LANDSCAPE STEWARDSHIP PLAN:

Macomb and St. Clair Counties, Michigan

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The Stewardship Network
Connect to Conserve

Landscape Stewardship Plan for Macomb and St. Clair Counties, Michigan

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Table of Contents

1. Executive Summary 5

2. Project Introduction 7

2.1 Project Goals and Objectives 9

2.2 The Need for Active Forest Stewardship 10

2.3 Methodology: A Landscape Approach to Natural Resource Conservation 11

3. Landscape Context 13

3.1 The Physical, Ecological and Cultural Landscape 14

3.1.1 Geographic Scope 14

3.1.2 Cultural Landscape 16

3.1.3 Climate, Geology, Topography and Land Cover 18

3.1.4 Soils 28

3.1.5 Water 33

3.1.6 Wetlands 36

3.1.7 Biological Diversity and Wildlife Habitat 41

3.1.8 Forest Resources 47

3.1.9 Forest Health 51

3.1.10 Invasive Species 58

3.1.11 Tourism and Recreation 61

3.1.12 Archaeological, Cultural and Historic Sites 63

3.2 Acoustic Monitoring 64

3.3 Existing Stewardship Plans 66

3.3.1 Government plans 67

3.3.2 Non-Governmental Conservation Organization Plans 68

3.4 Resources and Programs for Landowners 71

3.4.1 Government Agencies 71

3.4.2 Non-Governmental Agencies 77

3.4.3 Private Sector Natural Resource Professionals 82

4. Landscape Stewardship Stories 87

4.1 Adopt a Stream 87
4.2 Green Macomb 90
4.3 James & Alice Brennan Memorial Sanctuary 92
4.4 Friends of Wetzel State Recreation Area 94
4.5 North Branch of the Clinton River 96
4.6 Cuttle Creek Restoration 98
4.7 An Eco-tourism Vision for the use of the Inland Waterways of Harsens Island 101
4.8 I-75 Corridor Conservation Action Plan Monroe County 105
4.9 Stewart Farm Prairie Restoration Project 108
4.10 Acoustic Monitoring in the James and Alice Brennan Memorial Sanctuary 111
5. Develop Your Own Story: Resources and Services for Landowners 114
5.1 Forest Stewardship Program 114
5.2 American Tree Farm System 114
5.3 Qualified Forest Program 115
5.4 Commercial Forest Program 116
5.5 Environmental Quality Incentives Program 116
5.6 Best Management Practices for Forest Health, Water Quality and Wildlife 116
5.7 Capital Gains Tax Information 117
5.8 Opportunities for Partnerships between different types of landowners 117
Appendix A: Glossary of Common Forestry Terms 119
Appendix B: Michigan Laws Related to Forestry 122
Appendix C: Threatened, Endangered, and Special Concern Species 123
Appendix D: Additional Resources for Landowners 128
Appendix E: Bibliography 132

1. Executive Summary

This Landscape Stewardship Plan, covering Macomb and St. Clair counties, is one of nine such plans that were developed through a larger grant project funded by U.S. Forest Service and administered by the Michigan Department of Natural Resources. The intent of developing this plan was to connect the people and organizations to each other and to landscape stewardship information, resources, and assistance programs, thereby increasing our collective capacity to protect and maintain the ecosystem products, services, and values on which this region depends. Only by working collaboratively at the landscape scale we can better address landscape-scale challenges that threaten the health and sustainability of our natural resources.

The sustainable management of Macomb and St. Clair county's varied ecosystems face a diverse set of threats and challenges. Factors such as climate change, invasive species, tree diseases and insect pests, habitat fragmentation, nonpoint source pollution, limited financial resources of the managing entities, and lack of awareness or participation in active and sustainable land stewardship practices place our forests, water resources, wildlife, and human communities at risk. A major goal of the Landscape Stewardship Plan is to increase interest, awareness, and participation in active land stewardship opportunities throughout Macomb and St. Clair Counties, which is also an important first step in alleviating many of the other challenges mentioned above. We also understand that digesting a plan like this in its entirety will not be for everyone. We anticipate breaking this plan down into parts and pieces and sharing those via various methods over the coming weeks, months and years. Those methods may include short podcasts; social media posts; newsletter-type publications; distribution through partner organization publications; posting on websites among others.

