed information easily available to the public	MRWA, CLMCD	LSSU	Current, on-going	Website traffic – number of monthly hits	$200 per year hosting fees + 40 hours staff time per year
		Create display and participate in 1-2 community festivals per year	MRWA	CLMCD	Current, on-going (1-2 festivals per year)	Number of participants	$200 per event + 40 hours staff time development
		Produce and Distrubute 1-2 press releases per year	MRWA	CLMCD	Current, on-going	Number of readers	10 hours staff time/release
		Develop and install "Entering the Watershed" Signage at boundaries And major roads	MRWA	MDOT, CCRC	Within one year (Three signs per year)	Number of signs installed	$300 per sign for printing and installation
		Assist with hosting of Annual "Environmental Summit"	MRWA	CLMCD, BPAC, LSSU	Current, on-going	Number of participants	40 hours staff time
		Host annual float trips throughout the watershed highlighting natural aspects of the area	MRWA	LSSU	Current, on-going (1-2 trips per year)	Number of participants	40 hours staff time
	Students/ Kids	Expand student stream monitoring program	MRWA	CLMCD, LSSU	Current, on-going (One new school program per year)	Produce and distribute 1-2 press releases per year	$2,000 for program supplies + 100 hours staff time/year
		Distribute curriculum materials on watersheds and water quality to teachers	MRWA	LSSU, CLMCD	Within one year (Reach all schools within two years)	Develop and install "Entering the Watershed" signage at boundaries and major roads	$200 per school + 80 hours staff time
		Plan and offer one teacher training workshop	MRWA	CLMCD, LSSU, PHS	Within 2-3 years (One training per year)	Assist with hosting of annual "Environmental Summit"	$200 per workshop + 40 hours staff time

10.4 Distribution Formats

Because of the differences between target audiences, it will sometimes be necessary to utilize multiple formats to successfully get the intended message across. Distribution methods include the media, newsletters and direct mailings, and passive distribution of printed materials. Below is a brief description of each format with some suggestions on specific out-lets or methods.

10.4.1 Media

Local media is a key tool for outreach to several audience groups. The more often an audience sees or hears information about watershed topics, the more familiar they will become and the more likely they will be to use the information in their daily lives. Keeping the message out in front through press releases and public service announcements is essential to the success of education and outreach efforts.

Newspapers include: The Soo Evening News, St. Ignace News.

Radio outlets include: WHWG 89.9 FM, WLSO 90.1 FM, WIHC 97.9 FM, WCMZ 98.3 FM, WYSS 99.5 FM, WSUE 101.3 FM, WADW 105.5 FM, WIDG 940 AM, WSOO 1230 AM, WKNW 1400 AM.

Television outlets include: WFQX Fox 3, WTOM NBC 4, WGTQ ABC 8, WCML PBS 9, and WWUP CBS 10.

10.4.2 Newsletters and other direct mailings

Several municipalities, governmental agencies, utilities, County offices and non-profit organizations send out newsletters or other mailings which may be coordinated with various outreach efforts such as fact sheets or "Did you Know" messages. Currently identified mailings include Township utility bills, Chippewa County Farm Bureau newsletters, USDA Farm Service Agency newsletters, Chippewa/East Mackinac Conservation District newsletters, Munuscong River Watershed newsletters, MSUE, and Pickford High School.

10.4.3 Passive Distribution

This method relies on the target audience picking up a brochure, fact sheet, or other information. This can occur by placing materials at businesses, libraries, township/city/village halls and community festivals and events. The Chippewa Luce Mackinac Conservation District maintains an active website with web paged devoted to water quality and watershed management within the region. As part of the Information and Education plan, other organizations should be encouraged to supply watershed related educational materials through their websites where appropriate.

10.5 Plan Administration and Implementation

An information and education implementation strategy is laid out for the MRW in the Action Plan found at the end of this report. This table lists specific tasks or activities, a potential lead agency and partners, timeframe, milestones and costs to educate target audiences for each watershed issue.

10.6 Roles and Responsibilities

The MRWA and CEMCD will partner to oversee the implementation of the Information and Education Plan as well as make adjustments to the plan when necessary. An Information & Education committee will meet as needed to advise on educational efforts.

10.7 Priorities

Project priorities are established to direct resources to the areas that will gain the most benefit from the designated outreach activity. These priorities should be reevaluated over time and changed as necessary.

Highest priority activities include:

- Activities that promote or build on existing efforts and expand partnerships with neighboring watershed projects, municipalities, conservation organizations and other entities.
- Activities that lead to actions (especially those in the watershed management plan), which help to improve and/or protect water quality.
- Activities that promote general awareness and understanding of watershed concepts and project goals.Activities that leverage external funding from local, state or federal sources.

