Portage River Watershed Management Plan

#2012-0017

Prepared for: Michigan Department of Environmental Quality

Prepared By: Calhoun Conservation District
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Marshall, MI 49068
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STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
KALAMAZOO DISTRICT OFFICE

RICK SNYDER
GOVERNOR

C. HEIDI GRETHER
DIRECTOR

November 2, 2016

VIA E-MAL

Ms. Tracy Bronson
Calhoun County Conservation District
13464 Preston Drive
Marshall, Michigan 49068

Dear Ms. Bronson:

SUBJECT: Watershed Management Plans Approval for
Little Portage Creek Watershed Management Plan and
Portage River Watershed Management Plan

Thank you for submitting your watershed management plans titled "Little Portage Creek Watershed Management Plan" and "Portage River Watershed Management Plan" to the Department of Environmental Quality (DEQ) for review with respect to meeting criteria for: (1) the state Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control program, and (2) the U.S. Environmental Protection Agency (EPA) Section 319, Nonpoint Source Management Program, of the federal Clean Water Act (CWA). The efforts and support of the Calhoun County Conservation District and your partners to preserve and protect Michigan's surface water resources are appreciated.

As you may know, the CMI program criteria are specified in Administrative Rules promulgated pursuant to Part 88, Water Pollution Prevention and Monitoring, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, effective October 27, 1999. The EPA requires that all implementation projects funded under Section 319,of the CWA, be supplemented by a watershed management plan that meets nine required elements as described in the EPA's document titled, "*Nonpoint Source Program and Grants Guidelines for States and Territories (April 12, 2013).*" Our review of the watershed management plans that we received on August 18, 2016, indicates that the plans meet both the CMI criteria and the EPA criteria, and are hereby approved for the purposes of the CMI Nonpoint Source Pollution Control program and the federal Section 319 program.

Please note that the DEQ watershed management plan approvals are only good for the effective life of the plan. In this case, the watershed plans describe actions that are proposed to be implemented over a 10-15 year period, after which an updated plan will likely need to be submitted to the DEQ for review and approval to maintain eligibility for both CMI and 319 funds. In addition, the plan approval is effective as long as the underlying assumptions within the plan remain relevant. Underlying assumptions would include, but are not limited to, things like designated use impairment, land use distribution, and stakeholder's goals and objectives. Updates of approved watershed management plans are expected to be endorsed by the entity that developed and received approval of the plan. For information regarding funds that may be available on the DEQ's Nonpoint Source Grant Program, please monitor our web site at www.michigan.gov/deqnonpointsourcepollution.

Feel free to contact me or Kalamazoo Water Resources District Office, Program Staff, Mr. Kyle Alexander, 269-568-2681, alexanderk7@michigan.gov, Department of Environmental Quality, Water Resources Division, 7953 Adobe Road, Kalamazoo, Michigan 49009-50-25, if you have questions about the plan approval.

Sincerely,

Jerrod Sanders, Supervisor
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Kalamazoo District Office
269-350-1801
sandersj13@michigan.gov

JS:KA:dmm

cc: Mr. Bob Sweet, DEQ
Ms. Julia Kirkwood DEQ
Mr. Kyle Alexander, DEQ
Mr. Peter Vincent, DEQ

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GIS contributions and field work - Mike Rubley (CCD)
Technical and field contributions - Rick Pierson (CCD)
Project Management and Plan Writing - Tracy Bronson (CCD)

We would like to thank these individuals and organizations without their input this plan would not be possible:

Editing and project direction by: Chris Bauer (MDEQ), Alyssa Riley (MDEQ), Kyle Alexander (MDEQ), Julia Kirkwood (MDEQ), Joe Rathbun (MDEQ), Rob Zbiack (MDEQ), Bob Sweet (MDEQ), Tracy Bronson (CCD)

Landscape Level Wetland Functional Analysis by Jeremy Jones (MDEQ)

Technical assistance from: Melanie Stoughton (KCD), Jean Gagliardo (Kalamazoo NRCS), and Linda Zabik (KCD)
Planning and zoning contributions from: Wendy Ogilvie (FTCH)
MDNR Southern Lake Michigan Management Unit
Matt Meersman Van Buren Conservation District (VBCD)
Friends of the St. Joe (FoTSTR)
John Wilkes Indian Lake Association President
Park Township
Charleston Township
Brady Township
Steering Committee Participants

We would also like to recognize the St. Joseph River Watershed Management Plan 2005, the Portage River Watershed Management Plan 2006, the Paw Paw River Watershed Management Plan 2008, and the St. Joseph River Assessment 1999 for providing a template and building blocks for this plan. This plan was developed in concert with the Little Portage Creek Watershed Management Plan and as a result will have similar and some of the same information as the planning process was incorporated within the same project.

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1 PROJECT OVERVIEW AND INTRODUCTION

A watershed is defined as all of the land area that drains into a common low point, such as a lake or river. Rainwater and snowmelt run over the land and carry pollutants into those lakes and rivers. This form of pollution is nonpoint source pollution, since it originates from a variety of sources. Watershed management takes a holistic approach to natural resource protection, focusing on all the activities within the watershed boundaries that can impact water quality. This requires working across township, county, and sometimes state and international boundaries. The watershed management planning process also relies heavily on input from stakeholders within the watershed.

The 1987 amendments to the Clean Water Act (CWA) established the Section 319 Nonpoint Source Management Program. Section 319 addresses the need for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects (http://water.epa.gov/polwaste/nps/cwact.cfm). Michigan's Nonpoint Source Program assists local units of government, non-profit entities, and numerous other state, federal, and local partners to reduce nonpoint source pollution statewide. The basis of the program is watershed management and working with stakeholders to develop and implement plans to protect the watersheds of the state (www.michigan.gov/depnps). The state awarded the Calhoun Conservation District (CCD) with a 319 grant for Portage River/Little Portage Creek. Through this grant, watershed management plans (WMP) were developed for the Portage River Watershed and the Little Portage Creek Watershed. The focus of this WMP is the Portage River Watershed.

2 WATERSHED DESCRIPTION

2.1 GEOGRAPHIC SCOPE

Portage River Watershed (PRW) encompasses an area of 125,543 (196 mi^2) acres in southern part of Kalamazoo County and northern part of St. Joseph County. In Kalamazoo County, the watershed covers portions of Charleston, Texas, Pavilion, Climax, Prairie Ronde, Schoolcraft, Brady and Wakeshma Townships. In St. Joseph County, it includes portions of Park, Mendon, and Lockport Townships. The watershed also encompasses portions of the City of Portage, the City of Three Rivers, and the Village of Vicksburg. The Portage River Watershed is a subwatershed of the St. Joseph River Watershed which drains 4,685 square miles of southern Michigan and northern Indiana and enters Lake Michigan in the City of St. Joseph. The Portage River flows into the St. Joseph River in the City of Three Rivers.

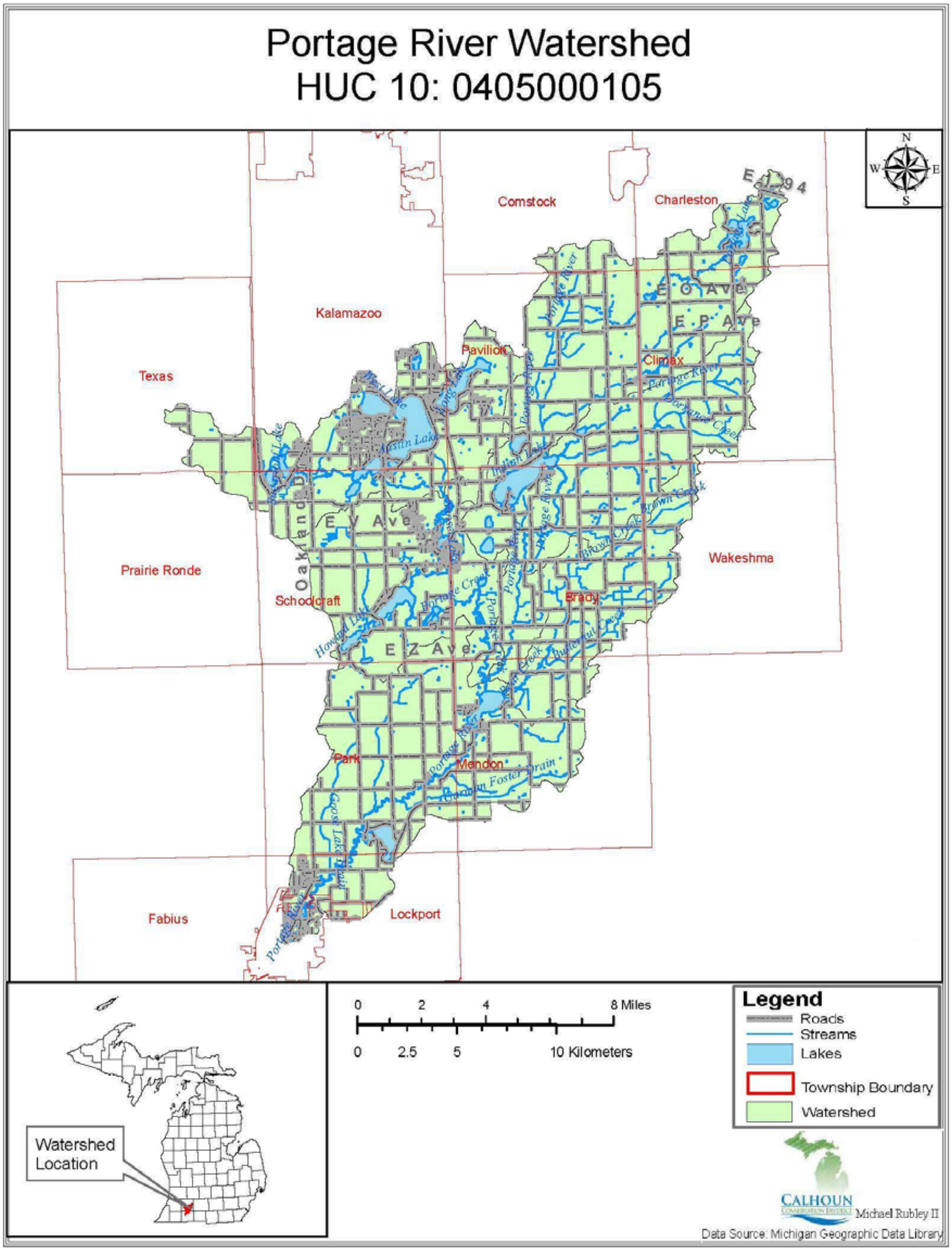


Figure 1. Map of Portage River Watershed

2.2 Ecoregion and Climate

The Portage River Watershed lies within the Southern Michigan/Northern Indiana Till Plains ecoregion. Rivers in the Southern Michigan/Northern Indiana Till Plains ecoregion are generally of good water quality in the headwaters. This ecoregion is drained predominantly by perennial rivers. Such rivers are typically sluggish and are bordered, often extensively, by wetland tracts. Drainage ditches and channelized rivers have been a common solution to assist drainage of areas that are too wet for settlement and agricultural needs (Goodwin et al., 2012).

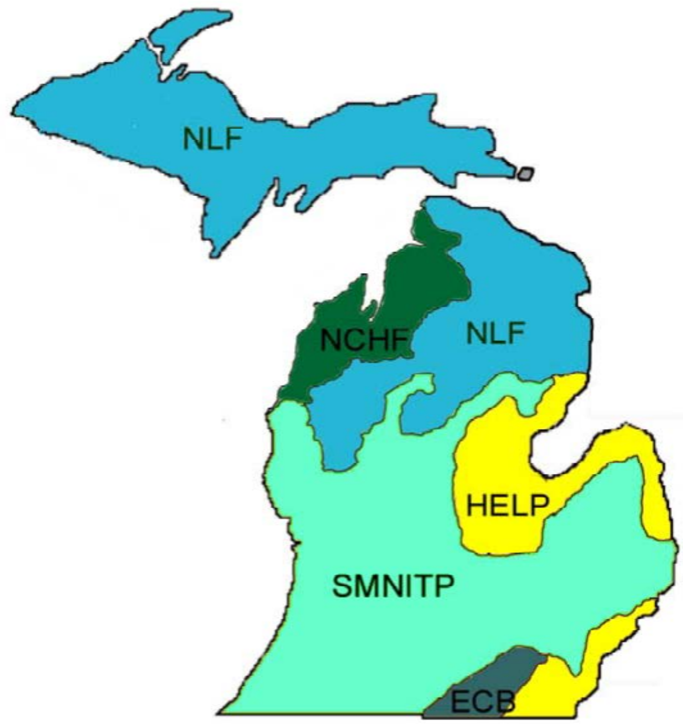


Figure 2. Ecoregions

SMNITP - Southern Michigan/Northern Indiana Till Plains
NCHF - North Central Hardwood Forests **NLF -** Northern Lakes and Forests **HELP** - Huron-Erie Lake Plains
ECB - Eastern Corn Belt Plains

The average winter temperature in this area is approximately 26.6° F. Average summer temperature is approximately 70.8° F. Total annual precipitation is approximately 34.2 inches. Average annual snowfall varies between Kalamazoo and St. Joseph Counties; Kalamazoo County averages 71.4 inches of snowfall per year, and St. Joseph County averages 45.6 inches. The prevailing wind direction for this area is southwesterly (Austin 1979 and Cowan 1983).

2.3 Soils

An evaluation of soil texture classes shows that 6,434 acres of water, 715 acres of variable, 14,909 acres of muck, 59,769 acres of loam, 34,979 acres of sandy loam, 8,529 acre of loamy sand, 0.87 acres of sand, and 204 acres of gravel exist in the watershed.

***Water/variable was omitted from this figure and sand and gravel are too insignificant to be illustrated**

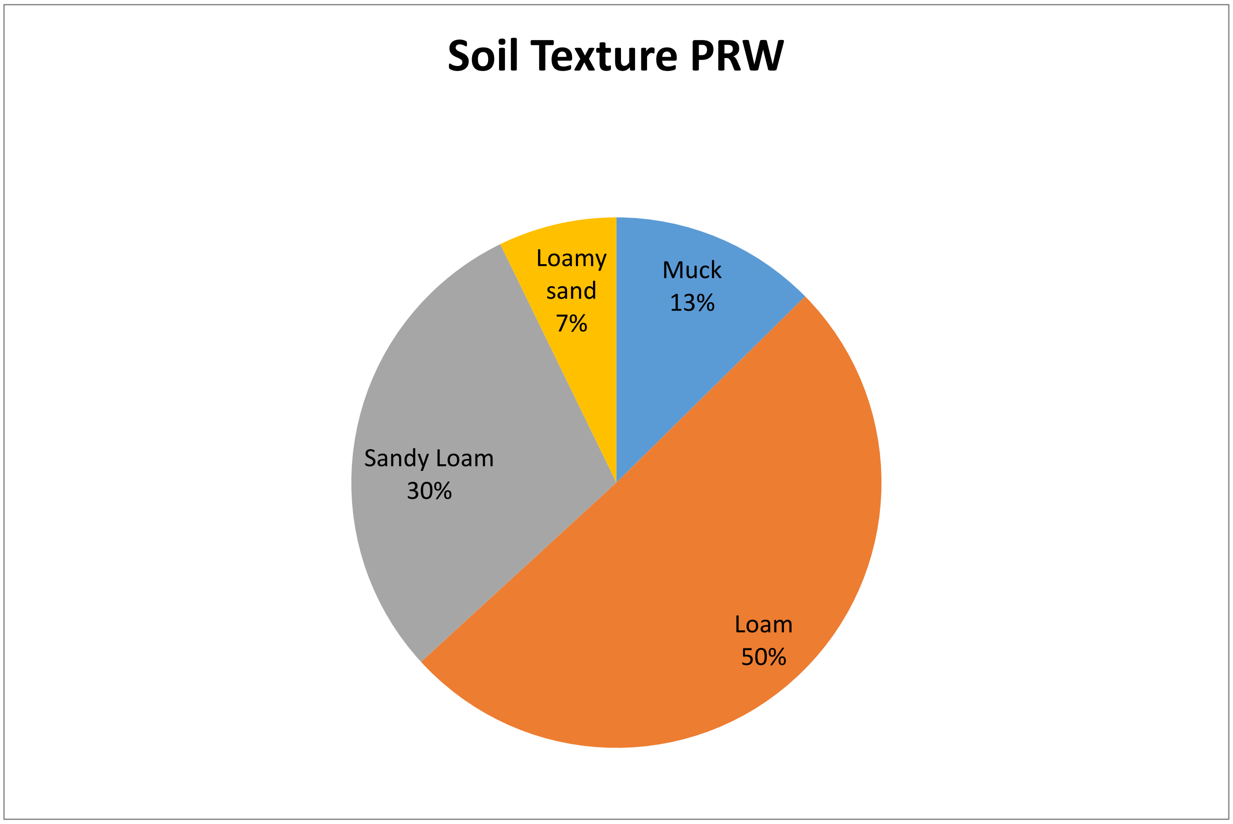


Figure 3. Soil Texture Percentages in the PRW

Soil surveys are available for every county in the United States, either online or in print (http://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/). These soil surveys contain predictions of soil behavior for selected land uses and highlight the limitations and hazards inherent in the soil, general improvements needed to overcome those limitations, and the impact of selected land uses on the environment. This information is extremely important for farming, planning land use(s), selecting construction sites, and identifying special practices needed to ensure proper performance.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are only moderately deep over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clay or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

A depiction of locations of soil texture is as follows:

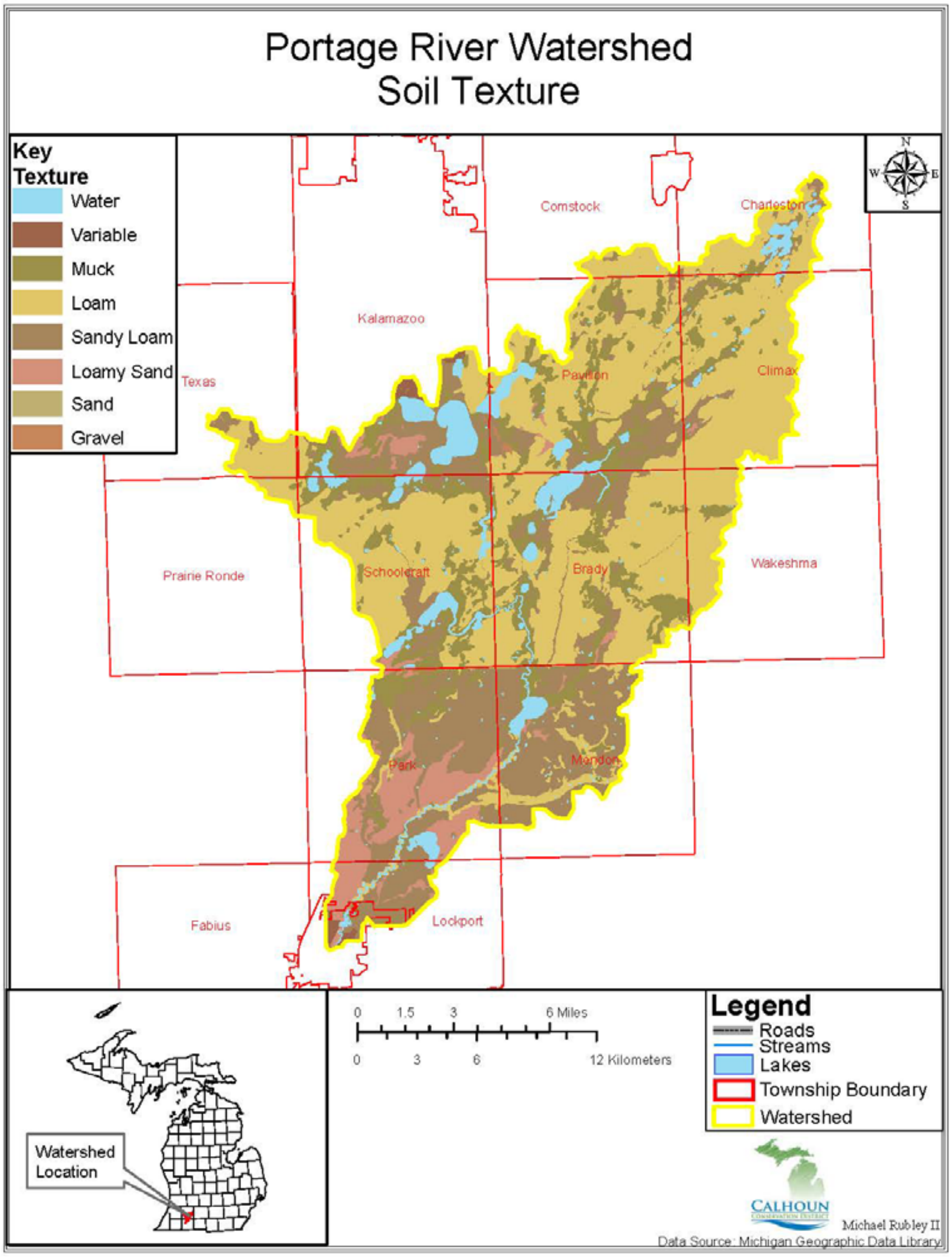


Figure 4. Soil Texture locations

The watershed shows six primary soil formations:

Coloma-Spinks-Oshtemo at 18,609 acres, Oshtemo-Kalamazoo-Houghton at 60,451 acres, Riddles-Hillsdale-Giffords at 17,979 acres, Schoolcraft-Kalamazoo-Elston at 20,897 acres, Sebewa-Cohoctah-Brady at 6,596 acres, and water at 1,008 acres.

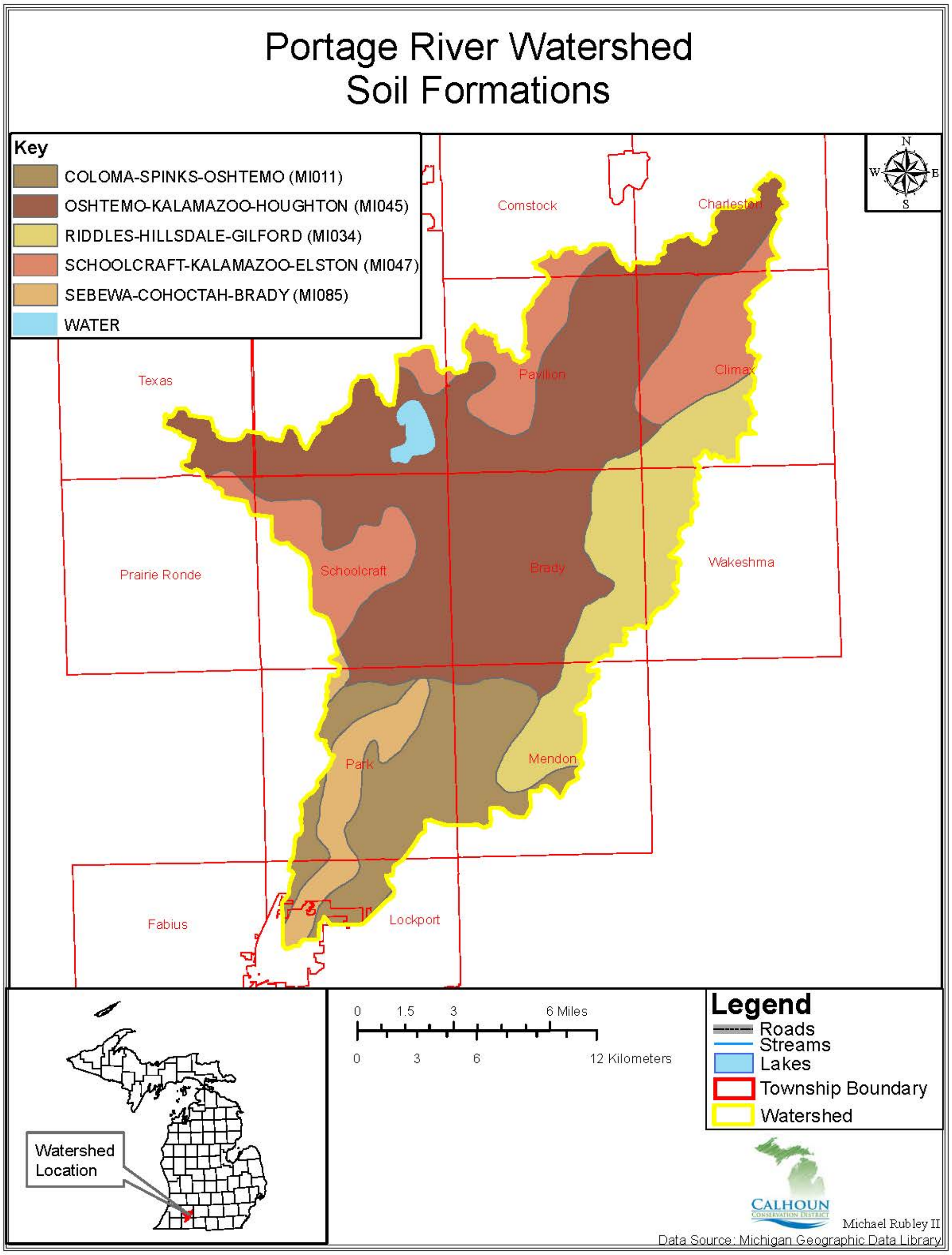


Figure 5. Soil Formations

There are four hydrologic soil groups, or HSGs, that along with land use, management practices, and hydrologic conditions determine a soils associated runoff curve or runoff from rainfall. Group A—Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. This group is primarily sand with small amounts of clay. Group B—Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. This group tends to be about 20% clay and 80% sand. Group C—Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. These soils tend to be 30% clay and 70% sand with loam mixed in. Group D—Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is very restricted. Soils are typically 40% clay, less than 50% sand and a small amount of other soil types.

A hydrologic rating showed that 7,354 acres of unknown/water, 8,530 acres of type A soils, 9,942 acres of type A/D soils, 79,233 acres of type B soils, 7,552 acres of type B/D soils, 7,421 acres of type C soils, and 5,508 acres of type D soils exist in the watershed. Soil hydrology is an important factor in watershed management planning to determine how land management practices affect the quantity, quality, timing, and velocity of water runoff and flow throughout a watershed.

Unknown/water was omitted from this figure

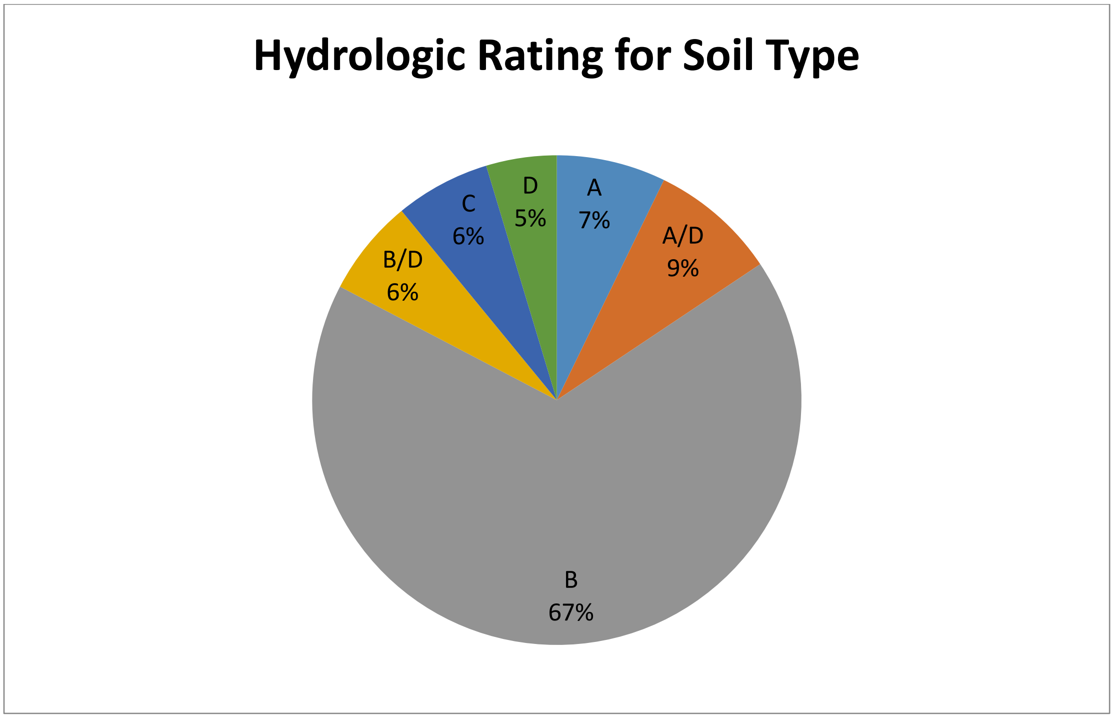


Figure 6. Hydrologic Rating for Soil Types

A depiction of where these soils are concentrated are in the following figure:

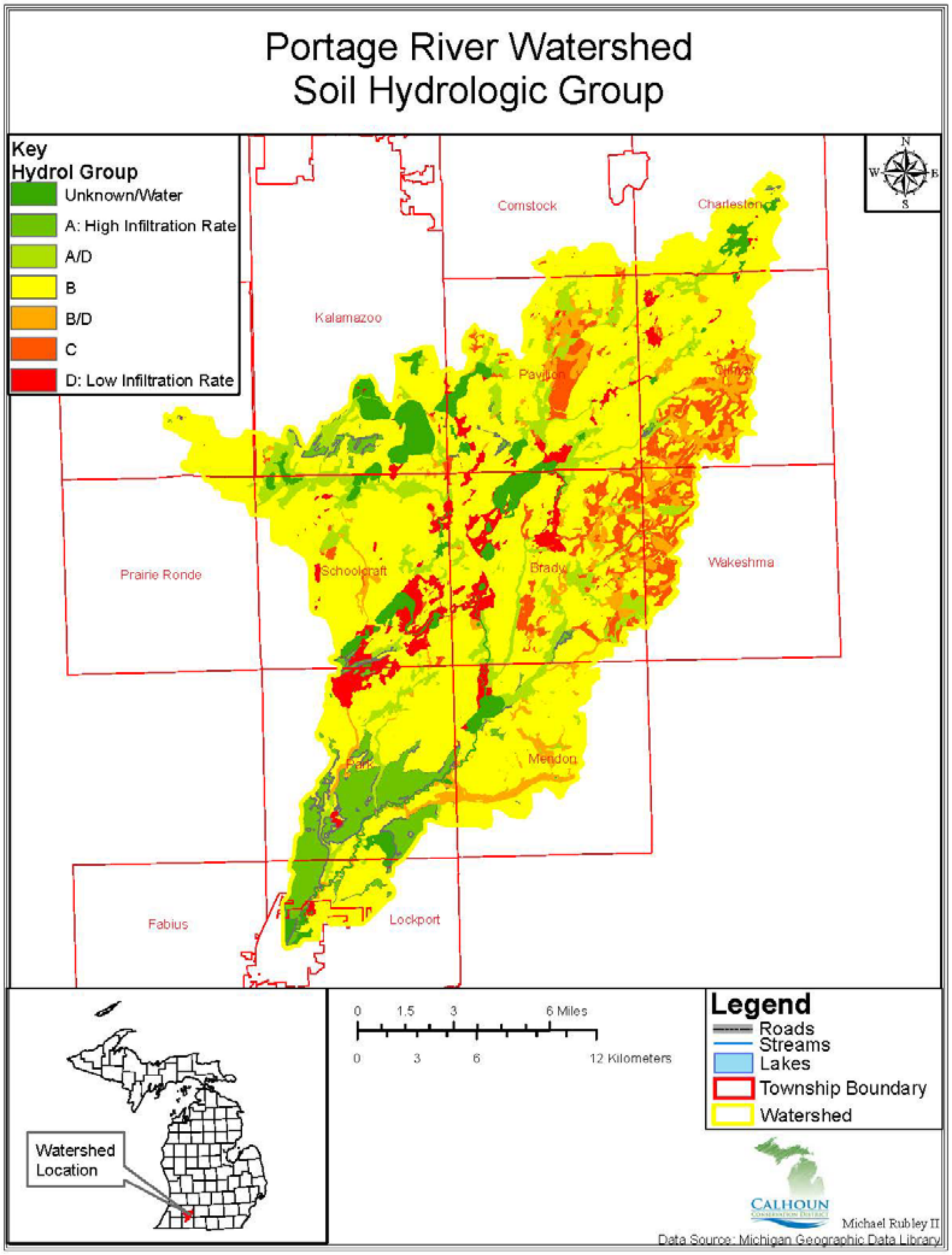


Figure 7. Soil Hydrologic Group

The United States Department of Agriculture (USDA) defines prime farmland as having the soil quality, growing season, and moisture supply needed for the agricultural productivity to sustainably produce high yields of crops when treated and managed according to acceptable farming methods. Farmland classification in the watershed was determined to be 22,484 acres of not prime farmland, 14,154 acres of prime farmland if drained, 19,250 acres of local importance, and 69,654 acre of prime farmland.