A good first step in this process is to coordinate with landowners to develop customized Forest Stewardship Plans, which characterize existing resource features found on a particular property and identify strategies for meeting each landowner's goals through on-the-ground stewardship activities that also yield public benefits such as protection of clean water, provision of wildlife habitat and mitigation of various negative factors acting on the landscape scale. In fact, the idea for this overall Landscape Stewardship Plan project was based on the idea of these individual Forest Stewardship Plans. These individual plans are incredibly valuable due to the fact that they are tailored to each individual property and the property owner's perspective. That said, due to their limited geographic scope, they fail to fully address some of the biggest challenges we face on a landscape scale. This highlights the challenge we face: collaborative landscape-scale approach to stewardship is critical, while success ultimately still depends on the participation of individuals.

Each of the nine Landscape Stewardship Plans characterizes the focal ecosystem's physical, biological, and cultural resources, including a summary of existing resource assessments and stewardship plans. The process of developing each Landscape Stewardship Plan has brought resource professionals and other stakeholders closer together, and the plans serve to connect landowners and land managers with information about practices and programs that will help people take the next step toward becoming more engaged land managers.

A key element of each Landscape Stewardship Plan is the collection of inspirational stewardship stories told by the people living and working within the focal landscapes. Through these stories, local landowners and land managers share why and how they are active stewards in their own ecoregions. Whether that means a small private property or a vast area of public land, these stories are told with the hope of inspiring other landowners and land managers to join in and become actively involved in the stewardship of our collective natural resources.

2. Project Introduction

This Landscape Stewardship Plan focuses on Macomb and St. Clair Counties, and was developed by The Stewardship Network as part of a larger collaboration to promote sustainable stewardship of private and public forest land across the state of Michigan. The larger project began in 2015 when the Michigan Department of Natural Resources (MDNR) received a grant from the United State Forest Service (USFS) to partner with Huron Pines, The Nature Conservancy and The Stewardship Network (all of which are 501(c)(3) nonprofit and non-governmental conservation organizations) to develop nine such Landscape Stewardship Plans, each covering unique Michigan ecosystems (Figure 2.1).

Each of the nine landscape stewardship plans covers a one to three county area in Michigan, characterizes the physical and cultural context of the focal landscape, and connects landowners to assistance programs by summarizing available opportunities and providing program contact information. Each Landscape Stewardship Plan also includes a collection of stewardship stories told by the local landowners and land managers working within each focal landscape. Rather than simply listing recommended land management practices, these stories demonstrate why and how real people, in their own words, choose to actively and sustainably manage their land.

The purpose of these Landscape Stewardship Plans is to inspire people to become more active land stewards by showcasing opportunities through stories and by connecting people with the resources that can help them take the next steps in that process. By increasing the voluntary participation in land stewardship activities, we are ultimately working to protect and preserve Michigan's unique natural resources. This can only be achieved at the landscape scale – with private and public land managers all working in concert to maintain healthy forests, clean water and other natural resources for the use and enjoyment of current and future generations.

The Stewardship Network developed six Landscape Stewardship Plans covering a large swathe of the southern Lower Peninsula. This region is a mosaic of urban areas, agricultural lands, and small private forests. There is comparatively little forest land under public ownership in southern Michigan. Seventy-five percent of Michigan's 10 million residents live in this region, so land management activities across this region of the state have the potential to impact a large number of people.

Huron Pines developed two of the nine Landscape Stewardship Plans for the Jack Pines Ecosystem and Northern Hardwoods, with a focus on Cheboygan and Otsego counties. Both of these northern Lower Peninsula landscapes contain fairly large tracts of forest land under a mixture of private, state and federal ownership. This rural area contains intact and functional forests, but long-term protection of these resources faces many challenges.