10.8 Evaluation

The goal of informing and educating the users within the MRW is that water quality is being improved and/or protected. With watershed being a changing system it can be hard to evaluate progress being made. Though with education efforts, evaluation can be assessed through the change in knowledge, increase in awareness, or increase in activity. Measures and data collection for this level can take place in three specific ways:

1. A large-scale social survey effort to understand individual watershed awareness and behaviors impacting water quality. This has been completed as part of the planning project and could be repeated in the future after tasks have been completed to see if knowledge and awareness have changed within the watershed. One limitation to this is the high cost to complete with the variability in response rates.
2. A pre- and post-test of individuals at workshops focused on specific water quality issues in the MRW. This will help to see how affective a particular workshop gets its message to participants but isn't able to adequately gage implementation of messages.
3. The tracking of involvement in a local watershed group or increases in attendance at water quality workshops or other events.

Chapter 11 Evaluation

Effective evaluation is an important part of any watershed management plan. An evaluation process will provide measures of the effectiveness of implementing the watershed management plan. Showing success will gain support from the community and increase the potential for project sustainability.

Since watersheds are extremely dynamic systems influenced by many factors, evaluation can be a difficult and expensive endeavor. As a result, different levels of evaluation are proposed to illustrate levels of success in the watershed. Lastly, this Watershed Management Plan should be reviewed and updated periodically.

11.1 Knowledge and Awareness

The first level of evaluation is documenting a change in knowledge or increase in awareness. Measures and data collection for this level can take place in three specific ways:

1. A large-scale social survey effort to understand individual watershed awareness and behaviors impacting water quality. This has been completed as part of the planning project and could be repeated in the future after tasks have been completed to see if knowledge and awareness have changed within the watershed. One limitation to this is the high cost to complete with the variability in response rates.
2. A pre- and post-test of individuals at workshops focused on specific water quality issues in the MRW. This will help to see how affective a particular workshop gets its message to participants but isn't able to adequately gage implementation of messages.
3. The tracking of involvement in a local watershed group or increases in attendance at water quality workshops or other events.

11.2 Documenting Implementation

The second level of evaluation is BMP adoption or implementation. The evaluation is mostly a documentation of successful implementation. The evaluation will involve identifying and tracking individuals, organizations and governmental units involved in implementing and adopting BMPs whether they be structural, vegetative or managerial. Data about the BMP implementation can be gathered simply through tracking the number of BMPs installed or adopted. To further show implementation success, maps and graphs of locations of implementation help to educate the public on practices being done and what their neighbors are doing. It has been seen that once a practice is installed within the area that if the person had a good experience they will talk about it and suggest it to their neighbors increasing implementation. This evaluation should be done annually.

Table 10.1 has milestones and specific evaluation methods proposed for measuring the progress of BMP implementation and improvements to water quality for each task in the MRW action plan. The action plan should be reviewed at least annually to ensure progress is being made to meet the milestones. During the annual review, the action plan should be updated as tasks are completed and as new tasks are identified.

11.3 Monitoring Water Quality

Another level of evaluation is documenting changes in water quality through monitoring. The monitoring of water quality is a very complex task, which involves gathering data from a number of sources. Periodic assessments of the water quality in the MRW are conducted as part of federal and state water quality monitoring programs. Local efforts to monitor water quality include those of the Munuscong River Watershed Association and Pickford High School. Combining data gathered under these programs, with other periodic water quality assessments will provide a picture of water quality in the watershed. Four types of monitoring are proposed for the MRW:

1. The inventory that was conducted during the plan development process could be repeated at the sites throughout the watershed. The results could be compared to see if any problem areas have been improved or if any areas are worsening. This activity should take place every 4-5 years.
2. Expanding Current Monitoring Efforts:
   A. Benthic Monitoring can evaluate changes in the presence and type of aquatic life in the Munuscong River and its tributaries to provide a general trend of water quality in the watershed. Routinely the MDEQ performs benthic monitoring in the watershed. With assistance from the MiCorps' Volunteer Stream Monitoring Program (VSMP), the MRWA could extend the sampling locations and increase sampling amounts within the watershed.
   B. Thermal monitoring is of special importance for the coldwater streams in the MRW. Routine monitoring of temperature regimes will help to evaluate if these coldwater streams are being protected with the BMPs that are being implemented in these subwatersheds. MDNR Fisheries Division sometimes conducts thermal monitoring. With assistance from LSSU there could be the potential for expanded thermal monitoring within the tributaries of the MRW.
   C. Continued *E.coli* monitoring in the targeted areas of the MRW and increased monitoring within tributaries is a high priority. The levels of *E.coli* have been extremely high in the MRW but pinpointing the sources is difficult and limited to finding sources or illicit pipes discharging to the streams. A specific monitoring effort in these subwatersheds will help to better understand the problem and to recommend appropriate BMPs for implementation.
   D. These monitoring efforts should be an on-going work activity before and after BMP implementation.

Benthic, habitat, and potential thermal monitoring efforts could be expanded with the development of a local volunteer monitoring program. This program could be a task that is completed through the MRWA. There is assistance to implement a volunteer river monitoring through MiCorps' (VSMP).