Highly erodible land (HEL) refers to land that is very susceptible to erosion, including fields that have at least one third or 50 acres of soils with a natural erosion potential of at least 8 times their T value (T value is the maximum average soil loss in tons per year that will still allow economical maintenance of the current level of production into the future). An evaluation of the FSA designated HEL soils layer showed that 3,103 acres of highly erodible land exist in the watershed. Highly erodible land comprises 2.5 percent of the total land area of the watershed.

USDA-Natural Resources Conservation Service (NRCS) uses the Nitrogen Leaching Risk Assessment to assess a field's potential for nitrates to leach out of the plant root zone and into tile flow or groundwater. Nitrogen leaching potential is determined by combining the soil's hydrologic soil grouping, the local county's annual rainfall, and the local county's seasonal rainfall. The Nitrate Leaching Risk Index for the PRW shows that 7,354 acres are not rated/water, 99,715 acre of medium risk, 9,942 acres of medium/high risk, and 8,530 acres of high risk for nitrate leaching exist in the watershed.

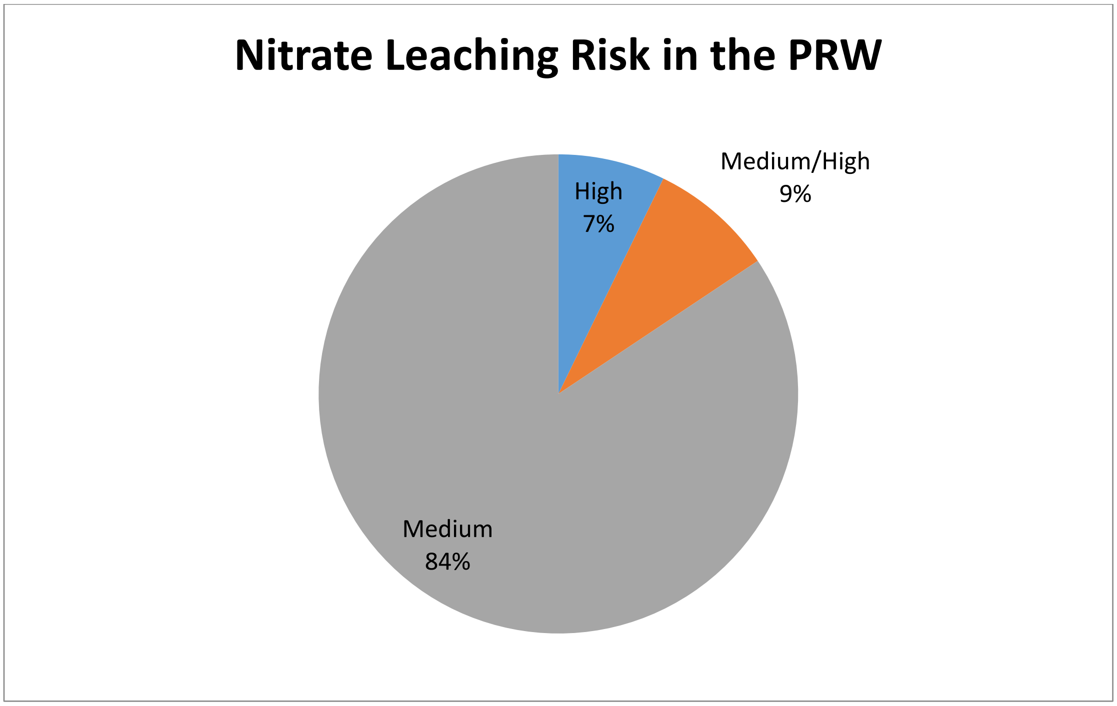


Figure 8. Nitrate Leaching Risk in the PRW

The following figure depicts the locations of risk within the PRW:

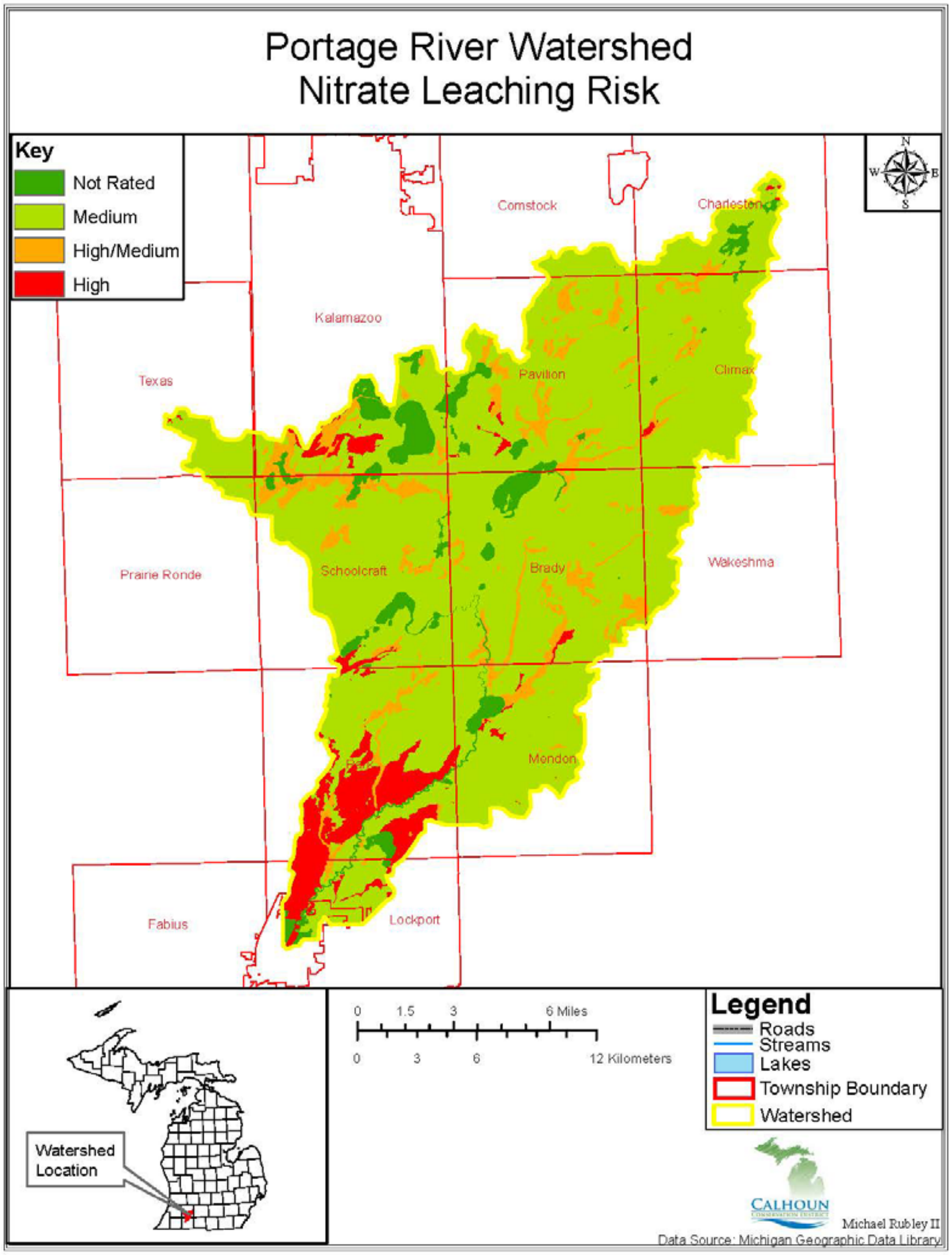


Figure 9. Nitrate Leaching Risk Locations

Table 1. Soil Associations

Soil Name	Acres	Percent of Watershed Area	Soil Name	Acres	Percent of Watershed Area
Adrian Muck	1489	1.19%	Houghton Muck	7161	5.70%
Aquents and Histosols Ponded	20	0.02%	Kalamazoo Loam	32431	25.83%
Barry Loam	205	0.16%	Oshtemo Sandy Loam	25682	20.46%
Brady Sandy Loam	2559	2.04%	Palms Muck	141	0.11%
Bronson Sandy Loam	1599	1.27%	Pits/Gravel	204	0.16%
Cohoctah Loam	679	0.54%	Plainfield Loamy Sand	21	0.02%
Coloma Loamy Sand	340	0.27%	Riddles Loam	7150	5.70%
Dowagiac Loam	628	0.50%	Riddles Sandy Loam	26	0.02%
Edwards Muck	609	0.49%	Schoolcraft Loam	5911	4.71%
Elmdale Sandy Loam	1169	0.93%	Sebewa Loam	5341	4.25%
Gilford Sandy Loam	715	0.57%	Sleeth Loam	7421	5.91%
Glendora Sandy Loam	574	0.46%	Spinks Loamy Sand	8167	6.51%
Granby Sandy Loam	576	0.46%	Teasdale Sandy Loam	470	0.37%
Hillsdale Sandy Loam	1604	1.28%	Thetford Loamy Sand	0.87	0.00%
Histosols and Aquents Ponded	981	0.78%	Urban Land Complex	715	0.57%
Houghton and Sebewa Soils, Ponded	4508	3.59%	Water	6,434	5.12%

The table above illustrates the soils, acres, and percentages of the watershed area for the PRW.

2.4 LAND USES

An investigation of the land use within the PRW determined the primary land use is 60 percent agriculture, with forested land being the second largest land use at 18 percent. A breakdown of land use land cover acreage shows 74,812 acres of agriculture, 21,940 acres of forested, 8,797 acres of wetland, 6,804 acres of open field, 7,750 acres of urban, and 5,436 acres of water (Rubley II, Calhoun CD).

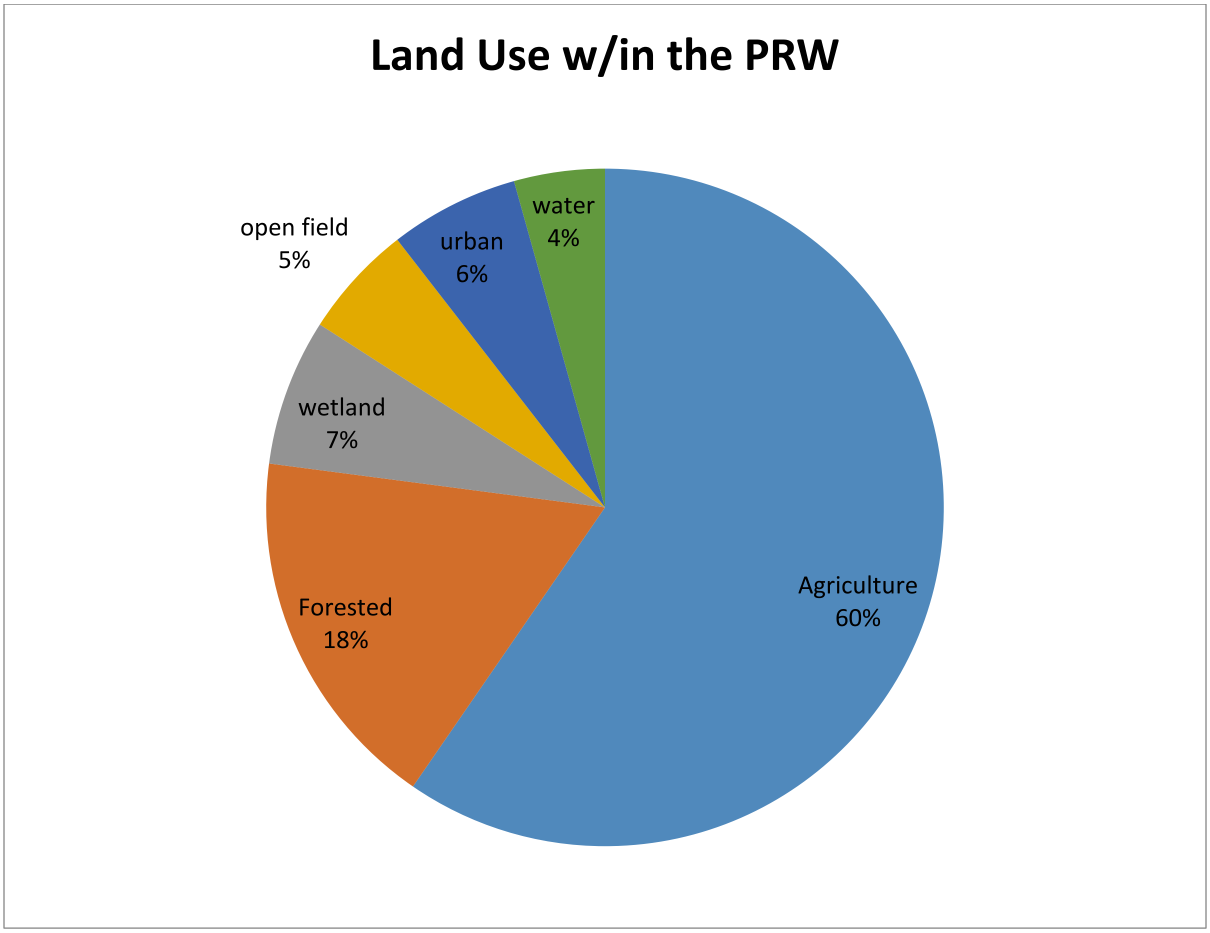


Figure 10. Land use in the PRW

The following figure depicts the location of these uses throughout the PRW:

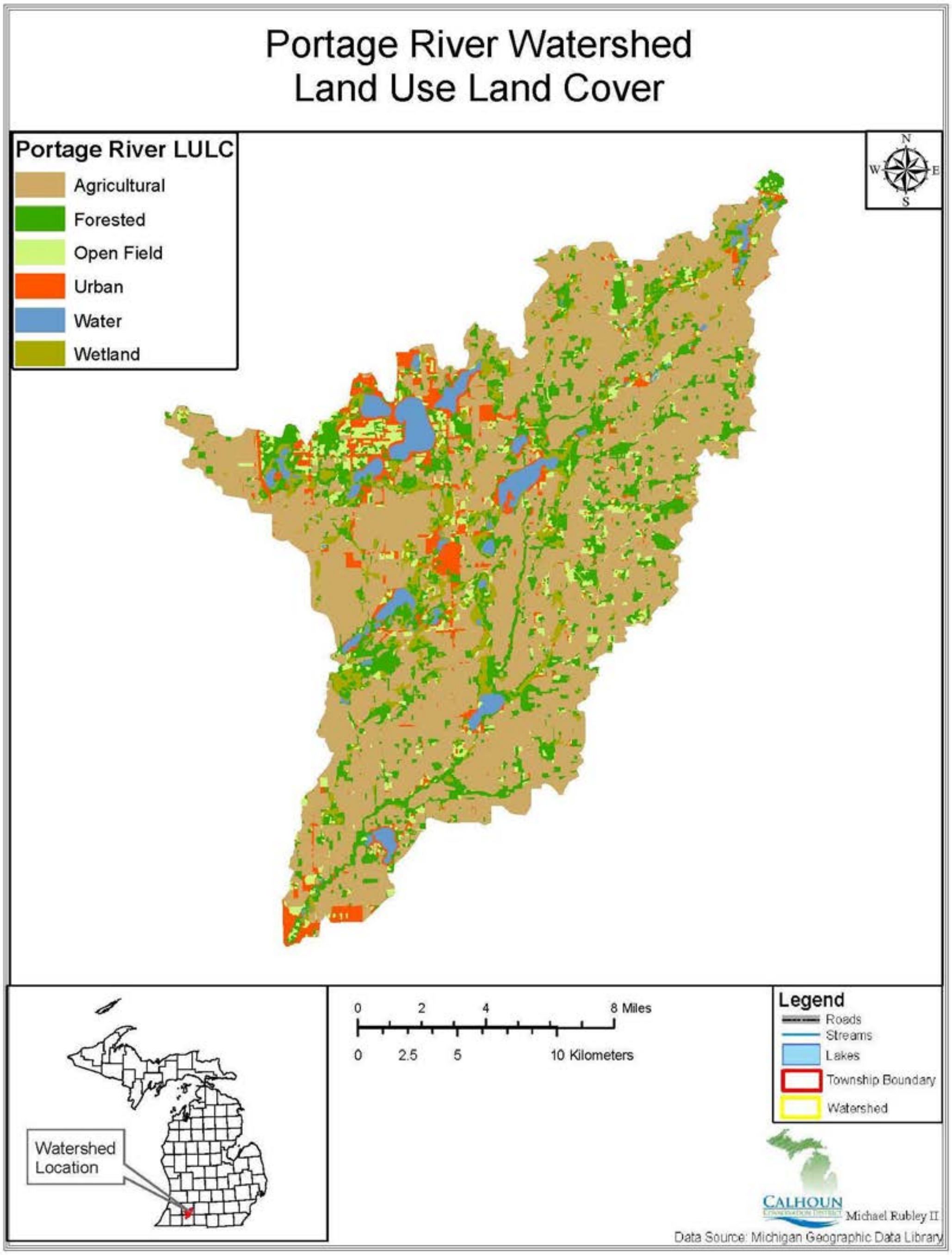


Figure 11. Land Use Land Cover

2.5 Hydrology

2.5.1 Geology and Groundwater

The PRW lies within the larger St. Joseph River Watershed. The St. Joseph River Assessment (Wesley and Duffy, 1998) described the geology of the region.

The retreat of glaciers 10,000 years ago shaped the contemporary landscape and left deposits that make up the surficial geology in the St. Joseph River basin. The basin consists of a mosaic of outwash sands, ice contact material (unsorted sands and gravel), coarse end moraine (sands and gravel), fine end moraine (loamy), and lake plain (Lineback et al. 1983).Glacial moraines with moderate elevation and pervious material have high water infiltration capacities and head pressure, which combine to produce high groundwater yields to low lying water bodies. Groundwater contribution to a stream determines the stability of both temperature and water flow. Basins, like the St. Joseph, with surficial geologic material dominated by outwash, ice contact, and coarse end moraine materials have higher groundwater yields compared to basins with less pervious and finer textured materials (Bent 1971; Richards 1990; Wiley and Seelbach 1997).

These glacial deposits have strong influences on the behavior of streams and rivers, as well as on land use patterns. Outwash and fine-textured end moraine areas are associated with sandy loam and loam type soils typically used for agriculture. The high, steep-sloped moraines, that are associated with coarse texture and ice contact material, are usually forested because of rough terrain, low moisture content, and low soil fertility.

The middle valley segment [of the St. Joseph River] flows across outwash sands between a mixture of ice contact and coarse to medium till. The Portage…river flows through and around medium and coarse till, so they have moderate to low ground water. Portions of Portage River receive high ground water yields from ice-contact hills.

The bedrock of the region is primarily composed of Coldwater Shale (Data sources are the 1:500,000 maps by R.L. Milstein, 1987, "Bedrock geology of southern Michigan"). Bedrock influenced ice movement during past glaciations, and most of Michigan is on soft bedrock that was easy for the glacier to move through and grind away. Because of this, most bedrock in Michigan is deeply buried beneath glacial material http://www.ncrs.fs.fed.us/gla/geology/mi-bedrock.htm.

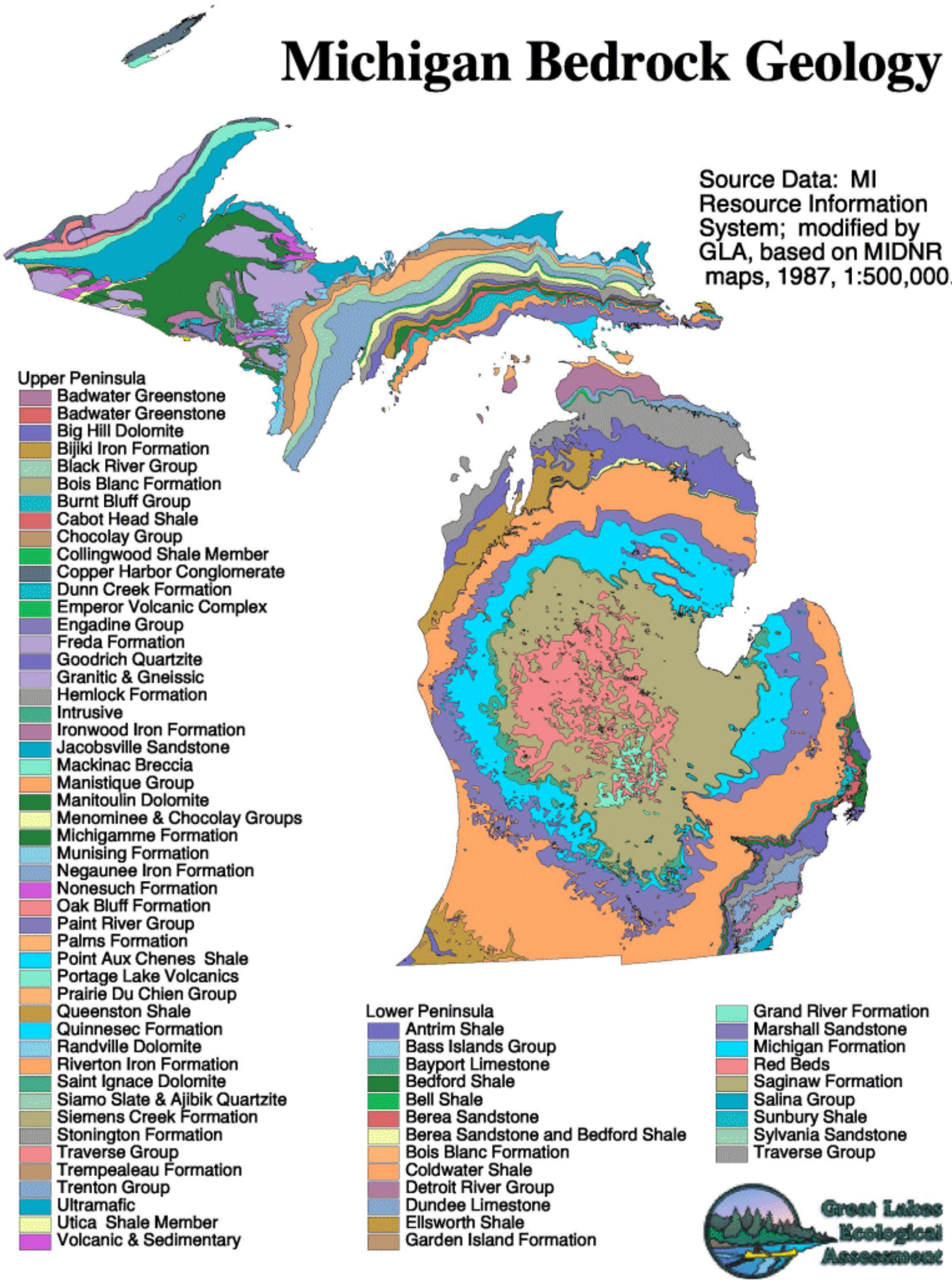


Figure 12. Michigan Bedrock Geology

2.5.2 Surface Water

The watershed contains 6,084 acres of lakes including 32 named lakes (see Table 4) accounting for 5,663 acres of the total 6,084 acres of lakes and numerous (over 500) small, unnamed lakes and ponds. Austin Lake is the largest of the lakes, having an area of 1,101acres. Indian Lake is the second largest having an area of 789 acres and Portage Lake is the third largest having an area of 727 acres. These and many of the other lakes in the watershed are connected by surface water to the Portage River system through streams and drains. The watershed contains approximately 300 miles of streams and drains that connect the Portage River Watershed with the St. Joseph River. The watershed contains roughly 538 miles of roads, and an analysis of the road and stream layers shows that approximately 139 road stream crossings exist in the watershed.

2.5.3 Sub-watersheds

Six 12 digit hydrologic unit code (HUC) sub-watersheds comprise the Portage River Watershed. These watersheds and their HUCs, in order of largest to smallest size, are:

- Goose Lake Drain (HUC 12: 040500010506) - 28,799 acres
- Indian Lake (HUC 12: 040500010505) - 22,759 acres
- Headwaters (HUC 12: 040500010501) - 22,597 acres
- Gourdneck Creek (HUC 12: 040500010502) - 21,938 acres
- Portage Creek (HUC 12: 040500010503) - 17,033 acres
- Butternut Creek – Bear Creek (HUC 12: 040500010504) - 12,415 acres

(Rubley II, Calhoun CD)

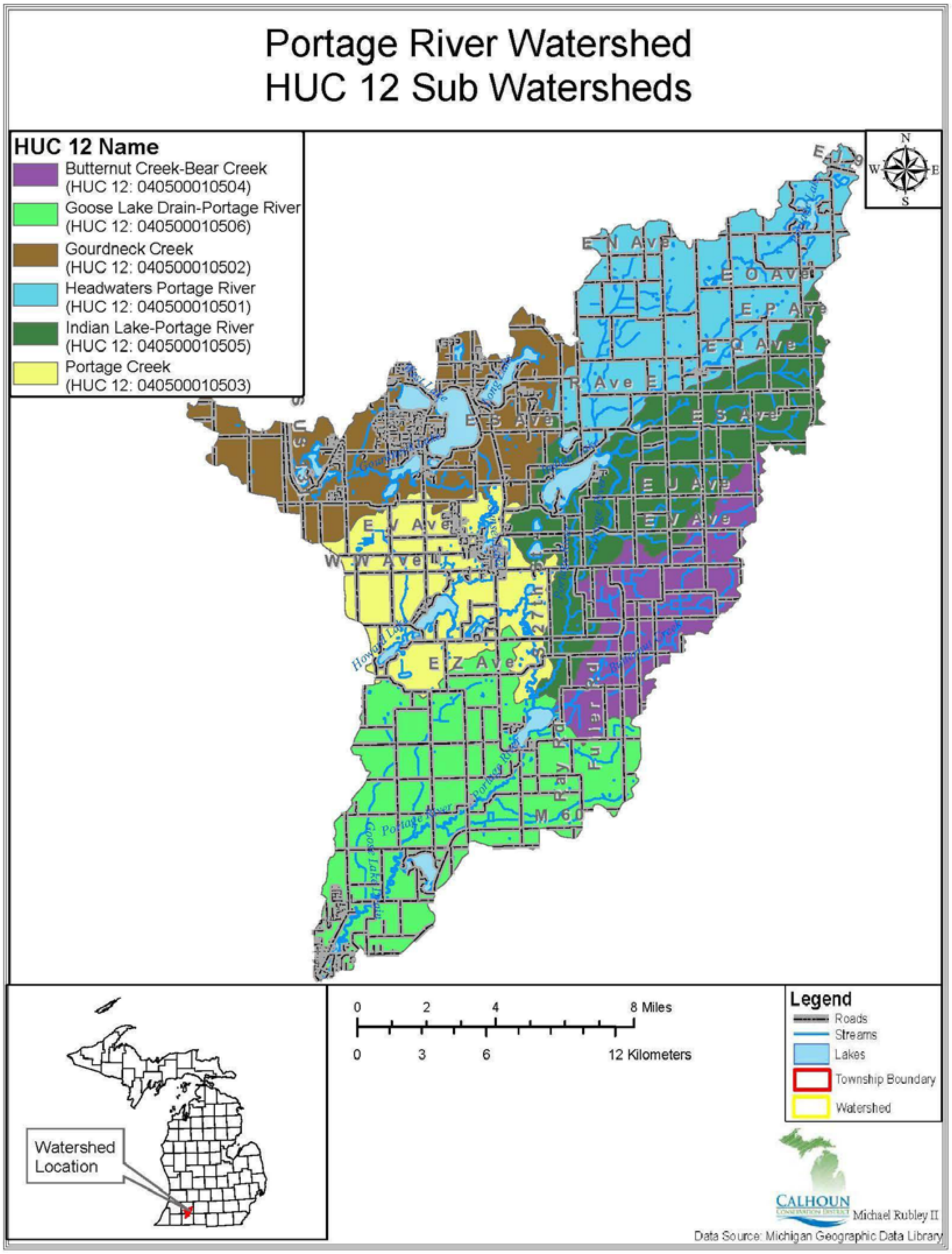


Figure 133. Portage River subwatersheds

3 Community Profile

3.1 History of Region

The region is thought to have been occupied by its earliest residents the Hopewell or "Mound Builders", an early race of Native Americans from approximately 500 BC to 900 AD. This farming civilization left behind mound structures that are still visible today. Kalamazoo's Bronson Park contains the most prominent. The Hopewell was followed by the Algonquin groups (Potawatomi, Chippewa, and Ottawa) and the Miami Tribe. The area at the time of European settlement was occupied primarily by the Potawatomi Tribe. The areas earliest documented visit by a European was Robert La Salle's visit to the mouth of the St. Joseph River, possibly in 1672 and for certain in 1679. The Treaty of 1795, between the United States and Spain opened up the Northwest Territory for settlement. Then the Treaty of 1821, known as the "Chicago Treaty", between the United States government and the Potawatomi, Chippewa, and Ottawa, opened up the area to European settlers. They ceded all of their lands south of the Grand River. In 1827 they exchanged all their small reservations for one large reservation tract of land that encompassed parts of Kalamazoo and St. Joseph counties totaling approximately 73,600 acres (Hawkins, 9). Now the descendants of these tribes have reservations in Fulton, MI (Nottawaseppi Huron Band of Potawatomi), Wayland, MI (Match-e-be-nash-she-wish Band of Potawatomi Indians [also known as the Gun Lake Tribe]), and Dowagiac, MI (Pokagon Band of Potawatomi). The early European adventurers to the area were comprised primarily of fur-traders and the region was widely unsettled or "undiscovered" until the Chicago Treaty opened up the area for European-American settlement.

The Portage River has long been used as a portage route between the Kalamazoo and St. Joseph Rivers. During a time when water was the preferred route of travel, the Portage River was an important travel route between the two rivers. There were three main roads used by the Potawatomi that still exist today: Portage Rd., Westnedge, and Oakland Dr. These trails extended south to the Old Sauk Trail which is now U.S. 12. The largest well known encampment was located at the now Kalamazoo/Battle Creek International Airport (Potts, 1-13). Simon Pokagen (1830-1899) son of Chief Pokagen, spoke of the game that they used to hunt in the area, "Here we killed the bear, the elk, and the deer. Here we trapped the otter, coon and beaver…but alas our forests have been cut down!" (Lane, 2010). This is a chilling observation of what was to come for our native game species and natural resources.

Early European-American settlement resulted in dams springing up along small tributaries to power saw and grist mills. The forests and prairies of the area were cut and tilled. The lumber was used to build homes and barns and the prairies to grow crops. Animals were hunted prolifically for meat and furs and were all but extirpated from the area. Residents of the area wanted the St. Joseph River kept open for navigation (to move goods) and a federal study (1879) was performed and determined it was adverse to this suggestion. At the time the railroad was emerging as a leader of moving goods so the rivers purpose turned to power production (Lane, 2010). Subsequently hydroelectric dams began to pop up along the St. Joseph River, which severely altered the run-of-the-river flows and altered the streams gradient. This would have drastic effects on stream health and water quality. Drain establishment practices were on on-going throughout this period in order to develop agricultural lands and as a method to address malaria. The dredging opened up land for establishment and agricultural land use but has had a lasting detrimental effect on water quality and fish communities. Evidence of water quality degradation in the greater St. Joseph Watershed can be traced back to the contamination of the river from South Bend to the mouth in 1925 and in the 1930's Michigan approached Indiana in attempts to address the problem (Lane, 2010). Water quality has been an uphill battle but with the passing of federal and state water quality laws (i.e. The Clean Water Act (CWA) of 1972 and Michigan Environmental Protection Act of 1970 which most of which is now covered under the Michigan Natural Resources and Environmental Protection Act (NREPA)). The Portage River and the PRW continue to be impaired from point source and nonpoint source pollutants, with federal, state, local and stakeholder groups working to address impairments and threats to water quality.