The Nature Conservancy developed one Landscape Stewardship Plan for the eastern Upper Peninsula, which covers parts of Alger, Luce, Mackinac and Schoolcraft counties—an area dominated by large blocks of public and private forest land.

While the lead organizations were responsible for developing their respective Landscape Stewardship Plans, the content of each plan was generated with substantial input from other resource professionals, the landowners and land managers willing to tell their stories, and were based upon existing resource assessments, stewardship plans and other available literature. Project partners also worked with Dr. Stuart Gage, Michigan State University professor emeritus, to install acoustic monitoring devices in each landscape to capture the "soundscape" of each landscape. The sounds of the forest tell a story of their own. Eventually, a web site will be created to host an interactive "story map" that will allow people to view stories in their region, share their own stories, and listen to the stories of the forest.

Finally, a portion of the grant funding will be administered by the MDNR to provide cost-share to landowners within the nine landscape focus areas for developing and implementing unique Forest Stewardship Plans for their properties.

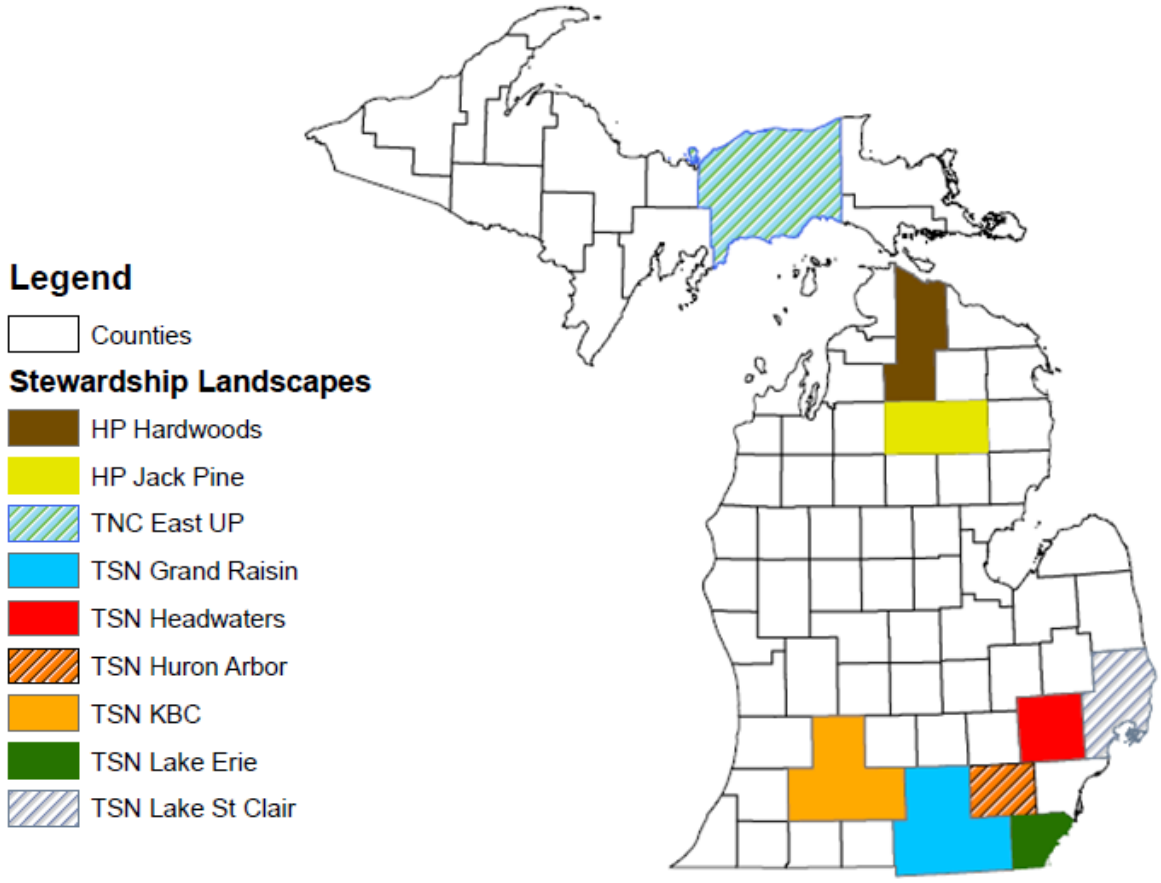


Figure 2.1 Map of areas covered by the nine landscape stewardship plans. TSN Lake St Clair includes Macomb and St. Clair Counties. (Michigan DNR)