11.4 Estimating Pollutant Load Reductions

The last level of evaluation is to estimate a reduction in pollutant loadings. A pollutant loading is a quantifiable amount of pollution that is being delivered to a water body. Pollutant load reductions can be calculated based on the ability of an installed BMP to reduce the targeted pollutant.

Pollutant loading calculations are best used at specific sites where structural BMPs are installed and detailed data about the reduction of pollutants can be gathered. Specific pollutant load reduction calculations should be completed for structural BMPs when they are proposed and installed.

The MRW plan is mostly focused on the preservation of water quality and habitat. However, there are pollution problems throughout the watershed. Pollutants of concern include bacteria/pathogens (*E.coli*), sediment, nutrients (nitrogen and phosphorus), and temperature.

In Table 10.1 there is a column with estimated pollutant loads per site. Evaluation of BMPs installed can be measured in the amount of those pollutants reduced per site and throughout the watershed. Specifically these tasks include:, installing agricultural BMPs (filter strips, no-till, grassed waterways, nutrient mgt, etc), restoring riparian buffers and stabilizing streambanks, utilizing urban stormwater BMPs (road/parking lot sweeping, stormceptors, rain gardens, vegetated swales, constructed wetlands, etc), correcting livestock access problem sites, correcting road/stream crossing problem sites, correcting failing septic systems, and protecting and restoring wetlands and sensitive lands.

To address threatened and impaired designated uses in the priority agricultural areas, BMPs should be implemented in at least 75% of those areas. At this level of implementation, an estimated reduction of sediment by 2,647 pounds, total phosphorus by 4,055 pounds and total nitrogen by 8,109 pounds needs to be realized at the mouth of the Munuscong River.

To address the threatened and impaired use of Partial and Total Body Contact, BMPs must be implemented in agricultural, protection and urban areas to ensure all water bodies meet water quality standards for Escherichia coli (*E. coli*). For Total Body Contact, E. coli levels need to be reduced to 130 E. coli per 100 milliliters (ml) water as a 30-day average and 300 *E. coli* per 100 ml water at any time during the time period of May 1 to October 1 to meet the water quality standard. For Partial Body Contact, E. coli levels need to be reduced to 1000 E. coli per 100 ml water to meet the water quality standard.

11.5 Evaluating the Watershed Management Plan

The watershed management plan should be reviewed and updated as needed. Munuscong River Watershed Association should take the lead in the management and action plan review process. As general guidance, the review should at a minimum include the following updates:

- Land Cover (Chapter 3) – at a minimum every 10 years
- Demographics (Chapter 3) – with every new US Census
- Future Growth and Development (Chapter 3) – every 5-10 years
- Local Water Quality Protection Policies (Chapter 4) – every 3 years
- Water Quality Summary (Chapter 7) – every two years with the release of MDEQ Integrated Reports
- Scheduled TMDLs (Table 10.1) – every two years with the release of MDEQ Integrated Reports or when a TMDL is completed
- Prioritization of areas, pollutants and sources (Chapter 8) – every 5-10 years
- Goals and Objectives (Chapter 9) – every 5-10 years
- Implementation Strategy (Chapter 10) – review annually and update as needed

11.6 Water Quality Improvement Goals and Indicators for the Munuscong River Watershed

The following set of qualitative evaluation indicators can be used to determine whether pollutant-loading reductions are being achieved over time and whether substantial progress is being made towards attaining water quality goals in the Munuscong River watershed. The indicators can be used for determining whether this plan needs to be revised at a future time in order to meet water quality goals.

Table 11.1 Water Quality Improvement Goals and Indicators

Water Quality Improvement Goal	Indicators
Michigan Water Quality Standards are not exceeded in any of the watersheds	1) During next scheduled MDEQ water quality assessment of the Munuscong and Little Munuscong and tributaries, no E. coli levels will exceed Michigan and US EPA water quality standards for both single day measurement (300 E coli per 100 ml of water) and 30 day geometric mean measurement (150 E. coli per 100 ml of water in 5 samples over 30 days) 2) All sites surveyed in the MDEQ Biological Survey will rate good to excellent for in-stream, riparian habitat assessments 3) All sites surveyed for sediment and siltation rate acceptable
Runoff volume increase and peak flood yield change nonexistent in MDEQ Hydrology Study Critical Subbasins.	1) Completion of wetland restoration projects in areas of hydrological instability (Fongers 2011) 2) Re-evaluation of streambank erosion sites to determine status of erosion trends 3) Follow up of Fonger's hydrology study to compare hydrology status with 1987.
Fishery habitat maintained	1) All sites surveyed in the MDEQ Biological Survey will rate good to excellent for in-stream 2) Creel surveys and MDNR fisheries assessments confirm healthy fish populations and life cycles
On-site septic systems managed appropriately	1) Chippewa County Health Department OSS failure rates decrease by 50%

Munuscong River Watershed Management Plan
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