3.2 Governmental Units

Local governmental units that fall within the PRW are as follows:

Counties - Kalamazoo and St. Joseph

City/Village - City of Portage, City of Three Rivers, City of Schoolcraft, and Village of Vicksburg

Townships - Comstock, Charleston, Climax, Portage, Texas, Prairie Ronde, Schoolcraft, Brady, Wakeshma, Mendon, Park, Lockport, and Pavilion

Table 2. Watershed Area, % Area in Watershed, Lake Area, River Length by Township

Governmental Unit	County	Watershed Area (Sq. Mi.)	% Area in Watershed	Lake Area (acres)	River Length (Mi)
Charleston Township	Kalamazoo	6.6	3.4	428.0	12.3
Comstock Township	Kalamazoo	2.1	1.1	2.5	0.5
Climax Township	Kalamazoo	20.5	10.5	135.3	37.9
Pavilion Township	Kalamazoo	30.3	15.5	802.7	56.4
Texas Township	Kalamazoo	3.4	1.7	1.2	0.3
Wakeshma Township	Kalamazoo	5.6	2.8	4.7	9.9
Brady Township	Kalamazoo	35.3	18.0	982.9	81.9
Prairie Ronde Township	Kalamazoo	1.0	0.5	0.6	0.3
Schoolcraft Township	Kalamazoo	28.3	14.5	1200.1	64.1
Mendon Township	St. Joseph	17.8	9.1	467.5	38.0
Park Township	St. Joseph	24.6	12.5	395.2	37.8
Lockport Township	St. Joseph	4.9	2.5	81.0	10.3
Portage Township	Kalamazoo	13.9	7.1	1903.0	27.9

3.3 Demographics

Approximately 317, 689 people live within the counties (i.e. St. Joseph—60,964 and Kalamazoo—256,725) (U.S Census Bureau Quick Facts) that contain the majority of the watershed area. Of the total 317,689, 81% live within Kalamazoo County and 19% live within St. Joseph County. The PRW boundaries fall outside of most of the urban areas (except Portage) within Kalamazoo County, but encompass St. Joseph Counties second largest city, Three Rivers (Sturgis is the largest at approximately 10,994). Kalamazoo has gained approximately 6394 individuals or 2.5% from 2010 to 2013.St. Joseph County has lost 331 residents or -0.5% of the population.

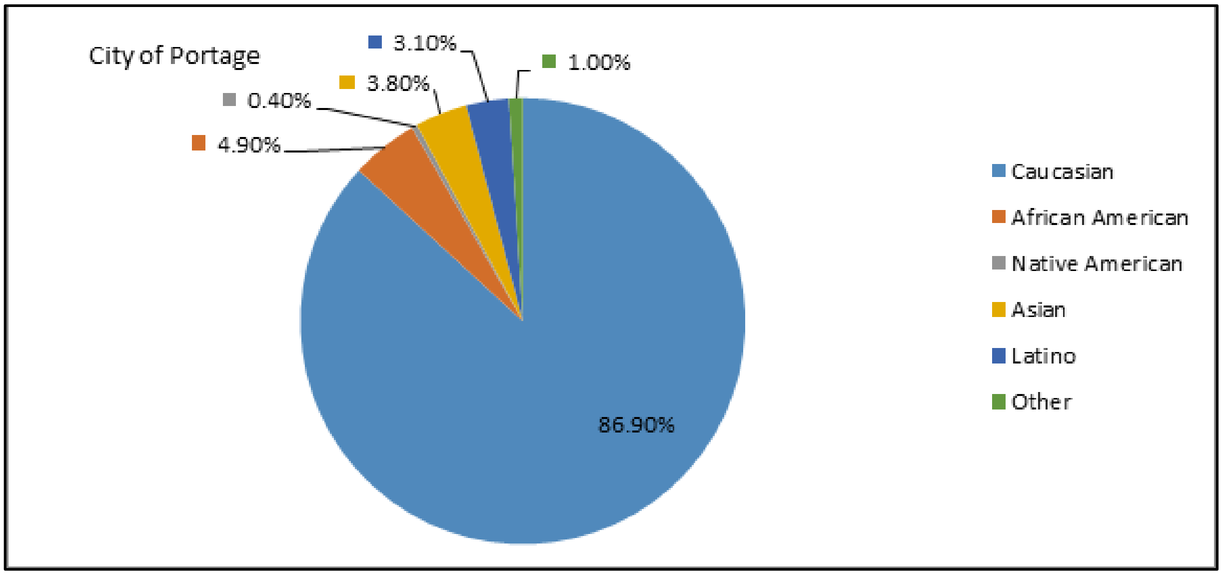


Figure 14. City of Portage Population Ethnicity

The City of Portage is the largest within the PRW, totaling 46,292 (not all of the City of Portage is within the PRW). Portage has continued to grow from 2000 to 2010 with the third highest gain in the county. It is also diversifying and gaining population within the minority populations. (http://www.portagemi.gov/About-Portage/Community/Demographics.aspx).

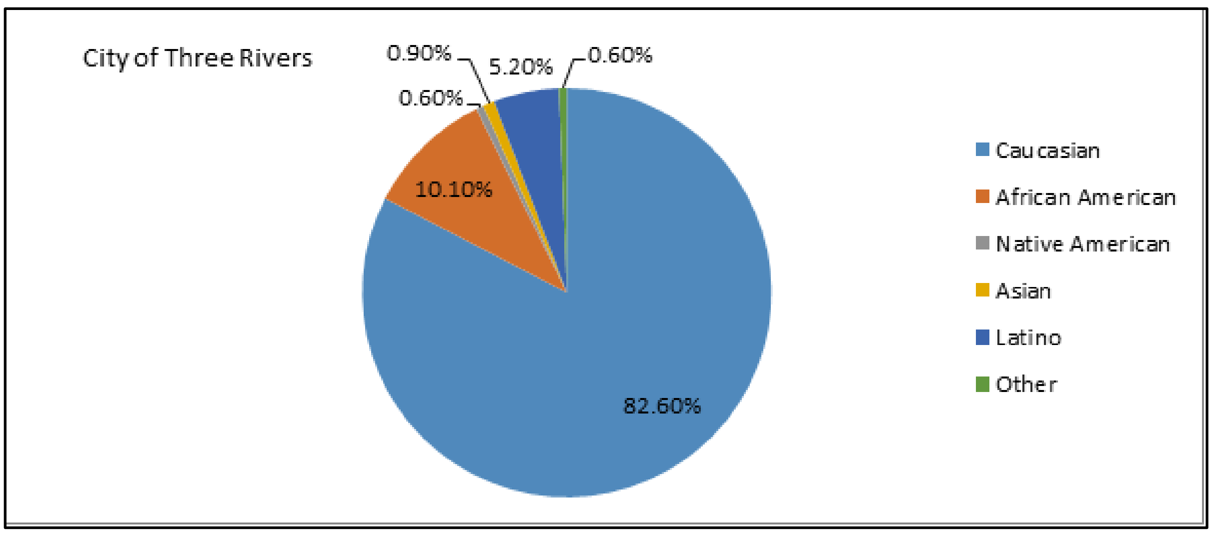


Figure 15. City of Three Rivers Population Ethnicity

The City of Three Rivers is the second largest within the PRW, totaling 7811. The population has grown 5.6% since 2000 according to City-Data.com.

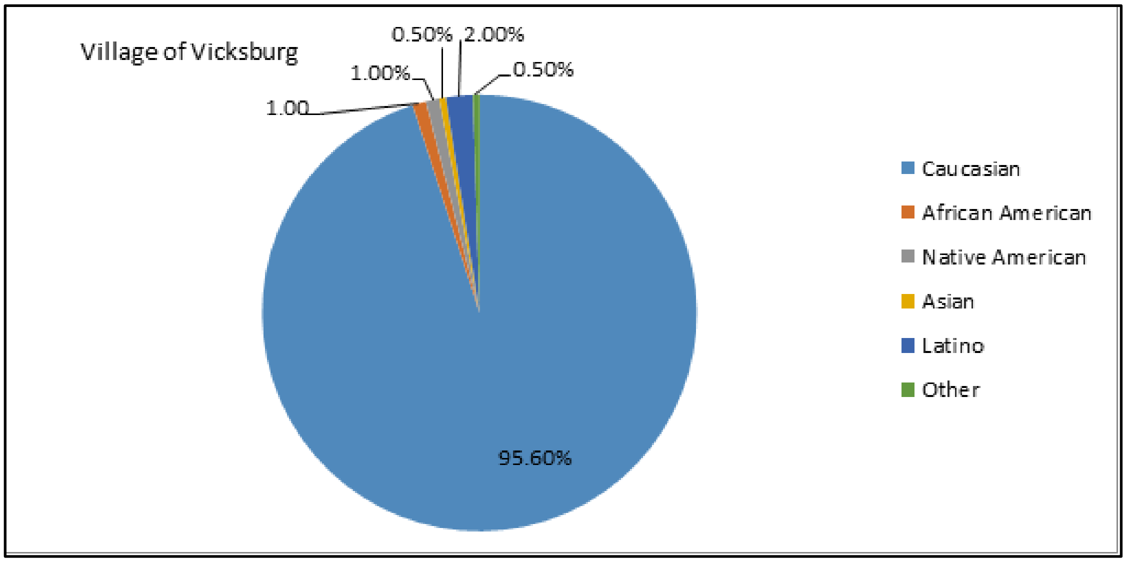


Figure 16. Village of Vicksburg Poplulation Ethnicity

The Village of Vicksburg is the third largest within the PRW, totaling 2906. The population has grown approximately 25% since 2000, resulting in the addition of 586 individuals.

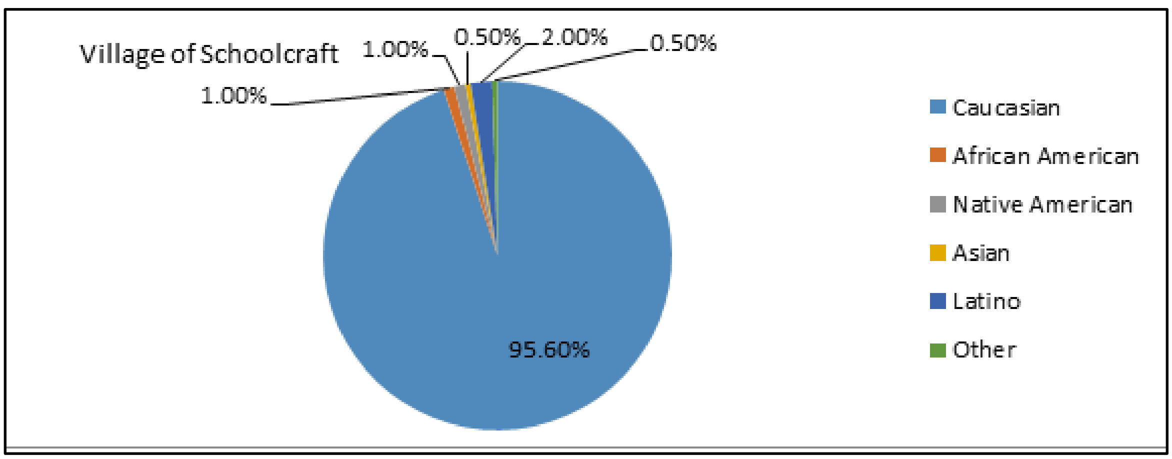


Figure 17. Village of Schoolcraft Population Ethnicity

The Village of Schoolcraft is the fourth largest within the PRW, totaling 1525. The population has experienced a slight decline with approximately -3% growth.

Table 3. Townships & Populations in PRW

POPULATION DISTRIBUTION WITHIN THE PRW		
Townships within the Watershed	**Population**	**Est. Pop within the PRW**
Comstock	14,854	490
Charleston	1,975	652
Climax	2,463	1,009
Pavilion	6,222	6,222
Portage	46,292	13,888
Texas	10,195	1,019
Prairie Ronde	2,086	83
Schoolcraft	7,260	6,098
Brady	4,263	4,092
Wakeshma	1,301	208
Mendon	2,775	1,332
Park	2,669	1,708
Lockport	3,814	3814
Total	106,169	**40,615**

**Population estimates were derived by using township land area within the PRW, census data, and total population within cities and villages within the PRW. A weighting factor was then applied to determine an estimate of total population within the PRW.*

3.4 Future Growth and Development

Due to the recent recession, overall growth within the PRW has been low. The largest urban area, consisting of industrial and residential growth, is Portage. The population of Portage increased from 44, 897 in 2000 to 46,262 in 2010, the third highest population gain in the county. The cities of Three Rivers, Schoolcraft, and Village of Vicksburg as well as areas near the I-94 corridor, U.S. 131, and M-60, are areas where significant residential and industrial growth and development could occur. Municipalities in these areas or surrounding these areas should consider planning for smart growth techniques to protect their water quality, while also getting the greatest possible benefit from every investment the community may make. Communities should look to conserve, restore, or enhance natural areas while incorporating, trees, rain gardens, vegetated roofs, and other practices that mimic natural systems in developed areas where rainwater falls. These types of approaches known as "green infrastructure" are an integral part of sustainable communities because they can help local governments and communities to protect the environment and human health, while providing other social and economic benefits. (http://www.epa.gov/smartgrowth/green-infrastructure.html). The EPA has prepared a guide, *Enhancing Sustainable Communities With Green Infrastructure: A guide to help communities better manage storm water while achieving other environmental, public health, social, and economic benefits (PDF)* which assists communities with green infrastructure approaches for developing plans to address technical, regulatory, financial, and institutional obstacles to better manage storm water. Rural communities should also consider future growth and development. Master plan and ordinance reviews should be implemented to consider the types of development that are most likely to occur within the area. For a complete list of publications pertaining to Rural Smart Growth, Business and Economic Development, Water, Transportation and Air Quality, Climate Change, HUD-DOT-EPA and Energy etc. see (http://www.epa.gov/smartgrowth/publications.htm).

4 Resource Management

4.1 Land Use and Water Quality

The way that we use the land ultimately affects water quality. Different types of land use are more “intense” and subsequently negatively affect the health of our rivers and streams. The way that we use our land also shapes the ecology of our water resources. Changing the shape of our landscape can cause severe detriment to water quality. Locally we look to land use planning and ordinances from local governmental units to control the way that we use the landscape. Local planning is essential to plan for urban sprawl, preservation of agricultural production, and interacting with the landscape in a manner that reduces our impacts to water quality. As of January 2012, a State-level ban was placed on the use of phosphorous fertilizer applications on residential and commercial lawns. Federal protection typically is manifested through water quality funding administered through a state management body. In Michigan’s case, it is administered through MDEQ.

Land use planning was once an afterthought, now it is essential to protect existing land uses, natural features, and the integrity of our natural resources. The landscape itself should dictate how we manage our land. Areas with extreme slopes, drainage, and soil formations that increase surface water runoff that slope toward waterbodies should incorporate conservation friendly practices so as to lessen the effects to water quality. In areas of urban development consideration must be given to impervious surfaces and associated increased runoff that delivers pollutants to our waterbodies. Watershed planning takes an ecological based approach with a holistic view of nonpoint source pollution. Nonpoint sources of pollution affect not only areas of entry but also areas downstream from its delivery source point. Land use within the PRW is predominantly agricultural; subsequently we should plan for this predominant use, as well as low intensity residential development. Where industrial and residential development occurs, smart growth and low intensity practices should be utilized to reduce the impacts to water quality.

4.2 Regulatory Authority and Water Resources

4.2.1 Water Bodies (rivers, drains, streams, lakes)

The Clean Water Act (CWA) covers a number of regulatory, funding, and education programs aimed at protecting and restoring the nation’s surface water. Federal roles in protection are used as a blanket to provide national environmental standards with State and local governance at the local level. MDEQ’s, Water Resource Division (WRD), is responsible for protecting the public trust waters of Michigan’s inland lakes and streams under the authority of Part 301, Inland Lakes and Streams, of the Natural Resources and Environmental Protection Act, 1994 PA 451 (NREPA). WRD oversees 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 Michigan Department of Natural Resources (MDNR) has the authority to regulate boating activities and MDNR access sites pertaining to human health and species protection (i.e. engine size, number of boats). MDNR is also responsible for managing fish and wildlife species within our waterbodies and regulating human use of this resource. For further protection of our states water resources municipalities and local governments should consider enacting ordinances that further protect water quality of waterbodies.

MDEQ regulates direct discharges into the states waterbodies through the National Pollutant Discharge Elimination System (NPDES). This regulates the discharge of pollutants into surface waters by imposing effluent limitations. MDEQ’s Municipal Separate Storm Sewer System (MS4) program is designed to reduce the discharge of pollutants to surface waters of the State, as well. An MS4 is a system of drainage (including roads, storm drains, pipes, and ditches, etc.) that is not a combined sewer or part of a sewage treatment plant. MDEQ also administers the Federal Phase II Storm Water

Regulations to address storm water discharges from small municipal separate storm sewer systems. See http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3716-24707--,00.html.

County Drain Commissioners or Water Resource Commissioners are responsible for the administration of the Drain Code of 1956, as amended. They are responsible for upholding the Drain Code which addresses construction and maintenance of drains, provides storm water guidance, delegates drain districts, and schedules maintenance. Kalamazoo, St. Joseph, and Calhoun County Drain Commissions and Water Resource Commission are responsible for drains within the PRW. Kalamazoo County Soil Erosion and Sedimentation Control (SESC) is housed within the County Drain Commissioner's Office. The SESC Ordinance, established under Act 347of 1974, as amended, is designed to regulate earth change activities and prevent erosion and sedimentation associated with those changes. The Drain Office regulates the Ordinance except in governmental units that elect to adopt their own soil erosion and sedimentation control ordinance. The City of Portage is the only such municipal enforcing agency within the Kalamazoo County portion of the watershed.

St. Joseph County SESC is also housed within the Drain Commission Office. As of May 15, 2012 the County Drain Commissioner is also the County Enforcement Agent (CEA). In Calhoun County the SESC program is administered by the Calhoun County Road Department (CCRD).

4.2.2 Wetlands

There are federal, state and local laws and ordinances that govern and help to protect wetlands. The federal government protects wetlands through Section 404 of the Clean Water Act. Michigan received authorization from the federal government to administer Section 404 of the federal Clean Water Act in most areas of the state. The state administered program must be consistent with requirements of the federal Clean Water Act. The Michigan Department of Environmental Quality (MDEQ) regulates wetlands within the state under Part 303, PA 451 Wetland Protection. This law establishes minimum wetland protection controls for regulated wetlands, requires a permit to conduct dredge, fill, or construction activities in regulated wetlands, but does not regulate all wetlands. Wetlands are regulated by MDEQ if they meet any of the following criteria:

- Connected to one of the Great Lakes (does not apply to the PRW)
- Located within 1,000 feet of one of the Great Lakes (does not apply to the PRW)
- Connected to an inland lake, pond, river or stream.
- Not connected to one of the Great Lakes or an inland lake, pond, stream, or river, but are more than 5 acres in size.
- Not connected to one of the Great Lakes, or and inland lake, pond, stream, or river, and less than 5 acres in size, but the DEQ has determined that these wetlands are essential to the preservation of the state's natural resources and has notified the property owner.

Naturally, there are "gaps" within the wetland protection laws of the state. This is where local governments have the authority to create wetland regulations that address wetlands not protected by the state. Part 303, section 324.30307 authorizes local units of government to adopt and administer their own wetland regulations, provided they are at least as restrictive as state regulations.

Some local governmental units mention wetlands within zoning ordinances and master plans which can give consideration to approving various permits pertaining to land use practices and developments which can provide some wetland protection.

The MDEQ provides guidance and documents to assist local governments in the development of wetland protection. These can be found at http://www.michigan.gov/deq/0,4561,7-135-3313_3687-24312--,00.html. 77

The United States Department of Agriculture's (USDA) Farm Service Agency (FSA) and the Natural Resource Conservation Service (NRCS) inherently protect wetlands on private lands through economic incentives and disincentives administered to agricultural producers who participate in incentive programs.

The Food Security Act of 1985, as amended, requires producers participating in most programs administered by FSA and NRCS to abide by certain conditions on any land owned or farmed that is considered a wetland. A participant who violates wetland conservation provisions is determined ineligible for applicable FSA and NRCS benefits for year(s) in violation.

4.2.3 Floodplains

A river, stream, lake, or drain may on occasion overflow its banks and inundate adjacent land areas. The land that is inundated by water is defined as a floodplain. In Michigan, and nationally, the term floodplain has come to mean the land area that will be inundated by the overflow of water resulting from a 100-year flood (a flood which has a 1% chance of occurring any given year). It is estimated that about 6% of Michigan's land is flood-prone, including about 200,000 buildings (http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725---,00.html).

Floodplain guidance comes from both the state and federal governments and focuses on protecting people and property rather than natural resources (Ardizone and Wyckoff, 2003). Development within floodplains is regulated through Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. This requires a permit be obtained prior to any alteration or occupation of the 100-year floodplain of a river, stream, or drain. Floodplains are also regulated federally through the Federal Emergency Management Agency (FEMA). The MDEQ and FEMA have developed a *Quick Guide: Floodplain Management in Michigan* available at http://www.michigan.gov/documents/deq/lwm-quickguide_202673_7.pdf.

The floodplain is divided into two parts, the floodway which carries most of the flow during a flood event, and the floodway fringe which is an area of very slow moving water or "slack water". Floodways are the channel of a river or stream and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the 100 year flood; these are high hazard areas of rapidly moving water during times of flood. The purpose of Part 31 is to assure that the flow carrying capacity of a watercourse is not harmfully obstructed, and that the floodway portion of the floodplain is not used for residential construction. For a more in-depth review of floodplain management please refer to http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725-11255--,00.html.

The minimum standard for residential construction within the 100-year floodplain requires that the lowest floor of a structure be elevated one-foot above the 100-year flood elevation. Local governmental ordinances and building standards must be met.

4.2.4 Groundwater

In 1974 Congress passed the Safe Drinking Water Act which required the USEPA to determine the level of contaminants in drinking water at which no health effects are likely to occur. To see more on the Safe Drinking Water Act (SDWA) see http://water.epa.gov/lawsregs/rulesregs/sdwa/index.cfm.

Although this plan addresses surface water runoff from nonpoint source pollutants, groundwater must also be considered as there is interaction between surface water and groundwater, both from natural water cycle processes and from manmade interaction through well withdrawal and irrigation practices.

Within the PRW the Kalamazoo County Health Services and Branch-Hillsdale-St. Joseph Community Health Agency plays a role in the protection of groundwater protection with regulation with the installation and design of septic systems. This authority was conferred upon the local health departments by Section 2441(1) of the Michigan Public Health Code, Act 368, 1978, as amended. Information on obtaining information and or permit requirements please refer to http://www.bhsj.org/eh/environment.htm for St. Joseph County information or http://www.kalcounty.com/eh/default.asp for the Kalamazoo County Environmental Health Division. An option that some local government authorities have enacted at the township and county level is a time-of-transfer sale inspection. When property is sold a requirement of an inspection is required. This option is gaining some popularity and has been instituted recently. Some people feel the need for a State mandated time-of-sale-transfer. There is also some added protection from real estate company sale transactions that can require septic tank testing at time-of-sale-transfer.

On a statewide level, monitoring groundwater is up to MDEQ and the Michigan Department of Agriculture and Rural Development (MDARD). Michigan's water use reporting program requires that industries with the capacity to withdraw over 100,000 gallons per day (70 gallons per minute) are required to report to the state the water withdrawals and water conservation practices of their pumps. This was initially mandated by the Public Act 148 of 2003, now Part 327 of P.A. 451 of 1994, NREPA.

A Great Lakes compact was signed by the Great Lakes Governors and Premiers (Annex 2001). It provided protections which includes a ban on new diversions of water outside of the Basin (Great Lakes-St. Lawrence River Basin) and stipulated that each State would create a program for the management and regulation of new or increased large withdrawals (http://www.michigan.gov/mdard/0,4610,7-125-1599_29980-89234--,00.html). The above-mentioned water use reporting program is Michigan's solution. Agricultural producers must report to MDARD and all other industries must report to MDEQ. Any new, proposed new, or increased volume large capacity pumps must also now consult the Michigan Water Withdrawal Assessment Tool (WWAT) prior to installation and subsequent reporting.

The Michigan Agriculture Environmental Assurance Program (MAEAP) provides some protection for private agricultural lands. The comprehensive, voluntary, proactive program is designed to reduce farmers' legal and environmental risks through a three-phase process: 1) education; 2) farm-specific risk assessment and practice implementation; and 3) on-farm verification that ensure the farmer has implemented environmentally sound practices. There are four programs—Farmstead, Cropping, Livestock and the newly developed Forest, Wetlands, and Habitats System. Groundwater is considered in the education component and MAEAP provides annual well-water testing focused primarily on nitrates and Coliform bacteria. Open, in-active wells are located and decommissioned to help protect possible groundwater contamination. More information can be found at http://www.maeap.org/ or by contacting your local conservation district.

Michigan participates in a voluntary Wellhead Protection Program (WHPP). The program is designed to safeguard public water supply systems (PWSS). Michigan's WHPP is composed of a set of guidelines that help communities protect their drinking water by identifying the area that contributes groundwater to PWSS wells, identifying sources of contamination within that area, and developing methods to cooperatively manage the area and minimize the threat to the PWSS. The following PRW communities participate in WHPP:

City of Portage, City of Galesburg, City of Three Rivers, Village of Vicksburg

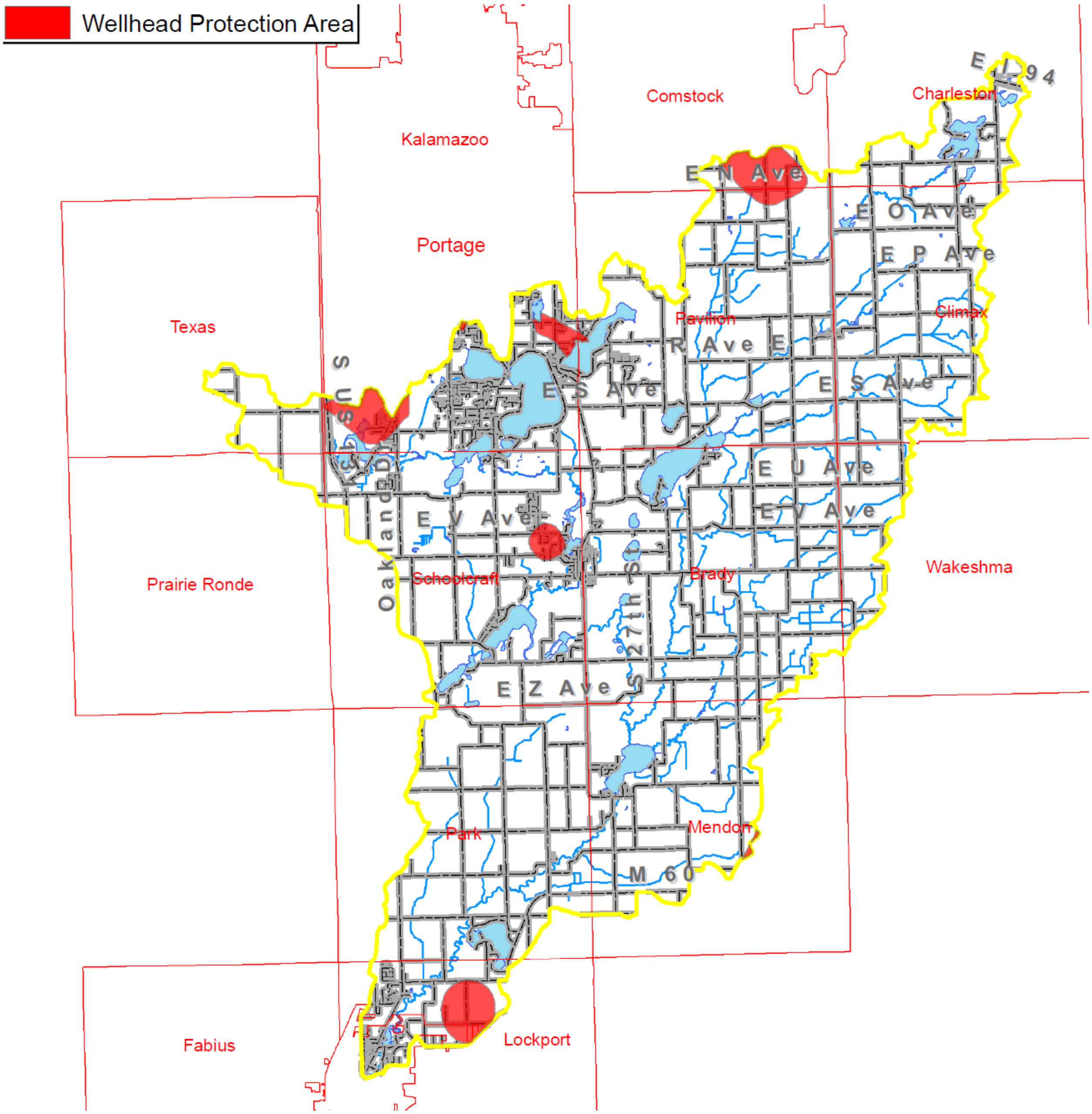


Figure 18. Wellhead Protection Area

4.3 Local Water Quality Protection Policies

Local governments regulate land use mostly through master plans and zoning ordinances.

Through the PRW planning process, several local units of government agreed to work with CD and Fishbeck, Thompson, Carr, and Huber Inc. (FTCH) to do a review of their master plans and zoning ordinances to evaluate their techniques for resource protection. CD and FTCH met with their planning commissions to evaluate townships needs and wants pertaining to natural resources and water quality and how that was considered in the master plan and zoning ordinances. A document review for water resources protection considered:

- I) Watershed Activities—plans and policies
- II) Stream corridors—plans and policies, development/redevelopment regulations
- III) Flood Control—plans and policies, development/redevelopment regulations
- IV) Impervious Surface Reduction—plans and policies, development/redevelopment regulations, and design standards

However, these were not the only protections considered throughout the process. Planning considered uses of natural resource land use maps, farmland and open space preservation, wellhead protection, MDNR-approved recreation plan, community identification of storm water drainage systems, illicit discharges, sanitary sewer or septic systems, installation of public utilities, etc.

After meeting with Townships on multiple occasions an exhaustive review was performed for each planning commission with a detailed report. Each municipality was encouraged to accept recommendations for master plans and zoning ordinances to protect the integrity of its natural resource character and water quality. For some of these townships timing was appropriate due to the need to address the Michigan Planning Enabling Act 33 of 2008 (MPEA) (and amendments to Michigan Zoning Enabling Act). This act impacted every single planning commission in the State of Michigan. It requires the review of the ordinance or resolution which created the planning commission, with nearly all such ordinances needing to be amended or replaced (http://lu.msue.msu.edu/2008MPEA.htm). This site can be accessed for documents helping to summarize responsibilities of local governments pertaining to MPEA.

Recommendations of the reviewed documents that focused planning for water quality protection and natural resource protections focused on:

Master Plan Revisions

1. Create a Resource Protection Overlay District (RPOD) and update the Master Map with identification of natural resources and RPOD delineation.
2. State the importance of a storm water management plan, with a goal of increasing infiltration and decreasing imperviousness in new construction and redevelopment to reduce the amount of storm water runoff.
3. Broaden the Water Resources Objectives and Policies to include other natural resources, including floodplains, high-quality natural areas, woodlands, wetlands, and greenways.

Zoning Ordinance Revisions

1. Create specifications for a RPOD to protect natural resources.
2. Requiring building setbacks from water bodies (streams, rivers, lakes, wetlands) with a native vegetative buffer.
3. Protecting wetlands through a Township wetlands ordinance.
4. Improving parking lot standards to reduce impervious surfaces (shared parking, parking space size, and minimum parking requirements).
5. Improving site plan review.
    a. Identify natural features.
    b. Review standards for protection.
    c. Label Best Management Practices (BMPs) on site plan.

6. Encouraging LID techniques and BMPs to reduce runoff and increase infiltration.
7. Coordinating with the County Soil Erosion and Sedimentation Control (SESC) program and require compliance with County SESC standards.
8. Coordinate with receipt of other required state and county permits.
9. Requiring new septic systems be located at least 150 feet from a waterway.
10. Encouraging the use of native species in landscaping to increase infiltration of storm water and to discourage the use of invasive species.
11. Improve private road standards to reduce impervious surfaces.

Other Recommendations

1. Update the Capital Improvement Program to include policies related to natural resource protection and storm water management.
2. Develop a Recreation Plan and obtain approval of the plan from the Michigan Department of Natural Resources (MDNR).
3. Investigate funding options for conducting additional studies and projects to assist the Township in implementing the recommendations in this report.