2.1 Project Goals and Objectives

Michigan's forests face a myriad of threats—invasive species, tree diseases, habitat fragmentation, agency funding challenges—that sometimes make it difficult to achieve forest stewardship goals. It is estimated that only 20% of Michigan's 12 million acres of non-industrial private forest lands are being actively managed, yet active stewardship of private forest land is vital to the long-term health and productivity of the forest resources (including soil, water and wildlife) on which our local economies and communities depend. Therefore, the overarching goal of this project is to increase interest, awareness, and participation in active forest stewardship opportunities through the development of nine Landscape Stewardship Plans covering strategic and unique forest ecosystems throughout the state of Michigan.

Specific objectives that we seek to accomplish in order to achieve that goal include:

- Objective 1: Describe the physical, cultural and resource management context of each of the nine landscapes to serve as a comprehensive reference for landowners and land managers.
- Objective 2: Facilitate collaborative management of multi-county areas by state, federal and local resource agencies, nonprofit conservation organizations, private sector professionals and individual landowners.
- Objective 3: Promote sustainable forest management practices and encourage people to be more active stewards of their land (e.g., develop and implement a Forest Stewardship Plan).
- Objective 4: Connect people with tools, resources and programs to help them take the next steps toward achieving their personal land management goals and increase our collective capacity to manage forest resources at the landscape scale.

These Landscape Stewardship Plans also aim to support and inform strategies for addressing national priorities and state-level issues identified in "Michigan Forest Resource Assessment and Strategy," which was completed by the MDNR in 2010. These priorities and issues are:

- National Priority 1: Conserve Working Forest Landscapes
    - Issue 1.1: Promote Sustainable Active Management of Private Forests
    - Issue 1.2: Reduce Divestiture, Parcelization, and Conversion of Private Forestlands
    - Issue 1.3: Reduce the High Cost of Owning Private Forestland

- National Priority 2: Protect Forests from Threats
    - Issue 2.1: Maintain and Restore Aquatic Ecosystems and Watersheds
    - Issue 2.2: Reduce Threats from Invasive Species, Pests, and Disease
    - Issue 2.3: Reduce Impact of Recreational Activities on Forest Resources

- National Priority 3: Enhance Public Benefits from Forests
    - Issue 3.1: Maintain Markets for Utilization of Forest Products
    - Issue 3.2: Maintain Ecosystem Services from Private Forestlands

- Issue 3.3: Provide Effective Conservation Outreach for Private Forestlands
- Issue 3.4: Maintain Community Quality of Life and Economic Resiliency
- Issue 3.5: Maintain and Enhance Scenic and Cultural Quality on Private Forestland
- Issue 3.6: Maintain Forested Ecosystems for Biodiversity and for Wildlife Habitat
- Issue 3.7: Maintain and Enhance Access to Recreational Activities on Private Forestlands

2.2 The Need for Active Forest Stewardship

Forest land accounts for 55% of Michigan's total land area, and of Michigan's 20 million acres of forests, 12 million of those acres are privately owned. State and federal agencies are responsible for managing our public lands, but the overall health of Michigan's unique forest, water, and wildlife resources ultimately depends on the collective management activities of all landowners. Unfortunately, a survey conducted by Michigan State University revealed that only about 20% of Michigan's non-industrial private forest lands are currently under active management.