The townships that volunteered to have their plans and ordinances reviewed by FTCH and CCD were:
Park Township, St. Joseph County
Charleston Township, Kalamazoo County
Brady Township, Kalamazoo County

To see a full review of the plans and zoning ordinance recommendations refer to Appendix 3 - Master Plan and Zoning Ordinance Review.

FEMA provides participation for local units of government in their National Floodplain Insurance Program (NFIP). Community participation in the NFIP is voluntary and based on an agreement between local governmental units and the Federal Government that states if a governmental unit will adopt and enforce a floodplain management ordinance to reduce the future flood risks to new construction in Special Flood Hazard Areas, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. Several PRW governmental units participate in the NFIP. For a complete listing, visit https://www.fema.gov/cis/MI.html.

Implementation of the CWA often has effects that extend beyond water quality. For example, management of flood hazards can be influenced by NPS pollution in several ways. First, sedimentation of channels, reservoirs, and wetlands reduces flood storage and exacerbates flooding. Second, the urbanization of wetlands, floodplains, and other lowland areas removes both flood storage and natural water-treatment functions. The mutual interdependence of water and environmental quality requires the protection of existing riparian, lacustrine, and other wetland areas from pollution, and this objective is compatible with many aspects of floodplain management. Third, diverse methodologies and jurisdictions used in floodplain and NPS pollution management are complementary. Efforts to manage floodplains are often well- organized at the local government and community level, and they may include education and incentive programs. Conversely, regulatory provisions of the CWA can provide the authority needed to protect flood conveyance systems from sedimentation. Monitoring and controlling NPS pollution, therefore, can be tied to flood-hazard mitigation efforts and the social mechanisms utilized in floodplain management may be beneficial to water-quality management.

4.4 Private Land Management

State and federal laws can only do so much to protect water quality. The majority of land holdings within the PRW are privately owned. This would indicate that private landowners impact the land more than any other group within the watershed. Education of land use practices and how this affects our water resources could be one of the single most important factors to safeguard our water resources. Watershed education efforts through the federal and state government, county organizations and local stakeholder groups are the frontline to keeping our water clean. There are many organizations that provide technical assistance to landowners on how to better manage their lands to protect natural resources and water quality. These organizations include the Natural Resource Conservation Service (NRCS), MSU County Extension Offices, Conservation Districts, Kalamazoo Nature Center (KNC), Native Connections of Three Rivers (private), United States Fish and Wildlife Service (USFWS), Michigan Department of Natural Resources (MDNR), Land Conservancies (Southwest Michigan Land Conservancy), Audubon Society, and the Nature Conservancy.

5. Natural Features

5.1 Protected Lands and Parks

The PRW contains several significant natural areas. Approximately 1,663 acres of the Gourdneck State Game Area (Kalamazoo County), and the entirety of the Spring Creek State Game Area (80 acres in St. Joseph County) lie within the watershed.

Three Kalamazoo County parks lie within the watershed. These include Prairie View Park (208 acres), Scotts Mill Park (108 acres) and Cold Brook Park (276 acres).

The City of Portage also owns several natural areas and parks within the watershed. These include the West Lake Nature Preserve (110 acres of bog habitat which provides over 3,000 feet of natural shoreline buffer); Bishop's Bog Preserve (152 acres of bog habitat containing several rare plant species); Schrier Park (which has trails and facilities as well as providing open space/green preservation); South Westnedge Park; Eliason Nature Reserve (a 123 acre parcel east of Shaver Road that connects to Bishop's Bog and is classified as a "relict bog" and is part of the 250 acre bog complex that the City manages), Lakeview Park (26-acre park located along the shores of Austin Lake with fishing access, walking/nature trails); Ramona Park (on the west shore of Long Lake which has amenities and fishing access with some natural shoreline and trails).

The Vicksburg Trail and Recreation Park Area was reclaimed as part of the rails to trails program, the non-motorized trail runs 1.8 miles from the northeast side of Vicksburg on 24th St. to TU Ave just off Sprinkle Rd. The recreation area has natural shoreline on Sunset Lake.

The Southwest Michigan Land Conservancy protects several properties in the watershed. These include the Hidden Marsh Preserve (38 acres) and the Lacey Preserve (5 acres). In addition, this organization holds one conservation easement (172 acres) in the watershed.

A portion of the Portage River from Portage Lake (in St. Joseph County) to the City of Three Rivers is designated as a Michigan Heritage Water Trail (http://www.wmich.edu/glcms/watertrails/). This trail is approximately 16 miles in length, contains designated access sites and is posted with signs highlighting historical events and natural features of the river.

5.2 Rivers/Streams/Drains

5.2.1 History and Background

The channel morphology of the Portage River is extremely variable within its different stream reaches and tributaries. Historically, during settlement by European settlers in the 1830s, the landscape was systematically drained to allow increased settlement and agricultural production. Malaria and other sicknesses were a concern and relief was commonly associated with draining the surface water off the landscape. As a result, a significant amount of the Portage River morphology has been altered from pre-settlement conditions. The Portage River maintains a sinuous pattern (meandering pattern) and areas of the river and tributaries that have been altered and straightened are constantly working their way back toward this pattern and profile. Traditional drain maintenance techniques of straightening these channels, in essence, have a very limited lifespan and result in continued expenditures for maintenance. Due to the current Drain Code of 1956, drain commissioners have to address petitioned drainage maintenance projects and as a result continue the cycle of perpetual impairments to channel morphology. There are many new and innovative drain maintenance techniques but a cost effective universal set of practices has not been established. (See Section Water Quality for a more in depth discussion on this topic).

Evidence of manipulating stream channels date back as far as eight millennia (eight thousand years) to the Jordan River Valley in the ancient city of Jericho. As agriculture and grazing expanded into the upper reaches of the watersheds silts and sediments were carried downstream clogging canals reducing effectiveness, removing the silts and diking river courses became labor intensive and some cultures resorted to enslaving others for labor (R. Lal, 2006). As far back as eight thousand years ago channelizing has been a labor intensive and expensive temporary fix to moving water. We still use the same method of channelizing and straightening streams to move water and experience the same problems that ancient civilizations experienced. New approaches to drain maintenance needs to be established to alleviate problematic maintenance activities that have persisted through millennia, which continually disturb natural channel evolution which is less impactful and are typically not associated with impairments to water quality.

5.2.2 Current Conditions and Threats

Most of the main stem is of considerable trapezoidal channel area with a relatively expansive floodplain area and as a result has avoided much dredging and straightening of its channel. There are locations where damming has altered its hydraulics and channel morphology. Smaller tributaries have been channelized and or straightened resulting in entrenchment and degradation to stream processes.

CCD conducted a Bank Erosion Hazard Index inventory (BEHI), Near Bank Assessment (NBS) and bank and toe pins were installed to collect baseline data for stream banks. The bank stability inventory, consisting of BEHI and NBS assessments and bank and toe pin installations, will be used to evaluate conditions of stream banks within the Portage River (See Appendix 1 – Geomorphic Assessment of the PRW). The only other known morphological assessment of the Portage River was conducted at one location within the PRW as part of a Regional Reference Curve by the Michigan Stream Team. Information on this can be found at http://www.michigan.gov/deq/0,4561,7-135-3313_3684_41228-141575--,00.html.

Threats to natural stream processes are stream manipulation from dredging, irrigation, well-water withdrawal, lake-level control structures, low head and high head dams, perched/undersized culverts, nonpoint source pollutants, unregulated stream manipulation, development practices, road stream crossings and new road construction, and removal of riparian vegetation (i.e. thermal implications, bank stabilization)

5.3 LAKES

5.3.1 History and Background

There are 32 lakes within the PRW (see Table 4). Most of these lakes within the watershed are fed and drained by the Portage River and other tributaries. Lakes that are disconnected and not drained by an obvious channel formation of surface water are referred to as kettle lakes. Lakes in the Great Lakes Region were primarily formed from glaciation. Glaciers formed lake basins by gouging holes in loose soil or soft bedrock, depositing material across stream beds, or leaving buried chunks of ice that later melted to leave lake basins (see Figure 12, below). When these natural depressions or impoundments filled with water, they became lakes (A Primer on Limnology, USEPA).

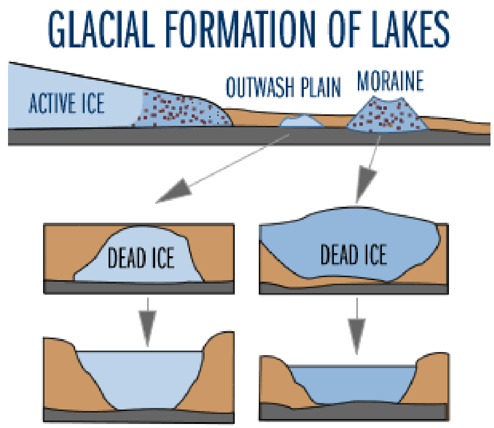


Figure 19. Glacial Formation of Lakes

Taken from USEPA's A Primer on Limnology

Lakes vary tremendously from their physical appearance, chemical (e.g. nutrients, pH, etc.) and biological makeup (i.e. plant and animal life). Temperatures, ability of light to penetrate to different depths, winds, currents, and surrounding land uses all influence a lakes makeup and cause each lake to be unique. For the most part lakes are generalized into three categories determined by nutrient concentrations, lake climate, and lake basin (i.e. depth and size). Trophic status is the term used to describe the nutrition supplied to the lake: and of these we typically use oligotrophic, mesotrophic, and eutrophic. Oligotrophic lakes tend to be deep and lacking in nutrient rich sediments. An example of an oligotrophic lake in Michigan would be Higgins Lake near Roscommon, MI. These types of lakes have cool water, low productivity and fish communities like cisco (lake herring), perch, walleye, and lake trout. Eutrophic lakes are highly productive, nutrient enriched lakes, shallow, and tend to have high amounts of detritus (dead organic matter originating from decaying plants). These systems have fish communities consisting of species like flathead catfish, dogfish, common carp, and other species tolerant of low oxygen levels and high temperatures. Hypereutrophic lakes are extreme examples of eutrophication and usually do not support fish life, at least during summer months. Much of southern Michigan lakes are eutrophic and this process has been exacerbated from nonpoint source pollution. Mesotrophic lakes lie within the middle of these spectrums and are productive enriched lakes with a middle range of nutrients and production of biological life. Mesotrophic lakes usually have an assemblage of cool water and warm water fish species like northern pike and largemouth bass, respectively.

Table 4. Lakes at a Glance

Name	County	Acres	Depth Range	Public Access	Cooperative Lake Management Plan (CLMP)	Lake Association	Surface Water Connec-tion	Sewer
Austin Lake	Kalamazoo	1101.43	0-11ft	Yes	No	Yes	Yes	Yes
Barton Lake	Kalamazoo	335.51	----	Yes	Yes	Yes	Yes	
Black Lake	Kalamazoo	26.96	----	----	No	----	----	----
Burnham Lake	Kalamazoo	25.87	----	----	No	----	----	----
Fishers Lake	St. Joseph	330.08	0-42ft	Yes	Yes	Yes	Yes	No
Goose Lake	Kalamazoo	26.44	----	Private/Limited	No	----	----	----

Name	County	Acres	Depth Range	Public Access	Cooperative Lake Management Plan (CLMP)	Lake Association	Surface Water Connec-tion	Sewer
Gourdneck Lake	Kalamazoo	225.10	0-50ft	Yes	No	----	Yes	----
Hogset Lake	Kalamazoo	79.08	0-32ft	Yes	No	----	Yes	----
Howard Lake	Kalamazoo	118.27	0-47ft	Private/Limited	No	Yes	----	----
Indian Lake	Kalamazoo	789.70	0-75ft	Private/Limited	Yes	Yes	Yes	Yes
Kimble Lake	Kalamazoo	62.09	----	Private/Limited	No	----	----	----
Le Ferre Lake	Kalamazoo	18.65	0-54ft	Yes	No	----	Yes	----
Little Sugarloaf	Kalamazoo	93.05	0-31ft	Yes	No	----	Yes	----
Long Lake	Kalamazoo	501.48	0-57ft	Yes	No	----		----
McGinnis Lake	Kalamazoo	18.56	----	----	No	----	No	----
Mud Lake	Kalamazoo	47.11	0-20ft	Private/Limited	No	----	Yes	----
Old Mill Pond	Kalamazoo	8.22	----	----	No	----	----	----
Pickerel Lake	Kalamazoo	131.82	0-10ft	Yes	No	----	No	----
Portage Lake	St. Joseph	727.47	0-38ft	Yes	No	Yes		Yes
Potter Lake	Kalamazoo	26.91	----	----	No	----	No	----
Sagamaw Lake	Kalamazoo	36.66	----	----	No	----	----	----
Sugarloaf Lake	Kalamazoo	196.14	0-30ft	Yes	No	----	----	----
Sunset Lake	Kalamazoo	139.59	----	Yes	No	----	Yes	----
Thrall Lake	Kalamazoo	94.40	----	Private/Limited	No	----	----	----
Tub Lake	Kalamazoo	20.81	----	----	No	----	----	----
Upjohn Pond	Kalamazoo	79.81	----	----	No	----	----	----
Updegrove Lake	Kalamazoo	34.81	----	Private/Limited	No	----	Yes	----
West Lake	Kalamazoo	334.87	0-12ft	Yes	No	Yes	Yes	Yes
Wood Lake	Kalamazoo	28.82	----	----	No	----	----	----

Note: ---- means information unknown

The 32 bodies of water within the PRW comprise approximately 5,660 acres of lakes and ponds.

5.3.2 Current Conditions and Threats

It is desirable to PRW stakeholders to maintain a lakes natural state of eutrophication and not to increase the rate of this process. Sedimentation is a direct threat to lakes in the Portage River Watershed (Section 3.5 Table 5, Portage River Watershed Management Plan, 2006). Non-point source sediment is carried overland from surface water runoff (rain) into the Portage River and small tributaries which consequently, makes its way into the natural lakes within the watershed. Historically, our water resources were used as ways to get rid of pollutants (dumping waste into surface water). Lakes were used much in the same way and have been looked at as being giant filters with buffering capacities. We now approach watershed management with a holistic approach. Actions on the land in the headwaters or upper reaches of the watershed affect lakes downstream. This is a common problem in agricultural dominated watersheds and can create high costs for landowners within that particular watershed. This is exemplified from the in-depth analysis of environmental risk and costs associated with these exact problems. The following is an in-depth look at associated costs and threats to just one lake within the watershed.

In-lake management can reach upwards of $30,000 per year just for aquatic weed management. One Lake Association in particular, the Indian Lake Association, has been performing extensive data collection above and beyond CLMP testing. Through this data collection, it has been determined that:

- Lake basins will differ dramatically in water quality, especially when streams enter a lake.
- Phosphorous is likely the limiting nutrient for aquatic vegetation & algae growth (this has also been indicated in MDNR Status of the Fishery Resource Report 2011-120 Indian Lake) in Basin #1 of Indian, which has three basins (basin #1 has two inlets and one outlet).
- Phosphorous concentrations at shoreline lawns are two-fold (times) greater than CLMP measurements, but still in the mesotrophic range.
- Nitrate concentrations at shoreline lawns are in the mesotrophic range.
- Nutrient concentrations at road culvert sites are in the mesotrophic range
- Elevated nutrients entering Indian Lake through Portage River & Dorrance Creek are likely contributing to vegetation and algae growth in Basin #2, including harmful algae blooms.
- Individual sample variation demands continuing assessments to establish consensus trophic status and changing trends in nutrient status
- Water quality volunteers should leverage their data & expertise to initiate change at their lakes and streams by working with other agencies or groups.

Indian Lake Association's data collection also raises some valid unanswered questions like:

1) Will the current TMDL study performed by MDEQ for *E. coli* reduce nutrient loads?
2) Are zebra mussels contributing to the growth of aquatic vegetation?
3) Does climate change contribute to the recent excessive growth of aquatic vegetation?
4) Does phosphorus in lake sediment control the growth of aquatic vegetation due to precipitation by calcium carbonate ($CaCO_3$)

During the spring and summer of 2013 Indian Lake experienced extremely high water levels that brought problems with water recreational use and functions of many homes. The fall of 2008 and the spring of 2009 marked the 4th highest and 7th highest lake levels, respectively, in the past 65 years (Indian Lake Association Data). The solution then and in the summer of 2013 was to remove large woody debris downstream of the lake. This, however, is a short-sighted, temporary fix to a problem that will continue to exist. The tributaries above Indian Lake are channelized and the sub-watersheds, the headwaters of Portage River and Indian Lake-Portage River, have experienced a loss of 19.54% and 10.67% of wetlands, respectively. This loss of wetland storage for flooding and channelization has decreased the amount of flood water storage and increased the rate at which Indian Lake receives surface water from snowmelt and rains. The floodplain downstream of Indian Lake is, for a large part, natural and meandering with a Study Bank Height to Bankfull

Height Ratio (actual top of the stream bank to inception point where at flood stage the stream water moves onto the floodplain) close to 1/1 ,which allows for floodwater to be stored upon the floodplain. It might sound, after reflection on the previous sentence, that a river will always have a 1/1 ratio, but this often is not the case because of manmade alterations and geologic processes (glaciation) and downcutting from stream processes. Almost all of the road-stream crossings are of span bridge design, which is the most conducive to allow natural hydraulics or movement of volumes of water. One can hardly blame homeowners and lake riparian's for wanting relief from seasonal flooding, but this very situation is one of the reasons stakeholders are developing a watershed management plan and looking for more cost-effective longer-term solutions. This also is an example of how proper planning and zoning, preservation of wetlands and establishment of wetlands and/or floodplain reconnection projects (a type of BMP that takes down the bank to bankfull levels and allows flood storage on the floodplain), and establishment of natural channel design (a more natural channel pattern and profile (i.e. sinuous stream channels and two-stage ditching where a more natural channel design is not acceptable) can help to alleviate flooding and represent a more long-term sustainable solution.

Then there is a need to address land use practices surrounding small tributaries and pathways that ultimately lead to the main stem and deliver nonpoint pollutants to those lakes. There are large amounts of sediments in the channelized portions of the upper reaches that were observed within the channel while CD staff and biologists were inventorying stream reaches. Excess of 6-12 inches of sediment has inundated stream reaches throughout channelized portions of the stream upstream from the confluence of Indian Lake. A uniform channel that tends to be shallower and filled with sand, silt, and other particles with a complete lack of pools, riffles, and runs, which process natural amounts of sediment associated with erosion, natural channels and recovering channels have a quicker capacity to process these sediments and deposit sediment in depositional areas (slow backwater areas with low water velocities allow lighter material to settle out). Pool, riffle, run sequences have a more natural channel pattern and profile than a uniform, shallow, straight channel. This can indicate an overload of sediment within the system. These sediments are associated with nutrients that are leading to an increased eutrophication process and harmful algal blooms. This indicates the need to stop nonpoint source pollutants from entering the streams and tributaries that deliver pollutants to our water bodies and allow lakes to process the excess nutrients that are within the system. Lake use by landowners and visitors involves recreational activities like boating, fishing, swimming and aesthetic uses. Excess nutrients can negatively impact these uses. Lake associations have spent much time and resources attempting to control non-native weed growth and excess sediments associated with sedimentation and detritus from increased weed growth and decay. Austin Lake is currently experimenting with ways to deal with an extreme amount of excess sediments through aeration techniques.

Alternative methods that are being explored and should be evaluated for success in dealing with the increased rates of eutrophication are aeration. Near-by lakes and lakes within the PRW that have initiated this method of lake management include:

Pickerel Lake: Pickerel Lake members conducted an extensive and thoughtful review of all methods to manage lake vegetation, including Eurasian watermilfoil. They established a Special Assessment District in Pavilion Township to use aeration as the sole approach.

Austin Lake: The Kalamazoo Gazette reported on Austin Lakes efforts. A Special Assessment District was established for 5 years to use aeration on 225 acres of Austin Lake. Interestingly, property owners in the bay that will benefit most from this intervention are being assessed $420/year in contrast to all other property owners on the lake ($80/year).

Nearby lakes where this method has been used for several years, and some outcomes should be available, are Sherman Lake and Indian Lake (Dowagiac). Exploration in terms of reducing sediments could be explored further for results of slowing or reducing the eutrophication process as opposed herbicide treatments, mechanical treatment and dredging practices.

5.3.3 Fish Assemblages

Fish species common to the lakes of the PRW are fish species found within the greater St. Joseph River. The most common game fish species found in Indian Lake in 2010 by the MDNR were:

Bluegill (21%), rock bass (7.8%), largemouth bass (3.2%), black crappie (1.5%), northern pike (0.8%), yellow and brown bullhead (0.7% and 0.1%) ,and smallmouth bass (0.3%)

Other common fish species were sand and mimic shiners (36.7% and 22.5%), longnose gar (0.3%), common carp (0.1%) and bowfin or dogfish (0.1%).

A species of **special concern** was also found, the **spotted gar**. Ciscoes, a threatened species, weren't sampled in the 2010 survey, but that does not necessarily indicate extirpation of the species. Ciscoes have also been sampled by MDNR in Barton Lake.

Fish communities throughout the watershed resemble bass and bluegill fisheries with northern pike, smallmouth bass, gar, rough fish (i.e. carp), minnow species, and catfish. Some fish communities may differ when changing from a lotic or river type of environment to a lentic or lake type of environment. And some fish assemblages will be similar in both as some Midwest fish species inhabit both types of environments. It is important to note that the interconnectedness of lake and riverine environs are important to ensure that fish life histories (some fish live in lakes and spawn in rivers) and seasonal habitat requirements are fulfilled. The interruption of this from lake-level control structures or impassable culvert road-stream crossings can severely impair healthy and balanced fish communities.

5.3.4 Aquatic Plant Communities

Emergent (underwater and above), submergent (below), and free-floating plant communities are present within lakes in PRW. Aquatic vegetation is important to water quality, fish and wildlife habitat, fish and wildlife food, and aesthetics (or beauty). Macroinvertebrates, fish, amphibians, reptiles, mammals and shorebirds all use aquatic vegetation during their life cycles. Plants provide shelter, food, spawning, feeding, and every other life history stage. Macroinvertebrates use plants as a permanent residence or home, fish, amphibians and reptiles use it as cover for juveniles, concealment, and spawning. Waterfowl and shorebirds use plants for food, shelter, and nesting material. Mammals like the beaver and muskrat use it for food and nesting material. Deer will use it as a food source.

Aquatic plants can improve water quality. Plants sequester phosphorus, nitrogen, and other nutrients and nonpoint source pollutants. Aquatic plants anchor sediments and prevent them from resuspension (Borman et al. 1997). Although dense stands of aquatic vegetation can lead to increased amounts of detritus or organic matter this usually does not happen in well balanced aquatic communities. This is typical to areas of disturbance or areas where excessive amounts of nutrients are brought into the system.

Invasive plants pose a serious threat to native plant communities that the previously mentioned animals depend on and directly contributes to degrading our water resources by outcompeting our native plant communities and speeding up the eutrophication process. Invasive plants like phragmites replace native cattails that provide food and shelter for muskrat. Eurasian water milfoil and curly-leafed pondweed grow at accelerated rates and begin to decay earlier in the growing season creating dramatic shifts in dissolved oxygen levels at critical times when temperature and oxygen can reach terminal levels for aquatic animal species (e.g. fish). These invasives are a nuisance to human activities such as swimming, boating, and other recreational activities.

A list of aquatic plants observed within lakes are:

Natives:

Elodea, largeleaf pondweed, northern milfoil, white and yellow lily pads, coontail, wild celery (*Vallisneria americana*), duckweed and emergent bulrush, arrowhead, numerous rushes, wild rice and cattails (some are non-native narrow-leaved cattail)

Invasive Exotic Aquatic Plants:

Fanwort *(Cabomba)*, Eurasian watermilfoil, various leaved watermilfoil, curly-leaf pondweed, emergent Purple Loosestrife, and Giant Common Reed (*Phragmites australis*).

5.4 WETLANDS

5.4.1 History and Background

During European settlement wetlands were systematically drained to prevent malaria outbreaks and to provide more farmland for production and settlement. This systematic drawdown of the water table through drainage consequently reduced the amount of wetlands throughout the PRW. Manipulation of the landscape may have been necessary to accommodate settler's needs, but two centuries later we are starting to realize the importance of wetlands and the role they play in processing nonpoint source pollutants, providing flood storage, and providing critical habitat for sensitive animal species. According to the Landscape Level Wetland Functional Assessment Methodology Report, "the emergence of watershed management planning is driving an interest in understanding the relationship between wetland loss and degraded surface water quality". A bulleted list of evaluated wetland functions reported by the Portage River Watershed Landscape Level Wetland Functional Assessment (Enhanced NWI) (Appendix 2 – Landscape Level Wetland Functional Analysis), 2013 follows:

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

Some wetlands can provide all of these functions but most wetlands within the PRW provide at least one or more of these functions. Location of wetlands, size and type all influence how wetlands function and what role they play.

The following diagram, taken from PRW Landscape Level Wetland Functional Analysis (LLWFA), 2013 shows wetlands within a typical watershed.

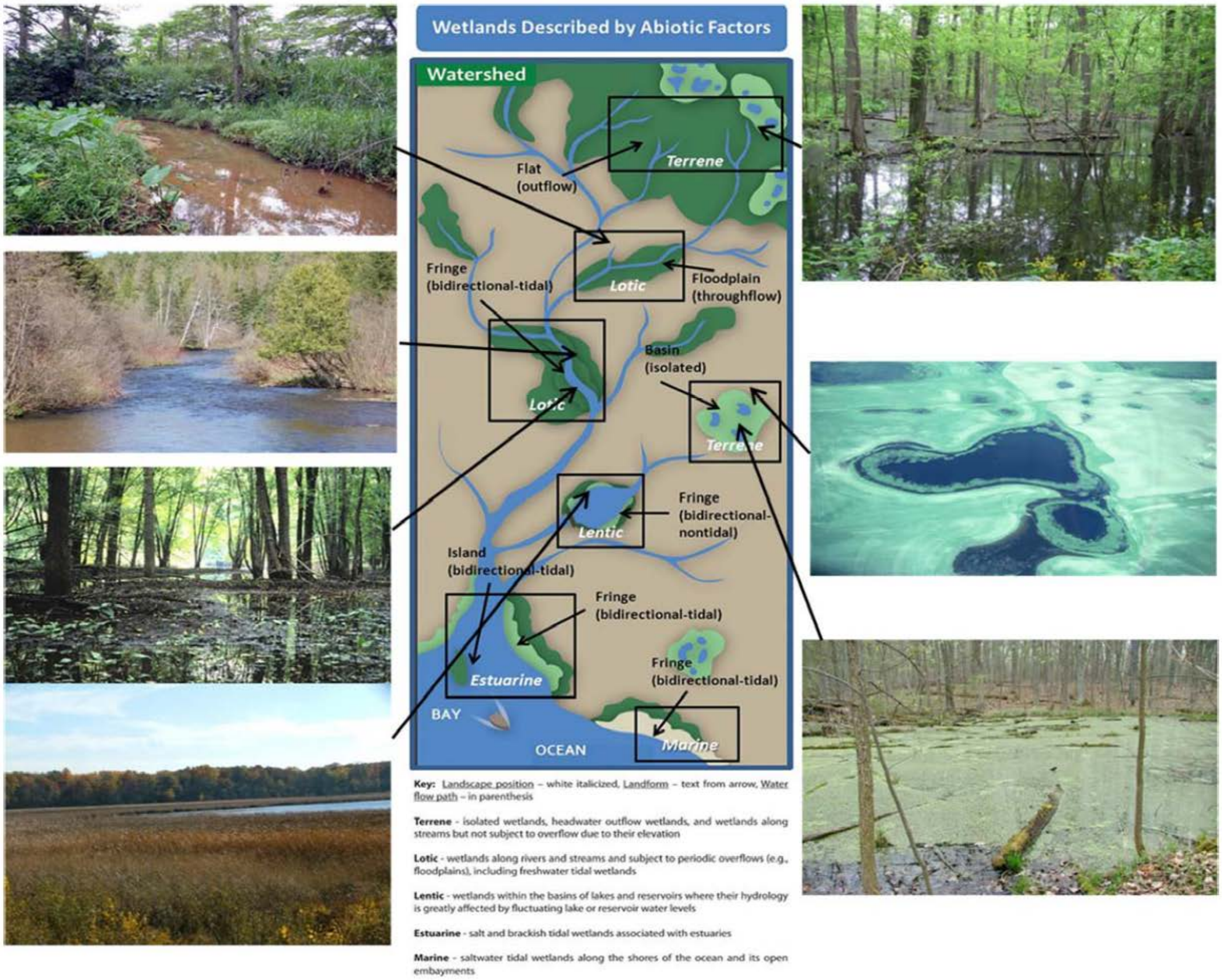


Figure 20. Wetlands Described by Abiotic Factors

5.4.2 Current Conditions and Threats

As of 2005, the PRW maintains 18,725 acres of wetlands with an average wetland size of 6.5 acres. The pre-settlement wetland acreage was 23,773 with an average wetland size of 34 acres. This accounts for a total wetland acreage loss of 5,048 amounting to a 22% loss of total wetland resource with 78% of original wetland acreage remaining (PRW LLWFA, 2013). Four of the most influential types of wetland functions affecting nonpoint source pollutants are flood water storage, stream flow maintenance, nutrient transformation, and sediment and retention of other particulates; all of which have decreased significantly. The following figure looks at acreage loss of functions of high and medium significance.

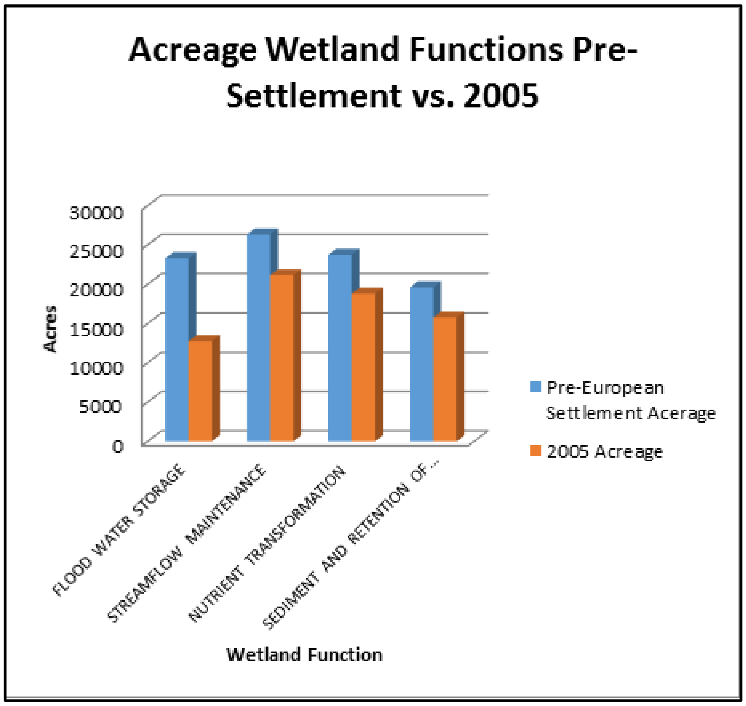


Figure 21. Acreage of Wetland Functions Pre-European Settlement vs. 2005 Acres

The percentage change in acreage of functions of high and medium significance is displayed in the figure below. Notice a net loss in every category.

Table 5. Wetland Function, % Change in Acreage

Wetland Function	% Change in Acreage
Flood water storage	-45%
Stream flow Maintenance	-20%
Nutrient Transformation	-21%
Sediment and Retention of Other Particulates	-20%

The data derived from the (PRW LLWFA, 2012) shows a significant loss in the watershed wetlands ability to process nonpoint source pollutants adding to the degradation of water quality throughout the PRW.

Wetlands are extremely important for reptile and amphibian species like the massasauga rattlesnake (*Sistrurus catenatus catenatus*), a species of special concern, northern water snake (*Nerodia sipedon sipedon*), the northern spring peeper (*Pseudacris crucifer*), wood frog (*Rana sylvatica*), northern leopard frog (*Rana pipiens*), and the eastern american toad (*Bufo americanus*). A unique kind of wetland, vernal ponds, which are wetlands that are isolated or not connected to other bodies of water support the spotted salamander (*Ambystoma maculatum*) and the blue-spotted salamander (*Ambystom laterale*).

Human interactions with wetlands are the main reason for wetland loss and threats. We cause degradation to wetlands by altering hydrology (quantity of water and flow rates), water quality degradation, increasing pollutants, and the introduction of non-native species (e.g. Eurasian phragmites (*Phragmites australis australis*) and purple loostrife (*Lythrum salicaria*) has been observed in the PRW). Other threats to native wetland plants include narrow-leafed cat-tail (*Typha angustifolia*) and reed canary grass (*phalaris arundinacea*).

Hydrologic alterations are common within the PRW. When the water table is altered, it changes surrounding wetlands and the soil chemistry and plant and animal communities that live and grow within those wetlands. Hydrologic activities within the Watershed that negatively affect wetlands are: deposition of fill material for development, drainage for agricultural production, dredging for stream channelization for development agricultural production and drain maintenance, diversion of water to irrigation ponds, damming and development of irrigation ponds, diversion to and from wetlands, and impervious surfaces increasing water and pollutant runoff into wetlands.

Some examples of these observed practices within the PRW are: irrigation pond development, impervious surfaces within developed areas, agricultural tiling, road systems, dredging, drain maintenance, filling, and excavating of wetlands.

Drainage and filling of wetlands, residential and industrial expansion, road systems, and agricultural expansion are major areas of concern that are threatening wetlands in the PRW. Drain maintenance practices, and tiling of agricultural fields move water from the landscape. Residential and industrial expansion increase impervious surfaces. Road systems alter hydrology and can divert surface drainage direction and can increase or decrease hydrologic water flows.

The following diagram depicts potential wetland restoration areas:

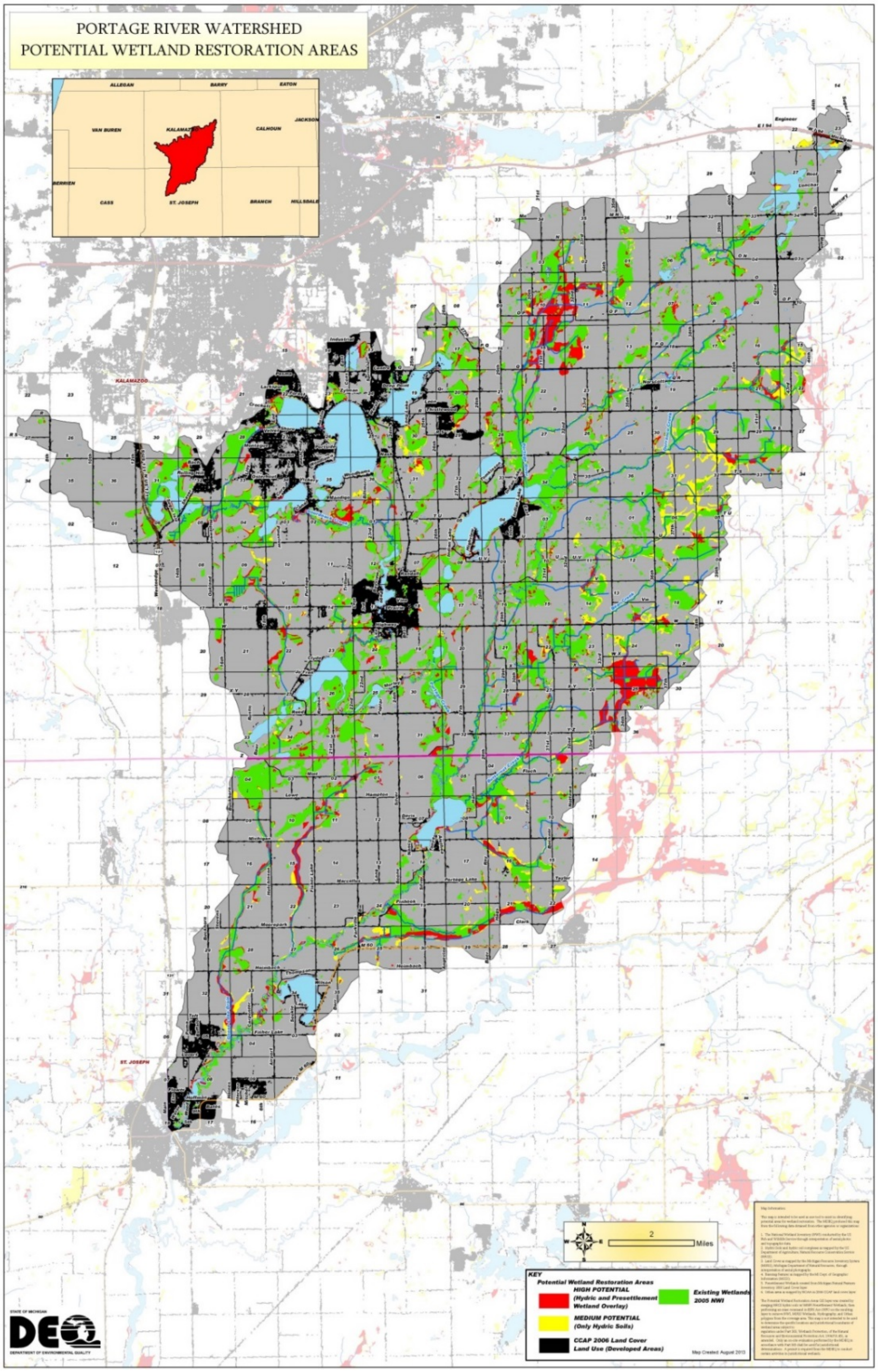


Figure 22. LLWFA for PRW

5.5 Floodplains

5.5.1 History and Background

A floodplain is a level area near the stream channel that is inundated during moderate flow and is constructed by the river under present climatic conditions by deposition of sediments during overbank flooding (Leopold, 1994).What Leopold was referring to is the area around a stream, creek, drain or other body of water that is occupied by water during periods of high volumes of water. Unconfined flat valleys, which occur most commonly in lowland rivers, permit considerable meandering and lateral migration, and so tend to have well developed floodplains (Allan and Castillo, 2007). The PRW displays these tendencies of its river channel and its floodplains. These floodplain areas tend to not have been developed or farmed due to the tendency to flood and due to its saturated soils. Precipitation makes its way through surface water and groundwater pathways and enters the stream either across the floodplain or through subsurface pathways and enter the river system via the hyporheic zone or the area directly below the bottom of the stream or the area submersed below the stream. Floodplains are often part of wetlands. When wetlands are adjacent to water bodies they are described as lotic wetlands (encompassing one or both sides of a river, stream etc.) and lentic wetlands (surrounding a lake).

Before European settlement the PRW experienced very little manipulation from humans to its floodplains. Inhabitants likely built within the floodplain but structures were much more mobile and made from natural materials. The rivers and streams were used as highways for movement, fishing and trapping. Floodplains had much less manipulation than compared to today. Structures like roads, culverts, bridges, and permanent homes are new human manipulations that have an effect on floodplain size and function.

5.5.2 Current Conditions and Threats

An analysis of the valley length of the Portage River main stem from the confluence of the St. Joseph River in Three Rivers to Cold Brook County Park and the main stem of Portage Creek revealed that of ~29.33 miles of valley length, 21.6% had inadequate floodplain dimensions and that 78.4% had adequate floodplain dimensions. Adequate floodplain was derived from determining whether the floodplain valley width was wide enough to allow the stream to find its own pattern or sinuosity appropriate to its size or discharge. In essence, the floodplain was wide enough and left untouched to allow the river channel to maintain a meandering pattern or sinuosity. Smaller lateral drains and tributaries were not included in the analysis but pattern and profile within those stream reaches tend to be highly manipulated with very little if any floodplain due to agricultural land use practices.

> Approximately **22%** of the 29 miles of floodplain valley analyzed in the Portage River Watershed was “inadequate” in size due to manmade alterations.

Wetland types within the PRW floodplains consist of palustrine (or nontidal wetlands dominated by trees, shrubs, persistent emergents (e.g. cattails, lily-pads)) and are typically emergent, shrub-scrub, aquatic bed and forested wetland. These inundated areas provide spawning for some fish species particularly of importance to northern pike (*Esox luscius)*. Northern pike spawn earlier than most species of Midwestern fish typically just after ice-out February to April. Pike spawn in marsh areas with aquatic vegetation that is submerged and emergent like rushes, grasses, and sedges. Destruction of these spawning areas is a huge threat to the pike population. Floodplains are important areas for resident and migratory duck, geese and swan species. These areas provide food, habitat, and nesting for many types of wildlife.

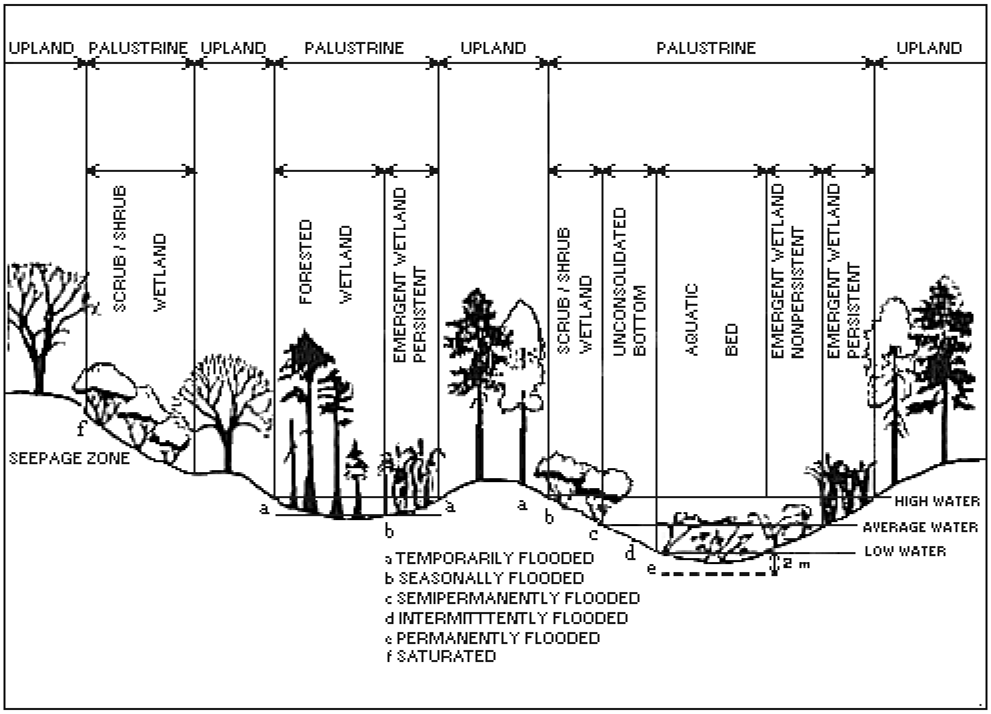


Figure 22. Wetland Classification

(Taken from USGS Classification of Wetlands and Deepwater Habitats of the United States [http://www.npwrc.usgs.gov/resource/wetlands/classwet/palustri.htm)](http://www.npwrc.usgs.gov/resource/wetlands/classwet/palustri.htm)

Waterfowl observed using the PRW:

Wood Duck (*Aix spona*)
Mallard (*Anus platyrhynchos*)

Amphibians and reptiles observed using the PRW:
Eastern Box Turtle (*Terrapene carolina carolina*)
Spotted Turtle (*Clemmys guttata*) – State threatened species

Shorebirds observed using the PRW:
Great Egret (*Ardea alba*)
Sandhill Crane (*Grus canadensis*)
Great Blue Heron (*Ardea herodias*)
Green Heron (*Butorides virescens*)

Woodland birds observed using the PRW:
Cedar Waxwing (*Bombycilla cedroroum*)
Yellow Warbler (*Denroica petechia*)
Baltimore Oriole (*Icterus galbula*)
Eastern Kingbird (*Tyrannus tyrannus*)
Gray Catbird (*Dumetella carolinensis*)
Hairy Woodpecker (*Picoides villosus*)

Downy Woodpecker (*Picoides pubescens*)
Pileated Woodpecker (*Dryocopus pileatus*)

Birds of prey observed using the PRW:
Coopers Hawk (*Accipiter cooperii*)
Red-tailed Hawk (*Buteo jamaicensis*)
American Kestrel (*Falco sparverius*).

Large portions of the PRW floodplain are forested with tree, shrub and plant species.

Dominant tree species in the PRW:
Silver Maple (*Acer saccharinum*)
Swamp White Oak (*Quercus bicolor*)
American Elm (*Ulmus* americana)
Slippery Elm (*Ulmus rubra*)
Basswood (*Tilia americana*)
Eastern Cottonwood (*Populus deltoids*)

Common shrub species in the PRW:
Buttonbush (*Cephalanthus occidentalis*)
Red-Osier Dogwood (*Cornus sericea)*
Silky Dogwood (*Cornus amomum*)
Speckled Alder (*Alnus incana*)
Spicebush (*Lindera benzoin*)

Common plant species in the PRW:
Trillium (*Trillium nivale*)
Wild Ginger (*Asarum canadense*)
Wild Geranium (*Geranium maculatum*)
Eastern Skunk Cabbage (*Symplocarpus foetidus*)
Jack-in-the-Pulpit (*Arisaema triphyllum*)

Floodplains are often considered the last line of defense against nonpoint source pollutants and a home to unique wetland species of plants that have the ability to process pollutants and absorb and use excess nutrients and fertilizer. Broad expansive floodplains are associated with having large barriers to defense, and river reaches with narrow floodplains or less than 25-30ft are inadequate in protecting from nonpoint source runoff.

Human alterations to the stream from road building, improper bridge culvert installation, drainage, surface and groundwater withdrawals from irrigation, and building within floodplains are currently threatening floodplains.

5.6 Groundwater

5.6.1 Background and History

Groundwater is the water that is located in the porous areas between sand, gravel, silt, and clays below the ground. This saturated zone is highly important to humans because we get almost 100% of our drinking water from the groundwater.

When rain falls to the ground, the water does not stop moving. Some of it flows along the land surface to streams or lakes, some is used by plants. Some evaporates and returns to the atmosphere. And some seeps underground, into pores between the soils and bedrock formations called aquifers. Water is not stagnate and moves via channels in these areas.

Nearly 100% of people in the watershed get there drinking water from groundwater (St. Joseph Watershed Management Plan, 2005). Water suppliers (cities and villages) drill wells through soil and rock into aquifers to reach the ground water and supply the public with drinking water. Rural homes have their own private wells drilled on their property.

5.6.2 Current Conditions and Threats

Most of the PRW is comprised of Galesburg-Vicksburg outwash plain. Coldwater Shale Formation lies under the glacial outwash plain. Information from some drillers has depths of over 4,000 feet of shale, approximately 626 feet in Charleston Twp. Because of the shale thickness it limits the freshwater supply to the deposits above the shale (Luukkonen et al., 2004) or in essence the shallow area of glacial deposits above the shale. This means that most of the PRW's groundwater is highly permeable.

Thick glacial sand and gravel deposits provide most ground-water supply. The deposits range in thickness form 50 to about 600 feet in. Most wells are completed at depths of less than 75 feet in the sand and gravels that yield adequate water supplies (Rheaume, 1990).

Nitrates are a major concern within Kalamazoo and St. Joseph Counties because of the shallow permeable water table. Nitrates are a concern because elevated levels in well-water have been known to cause blue-baby syndrome (methaemoglobinemia), which can lead to death in the elderly and infants. The average concentration of nitrates in the ground water wells in Kalamazoo County was 0.01mg/L, which is equal to the statewide average. The highest average of nitrate (48.60 mg/L) was found in Charleston Twp. (Chowdhury et al., 2003). The World Health Organization (WHO) cites keeping nitrates below 50mg/L as an effective treatment measure. The USEPA set the level of contaminants in drinking water at which no health effects are likely to occur at 10mg/L. This level is far below the WHO's level and was set at this level of protection based on the best available science to prevent potential health problems (USEPA).

Major factors affecting groundwater contamination within the PRW determined from Rheaume were: municipal and industrial inputs, agricultural and rural residential inputs, animal wastes, septic-tank discharges, and fertilizer applications.

Geohydrologic factors that affect susceptibility of ground water to contamination are: depth to water, net recharge or "the amount of water per unit area of land which penetrates the ground surface and reaches the water table" (Rheaume, 2003) and (Aller and others, 1985), topography, aquifer media "path length" in general the larger the particle size the less retention time of water (sand and gravel channel contaminants faster), soil media or the upper portion of the ground composition (fines retain water and promote filtration, biodegradation, sorption, and volatization where larger particles (sand) promote groundwater infiltration, and finally hydraulic conductivity of the aquifer (ability of groundwater to move via groundwater channels).

Irrigation is a major withdrawal of groundwater within the PRW. Bedell, 1979 determined that St. Joseph ranked 2nd in amount of irrigation water used and number of irrigators in the State. St. Joseph county ranked 1st in number of irrigated acres. St. Joseph County contains more irrigated land than any other county east of the Mississippi (Michigan State University Extension of St. Joseph County, 2006).

Table 6. Acres of Irrigated Land in St. Joseph County

Acres of Irrigated Land

	1997	**2002**
St. Joseph County	94,999	103,980
Michigan	407,071	456,278
% in St. Joe County	23%	23%

Source: http://www.nass.usda.gov/

(St. Joseph County has experienced a 9% increase in irrigation acreage from 1997 to 2002.) *Not all of irrigated land is from groundwater withdrawal. However, the sheer amount of irrigated land poses implications for groundwater. Rheaume concluded that potential nitrogen inputs are 41.9% from precipitation, 4.7 percent form septic tanks, 2.5 percent from animal wastes, and 50.9 percent from fertilizers. And the trend was that average concentrations increase as fertilizer application increases and percentage of area irrigated increases.*

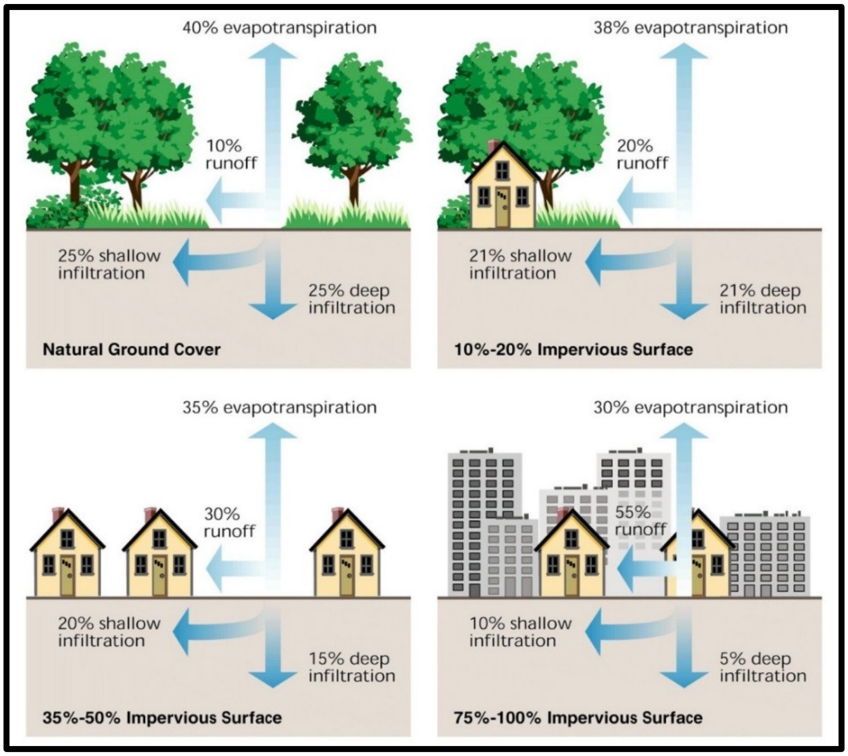


Figure 23. From Stream Corridor Restoration: Principles, Processes, and Practices

http://www.nrcs.usda.gov/Technical/stream_restoration/. Federal Interagency Stream Restoration Workshop

5.7 Forests

5.7.1 Background and History

When settlers arrived to the region there were accounts of large oak, beech, and maple forests. The area was well known for its broken landscape of upland forested areas with mixed prairie. Forested wetlands and forested floodplain comprised a large portion of woodlands and are still important areas today.

5.7.2 Current Conditions and Threats

Currently there are 21, 940 acres of forested land within the PRW. Current forested areas tend to follow the river and stream tributary corridors. The areas that are left within the PRW are areas that were too hard to clear for agricultural land. Current threats to forests within the PRW are the emerald ash borer, oak wilt, pathogens, viruses, blight, clearing land for agricultural purposes and development.

6 PLAN DEVELOPMENT PROCESS

6.1 PUBLIC INPUT

Public input and stakeholder concerns were derived from a review of existing materials, interviews with stakeholders, and other forms of stakeholder input such as informal surveys and conversations. The Planning process included acquiring public input, and looking at previous studies and reports, conversing with watershed landowners, and relying on public meetings to solicit information from different stakeholder groups.

From this public input, the term "desired uses" is used to represent those uses of the watershed that may not be protected by law, but are of interest to local stakeholders.

Table 7. Desired Uses

Desired use	Source
*Environmental education	Fishbeck, Thompson, Carr and Huber, Inc. 2001
*Maintain commercial discharges	Fishbeck, Thompson, Carr and Huber, Inc. 2001
*+Protect wetlands	Fishbeck, Thompson, Carr and Huber, Inc. 2001, stakeholder interviews
*+Protect riparian corridors/floodplains	Stakeholder interviews
*+Protect wildlife corridors and breeding areas	Stakeholder interviews
*Expanding existing protected open space	Stakeholder interviews
*Explore natural rivers designation	Stakeholder input
River corridor maintenance for kayaking	Steering committee survey
Agriculture	Steering committee survey
Abandoning old drains	Stakeholder interviews
River connectivity (e.g. fish passage)	Stakeholder interviews
Irrigation	Steering committee survey
Protection of wild rice	Steering committee survey
Stream access sites for recreational use and resource protection	Steering committee survey
Increased protection of water quality through township ordinances	Steering committee survey
Mandatory buffer strips along riparian corridors	Steering committee survey
Wet meadow, sedge plantings and protection	Steering committee survey
Stream bank stabilization	Steering committee survey

Desired use	Source
Monies allocated for water quality from local, state, and federal graphically represented on a watershed basis	Steering committee survey
Soil phosphorous concentrations of fields made available to the public	Steering committee survey
Hunting and fishing	Steering committee survey
Fish habitat improvement	Steering committee survey
Water recreation without excessive vegetation, *E. coli,* toxic algal blooms	Steering committee survey
Controlled animal access	Steering committee survey
Warm water fishery	Steering committee survey
Subsistence hunting and fishing for tribal members	Steering committee survey
Harvesting wild rice and other gathering activities	Steering committee survey
Total body contact (e.g. swimming) and partial body contact (e.g. fishing, canoeing)	Steering committee survey
Continued watershed monitoring	Steering committee/watershed residents

*Taken from Portage River 2006
+Expressed desire during planning phase of Portage River 2014

Stakeholder concerns include agricultural run-off—*E.coli*, phosphorous and nitrogen associated with sediment, hydrologic manipulation from dredging, sediment from roads, goose waste runoff, *E. coli*, stormwater outfalls connected directly to lakes, too much natural debris in stream, not enough natural debris in the stream, unnatural streambank erosion, road-stream crossing erosion, unauthorized public access leading to trespassing and bank erosion, vandalism on private property where the river is accessible to the public, trash dumping, and lack of collaboration between units of government.

Stakeholder input was gained throughout the watershed planning process through personal communication, stakeholder steering committee meetings, and from the Portage River Watershed Management Plan 2006.

6.2 Previous Studies/Reports

Current information concerning water quality, stream habitat and aquatic biota in the Portage River Watershed is lacking (Walterhouse 2003). Since this statement there has been increased water quality monitoring and interest in the Portage River Watershed. The following studies have been outlined below:

The Michigan Department of Environmental Quality Water Resources Division: Biologists from MDEQ are performing a Total Maximum Daily Load (TMDL) assessment of the entire Portage River Watershed for *E. coli*. Section 303(d) of the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads for water bodies that are not meeting water quality standards (WQS). The assessment is scheduled for 2018 according to the Surface Water Divisions Integrated Report Appendix B, 2014, to determine whether the Portage River meets levels safe for total and partial water body contact.

Calhoun Conservation District: Calhoun Conservation District (CD) performed a Bank Erosion Hazard Index (BEHI) study and installed bank pins to measure erosion rates of streambanks and susceptibility to degradation of water quality in the Portage River. For more information, see Appendix 1 - Geomorphic Assessment of the PRW.

Monitoring Nutrient Inputs on Indian Lake

Indian Lake which lies primarily within, Brady Township with a portion of the North Basin within Pavilion Township, is the first substantial Lake Basin within the upper reaches of the Portage River Watershed. The Portage River and Dorrance Creek drain into the Upper Basin of Indian Lake and exit the south end of the basin in one channel forming Portage River. The Indian Lake association has been monitoring water quality conditions through the Michigan Clean Water Corps (MiCorps), which is a network of volunteer monitoring programs in Michigan. Indian Lake presented their findings at the 8th Annual MiCorps Conference at Higgins Lake, MI, 2012. The presentation, *Monitoring Nutrient Inputs on Indian Lake, Kalamazoo County: A Study funded by the Indian Lake Association of Vicksburg, Inc.* highlighted elevated nutrient levels of Nitrates and Phosphorous in the North Basin. Indian Lake Association is largely responsible for the updating and development of the current Portage River Watershed Management Plan. See Appendix 9 – Indian Lake Presentation for a closer look at the presentation.

Kalamazoo County Surface Water Monitoring Program: The Kalamazoo County Health and Community Services Department monitored surface water quality at locations throughout the county. Lake access sites, county drains, creeks, and streams were monitored from 2001 to 2009. During each sampling event measurements of water temperature, dissolved oxygen, pH, conductivity, and turbidity were also recorded. Forty-seven of those sites fell within the Portage River Watershed. The sampling procedures used did not comply with Michigan's Water Quality Standards requirements, but the results can be used to assess general water quality. Many of the sites sampled have had high levels of *E. coli* at least once since sampling began in 2001. Bacterial sources are found in both rural and urban drainages. Higher bacteria counts are evident at most surface water monitoring locations within 24 hours of a rain event (Kalamazoo County Human Services Department 2004).
Since 2009 Kalamazoo has not maintained the same monitoring regime and currently monitors the beach locations below.

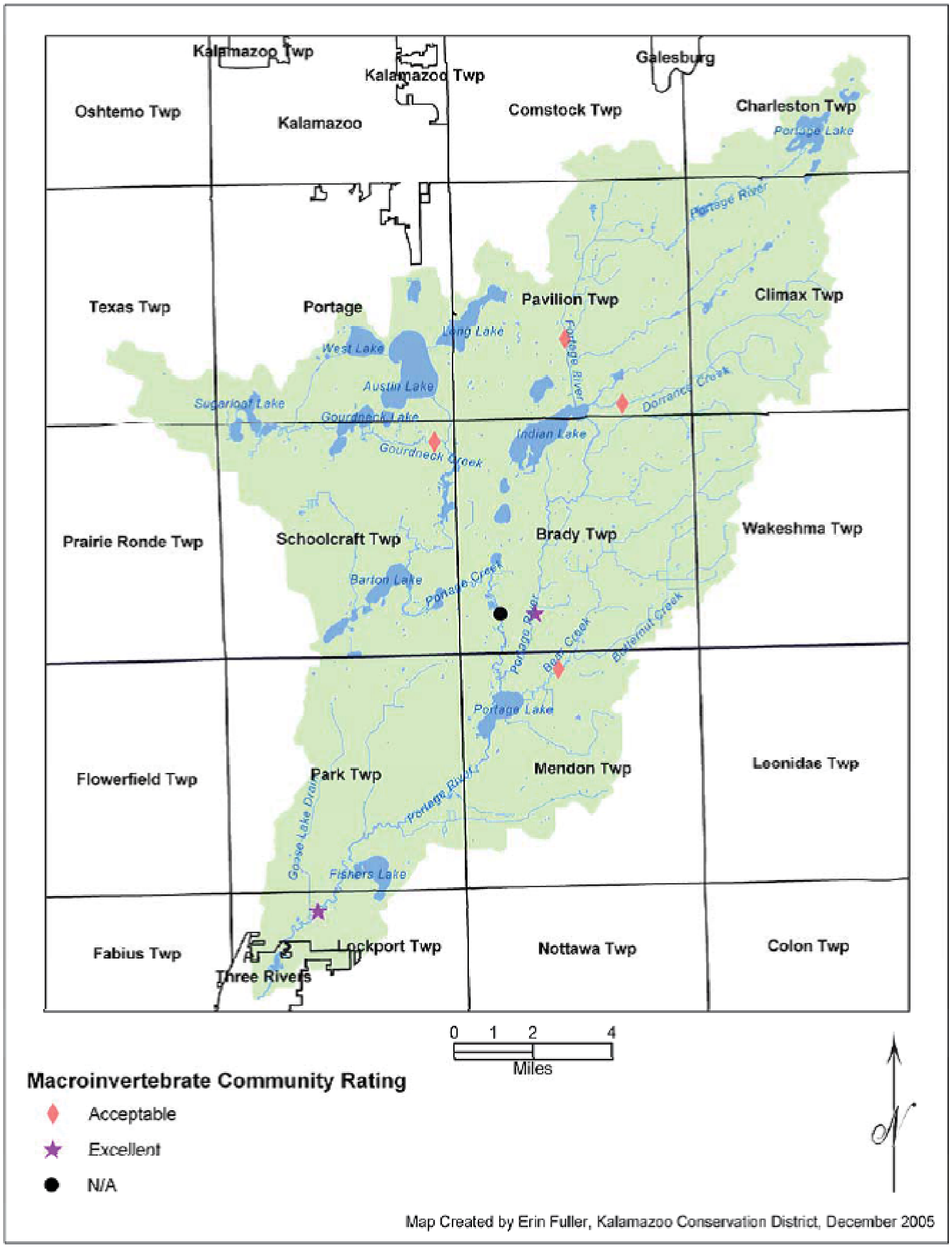
Beach Water Monitoring: The Kalamazoo County Health and Human Services Department assesses bathing beaches for Escherichia coli (E. coli) bacteria, an organism that indicates the presence of human and animal waste. The following bathing beaches are monitored once each week (typically between Memorial Day and Labor Day):

Table 8. Beach Water Monitoring Locations

Waterbody	**Township**
Blue Lake, Cold Brook County Park	Charleston
Long Lake, Ramona Park	City of Portage
Sunset Lake, Sunset Lake Park	Village of Vicksburg
Hogsett Lake, Prairie View County Park	Schoolcraft

Blue Lake in Cold Brook County Park had 3 beach closures in 2001 (May, July, and August) and again in July of 2002 but has yet to experience anymore closures since this time. Hogsett Lake has had no closures. Long Lake in Ramona Park has experienced closures in 2010, 2008, 2006, 2004, 2002—all within the months of June, July and August. Sunset Lake's last beach closure was July of 2009.

No beaches are currently monitored in the Portage River Watershed. MDEQ Biosurvey (Walterhouse 2003): The MDEQ performed a biological survey of portions of this watershed in the summer of 2000. Water quality throughout this watershed was generally rated as good. The lower Portage River (downstream of Indian Lake) and Portage Creek have not been channelized, and stream habitat is suitable for diverse macroinvertebrate communities. Most of the river and its tributaries upstream of Indian Lake have been channelized or are managed to move stormwater off the landscape. Impacts to the macroinvertebrate community and aquatic habitat were attributed to channelization, row cropping, and alteration of riparian buffers by riparian landowners.



Source: Walterhouse 2003

Figure 24. Macroinvertebrate Community Rankings

Water chemistry sampling from seven sites in this watershed indicate that nutrient levels at all sites were in compliance with Michigan water quality standards, and were less than mean values at reference sites within the same ecoregion. Despite heavy rainfall during the sampling period, stream water levels and water clarity remained stable, likely due to the buffering capacity of the lakes and wetlands in this watershed (Walterhouse 2003).

St. Joseph River Watershed: The Portage River Watershed is a subbasin of the St. Joseph River Watershed. A plan has been developed for the St. Joseph River Watershed (DeGraves 2005), and some information from that plan is applicable to the Portage River Watershed. This watershed management plan identifies agriculture as having the most significant impact on surface waters in the St. Joseph River basin. In this WMP, the Portage River basin was not identified as having any impaired or threatened designated uses. The Portage River Watershed is among the top of the major watersheds in the St. Joseph river basin in terms of remaining wetlands.

As part of the St. Joseph River planning process, modeling was done to estimate wet weather total phosphorus loading per acre for each subwatershed. The Portage River Watershed averaged 0.1891 lbs/acre of phosphorus. A model was also created to estimate wet weather total suspended solid loading per acre. The Portage River Watershed averaged 83.2 lbs/acre of total suspended solids (DeGraves 2005).