The condition of a particular forest property is highly dependent on the condition of other forest lands throughout the landscape. Conversely, the management actions (or lack of active forest management) on a single property can impact forests, rivers, wildlife, property, and people far beyond the boundary of that individual piece of land. Native wildlife, forest fires, harmful invasive species, tree diseases, and insect pests all move freely among private and public land—they do not recognize property boundaries. Likewise, rivers and streams flowing from one property to the next carry the effects of poor land management activities downstream (or even upstream, as is the case with dams or poorly designed road crossings that block fish passage).

Maintenance of healthy forest landscapes is also important at the regional and global scale. We depend on our forests for timber and other forest products, to provide wildlife habitat, to help mitigate climate change, to protect the quality and quantity of our water resources and for the plethora of aesthetic, recreational, and spiritual values they provide. Protecting our forest products, services, and values starts with the active stewardship of individual properties by landowners and land managers. Because widespread threats to forest health act at scales larger than single parcels, our approach to maintaining healthy, functional, and sustainable forests must also incorporate landscape-scale considerations. The purpose of this project is to encourage and inspire people to actively manage their forests to realize benefits for both individual landowners and the larger community. The next section describes our methodology for doing so.

2.3 Methodology: A Landscape Approach to Natural Resource Conservation

The Michigan DNR applied for and was awarded funding by the USFS in 2015 to coordinate with Huron Pines, The Stewardship Network, and The Nature Conservancy to develop nine Landscape Stewardship Plans. These partners strategically identified landscape types containing a set of unique physical and cultural features that help define each landscape area while also distinguishing them from other landscapes. Of course, ecological landscapes do not adhere to our political boundaries and tend to transition gradually and unevenly from one landscape type to another. However, for the purpose of managing landscape-scale issues and challenges while also keeping the project areas manageable and relevant to local landowners and land managers, we've defined each landscape area as ranging from one to four counties in geographic scope. One advantage of defining the project area based on county boundaries is that these align with jurisdictional areas of different resource agencies and nonprofit organizations. Therefore, the assistance programs, resources, and opportunities offered within each landscape project area are generally consistent and the background information and stewardship stories are tailored to a particular local audience. Nevertheless, people in surrounding counties or other areas with similar characteristics will generally also find that these Landscape Stewardship Plans are useful.

The Stewardship Network coordinated with the landscape stewardship project partners to develop the text in Section 2, including the project background and project goals, objectives, and methodology. To complete Section 3: Landscape Context, The Stewardship Network conducted a review of existing resource assessments and management plans/strategies. We also met with government agencies, private resource providers, and nonprofit organizations to collect information on the various assistance programs and opportunities that are available, with a focus on forest stewardship. Contacts for each program are included to make it easy for property owners and land managers to learn more and to take the next step toward becoming a more active land steward, that said, be sure to check the web for the most up to date contact information

A collection of stewardship stories, told by local landowners and land managers, are included in Section 4 to illustrate some of the opportunities and practices that people are doing in this area. Rather than simply providing a list of recommendations that property owners should be doing, we hope these stories inspire others to learn more and to take advantage of the opportunities and resources that are out there. The Stewardship Network and our partners identified people that are doing great work managing natural areas and who want to tell their stories. We had conversations with individual, corporate, state, and federal land owners and managers to hear about the wide range of land stewardship activities people are doing in Macomb and St. Clair counties. All landowner stories were provided voluntarily for inclusion in this plan and with permission to distribute in the hopes of encouraging other landowners to become active land stewards. If you have your own story that you would like to add to our collection, please contact us. We would love to include your story!

Forests also tell their own stories. Under the direction of Dr. Stuart Gage, acoustic monitoring devices were deployed at a site within each region of focus to capture the unique sounds of the landscape. The Michigan Department of Natural Resources is planning to host an online story map where people can read the stewardship stories collected through this project, submit their own stories, view images and listen to sounds of our forests.

For your convenience, a summary of the available assistance programs, additional resources, and contacts is included at the end of the plan to guide you to becoming an active land steward.