Michigan Tributaries of the St. Joseph River Basin Report

A 1985 survey of the Michigan tributaries of the St. Joseph River (USDA 1985) contained some information about the Portage River. For the St. Joseph River basin, this report cited the need for the promotion and adoption of conservation tillage and conservation cropping systems to reduce erosion in the watershed. The Portage River was identified as a priority watershed for these land treatments. Primary resource concerns in the Portage River Watershed included cropland soil erosion and sedimentation, impaired drainage, and water quality degradation due to improper animal waste disposal.

Austin and West Lakes

A variety of studies have been performed on Austin and West Lakes in the City of Portage. These lakes are surrounded primarily by residential development. A channel connecting Austin Lake to Gourdneck Creek (at the southeast end of the lake) has in the past been designated as a trout stream by the Michigan Department of Natural Resources (Snell 1975), though it no longer holds this designation. Weeds and algae have been considered a problem in these lakes (Payne et al. 1985). At one point, Eurasian Water Milfoil was estimated to occupy 40% of the lake area in Austin Lake (Snell 1975). Carp have also been considered a problem. In the early 1960s Michigan Department of Natural Resources chemically treated Austin West, and Long Lakes to eradicate all fish species, then restocked the lake with bass and pike (Snell 1975). Carp have since reinfested the lake, however (Payne et al 1985).

One study estimated pollution in Austin Lake to be attributed to overland and street runoff (15%), leaching septic systems and tile fields (30%), agricultural runoff (20%), overuse of lawn fertilizers (30%), and animal pollution (5%) (Snell 1975). Chemical analysis of sediments from Austin Lake showed significant contamination by chromium, copper, lead and zinc, with many of these samples characterized as heavily polluted (Western Michigan University 1978).

A more recent study of West Lake (Kieser & Associates 1999) determined that phosphorus concentrations are similar to a 1986 study on the lake. Over those years, some stormwater drains had been disconnected. The remaining stormwater outfalls to West Lake still apparently contribute pollutants such as phosphorus and *E. coli*. This report recommended disconnecting storm drains that discharge directly into the lake, and instead installing leaching basins to promote infiltration.

Groundwater

At least two sites in the watershed are considered to be land use restricted sites. This designation applies when the property has groundwater use restricted by deed due to existing levels of groundwater contamination that cannot be economically cleaned up. The watershed also has at least 11 leaking underground storage tanks (LUSTs), and 9 sites of environmental contamination (Kalamazoo County Human Services Department 2001).

6.3 Watershed Inventory

CD performed multiple inventories of the watershed from 2012 through 2014 to locate, identify, and prioritize nonpoint source pollutants in the Watershed. Multiple forms of inventory were used ranging from desktop analysis (i.e. GIS, aerial imagery), driving the road system, walking stream reaches, and in-stream studies (See Appendix 10).

A span of two seasons of inventory resulted in establishing and conducting a geomorphic assessment of the PRW (Appendix 1 – Geomorphic Assessment of the PRW) and a systematic analysis was taken to evaluate known, impaired and suspected areas contributing nonpoint sources of pollution. A desktop analysis of those areas, as well as factors like land use/land cover, soil types, and location to water bodies contributing to surface water that is connected to the Portage River and surrounding tributaries was evaluated pre and post field inventory.

Ground-truthing suspected areas from the desktop analysis resulted in mapping concerns if they were validated and in some cases measurements were taken and used to estimate contributions. After compassing almost every road within the watershed and time spent walking tributaries and floating stretches of navigable reaches of the river, conditions within the watershed were able to be evaluated with confidence. A combination of desktop analysis and ground-truthing lead to a better understanding of actual problem areas and risks associated with those areas. It is impossible to monitor all issues within the watershed, so management recommendations and areas that are threatened or impaired were determined so using a combination of observation, evaluation, and actual field data or measurements.

Driving the watershed provided observation evaluation of land based practices and a chance to map areas that were receiving land based application of manure and herbicides and pesticides adjacent to pathways of delivery to water bodies. Floating stretches of the watershed allowed practitioners to evaluate in-stream conditions and make observations of stream reaches and natural vs. human induced impacts and how much those were threatening each particular stream reach. Culverts and dirt roads impacting or contributing to nonpoint source pollution were recorded when found contributing to water bodies. Multiple inventories after rain events allowed insight into suspended sediment delivery from tributaries and visual observation of elevated levels of nonpoint source runoff. Often times this lead to an area that was ½ mile to a mile from the actual water body. These areas would not have been located had practitioners not performed ground-truthing and located nonpoint source pathways.

Watershed inventory should include the land area surrounding the stream and tributaries, the riparian area surrounding the stream and tributaries, and areas in-stream or within the channel itself. Nonpoint source pollutants originate from agricultural lands, urban areas and other land use types surrounding the channel, from the riparian area and channel bank, and from within the channel itself, but often the material within the channel itself comes from sources outside of the channel. As a result, inventory has to be directed toward the suspected pollutants typically associated with nonpoint source pollutants (i.e. overland runoff). Runoff brings sediment, fertilizers, pesticides, salts and other pollutants into the stream causing impairments to water quality. Aerial imagery is used to look at: stream channel pattern which can indicate areas of stream manipulation, riparian areas lacking a sufficient buffer (natural vegetation greater than or equal to approximately 25-30 ft.)

The stream channel pattern itself can indicate if a stream has been manipulated. Undisturbed stream channels have a quicker ability to recover from impairments than does channelized or dredged streams. Stream channels that have a meandering or sinuous pattern are typically “natural” or have been left undisturbed. These types of streams have a floodplain (floodable area that is inundated with water from the channel at high flows) that is connected to the stream vs. an entrenched stream and floodplain that is disconnected from the stream. Think of a typical southern Michigan drainage ditch that is very deep and the actual wetted channel and stream surface is far below the top of the bank, this is an entrenched stream. Streams that are entrenched cannot overtop its banks and as a result move more water downstream quicker resulting in more erosional forces and downstream flooding. A stream that is connected to its floodplain deposits sediment and water onto the floodplain where physicochemical processes (the chemical changes that occur—often associated with the filtering of pollutants and toxins) are allowed to take place. The more connected our streams are to their floodplains and these processes filter nonpoint source pollutants that have moved overland into streams. It has been indicated that floodplain and wetland restoration is a productive best management practice for dealing with *E.coli.*

6.4 WATERSHED RESEARCH AND MODELING

MDEQ Landscape Level Wetland Functional Analysis

The National Wetland Inventory (NWI) database was developed by the US Fish and Wildlife Service Northeast Region (USFWS-NE) using spatial information to estimate qualitative loss of wetland functions. Based on that original technique developed additional information was added to the NWI database to characterize 13 general wetland functions at a landscape level. In cooperation with the Michigan Non-Point Source unit, this technique was applied to assist with watershed management plans with wetland conservation and restoration strategies for their watershed projects. Please see Appendix 2 – Landscape Level Wetland Functional Analysis.

STEPL Pollutant Loads Analysis

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) uses algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, biological oxygen demand, and sediment delivery based on various land uses and practices. Annual nutrient loading is calculated based on runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies (http://it.tetratech-ffx.com/steplweb/).

The STEPL Pollutant Loads Analysis was to determine load reductions after implementation of various BMPs for the PRW. Appendix 6 – Pollutant Load Estimates and Reductions provides the complete analysis.

Geomorphic Analysis/BEHI/Bank Pins

In order to gain a better understanding of susceptibility of stream banks to erosion, a bank stability assessment consisting of the Bank Erosion Hazard Index (BEHI), near-bank stress (NBS) and bank and toe pin installations were performed in the Portage River/Little Portage Creek Watersheds at 12 stations in each watershed. A morphological assessment was prepared by Fishbeck, Thompson, Carr & Huber (FTCH) in 2009 of Little Portage Creek, the adjacent watershed which shares some similarities, determined the overall drain was in fair to poor condition with problems including but not limited to erosion, sedimentation, undercutting, lack of vegetation and improper maintenance activities. A portion of Little Portage Creek is not maintained as a designated drain (headwaters region) but portions in Kalamazoo County and most of St. Joseph County are maintained as a designated drain resulting in heavy channelization, increased conveyance, and disconnection from the floodplain, and decreased bank stability.

The bank stability inventory performed by Calhoun Conservation District (CCD) attempted to understand what portions of the watershed have an elevated risk of contributing sediment to the watershed. A general watershed inventory will also be performed to locate, investigate and identify water quality pollutants and their sources in each priority sub watershed. Secondary data relating to potential *E. coli* contributions were collected throughout the inventory process.

A full report of the geomorphic analysis, BEHI, and bank pins assessment is contained in Appendix 1 – Geomorphic Assessment of the PRW.

7 WATER QUALITY SUMMARY

7.1 FEDERAL WATER QUALITY

Under the Clean Water Act (CWA), every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimmable/fishable" waters. Water quality standards are ambient standards as opposed to discharge-type standards. These ambient standards, through a process of back calculation procedures known as total maximum daily loads (TMDLs) form the basis of water quality based permit limitations that regulate the discharge of pollutants into surface waters under the National Pollutant Discharge Elimination System (NPDES) permit program.

The State of Michigan's Part 4 Rules (of Part 31, Water Resources Protection, of Act 451 of 1994) specify water quality standards which shall be met in all waters of the state. Common water pollutants and related water quality standards for Michigan waters are described below.

Bacteria/Pathogens

Bacteria are among the simplest, smallest, and most abundant organisms on earth. While the vast majority of bacteria are not harmful, certain types of bacteria cause disease in humans and animals. Concerns about bacterial contamination of surface waters led to the development of analytical methods to measure the presence of waterborne bacteria. Since 1880, coliform bacteria have been used to assess the quality of water and the likelihood of pathogens being present. Combined sewer overflows in urban areas and failing septic systems in residential or rural areas can contribute large numbers of coliforms and other bacteria to surface water and groundwater. Agricultural sources of bacteria include livestock excrement from barnyards, pastures, rangelands, feedlots, and uncontrolled manure storage areas. Stormwater runoff from residential, rural and urban areas can transport waste material from domestic pets and wildlife into surface waters. Land application of manure and sewage sludge can also result in water contamination. Bacteria from both human and animal sources can cause disease in humans.

Related water quality standards

Bacteria - Rule 62 of the Michigan Water Quality Standards (Part 4 of Act 451) limits the concentration of microorganisms in surface waters of the state and surface water discharges. Waters of the state, which are protected for total body contact recreation, must meet limits of 130 Escherichia coli (E. coli) per 100 milliliters (ml) water as a 30- day average and 300 E. coli per 100 ml water at any time. The total body contact recreation standard only applies from May 1 to October 1. The limit for waters of the state, which are protected for partial body contact recreation, is 1000 E. coli per 100 ml water. Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 ml water as a monthly average and 400 fecal coliform bacteria per 100 ml water as a 7-day average. For infectious organisms which are not addressed by Rule 62, The Department of Environmental Quality has the authority to set limits on a case-by-case basis to assure that designated uses are protected.

Sediment

Sediment is soil, sand, and minerals that can take the form of bedload, suspended or dissolved material. Sediment harms aquatic wildlife by altering the natural streambed and increasing the turbidity of the water, making it "cloudy". Sedimentation may result in gill damage and suffocation of fish, as well as having a negative impact on spawning habitat. Increased turbidity from sediment affects light penetration resulting in changes in oxygen concentrations and water temperature that could affect aquatic wildlife. Sediment can also affect water levels by filling in the stream bottom, causing water levels to rise. Lakes, ponds and wetland areas can be greatly altered by sedimentation. Other pollutants, such as phosphorus and metals, can bind themselves to the finer sediment particles. Sedimentation provides a path for these pollutants to enter the waterway or water body.

Related water quality standards
Total Suspended Solids (TSS) - Rule 50 of the Michigan Water Quality Standards (Part 4 of Act 451) states that waters of the state shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foam, settle able solids, suspended solids, and deposits. This kind of rule, which does not establish a numeric level, is known as a "narrative standard." Most people consider water with a TSS concentration less than 20 mg/l to be clear. Water with TSS levels between 40 and 80 mg/l tends to appear cloudy, while water with concentrations over 150 mg/l usually appears dirty. The nature of the particles that comprise the suspended solids may cause these numbers to vary.

Nutrients
Although certain nutrients are required by aquatic plants in order to survive, an overabundance can be detrimental to the aquatic ecosystem. Nitrogen and phosphorus are generally available in limited supply in an unaltered watershed but can quickly become abundant in a watershed with agricultural and urban development. In abundance, nitrogen and phosphorus accelerate the natural aging process of a water body and allow exotic species to better compete with native plants. Wastewater treatment plants and combined sewer overflows are the most common point sources of nutrients. Nonpoint sources of nutrients include fertilizers and organic waste carried within water runoff. Excessive nutrients increase weed and algae growth impacting recreational use on the water body. Decomposition of the increased weeds and algae lowers dissolved oxygen levels resulting in a negative impact aquatic wildlife and fish populations.

Related water quality standards
Phosphorus - Rule 60 of the Michigan Water Quality Standards (Part 4 of Act 451) limits phosphorus concentrations in point source discharges to 1 mg/l of total phosphorus as a monthly average. The rule states that other limits may be placed in permits when deemed necessary. The rule also requires that nutrients be limited as necessary to prevent excessive growth of aquatic plants, fungi or bacteria, which could impair designated uses of the surface water.

Dissolved Oxygen - Rule 64 of the Michigan Water Quality Standards (Part 4 of Act 451) includes minimum concentrations of dissolved oxygen, which must be met in surface waters of the state. This rule states that surface waters designated as coldwater fisheries must meet a minimum dissolved oxygen standard of 7 mg/l, while surface waters protected for warmwater fish and aquatic life must meet a minimum dissolved oxygen standard of 5 mg/l.

Temperature/Flow
Removal of streambank vegetation decreases the shading of a water body, which can lead to an increase in temperature. Impounded areas can also have a higher water temperature relative to a free-flowing stream. Heated runoff from impervious surfaces and cooling water from industrial processes can alter the normal temperature range of a waterway. Surges of heated water during rainstorms can shock and stress aquatic wildlife, which are adapted to "normal" temperature conditions. Increased areas of impervious surfaces, such as parking lots and driveways, and reduced infiltration from other land use types, such as lawns and bare ground, leads to an increase in runoff. Increased runoff reduces groundwater recharge and leads to highly variable flow patterns. These flow patterns can alter stream morphology and increase the possibility of flooding downstream.

Related water quality standards
Temperature - Rules 69 through 75 of the Michigan Water Quality Standards (Part 4 of Act 451) specify temperature standards which must be met in the Great Lakes and connecting waters, inland lakes, and rivers, streams and impoundments. The rules state that the Great Lakes and connecting waters and inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees Fahrenheit above the existing natural water temperature (after mixing with the receiving water). Rivers, streams and impoundments shall not receive a heat

load, which increases the temperature of the receiving water more than 2 degrees Fahrenheit for coldwater fisheries, and 5 degrees Fahrenheit for warmwater fisheries. These waters shall not receive a heat load, which increases the temperature of the receiving water above monthly maximum temperatures (after mixing). Monthly maximum temperatures for each water body or grouping of water bodies are listed in the rules. The rules state that inland lakes shall not receive a heat load, which would increase the temperature of the hypolimnion (the dense, cooler layer of water at the bottom of a lake) or decrease its volume. Further provisions protect migrating salmon populations, stating that warmwater rivers and inland lakes serving as principal migratory routes shall not receive a heat load which may adversely affect salmonid migration.

Chemical Pollutants

Chemical pollutants such as gasoline and oil can enter surface water through runoff from roads and parking lots, or from boating. Other sources can be approved processes such as permitted application of herbicides to inland lakes to prevent the growth of aquatic nuisance plants. Other chemical pollutants consist of pesticides and herbicide runoff from commercial, agricultural, municipal or residential uses. Impacts of chemical pollutants vary widely with the chemical.

Related water quality standards

pH - Rule 53 of the Michigan Water Quality Standards (Part 4 of Act 451) states that the hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 in all waters of the state.

7.2 DESIGNATED USES

The State of Michigan's Part 4 Rules also require that all designated uses of the receiving water be protected. Designated uses include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or coldwater fish and other indigenous aquatic life and wildlife, partial body contact recreation, and total body contact recreation from May 1 to October 31.

The following table summarizes these designated uses and provides appropriate definitions.

Table 9. Designated Uses

Designated Use	General Definition
Agriculture	Water supply for cropland irrigation and livestock watering
Industrial Water Supply	Water utilized in industrial processes
*Public Water Supply	Public drinking water source
Navigation	Waters capable of being used for shipping, travel, or other transport by private, military, or commercial vessels
Warm water Fishery	Supports reproduction of warm water fish
Coldwater Fishery (as applicable)	Supports reproduction of cold water fish
Other indigenous aquatic life and wildlife	Supports reproduction of indigenous animals, plants and insects
Partial body contact	Water quality standards are maintained for canoeing, and wading
Total body contact	Water quality standards are maintained for swimming & water skiing

*The Public Water Supply use is not applicable in the watershed because no communities withdraw water directly from surface water

7.3 IMPAIRMENTS

The state of Michigan is required by federal statute to provide an assessment of the water quality. Part of this process is developing an Integrated Report, which is prepared biennially.

Michigan Department of Environmental Quality (MDEQ) 2012 Integrated Report reported these findings:

> *Biosurvey sampling conducted at a single station in 2005 resulted in an acceptable fish metric score, and an excellent macroinvertebrate metric score. The total and partial body contact recreation designated uses are impaired in Dorrance Creek, with an* E. coli *TMDL scheduled for 2018. The current WMP was developed by an MS4 group; however, it does not meet CMI or Section 319 criteria. There is local interest in upgrading the WMP to meet the aforementioned criteria.*

The above MDEQ Integrated Report was the impetus for this watershed management planning process.

Current designations of impaired waters summarized from the Integrated Report, 2014 are as follows:

Table 10. Impaired Uses in the PRW (non-point source related)

Water Body	AUID	Impaired Use	Cause	TMDL Status
Dorrance Creek and Tributaries	0505-05	Total Body Contact	*Escherichia* coli	2018

Table 11. Impaired Uses in the PRW (consumption related)

Water Body	AUID	Impaired Use	Cause	TMDL Status
Headwaters Portage River	0501-01	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Gourdneck Creek and Lake connections	0502-01	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Gourdneck Lake	0502-07	Fish Consumption	Mercury in Fish Tissue	2014
Gourdneck Creek	0502-08	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Barton Lake	0503-02	Fish Consumption	Mercury and PCB in Fish Tissue	2014
Gourdneck and Portage Creeks	0503-03	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Portage Creek	0503-04	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Butternut Creek-Bear Creek	0504-01	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Indian Lake-Portage River	0505-01	Fish Consumption	PCB in Fish Tissue/Water Column	2014

Dorrance Creek and Tributaries	0505-03	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Portage River	0505-04	Fish Consumption	PCB in Fish Tissue and Water Column	2014
Goose Lake Drain	0506-03	Fish Consumption	PCB in Fish Tissue and Water Column	2014
Garmin Foster Drain	0506-04	Fish Consumption	PCB in Fish Tissue/Water Column	2014
Portage River	0506-05	Fish Consumption	PCB in Fish Tissue/Water Column	2014

All current designated uses are being met except for total body contact in Dorrance Creek and Tributaries. Elevated levels of *E. coli* are impairing its waters.

Navigation, Industrial Water Supply, Agriculture, Warm Water Fishery, Other Indigenous Aquatic Life and Wildlife, and Coldwater Fishery (where applicable) are all currently being met. The State of Michigan also considers Fish Consumption a designated use for all water bodies. There is a generic, statewide, mercury-based fish consumption advisory that applies to all of Michigan's inland lakes.

Navigation. The main stem of the St. Joseph River and portions of several of its tributaries are declared legally navigable by the courts. All waters in the St. Joseph River basin are presumed navigable unless legally declared non-navigable. The Portage River from Parkville (T5S, R10W, Sec. 24) through Portage Lake and up Bear Creek to Portage Lake Station on the old Grand Rapids &Indian Railroad (T5S, R10W, Sec. 8) (Wesley and Duffy, 1999).

Public Water Supply. There are no municipal drinking water systems on the river. The primary source for drinking water comes from groundwater through private wells and municipal.

Industrial Water Supply. Supply for industrial processes. National Pollutant Discharge Elimination System (NPDES) is designed to protect Michigan's public water bodies and is administered by the MDEQ.

The state of Michigan has determined that 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.

Agriculture. All uses for agriculture are currently being met. There is surface water withdrawal for irrigation and livestock watering from the Portage River and its tributaries.

Warm Water Fishery. All uses for Warm Water Fishery our being met.

Other Indigenous Aquatic Life and Wildlife. All uses for Other Indigenous Aquatic Life and Wildlife are being met.

These determinations are made by MDEQ technical staff to their standards and assessment practices. It may be perceived that some uses are not being met but an overall determination is made on a watershed basis.

7.4 POTENTIAL IMPAIRMENTS

Water quality can vary greatly within a single watershed. An overall assessment of the Portage River watershed's designated uses was made using several sources of information such as MDEQ Integrated Reports, MDNR Fisheries Reports, Stakeholder Input, MDEQ Wetland Functional Analysis, and CCD Staff Inventories. Potential impairments exist throughout all waterbodies.

Table 12. Pollutants threatening designated uses

Designated use	Pollutant causing threat	Ranking
Navigation (threatened)	Sediment	1
	Hydrology	2
	Nutrients	3
Warm water fishery (threatened)	Hydrology (i.e. dams, channelization, dredging)	1
	Sediment	2
	Temperature	3
	Bacteria/pathogens*	4
	Nutrients	5
	Chemical pollutants	6
Other indigenous aquatic life and wildlife (threatened)	Sediment	1
	Hydrology	2
	Temperature	3
	Chemical pollutants	4
	Nutrients	5
	Bacteria/pathogens	6
Partial body contact recreation (threatened)	Bacteria/pathogens (i.e. *E.coli*)	1
	Nutrients	2
Total body contact recreation (threatened)	Bacteria/pathogens (i.e. *E. coli*)	1
	Nutrients	2

* Largemouth bass virus

Table 13 shows the pollutants that have been identified in the watershed, and their typical sources and causes.

Table 13. Pollutants, Sources, and Causes

Pollutant/Problem*	Sources*	Causes*	Documented Presence in Watershed
1. Bacteria/pathogens (K)	1. Livestock (K)	1. Manure Application (K)	Lack of adherence to manure management plans. Improper handling or spreading. Manure management not used by small to medium sized operations. CAFO's can sell manure to landowners and then apply to landscape for landowner with no restrictions.
		2. Livestock facility runoff (S)	Improper manure storage and feedlot run-off.
		3. Unrestricted access (K)	Livestock observed in stream. Fenced livestock areas still allow for overland surface run-off (observed by technician).
	2. Wildlife (geese) (K)	1. Lack of riparian buffers (K)	Lack of vegetative buffer and mowing to lakeshore/stream edge makes conducive habitat for geese.
	3. Septic systems (S)	1. Poorly maintained, designed, or sited septic systems (S)	Stakeholder interviews with lake landowners stated that using dye in toilet revealed infiltration into lake

Pollutant/Problem*	Sources*	Causes*	Documented Presence in Watershed
1. Bacteria/pathogens (K) 2. (con't)		2. Lack of education or awareness (S)	Improper installation, design, and maintenance.
	4. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.
		2. Lack of education or awareness (S)	Improper design, construction and or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.

2. Sediment (K)	1. Cropland run-off (K)	1. Conventional tillage practices. Plowing adjacent to water bodies. Agricultural tiled drains. (K)	Agriculture makes up over 70% of the watershed. Documented by Watershed Technician
		2. Unrestricted access (K)	Agriculture makes up over 70% of the watershed. Documented by watershed technician.
	2. Stream bank erosion (K)	1. Change in hydrology (channelization/ditching, e.g.) (K)	Stream reaches straightened for increased drainage.
		2. Removal of stream bank vegetation (K)	Stream reaches straightened for increased drainage.
		3. Natural debris deflecting water into banks (K)	Stakeholder group observations (i.e. lake associations, watershed technicians).
		4. Improper road-stream crossing design (S)	Portage River WMP 2006
		5. Human access (K)	Portage River WMP 2006
		6. Livestock access (S)	Unimpeded access has created bank instability, lack of vegetation, and gully formation.

2. Sediment (K) *(con't)*	3. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surfacewater run-off from parking lots, roads, driveways.
		2. Lack of education or awareness (S)	Improper design, construction and/or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.
	4. Roads (K)	1. Dirt roads w/significant gradient (K)	Steep gradient roads contributing sediment because of lack of turnouts.
	5. Road-stream crossings (S)	1. Improper road-stream crossing design (S)	Portage River WMP 2006
		2. Gravel road grading (S)	Portage River WMP 2006
	6. Construction site runoff (S)	1. Lack of or improperly installed erosion control measures (S)	Portage River WMP 2006

3. Nutrients (K)	3.Fertilizer use (K)	1. Improper application (S)	Lack of adherence to nutrient management plans. No nutrient management plan.
		2. Lack of adequate buffers (S)	Less than 25-30 ft. of buffer along surfacewater.
		3. Tiled drains and open drains (S)	Agricultural tiled drains and open drains
		4. Lack of education or awareness (S)	No knowledge of nutrient management.
	2. Livestock (S)	1. Unrestricted access (K)	Documented by watershed technician.
		2. Lack of riparian buffers (K)	Documented by watershed technician.
	3. Septic systems (S)	1. Poorly maintained, designed, or sited septic systems (S)	Septic systems are widespread throughout the majority of the watershed. Some residential lake communities still do not have lake wide sewer systems.
		2. Lack of education or awareness (S)	Lack of knowledge of proper installation, design and maintenance.
	4. Wildlife (geese) (K)	1. Lack of riparian buffers (S)	Lack of vegetative buffer and mowing to lakeshore/stream edge makes conducive habitat for geese.

3. Nutrients (K) *(con't)*	5. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Loss of sediment and nutrient retention capacity of floodplains and wetlands. Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.
		2. Lack of education or awareness (S)	Improper design, construction and or lack of installation of proper drainage methods (i.e. riser pipe, retention basin).
		3. Poor storm water management practices (S)	Urban/residential growth. Wetland drainage.
		4. Lack of riparian buffers (S)	Lack of natural shoreline design. Mowing to stream edge.
4. Hydrology (K)	1. Surface water (K)	1. Historic settlement and draining of landscape (K)	Pre-settlement vs. present wetlands/floodplain
	2. Reduction of base flow (K)	2. Drought (K)	Historical records indicate.
4. Hydrology (K) *(con't)*	3. Water use (K)	3. Withdrawals (K)	Increased withdrawals from agricultural irrigation. A model predicts water use.

	4. Low groundwater levels (S)	4. Increased impervious surfaces (S)	Increasing flashiness of stream resulting in less groundwater recharge/retention
		5. Lack of education or awareness (S)	Urban/residential growth. Wetland drainage.
Temperature (S)	1. Wetland/ Floodplain loss	1. Settlement, drainage, agriculture, and development (K)	Groundwater recharge is lost. Water retention/filtration is lost increasing temperature.
	2. Lack of riparian buffers (S)	1. Insufficient land use planning (S)	Urban residential growth.
		2. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Reduced water infiltration/percolation resulting in increased water temperature.
	3. Storm water runoff (S)	1. Lack of education or awareness (S)	Urbanized storm water drainage systems.
		2. Poor storm water management practices (S)	Reduced water infiltration/percolation resulting in increased water temperature.
		3. Lack of riparian buffers (S)	Extensive low density and agriculture along many water bodies.
		4. Agricultural pesticides applied to croplands drains	Observed by watershed technician.

6. Chemical pollutants (oils, metals, pesticides, etc.) (S)	1. Storm water runoff (S)	1. Change in land use (increase in impervious surface causing higher volumes of runoff) (S)	Documented by pre-settlement vs. present floodplains/wetlands. Tile drains routed to lake shore. Road and drain tiles leading to river and lakes. Surface water run-off from parking lots, roads and driveways.
		2. Lack of education or awareness (S)	
		3. Poor storm water management practices (S)	Urban/residential development
		4. Lack of riparian buffers (S)	Extensive low density and agriculture along many water bodies.

** K = Known and S = Suspected*

8 Critical & Priority Areas, Pollutants, Sources

Critical areas are areas that have been determined to be contributing, or have the potential to contribute, a majority of the pollutants threatening and impairing water quality within the PRW. Priority areas have been determined through historical information, studies and reports performed separate from nonpoint source funding within the PRW, computer modeling, areal imagery, ArcMap GIS, and watershed inventory and studies performed due to nonpoint source funding. These areas were identified and grouped into protection, agricultural, and urban areas.

8.1 Protection Areas

Protection within the PRW should address preventing and protecting water bodies from receiving nonpoint source pollutants that will directly impact water quality. Prioritization was determined by proximity to surface water bodies, likelihood of pathway contribution to water body, development pressure, wetland retention, existing impairments, soils, land use, and protection provided currently. Review of the PRW was taken with a holistic approach, however factors were given to prioritize management from an approach that looks at natural resources/areas currently providing water quality protection. Natural resource protection and proper land use management for each particular use is extremely important to insure water quality protection. Certain land use practices can become extremely more dangerous for short periods of time and/or can be continuous problems. Areas that are continually contributing to water bodies become an extreme contributor to degradation and need to be addressed through BMP's.

Protection areas are areas that were determined to possess certain natural resource features or characteristics that were deemed corrective to and resilient to non-point source pollutants. These characteristics can help to filter, process, and store pollutants in-order to lessen the impacts to the resource from nonpoint source pollutants.

Each subwatershed was represented on the y-axis and each metric was represented on the x-axis. For each subwatershed each individual metric was marked within those columns. A total was determined from those columns and a score delineated to each subwatershed in order to rank protection zones. Protection priority watersheds were highlighted in green with a protection buffer (dark green) around surface water that has characteristics which are resilient toward nonpoint source pollution. The parameters wetland loss and pollutant loading were weighted more heavily and impairments, E. *coli* studies data and watershed analysis were weighted less heavily.

1. ***Escherichia coli***- Water quality data performed by Kalamazoo County Health and Community Services from approximately 2002 to 2009 was used to determine elevated levels of *E. coli.* A complete analysis of the data resulted in ranking each subwatershed from the sum of all stations sampled within those subwatersheds that yielded results which exceeded 300 bacteria colonies per 100ml of water, between 130 and 299 bacteria colonies per 100ml of water and less than 130 ml of water. The categories established from the count was highest, high, medium, low, and none. The count and those categories were used to determine whether or not each subwatershed received a mark.
2. **Wetland Retention and functions** – Up to two marks were awarded within this category. Marks were awarded if wetland loss was under 15% and if there were multiple functions provided by those wetlands.
3. **No Impairments** - an analysis of MDEQ's 2012 and 2014 Integrated Report was used to delineate a mark for the impairment parameter. Marks were given when impairments listings were not currently listed.
4. **Watershed analysis and inventory**-Multiple watershed inventories and analysis were conducted to determine factors contributing non-point source pollutants (i.e. geomorphic assessment, aerial inventory, land based agricultural survey etc.) to the watershed and those watersheds resilience and ability to recover from and process those pollutants. Watersheds that had a risk received a mark and multiple risks from observations were given two marks.

Subwatersheds were totaled from all columns and assigned a protection designation: light green – low, green – protect, and dark green – river corridor/floodplain protection.

Table 14. Priority subwatershed protection area matrix

Watershed	Current Wetlands	No DEQ Impairments	Lowest Pollutants Loads	E. *coli*	Watershed Analysis	Total
Goose Lake Drain				I		1
Butternut Creek			I	I		2
Indian Lake	I					1
Headwaters Portage River		I			I	2
Portage Creek	II	I	I		I	5
Gourdneck Creek	II	I	I		I	5

The results from this matrix can be observed in Figure 25 below.