3. Landscape Context

As the third most populous county in the state of Michigan, Macomb County is an interesting mixture of urban area, industry, agriculture and natural features. Bordered to the west by Oakland County and to the south by Wayne County, the densely populated southern half of Macomb County contains two of Michigan's most populous cities: Warren (#3) and Sterling Heights (#4), (US Census Bureau, 2015) Macomb County is bordered to the east by Lake St. Clair, offering 32 miles of coastline to its residents for world-class fishing, boating, and an array of watersports. Lake St. Clair is one of the busiest recreational waterways in the Midwest and offers fishing charters, cruises, and the opportunity to explore the lake and connecting rivers by kayak or paddleboard utilizing the popular Clinton River and Lake St. Clair Coastal Water Trails. The City of St. Clair Shores, is home to The Nautical Mile District, which boasts seven major marinas with over 2700 boat slips, over 30 marine supply stores, and unique shops and waterfront restaurants (Macomb County, 2017). The northern half of Macomb County is primarily agricultural land and widely known for its orchards and vegetable production. It ranks 8th in the state in nursery, greenhouse, and sod production and brings in over $73,000,000 in total agricultural products. There is approximately 68,0000 acres of land being farmed in Macomb County. (www.agcensus.usda.gov).

To the North of Macomb County, at the base of the thumb area of the lower peninsula of Michigan, is St. Clair County. St. Clair County is the easternmost of Michigan's 83 counties. It's known as the Blue Water Area because its eastern and southern boundaries are formed by the waters of Lake Huron, Lake St. Clair, and the St. Clair River, which together form a natural boundary separating Michigan from Ontario, Canada. St. Clair County offers a temperate climate, being greatly influenced by Lake Huron.

The St. Clair River, which flows south from Lake Huron to Lake St. Clair, is one of the heaviest traveled rivers in the world and is part of the world's longest shipping canal, the St. Lawrence Seaway. Along with its extensive coastline, St. Clair County offers a wide-range of land types and uses, from the urban development of Port Huron, the County seat, to rural agriculture. St. Clair County has approximately 180,000 acres of land in agriculture producing over $107,000,000 in agricultural product sales, the largest commodity group by sales being grains, dry beans, and dry peas. St. Clair County is also a major international trade gateway between the United States and Canada for the movement of people and goods across the St. Clair River via the Blue Water Bridges and the international train tunnel. The natural resources of St. Clair County make it a tourist destination all year long for residents and visitors alike, who are attracted to the coastline, scenic landscapes, miles of trails, festivals, and seasonal agricultural offerings. St. Clair County has the highest number of boat registrations per capita in the United States and is the starting point for the largest freshwater sailing event in the world, the Port Huron to Mackinac Sailboat Race (www.stclaircounty.org).

3.1 The Physical, Ecological and Cultural Landscape

3.1.1 Geographic Scope

Macomb and St. Clair counties are found in the southeastern lower peninsula of Michigan and have a combined size of 1,408 square miles, approximately 207 of which (15%) is water (U.S. Census Bureau, 2015). The counties are coastal to Lakes St. Clair and Huron and encompass whole or in part seven major watersheds and numerous subwatersheds. While both counties are adjacent to each, they are still very different in terms of population, land cover, and land use. The Macomb and St. Clair counties are bordered by Wayne, Oakland, Lapeer, and Sanilac Counties, and to the east across the St. Clair River, Lambton, Ontario. Macomb County lies on the shores of Lake St. Clair, which covers over 440 square miles and provides the county with 32 miles of freshwater coastline. (http://www.stclaircounty.org/offices/parks/MasterPlan/01%20Introduction_ComDescription.pdf)

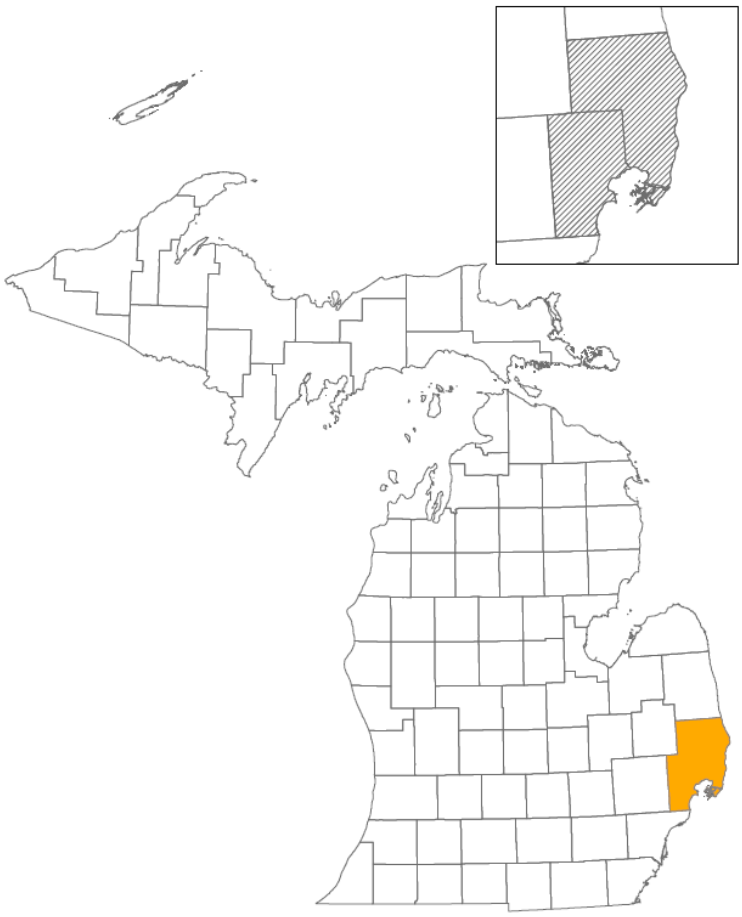


Figure 3.1 Macomb and St. Clair County in the larger context of the state of Michigan (Michigan DNR)