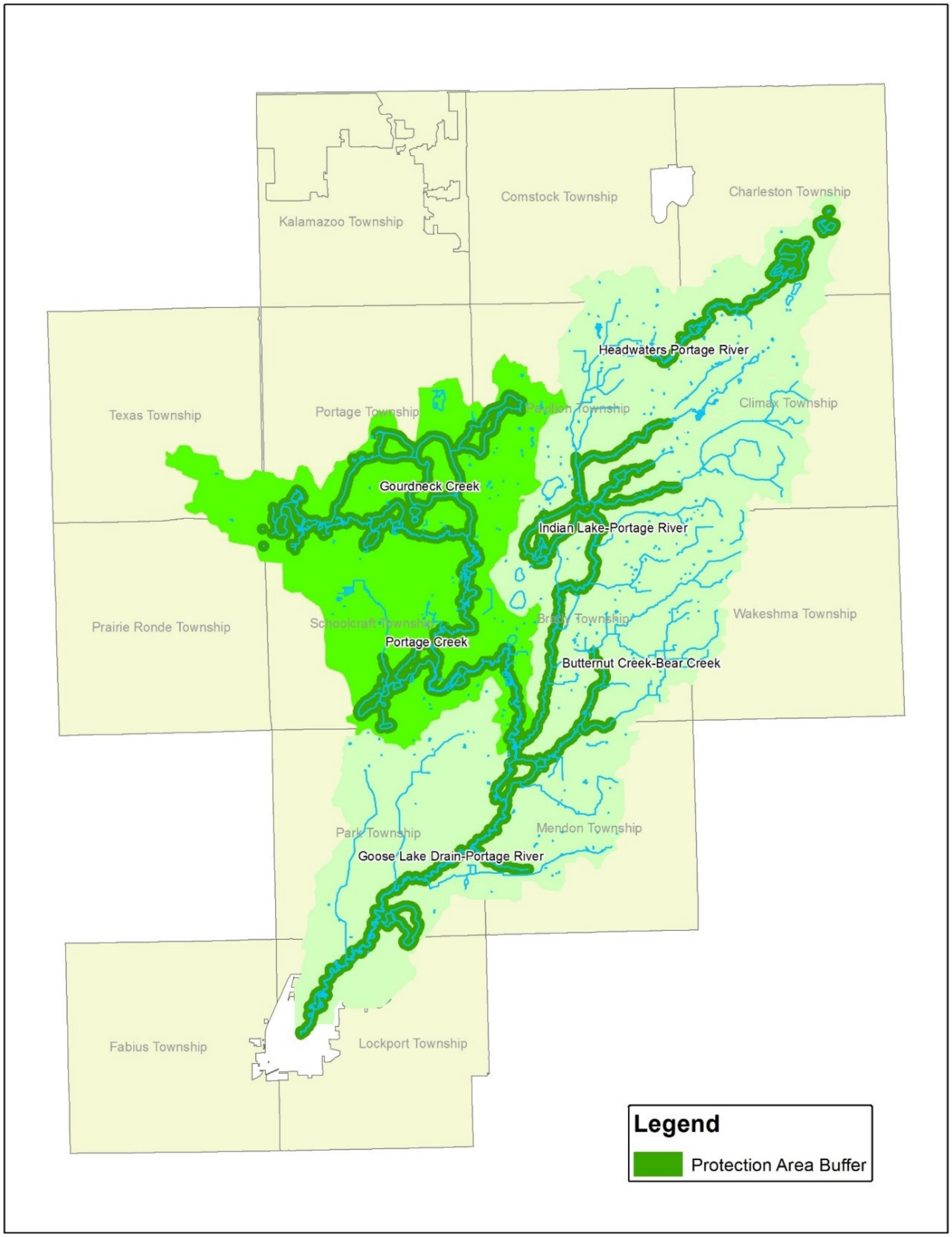


Figure 25. Protection Areas of the PRW

Hence, there is the need to prioritize high, medium, and low protection areas. Due to the amount of funding, education, and correction techniques needed to alleviate water quality degradation a holistic management approach cannot be implemented, forcing managers to address highest concerns first and foremost.

8.1.1 Protection Area Pollutants and Sources

Protection Area Pollutants and Sources

The pollutants and sources is based on the (Fuller, 2006), Kalamazoo County Health and Community Services data, and watershed and lake studies. This information was used to evaluate the risk or threat of these areas to contribute to degradation of water quality within the PRW.

Protection Pollutants are prioritized as follows:

1. **Bacteria and Pathogens** are a known pollutant within the PRW. Kalamazoo County Health and Community Services determined high levels of *E. coli* within the Watershed. MDEQ is currently performing a TMDL pertaining to *E. coli*. Agricultural practices, urban runoff, wildlife, and illicit septage systems are threatening the PRW.

2. **Sediment** is the number one pollutant in the St. Joseph River Watershed (Degraves, 2005) and is the number one pollutant in the Portage River Watershed (Fuller, 2006). Agricultural runoff, urban runoff, and stream manipulation are threatening the PRW and lakes within the watershed are dealing with ways to alleviate sedimentation from storm sewers, in-stream sedimentation, erosion of shorelines, stream banks, and agricultural runoff.

3. **Nutrients** are a major threat to the PRW and its lakes. Nutrients are often bound to sediments and agricultural runoff. Nutrients are contributing to algal blooms and accelerated rates of eutrophication within Indian Lake and others within the Watershed.

4. **Hydrological flow-** alterations to stream channels from drain establishment/maintenance threatens water quality throughout the watershed. Dams and lake-level control structures prevent run-of –the-river hydraulics and fish passage.

4. **Pesticides and Herbicides** have been observed and suspected throughout PRW. Evidence of their use has been observed along stream and tributary courses. Urban areas and communities surrounding lakes are likely contributors.

5. **Temperature** is a concern because of its direct effect upon aquatic life and raises in water temperatures are usually due to riparian corridor changes such as deforestation and increased surface runoff.

6. **Oils, grease and metals** are suspected within the PRW. Irrigation units adjacent to streams, boats and motors, and urban areas are suspected to be contributing these pollutants.

In the protection areas pollutant sources are prioritized as follows:

1. **Livestock manure, septage waste and wildlife**- elevated levels of *E. coli* documented in the PRW. Manure has been observed been applied to drains in upper reaches of the watershed.

2. **Agricultural Runoff and stream banks**- erosion from agricultural fields and due to channelization increasing exposure of stream banks (a moderate amount of natural erosion occurs and is not deemed to be significant)

3. **Septage waste (agricultural) -** haulers are suspected to be leaking and have been observed on roads.

4. **Herbicide and pesticide application**- have been observed being applied to drains.

5**. Stream banks and shorelines-**increased hydraulics from channelization and impervious surfaces erodes exposed stream banks and shorelines at higher than normal rates.

8.1.2 Agricultural Management (Protection) Areas

The agricultural management area rankings are based on the following parameters: wetland loss, pollutant loadings, current impairments, E. coli studies data, and watershed analysis and inventory. The agricultural management area rankings are based on the following parameters: wetland loss, pollutant loadings, impairments, E. coli studies data, and watershed analysis and inventory. A matrix with these parameters was used to rank areas for management based on priority levels very high, high, medium and low.

Each subwatershed was represented on the y-axis and each metric was represented on the x-axis. For each subwatershed each individual metric was marked within those columns. A total count of marks was used to indicate a priority level of very high (red), high (orange), medium (light green) and low (dark green). The parameters wetland loss and pollutant loading were weighted the same and impairments, E. coli studies data and watershed analysis were weighted more heavily due to multiple subcategories that contributed to one column category and multiple years' worth of information.

1. ***Escherichia coli***- Water quality data performed by Kalamazoo County Health and Community Services from approximately 2002 to 2009 was used to determine elevated levels of *E. coli.* A complete analysis of the data resulted in ranking each subwatershed from the sum of all stations sampled within those subwatersheds that yielded results which exceeded 300 bacteria colonies per 100ml of water, between 130 and 299 bacteria colonies per 100ml of water and less than 130 ml of water. The categories established from the count was highest, high, medium, low, and none. The count and those categories were used to determine whether or not each subwatershed received a mark.
2. **Wetland loss**- A mark was awarded to each subwatershed if the percentage of wetland loss exceeded 15%.
3. **Pollutants loading**- Marks were awarded to each subwatershed if nitrogen loading exceeded a 100,000lbs., phosphorus loading exceeding 25,000lbs., and sediment loading exceeding 4,500lbs. through a STEPL analysis. Those amounts were determined to be excessive within the overall watershed.
4. **Impairments**- an analysis of MDEQ's 202 and 2014 Integrated Report was used to delineate a mark for the impairment parameter.
5. **Watershed analysis and inventory**-Multiple watershed inventories and analysis were conducted to determine factors contributing non-point source pollutants (i.e. geomorphic assessment, aerial inventory, land based agricultural survey etc.) to the watershed and those watersheds resilience and ability to recover from and process those pollutants. Watersheds that had a risk received a mark and multiple risks from observations were given two marks.

Subwatersheds were totaled from all columns and assigned a priority level.

Very High- greater than or equal to 6 marks

High- 4-5 marks

Medium- 2-3 marks

Low- 1 mark

Table 15. Agricultural area protection matrix

Watershed	Wetland Loss	Pollutant Loading	Impairments	*Escherichia coli*	Watershed Analysis/Inventory	Total
Goose Lake/Portage	I	I	I		II	5
Butternut/Bear	I		I		II	4
Indian Lake		I	II	II	II	7
Headwaters	I	I		II	I	5
Portage Creek				I	I	2
Gourdneck Cr.				I	I	2

The results from this matrix can be observed in Figure 26. Agricultural Areas and Rank (below)

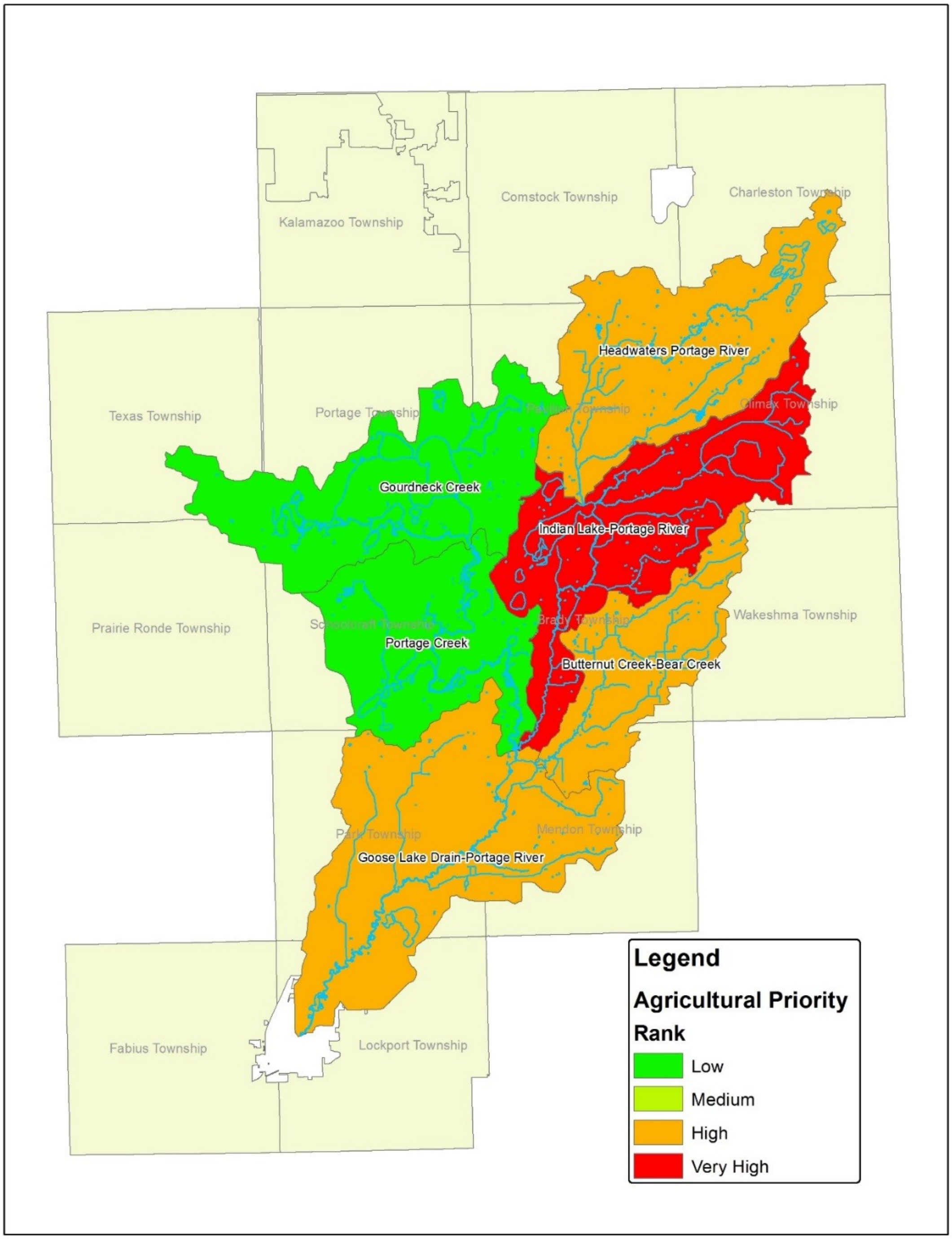


Figure 26. Agricultural Management Areas and Rank

Agricultural Management Area and Pollutant Sources

In agricultural management areas the prioritization of pollutants and sources is based on suspected significance to impaired and threatened water quality.

1. **Bacteria and Pathogens-** are a known pollutant within the PRW. Elevated levels are associated with human health risks. ediment has been observed entering water bodies throughout the PRW.

2. **Sediment**- associated with agricultural runoff introduces nutrients like nitrogen and phosphorus into our waterways. S

3. **Nutrients-** are suspected throughout the PRW. Stakeholders have tested and found elevated levels within the PRW.

4. **Pesticides and Herbicides-** have been observed being applied next to and within streams and generally tend to be applied in small tributary reaches.

5. **Temperature-** concern because deforestation in agricultural areas can lead to increases in temperature of streams leading to decreased oxygen levels available for survival during critical July-mean stress periods. Water withdrawal (lowering groundwater inputs) and surface water runoff can increase temperatures.

6. **Oil, grease, and metals-** are a concern due to the proximity of irrigation pumps (gasoline tanks) in and surrounding the stream and tributaries.

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

1. **Livestock manure and septage waste**- manure application is documented throughout the watershed. It has been applied adjacent to streams and has been observed running into water bodies. Septage haulers leak onto roads and spill large amounts on agricultural fields.

2**. Agricultural Runoff and stream banks**- erosion from agricultural fields and due to channelization increasing exposure of stream banks (a moderate amount of natural erosion occurs and is not deemed to be significant)

3. **Fertilizer**- Nitrogen and phosphorus is suspected to be delivered to water bodies from runoff, tiling, and sandy soils.

4. **Pesticide and herbicide application**- pesticide and herbicide application has been observed applied to drains, stream banks, and adjacent to water bodies.

8.1.3 Urban Management (Protection) Areas

The urban management (protection) areas are based upon likely contributions of pollutants to the watershed, amount of urban land cover, problems identified by the CD, management agencies, stakeholder groups, and municipalities, and watershed steering committee members.

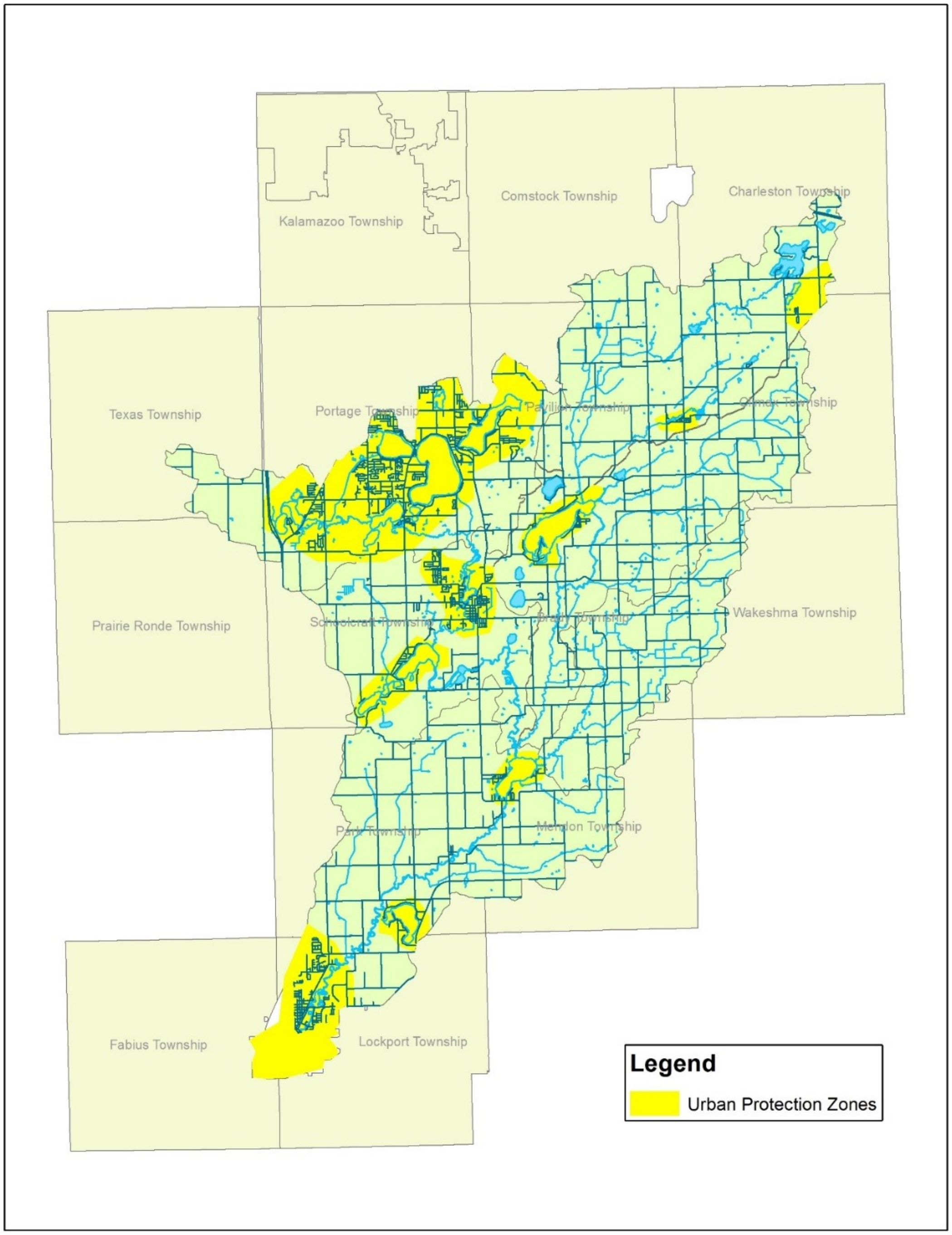


Figure 27. Urban Management (Protection) Areas

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

1. **Bacteria and Pathogens-** are suspected to be delivered from pet waste, wildlife, sewer system failure and illicit connections

2. **Sediment**- is a known pollutant in Gourdneck Creek sub-watershed area near Austin, West, and Long Lakes. Also in the urban areas of Vicksburg and Three Rivers.

3. **Nutrients**- are a known pollutant in urban storm water runoff. A study of Austin and West Lakes determined that storm water outfalls were contributing pollutants. Indian Lakes Assessment found elevated levels near storm water outfalls and shorelines.

4. **Temperature**- impervious surfaces can cause increases in urban areas. Lakes within the watershed are of concern due to proximity to urban areas (Austin, West, Long, and Indian).

5. **Pesticides and herbicides**- are suspected to be contributed from lawns in urban areas.

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

1. **Storm water 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.

2. **Stream banks and shorelines**- increases in impervious surfaces cause flashiness and undersized storm drains increase velocities at the effluent causing increased erosion.

3. **Septage waste**- Septic systems are suspected to be a source of bacteria and pathogens.

4. **Wildlife**- geese have been suspected to cause beach closures within the PRW.

8.2 Critical Problem Areas

The CDs, management agencies, steering committee and other stakeholders identified historic and emerging problem areas that are considered to be negatively affecting water quality (see Figure 25). These areas included culvert issues (perched, undersized, aquatic organism passage concerns), dams (old, unsafe, aquatic organism passage concerns), invasive species (phragmites), and agricultural practices (manure runoff and erosion).

Additional problem areas within the Portage River watershed include:

Areas within 1000 feet of the following features:

- Portage River
- Lakes
- Tributary streams, including drains
- Wetlands
- Agricultural land
- Urban areas that drain to surface waters via storm sewers or drainage ditches
- Areas of steep slopes (10% slope or greater) contiguous with any priority perimeter described above.

More problem areas are described in the Geomorphic Assessment (Appendix 1 – Geomorphic Assessment of the PRW), Water Quality Statement by Waterbody (Appendix 8 – Water Quality Statement by Waterbody), and the Master Plan & Zoning Ordinance Reviews (Appendix 3 – Master Plan and Zoning Ordinance Review).

Knowing that land uses change and new water quality issues or concerns can occur at any time, this list of problem areas should be considered, at best, a partial list that will need continual evaluation and updates.

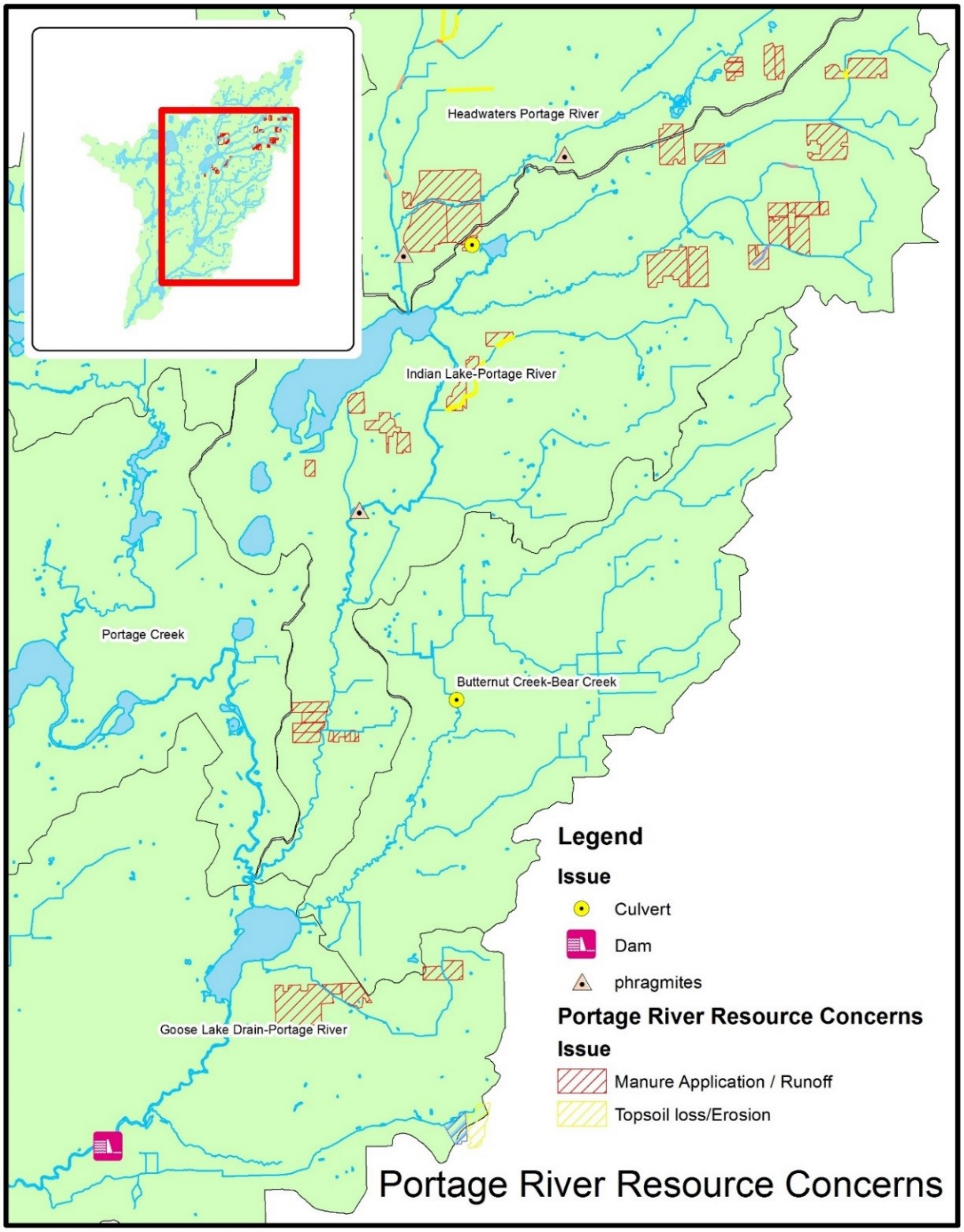


Figure 28. Portage River Watershed Critical Problem Areas

9 GOALS AND OBJECTIVES

Setting goals and objectives are necessary to implement an effective management strategy. Objectives help to set up obtainable steps to meet goals. Nonpoint source goals are not always achievable due to a multitude of factors but nonetheless are something to work towards.

9.1 GOALS FOR DESIGNATED USES

Ultimately the PRW has three goals to address designated uses:

1) Reduce nonpoint source pollutants impairing designated uses within the PRW from agricultural and urban uses and;
2) Protect and preserve natural resources and processes that are reducing nonpoint source pollutants and stop practices that are significantly reducing the PRW from recovery.
3) Implement an information and education program to increase awareness of the PR watershed non-point source pollution issues through demonstration sites, workshops, partnerships, host website, landowner guide, brochures and targeted letters.

Objectives for these goals are listed in Table 16.

9.2 GOALS FOR DESIRED USES

Table 16. Desired Uses & definition

PRW Desired Use	General Definition
Safe water use recreation	Reduce human health concerns within the water to improve water recreation.
Proper land use management from landowners	Promote sound agricultural and residential and municipal development use.
Continued watershed monitoring and implementation	Monitoring and protection of water resources and proper land use practices which reduce nonpoint source pollution.
Coordinated development	Promote and achieve the environmental and economic benefits of planned communities through land use planning and low impact development.
Protect and enhance natural features that protect water quality	Protect critical natural features (wetlands, floodplains) that allow for natural stream function and processes to recover from stream degradation and nonpoint source pollution.
Protect stream stage and groundwater levels	Regulate the amount of surface water and groundwater to where it is not drawn below average stream stage or groundwater reserve levels.

*These desired uses have been condensed from the list in Section 6, Table 7 in an effort to avoid duplication of the objectives listed below.

The following goals and their objectives were developed to address the desired uses identified by stakeholders.

1) **Safe Water Use Recreation**
    - Reduce agricultural manure application amounts (reduce the influx of *E. coli*)
    - Stop the spreading of manure until within a two day period of incorporation
    - Stop illicit discharge from septic tanks
    - Continue beach monitoring and inland lakes monitoring
    - Institute septage facilities on inland lakes
    - Reduce nutrients from illicit septic tanks, sediment and nutrients associated with sediments from agricultural lands
2) **Proper land use management from landowners**
    - Maintain setbacks from streams, tributaries and drains
    - Implement minimum tillage practices and bmp's to reduce nonpoint source pollutants
    - Work with FSA, NRCS and CD's to reduce impacts to surface water and groundwater
    - Properly store and dispose of fertilizers, pesticides, oil, other contaminants
3) **Continued watershed monitoring and implementation**
    - State, federal, county and private watershed monitoring to insure pollution is reduced
    - Monitoring to insure water levels are not depleted from increased irrigation practices
    - Beach monitoring, well monitoring, and nutrient monitoring to understand areas of pollution risk
    - Implementation of BMPs to alleviate nonpoint source "problem areas"
    - Coordinate lake association monitoring with CD implementation
4) **Coordinated development**
    - Review local plans, ordinances and regulations addressing storm water management, nonpoint source pollution, and related water quality and natural resource issues
    - Promote setbacks and buffer strips along water bodies
    - Develop model language for development standards
    - Develop resource maps for planning officials
    - Gain local commitment from municipalities to consider 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 mayors, city managers, county administrators, governing bodies, planning commissioners, community development corporations, and neighborhoods about the importance of watershed and land use planning
5) **Protect and enhance natural features that protect water quality**
    - Build support from municipalities and managing parties to enact and enforce building codes, floodplain and wetland protection, and river corridor consideration.
    - Establish protection policies through local governments
    - Promote permanent land conservancy of wetlands, floodplains, and prairies through Land Conservancies
    - Utilize NRCS and CD's to establish agricultural conservation practices
    - Plan and implement hydrologic friendly road stream crossings
6) **Protect stream stage and groundwater levels**

- Gain an understanding of normal surface water levels during low flow periods
- Establish baseline levels of surface water during low flow periods
- Regulate water withdrawal of irrigation units and industry

10 IMPLEMENTATION STRATEGIES

This chapter is designed to provide a management strategy and options for protecting and improving water quality in the PRW. Consider the fact that it will be impossible to implement urban and agricultural conservation practices on the majority of the watershed. As a result, priority sub-watershed management must take place and problem site management must also take place until nonpoint source levels can be kept in check or until new controls can be established watershed wide that will prevent every potential source from becoming a major contributor (i.e. increased regulation).

New and innovative techniques for planning and implementation are always welcome to help managers and stakeholders tackle the task of reducing pollutants but in the past a combination of one or more of the following has helped to reduce nonpoint source pollutants: educating land users and implementing cultural change; monetary incentives displayed through actual savings with practices; implementing BMPs to reduce problem sites and major contributing subwatersheds; restoring hydrologic function and the streams ability to process pollutants; and preservation and protection of current and existing natural resources. Only then can nonpoint source pollutants, which are a direct result of human activities, be rendered to the minimal.

In agricultural areas land use is highly subjective to agricultural commodity pricing and as a result tends to suffer from a protection standpoint when prices are up. Land is worth more in production than out. The Conservation Reserve Program (CRP) provides landowners with incentive to keep land out of production benefiting wildlife and water quality and providing agricultural commodity price support through the reduction of surplus. However, the ethanol policy makes the curb of surplus unnecessary and the average cost of $57 dollars paid per acre by CRP is far less than the average on marginal corn ground (Volume 6, Issue 2 Stearns Pheasants Forever, 2013). The average on dry land (non-irrigated land) in southwest MI was approximately $552 acre (personal communication with Calhoun County MEAEP Coordinator, 2015). Lands in the western Midwest and other areas (e.g. Minnesota, Iowa, South Dakota) have seen increased production and CRP acres drastically reduced. The price of an acre of land has increased upwards of 8-10 thousand dollars in some areas. And nationally 9.7 million acres of CRP have been lost in the past five years, to a 25 year low with corn increasing by 13 million acres and the USDA determined that the CRP Program reduces soil erosion by 450 million tons per year all the while protecting surface waters from sediment and nutrient enrichment with the enrollment of 1.8 million acres of streamside and forested buffers.

10.1 PRIORITY AREA IMPLEMENTATION

10.1.1 Protection Area Tasks

The following tasks should be implemented within targeted subwatersheds in high and medium protection areas:
Tasks to begin within 1-5 years:

- Enact/improve water quality protection related ordinances (see Chapter 4.3)
- Protect and restore wetlands (see Landscape Level Wetland Functional Assessment Report and Section 5.4)
- Develop and enact design and maintenance standards considering water quality for road stream crossings
- Enact a septic system time-of-sale transfer inspection ordinance at County level
- Identify and correct road/stream crossing sites
- Pave approaches that are contributing sediment and nonpoint sources of pollution

- Use innovative drain maintenance techniques and properly size road stream crossings to extend the life of drain maintenance practices and to allow improved hydraulics.
- Institute a manure management program to educate landowners on proper time application, storage, and management to prevent elevated levels of *E. coli* from entering the system
- Use MEAEP to combat poor agricultural practices

Tasks to begin in 6-10 years:

- Protect sensitive lands
- Institute mandatory buffers to help to stop nonpoint sources of surface water pollution and institute and follow setbacks for application of manure, pesticides, and herbicides
- Identify and correct failing septic systems

Tasks to begin within 11-15 years

- Enact all townships within areas to establish updated zoning ordinances and update master plans to consider water quality

10.1.2 Agricultural Area Tasks

<u>*TMDL Management Direction:*</u>

This should be updated when the TMDL is finished—projected to be done in 2016. A list of recommendations used in the Little Portage Creek Watershed (LPCW) are highly applicable to this plan. Those recommendations from (Rippke, 2012) are:

- Focused effort by local health departments and other agencies to locate and address failing OSDS and illicit connections where human bacteroides has been detected. This effort could include the adoption of a time-of-sale OSDS inspection program where none exists
- Outreach and educate residents on the signs that their residence may have a failing OSDS or improper connections to surface water body.
- Riparian vegetated buffer strips in agricultural areas that are not artificially drained (tiled).
- Promote wetland restoration projects in areas where historic wetlands have been lost and would be beneficial for removing *E. coli* from runoff.
- Conduct agricultural tillage and artificial drainage survey of the watershed, followed by implementing water table management (controlled drainage) where manure is applied to artificially drained land.
- Outreach to agricultural community to encourage becoming MEAEP-verified and/or the use of best management practices on manure storage, composting, and application and the development of nutrient management plans.
- Livestock exclusion from riparian areas and providing vegetated buffers between pasture and water.

End of (Rippke, 2012) recommendations

<u>*General Management Direction:*</u>

The following tasks should be focused in the high and medium priority agricultural management areas as indicated:

Tasks to begin within 1-5 years:

- Utilize alternative drain maintenance/construction techniques (such as two-stage ditch design, natural channel design- meander pattern and profile, cross vanes, log armoring, etc.)
- Restore riparian buffers and stabilize eroding stream banks (high priority banks which contribute unnatural amounts of erosion (see Geomorphic Assessment)

- Prevent and limit livestock access to stream with fencing and crossing (institute in combination with buffer strip to prevent runoff)
- Install agricultural BMPs (liquid and animal storage, animal composting, filter strips, no-tillage, cover crops, grassed waterways, etc.).
- Protect and restore wetlands (see Landscape Level Wetland Functional Assessment report to determine and Section 5.4)

Tasks to begin within 6-10 years:

- Develop and implement manure management plans
- Utilize soil testing to determine appropriate application rates for fertilizers and pesticides
- Utilize integrated pest management
- Construct secondary containment facilities for chemical/fuel handling areas (need to have these for irrigation fueling pads with priority given to those located within river corridor)
- Improve and enforce septage waste disposal regulations

10.1.3 Urban Area Tasks

TMDL Management Direction:

This should be updated when the TMDL is finished—projected to be done in 2016. A list of recommendations used in the Little Portage Creek Watershed (LPCW) are highly applicable to this plan. Those recommendations from (Rippke, 2012) are:

- Survey of storm sewer outfalls to look for dry-weather discharges or other signs of illicit connections.
- Outreach to educate residents on backyard conservation, which include proper pet waste management, rain gardens, rain barrels, improving storm water infiltration and storage, and discouragement of congregating wildlife. This effort could be targeted to residents in the cities and villages of Portage, Three Rivers, Vicksburg, Schoolcraft as well as riparian land owners throughout the watershed.
- Outreach to educate residents on the signs that their residence may have improper connections to a sanitary or storm sewer or a surface water body.
- Adoption of pet waste ordinances.

End of (Rippke, 2012) recommendations

The following tasks should be focused in the high and medium priority urban management areas as indicated.
Tasks to begin within 1-5 years:

- Utilize storm water best management practices (road/parking lot sweeping, stormceptors, rain gardens, constructed wetlands, vegetated swales, etc.)
- Enact storm water and post construction control ordinances (see the Southwest Michigan Planning Commissions Low Impact Development for Michigan; A Design Guide for Implementers and Reviewers at www.swmpc.org/downloads/lidmanual.pdf or see model storm water ordinance at www.swmpc.org/ordinances.asp).
- Identify and correct illicit connections or discharges to storm water system
- Utilize best management practices for road maintenance (such as alternative deicing methods)

Tasks to begin within 6-10 years:

- Install sewer systems in urban areas around populated lakes
- Increase or expand household hazardous waste disposal options

- Distribute spill kits

Tasks to begin within 11-15 years:

Properly maintain and design municipal sewer system infrastructure

10.2 Information and Education

It sounds elementary but a well implemented information and education strategy can lead to reform of traditional activities that cause degradation to water quality. People that use the land are not always aware that the day to day activities they are performing contribute to water quality degradation. Informing the public of what actions affect water quality and how they can change their activities to lessen the effects of nonpoint source pollution is critical.

An information and education strategy was developed and implemented during Phase 1 of the PRW process (see Appendix 4 – Social Survey). Phase 1 is merely the planning stage before implementation.

Information & Education Strategy to reach all audiences of the Portage River Watershed with water quality messages

Table 17. I&E Strategy to Reach all Audiences of the PRW with Water Quality Messages

Target Audience	Description of Audience	General Message Ideas	Potential Activities
Businesses	This includes businesses that perform activities that can impact water quality, for example lawn care/landscape companies, car washes, etc.	Clean water helps to ensure a higher quality of life that attracts workers and other businesses	Workshops, presentations, brochures, flyers, fact sheets, one-on-one contact
Developers/ Contractors/ Engineers	Developers, builders, engineers	Water quality is an important consideration to property values	Newsletter articles, workshops, presentations, tours, brochures, flyers, fact sheets, trainings
Farmers/ Producers	Agricultural landowners and renters of agricultural lands	Protecting water quality is a long-term investment that can save money by decreasing inputs	Workshops, presentations, brochures, flyers, fact sheets, one-on-one contact, tours, media articles
Government Officials/Staff	Elected and appointed officials of cities, townships, villages, counties, drain and road commissioners, state & federal elected officials	Water quality is tied to economic growth, property values, tax revenue, and public health	Training, workshops, presentations, brochures, flyers, fact sheets, WMP, one-on-one contact, media articles
Children/ Students	Any child visiting, living in, or attending school in the watershed	We all depend on clean water	Student stream monitoring, teacher trainings, videos, curriculum
Property Owners	All property owners in the watershed, including absentee	Water quality can impact property values and health	Media, flyers, brochures, fact sheets, website, tax bill inserts, workshops, presentations, one-on-one contact, signage

Riparian Property Owners	Owners of property adjacent to the River, stream, drain, or lake	Water quality can impact property values and health	Media, flyers, brochures, fact sheets, website, tax bill inserts, workshops, presentations, one-on-one contact, signage
Recreational users	Anyone engaging in recreational activities within the watershed	Healthy water is important for enjoying recreational activities	Website, kiosks, brochures/flyers/fact sheets, media

10.3 Planning and Studies

A geomorphic assessment of the PRW was performed by the CD to analyze the amounts of natural stream bank erosion vs. human induced erosion from agriculture and drain maintenance/establishment. Sediment is a major polluter and has been determined through the Portage River Watershed Management Plan 2006 and the St. Joseph River WMP 2005 to be the major nonpoint source pollutant. A biological assessment of the macroinvertebrate community by Walterhouse, 2003 determined that the macroinvertebrates community generally degraded as it moved from a more "natural river pattern" between Portage Lake and Fisher Lake to the headwaters which tended to have a channelized uniform straight channel. This could indicate that increased amounts of sediment are covering up critical habitat in the headwaters portions and other areas that have been altered, especially small creeks that were converted to agricultural drains.

Very little wetland restoration and protection has taken place in the watershed. Both are listed for protection areas and agricultural management areas. Implementation could result in a significant increase in nonpoint source protection and water quality.

10.4 Current Efforts

MDEQ is performing a TMDL study pertaining to *E. coli* in the PRW. Areas with high levels can be prioritized and should be considered for implementation of BMPs. Multiple lake associations within the PRW conduct CLMP testing. These are: Barton Lake, Fishers, and Indian Lakes.

Blue Lake in Cold Brook County Park, Hogsett Lake, Long Lake in Ramona Park, and Sunset Lakes are all monitored by the Kalamazoo County Health and Human Services Environmental Health Division. These should continue to be monitored for human health concerns.

Kalamazoo, Calhoun, and St. Joseph MAEAP provides annual well-water testing focused primarily on nitrates and Coliform bacteria. Residents within the watershed who are not aware of their results should participate in this program.

The CD hosted a Natural Shoreline Workshop for property owners in partnership with the Michigan Natural Shoreline Partnership (MNSP). Natural shorelines provide multiple benefits to inland lakes and streams. Natural shorelines provide erosion control, reduce runoff, deter geese, stabilize soils, improve fish and wildlife habitat and maintain aesthetically pleasing views of a natural lakeshore. Twenty-one landowners showed up for the workshop which featured speakers from the CD, MDNR, MDEQ, Kalamazoo Nature Center, and Native Connections. Information on natural shorelines can be found at https://sites.google.com/site/mishorelinepartnership/home.

Hopefully, this management plan will be used for implementing the management strategy. MDEQ and MDNR perform random rotational based sampling regimes determined in the year previous to sampling. There are no known efforts planned by MDNR at this time. Future monitoring by MDEQ will take place on a five-year rotational basin monitoring effort, when resources allow, and once actions have been performed to address the concerns of sources contributing to *E. coli*, as describe in the TMDL for LPCW.

MDEQ does regulate CAFOs and AFOs when they are of a certain size. For more on AFOs and CAFOs please see http://www.michigan.gov/deq/0,4561,7-135-3313_3682_3713-96774--,00.html. There are approximately 15 AFOs within the LPCW and 1 adjacent or on the border with land within the watershed. Kalamazoo, St. Joseph, Calhoun and Branch County offer MEAEP assistance to private individuals working towards environmentally friendly agricultural practices and agricultural producers with federal contracts have to comply with BMPs and certain considerations given to federal requirements administered through Farm Service Agency (FSA) and the Natural Resource Conservation Service (NRCS).

Table 18. Portage River Watershed Action Plan

Protection Areas (see Figure 25) High priority: Gourdneck Creek and Portage Creek entire watersheds, and the 100-year floodplain valley plus a 30' riparian buffer in the Headwaters of Portage River, Indian Lake-Portage River, Butternut Creek-Bear Creek, Goose Lake Drain-Portage River.									
Task	**Pollutant**	**Source**	**Cause**	**Begin Implementation**	**Potential Partners**	**Estimated Cost**	**Potential Funding or Program**	**Milestones (after implementation begins)**	**Proposed Evaluation Method**
Enact/Improve water quality protection related ordinances	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Streambanks, Stormwater runoff (impervious surfaces and storm drains)	Increased flow fluctuations, Insufficient land use planning	2016-2020	Municipalities, Land conservancies	$10,000 per municipality	Municipalities, MDEQ 319	By 2020: 3 municipalities By 2023: 7 municipalities By 2026: 13 municipalities	Number of ordinances enacted, Number of municipalities with ordinances
Protect/restore wetlands	Sediment	Streambanks	Increased flow fluctuations	2016-2020	Land conservancies, Nature Centers, Ducks Unlimited, NRCS, Counties, land use planners	$3,000-$6,000/acre to purchase $3,000/acre for easement	MDEQ 319, NAWCA, Ducks Unlimited, Counties	By 2020: 120 acres By 2023: 320 acres By 2026: 720 acres	Number of acres protected/restored, Number of landowners protecting/restoring wetlands, Estimate pollutant load reduction
Develop & enact design & maintenance standards for road stream crossings	Sediment	Streambanks	Lack of riparian buffers	2016-2020	Road Commissions, Municipalities, Land conservancies, Drain Commissions	$5,000/agency	Road Commissions, Municipalities, Drain Commissions (road agencies)	By 2020: 1 road agencies By 2023: 2 road agencies By 2026: 3 road agencies	Number of agencies enacting improved standards
Enact a septic system time-of-sale transfer inspection ordinance at County level	Nutrients, bacteria/ pathogens	Septage waste	Improper design or maintenance of septic systems	2016-2020	County Health Depts, Land conservancies	$2,000/county	Counties	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of counties enacting ordinances
Identify, correct road/stream crossing sites	Sediment	Streambanks	Lack of riparian buffers, failing culverts	2016-2020	Road Commissions, Municipalities, Drain Commissions	$10,000-$150,000/site	Road Commissions, Municipalities, Drain Commissions (road agencies), grants	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of road/stream crossing sites corrected
Pave approaches that contribute sediment and nonpoint sources of pollution	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff	Improper design, lack of stormwater mgmt	2016-2020	Road Commissions, Municipalities, Drain Commissions	$5,000-$20,000/site	Road Commissions, Municipalities, Drain Commissions, grants	By 2020: 1 county By 2023: 2 counties By 2026: 3 counties	Number of paved approaches

Use innovative drain maintenance techniques and properly size road stream crossings to extend the life of drain maintenance practices and allow improved hydraulics	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Streambanks, Stormwater runoff	Improper design, lack of stormwater mgmt, lack of land use planning	2016-2020	Drain Commissions, Municipalities, Road Commissions, Land conservancies	$10,000-$300,000/site (depending on technique)	Drain Commissions, Road Commissions, Municipalities, grants	By 2020: 1 site By 2023: 7 sites By 2026: 11 sites	Number of innovative drain maintenance techniques utilized, number or road stream crossings propertly sized
Institute manure mgmt program for education, storage, and mgmt	E.coli	Agriculture	Improper timing, lack of education, lack of mgmt planning	2016-2020	NRCS, Technical Service Providers, Conservation Districts, Ag producers	$500-$5000/per plan	NRCS Farm Bill, grants	By 2020: 5 plans By 2023: 12 plans By 2026: 20 plans	Number of plans written, Estimate pollutant loading reduction
Use MAEAP to combat poor ag practices	Seiment, nutrients, pesticides, oil, grease, metals, temperature	Agriculture	Lack of education, lack of planning	2016-2020	NRCS, Technical Service Providers, Conservation Districts, Ag producers	$30,000 per County	MDARD	By 2020: 10 MAEAP verifications By 2023: 15 MAEAP verifications By 2026: 20 MAEAP verifications	Number of MAEAP verified farms
Protect sensitive lands	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff	Insufficient land use planning	2021-2025	Land conservancies, Municipalities, Counties, land use planners, landowners	$3,000-$6,000/acre to purchase $3,000/acre for easement	MDEQ 319, NAWCA, Ducks Unlimited, Counties, grants	By 2026: 200 acres By 2029: 500 acres By 2032: 1000 acres	Number of acres protected, Estimate pollutant load reduction
Institute mandatory buffers to help stop nonpoint sources of surface water pollution and institute and follow setbacks for application of manure, pesticides, herbicides	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff, Agriculture, Riparian Landowners	Insufficient land use planning, insufficient education, lack of planning	2021-2025	Municipalities, land use planners, landowners	$700/acre	NRCS Farm Bill, grants, landowners, Municipalities	By 2026: 100 acres By 2029: 300 acres By 2032: 500 acres	Number of acres, Estimate pollutant load reduction

Identify and correct failing septic systems	Nutrients, bacteria/ pathogens	Septage waste	Improper design or maintenance of septic systems	2021-2025	Landowners, Health Departments	$200-$6000/system	USDA Rural Development	By 2026: 5 systems By 2029: 13 systems By 2032: 28 systems	Number of systems identified and corrected, Estimate pollutant load reduction
Agricultural Management Areas (See Figure 26)- VERY High priority watersheds: Indian Lake-Portage River. High priority watersheds: Goose Lake Drain-Portage River, Butternut Creek-Bear Creek.									
Task	Pollutant	Source	Cause	Begin Implementation	Potential Partners	Estimated Cost	Potential Funding or Program	Milestones (after implementation begins)	Proposed Evaluation Method
Focused effort by local health departments and other agencies to locate and address failing OSDS and illicit connections where human bacteroides has been detected	E coli	Failing OSDS, stormwater runoff, livestock, manure land applications, wildlife	Illicit connections, artificial drainage, manure, lack of buffer strips	2016-2020	County Health Depts, MDEQ	$500-$15,000	Landowner, grants	By 2026: 10 sites corrected By 2029: 15 sites corrected By 2032: 25 sites corrected	Estimate pollutant load reduction
Outreach & education to residents on signs of failing OSDS or improper connections	E coli	Failing OSDS, Improper connections	Lack of education	2016-2020	County Health Dept, MDEQ	$15,000/yr	County Health Depts, MDEQ	By 2026: 1 County Ed Prog By 2029: 2 County Ed Progs By 2032: 3 County Ed Progs	Number of residents reached
Install riparian vegetated buffer strips in ag areas that are not tiled	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Ag fields, streambanks	Lack of buffer strips to filter pollutants	2016-2020	NRCS, Ag producers, MAEAP, Conservation Districts	$700/acre	NRCS, grants	By 2026: 500 acres By 2029: 800 acres By 2032: 1500 acres	Estimate pollutant load reduction
Promote wetland restoration projects in areas where historic wetlands have been lost and would be beneficial for	E coli	Stormwater runoff, improper ag applications	Loss of historic wetlands & their functions	2016-2020	NRCS Farm Bill, CD's land use planners, MAEAP	$3,000-$6,000/acre to purchase $3,000/acre for easement	NRCS, USFWS, grants	By 2026: 3 restored wetlands By 2029: 8 restored wetlands By 2032: 12 restored wetlands	Estimate pollutant load reduction

removing E coli from runoff									
Conduct ag tillage and artificial drainage survey of watershed, followed by implementing water table mgmt where manure is applied to artificially drained land	E coli	Improper manure management practices	Lack of education, artificial drainage	2016-2020	NRCS Farm Bill, CD's, Land use planners, MAEAP	$1,000/acre	NRCS Farm Bill, MAEAP, grants	By 2026: 5 farms utilizing water table mgmt By 2029: 10 farms utilizing water table mgmt By 2032: 20 farms utilizing water table mgmt	Estimate pollutant load reduction
Outreach to ag community to encourage MAEAP verifications and/or the use of bmps on manure storage, composting, application & development of nutrient mgmt plans	E coli	Improper manure management practices	Lack of education	2016-2020	NRCS Farm Bill, CD's MAEAP	$30,000/County	MAEAP, grants	By 2026: 10 MAEAP verifications By 2029: 15 MAEAP verifications By 2032: 20 MAEAP verifications	Number of MAEAP verified farms
Livestock exclusion from riparian areas and providing vegetated buffers between pasture and water	E coli	Livestock access to water	Lack of livestock exclusion, lack of buffers	2016-2020	NRCS Farm Bill, MAEAP, CD's	$1,000-$3,000/acre	MAEAP, NRCS Farm Bill, grants	By 2026: 3 sites By 2029: 6 sites By 2032: 10 sites	Estimate pollutant load reduction
Develop & implement manure management plans	Nutrients, bacteria/ pathogens	Livestock waste	Improper manure management	2016-2020	NRCS, Conservation Districts	$4,000-$10,000/plan	Farm Bill Programs, MAEAP	By 2026: 2 plans By 2029: 5 plans By 2032: 8 plans	Number of plans developed, E.coli monitoring program
Utilize soil testing to determine appropriate application rates for fertilizers and pesticides	Nutrients, pesticides	Stormwater runoff (lawns, parks, golf courses, agricultural lands)	Improper application or overuse of fertilizers and pesticides	2016-2020	MSU-E	$4/acre/year for field crops $14/acre/year for specialty crops	None known	By 2026: 20 tests By 2029: 30 tests By 2032: 45 tests	Number of soil tests performed

Utilize integrated pest management	Nutrients, pesticides	Stormwater runoff (lawns, parks, golf courses, agricultural lands)	Improper application or overuse of fertilizers and pesticides	2016-2020	MSU-E, NRCS	30/acre/year for field crops $120/acre/year for orchards $80/acre/year for vegetables	None known	By 2026: 5 landowners By 2029: 8 landowners By 2032: 12 landowners	Number of landowners utilizing IPM

Urban Management Areas (See Figure 27) - High priority areas: Gourdneck Creek near Austin, West, and Long Lakes; Vicksburg and Three Rivers, Indian Lake

Task	Pollutant	Source	Cause	Begin Implementation	Potential Partners	Estimated Cost	Potential Funding or Program	Milestones (after implementation begins)	Proposed Evaluation Method
Utilize stormwater best management practices	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains), streambanks	Lack of stormwater management, increased flow fluctuations	2016-2020	Municipalities, Drain Commissions, Road Commissions	Practice dependent	Municipalities, MDEQ	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of municipalities using BMPs, estimate pollutant load reductions
Enact and enforce stormwater control ordinances	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains)	Lack of stormwater management	2016-2020	Municipalities, Drain Commissions, Road Commissions	$5,000/municipality	Municipalities, MDEQ	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of municipalities with ordinances enacted & enforced
Identify and correct illicit discharges or connections	Sediment, nutrients, pesticides, oil, grease, metals, temperature	Stormwater runoff (impervious surfaces and storm drains)	Illicit connections or discharges	2016-2020	Drain Commissions, Road Commissions, Municipalities	$500 - $5,000/site	Drain Commissions, Municipalities, Road Commissions	By 2026: 2 sites By 2029: 4 sites By 2032: 6 sites	Number of connections or discharges identified and corrected
Utilize best management practices for road maintenance	Sediment, salt	Stormwater runoff (roads and parking lots)	Improper road salt/sand application and snow disposal	2016-2020	Road Commission, Municipalities	$50-$1,000/practice	Road Commission, Municipalities	By 2026: 2 road agencies By 2029: 3 road agencies By 2032: 5 road agencies	Number of road agencies adopting improved practices, Estimate sediment load reduction
Increase household hazardous waste disposal options	Nutrients, pesticides, oil, grease, fuel	Stormwater runoff (lawns, parks, golf courses, agricultural	Improper storage/disposal of hazardous materials	2016-2020	Counties, Health Departments	$15,000/yr	Counties, Health Departments, Municipalities, Landfills, Private Sector	By 2026: increase by 2 days/sites By 2029: increase by 3 days/sites By 2032: increase by 5 days/sites	Number of disposal sites/days, Amount of waste collected

		lands, impervious surfaces, storm drains)							
Distribute spill kits	Oil, grease, fuels	Stormwater runoff (impervious surfaces and storm drains)	Spills and leaks	2016-2020	Conservation Districts	$200/kit	MAEAP, Conservation Districts	By 2026: 10 kits By 2029: 20 kits By 2032: 50 kits	Number of spill kits distributed
Proper maintenance and design of sewer system infrastructure	Nutrients, bacteria/pathogens	Septage waste	Sewer system/infrastructure failure	2016-2020	Municipalities, Drain Commissions, Road Commissions	Dependent on needs	Municipalities, MDEQ, USDA Rural Development	By 2026: 2 municipalities By 2029: 4 municipalities By 2032: 6 municipalities	Number of system improvements, Number of municipalities with regular system inspection

11 EVALUATION

Evaluation after the development of the plan, BMPs, and knowledge and awareness of watershed residents will help to understand the effectiveness of the watershed planning and implementation process and ultimately its effects on water quality. Measuring results and sharing information moves an effective plan forward toward achieving higher levels of water quality. This success cannot be measured instantaneously it needs to be monitored over time. The Calhoun Conservation District, in partnership with local, state, and federal agencies such as the Kalamazoo County Health Department, MDEQ, MDNR, USGS, and EPA should be the responsible party for managing, coordinating, and evaluating the effectiveness of implementation tasks.

11.1 KNOWLEDGE AND AWARENESS

Knowledge and awareness is a building block for changing our thoughts and actions on how we interact with the environment. Actually changing our way of thinking and our interaction with the land can result in positive change for water quality. Our first evaluation should consider knowledge and awareness. Documenting this change can help us understand effectiveness of our efforts. Ways used to measure and evaluate this during the planning and implementation process are and can be:

1.) Large watershed scale pre and post social survey of watershed residents
2.) Evaluating attendees and number of participants at watershed workshops (soil health workshop, MNSP)
3.) Targeted mailings to watershed residents with identified areas of protection or in need of BMPs (watershed model
4.) Use of websites (CCD, KCD, SJCD), pamphlets (landowners guide etc.), and other documents produced to educate landowners and watershed residents

11.2 DOCUMENTING IMPLEMENTATION

Implementation of BMPs or best management practices should alleviate identified water quality degradations to certain water bodies. Certain targeted concerns that are contributing considerable amounts of nonpoint source pollutants to the PRW need to receive spot treatment to allow the watershed to recover as a whole. Watershed recovery can take decades but in order to stop continued polluting and start the recovery process BMPs need to be installed to address these threats. The evaluation will involve identifying and tracking individuals, organizations, and governmental units involved in implementing and adopting BMPs. These are typically structural, vegetative, or managerial. Overall documentation can involve a number of BMPs installed, look at BMP estimated pollutant reductions and attempt to measure actual reductions.

Table 14 has milestones and evaluation methods proposed for measuring the progress of BMP implementation and improvements to water quality for each task in the action plan. The action plan should be reviewed and assessed at least annually to ensure progress is being made to meet the milestones as well as updating the action plan as tasks are completed and new tasks are identified. This can be done by CCD and/or partners.

11.3 MONITORING WATER QUALITY

Water quality monitoring can comprise a suite of different parameters. Federal, state, and local units of government as well as private organizations all monitor water quality in different forms and project scope. Water quality monitoring should be continuous and should take place year after year. This is not always possible and often time unfeasible. Costly monitoring equipment, software and training is a challenge for organizations and units of government. Between federal, state, and local monitoring efforts measurable parameters and standardized information can be used to measure and describe past and current water conditions and quality.

1. Lake that voluntarily performs CLMP monitoring could be expanded throughout the PRW.

2. Benthic Macroinvertebrate monitoring over a continued seasonal sampling regime would yield much better information as to what subwatersheds are continually being impaired with sediment

3. Thermal monitoring needs to be performed. 2014 was an especially cool year but tributaries in the headwater region indicate that they could be considered for a cold-transitional classification. Importance should be given to protecting riparian areas and stream pattern and profile within these reaches.

4. *E. coli* monitoring needs to be continued and built upon. MDEQs TMDL study will characterize current conditions within the PRW but continued monitoring to determine effectiveness of education and awareness, agricultural compliance, and BMP installations will need to be performed to determine success.

5. Nitrate and phosphorus levels need to be monitored tributaries to determine subwatersheds prioritization. Some private individuals have performed testing to establish baseline information. This could be expanded and coordinated to continue to add to data sets and understanding current conditions. This could lead to added implementation and protection.

11.4 Estimating Pollutant Load Reductions

The last level of evaluation is to estimate pollutant load reductions. Pollutant loadings are 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. STEPL (Spreadsheet Tool for Estimating Pollutant Load) was chosen as the model to use for calculating load reductions in the Portage River watershed.

STEPL Pollutant Loads Analysis

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) uses algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, biological oxygen demand, and sediment delivery based on various land uses and practices. Annual nutrient loading is calculated based on runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies (http://it.tetratech-ffx.com/steplweb/).

STEPL worksheets require data entry on specific physical characteristics of the watershed and probable best management practices (BMPs) which can be applied. Some data are constants based on geographic location, soil types, and other factors. Other sets of data can be varied. Particular attention was given to the “affective area” of any BMP. Affective area refers to the total acreage to which a selected BMP practice applies. Since the watershed is mostly in agricultural use, no BMP practice could be retroactively and/or successfully applied to the entire watershed. Therefore, a percentage was applied to each land use type to find the affective area. (Example: Wetlands in the watershed equal 8,797 acres. If BMPs could be applied to affect 10% of the wetland space, the “affective area” would be 88 acres with numbers rounded to the nearest whole.) Because of the uncertainty of the effectiveness of various BMPs on load reduction, the percentage of affective area was adjusted to reflect a 25% rate.

The STEPL Pollutant Loads Analysis was used to determine load reductions after implementation of various BMPs for the PRW, using 25% of affective area. Appendix 6 – Pollutant Load Estimates and Reductions provides the complete analysis.

Table 15 lists the proposed evaluation methods for pollutant reductions in the last column. These tasks include protecting and restoring wetlands and sensitive lands, correcting failing septic systems, installing agricultural BMPs, restoring riparian buffers and stabilizing streambanks, correcting road/stream crossings, etc.

Overall reductions in the Portage River watershed through agricultural BMPs will reduce nonpoint source pollution significantly. Additionally, to address the threatened uses 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 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 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. Examples of BMPs that could be used for E.coli reduction include buffers, livestock management, irrigation management, manure management, proper septic installation and maintenance, bioretention areas, and proper pet waste disposal.

11.5 Evaluating the Watershed Management Plan

The watershed management plan needs to be updated regularly to include changing land cover, demographics, local water quality protection policies, environmental protection laws (e.g. statewide phosphorus ban), TMDLs, prioritization areas, pollutants, and sources and goals and objectives and implementation strategies.

- Land Cover (Chapter 2.4)
- Demographics- with every new US census
- Future Growth and Development- every 5-10 years
- Local Water Quality Protection Policies- every 3 years
- Water Quality Summary – every two years with the release of MDEQ Integrated Reports
- Scheduled TMDLs- every two years with the release of MDEQ Integrated Reports or when a TMDL is completed
- Prioritization of areas, pollutants and sources- every 5-10 years
- Goals and Objectives- every 5-10 years
- Implementation Strategy- review annually and update as needed

Geomorphic Assessment/Bank Pin Analysis/BEHI Analysis

An assessment of the PRW was performed by the CD in 2013 and 2014 as a means of evaluating stream stability and overall channel morphologic conditions. Please see Appendix 1-Geomorphic Assessment of the PRW for the full assessment report.

12 STEERING COMMITTEE MEMBERS

Name	Association/Organization
W. Christopher Barnes, PE	City of Portage
Don Schultz	Township Supervisor
Matt Meersman	Friends of the St. Joseph River, Inc
Mark Parks	Friends of Portage Lake
John Wilks	Indian Lake Association
Linda Zabik	MAEAP Technician
Melanie Stoughton	Kalamazoo CD
Patricia Crowley	Kalamazoo County Drain Commissioner
John Byrnes	Kalamazoo County Road Commission
Josh Crandall	NRCS-District Conservationist
Joseph Eichorn	Park Township Supervisor
Patrick White	Pavilion Township
Jeffery Wenzel	St. Joseph County Drain Commissioner
Carol Higgins	St. Joseph CD
Rebeca Burns	Branch, Hillsdale, St. Joseph Community Health
Kathy Worst	Branch CD
Geoff Cripe	SWMLC
Matthew Crawford	Village of Vicksburg
Alyssa Riley	MDEQ-WRD NPS
Chris Bauer	MDEQ-WRD NPS
Wendy Oglivie	Fishbeck, Thompson, Carr, & Huber
Julia Kirkwood	MDEQ-WRD NPS
Steve Allen	Nottawaseppi Huron Band of Potawatomi
Eric Kerney	Nottawaseppi Huron Band of Potawatomi
Tracy Bronson	Calhoun CD
Diana Irizarry	NRCS-District Conservationist
Bill Martin	

Brian Gundermann	MDNR
Doug Brewer	West Lake Association
Jean Gagliardo	NRCS-District Conservationist
Rob Zbiciak	MDEQ
John Speeter	Long Lake Association

13 ACRONYM GLOSSARY

AFO	Animal Feeding Operation
AUID	Assessment Unit Identification
BEHI	Bank Erosion Hazard Index
BMP(s)	Best Management Practice(s)
CAFO	Confined Animal Feeding Operation
CCD	Calhoun Conservation District
CCRD	Calhoun County Road Department
CD	Conservation District
CEA	County Enforcement Agency
CFR	Code of Federal Regulations
CLMP	Cooperative Lake Management Plan
CRP	Conservation Reserve Program (Federal Farm Bill)
CWA	Clean Water Act
E. coli	Escherichia coli
FSA	Farm Services Agency
FTCH	Fishbeck, Thompson, Carr, and Huber Inc.
HUC	Hydrologic Unit Code
KCD	Kalamazoo Conservation District
KNC	Kalamazoo Nature Center
LLWFA	Landscape Level Wetland Functional Analysis
LPCW	Little Portage Creek Watershed
LUST	Leaking Underground Storage Tank
MAEAP	Michigan Agriculture Environmental Assurance Program
MDARD	Michigan Department of Agriculture and Rural Development
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MiCorps	Michigan Clean Water Corps
MNSP	Michigan Natural Shoreline Partnership
MPEA	Michigan Planning Enabling Act
MS4	Municipal Separate Storm Sewer System
MSU	Michigan State University
NAWCA	North American Wetland Conservation Act
NBS	Near Bank Assessment
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NREPA	Natural Resources and Environmental Protection Act
NWI	National Wetland Inventory
PCB	Poly Chlorinated Byphenol
pH	Power of Hydrogen (acidity level)
PRW	Portage River Watershed
PWSS	Public Water Supply Systems
RPOD	Resource Protection Overlay District
SESC	Soil Erosion and Sedimentation Control
SJCD	St. Joseph Conservation District
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWDA	Safe Water Drinking Act
SWMLC	South West Michigan Land Conservancy

TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WHO	World Health Organization
WHPP	Wellhead Protection Program
WMP	Watershed Management Plan
WQS	Water Quality Standards
WRD	MDEQ Water Resources Division
WWAT	Water Withdrawal Assessment Tool

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