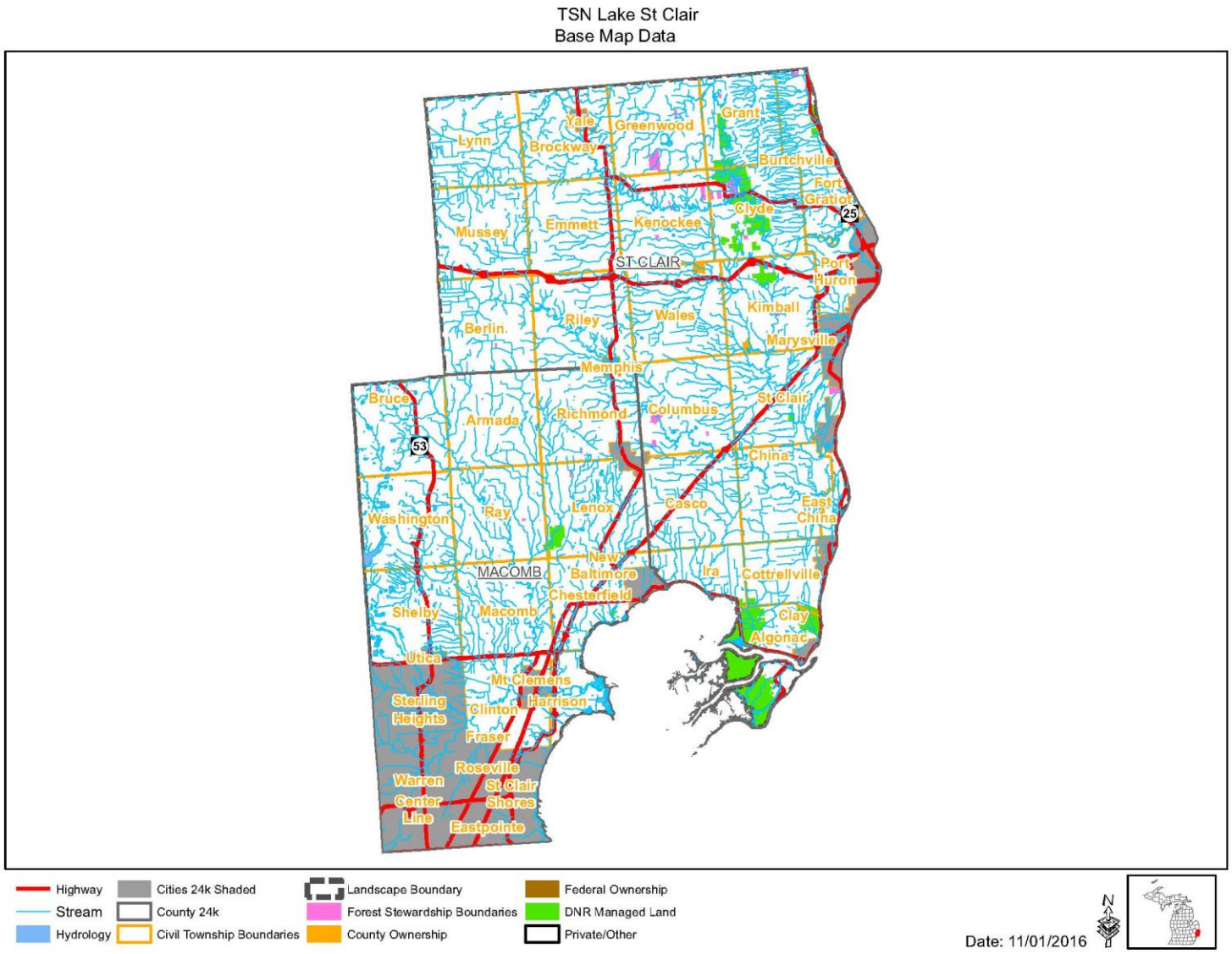


Figure 3.2 Base map of Macomb and St. Clair Counties (Michigan DNR)

3.1.2 Cultural Landscape

Macomb County, established in 1818, is the third most populous county in Michigan at 8.5% of the states total population (840,978 people), as per the 2010 census. St. Clair County is the 13th most populous at 1.65% (163,040 people). Macomb County is 480 square miles in area with a population density of 1,640 people per sq. mile and St. Clair is 721 square miles with a population density of 226 people per square mile according to 2010 US Census numbers. Both counties are strongly influenced by the Detroit metropolitan area to the south but also maintain their own unique cultural identity. Port Huron, St. Clair County's largest city, was established in 1857, however, the area had been a busy French trading post since the 17th century. The local population grew with the establishment of Fort Gratiot at the base of Lake Huron, following the War of 1812, and the area continued to attract immigrants due to a successful shipbuilding and lumber trade. Historic sites recognized by the State of Michigan include: Fort St. Joseph, the second European settlement in Michigan, built in 1686 by French explorers; Fort Gratiot Lighthouse, the first lighthouse in the State of Michigan, built in 1829; Lightship Huron, stationed at Port Huron from 1935 to 1970 and used by the US Coast Guard to mark dangerous shoals in Lake Huron; the Grand Trunk Railway Depot, built in 1859; The Port Huron Library built in 1904; the Harrington Hotel, built in 1896 (also listed on the National Register of Historic Places); and the Grand Trunk Western Railroad Tunnel, the first international submarine railway tunnel in the world, linking Port Huron with Canada, built in 1891.

The first Europeans arrived in Macomb County in the 17th Century. Moravian missionaries established the first refuge for Christianized Native Americans on the banks of the Clinton River in 1782, although their treatment of the Native Americans is highly criticized by many. In 1800, Christian Clemens purchased 500 acres, that included a distillery that is considered the first building on the site of what would become the Village of Mount Clemens in 1818. In the 1870's, mineral baths, believed to possess healing powers, brought international fame to Mount Clemens although interest in these spas declined significantly in the early 20th century. (www.about.macombgov.org)

Selfridge Field (Selfridge Air National Guard Base) was built in 1917 and named after Thomas Selfridge, an Army pilot who became the first person to die in an airplane crash while flying with Orville Wright in 1908. Today, Selfridge is home to the 171st Air Refueling Squadron (KC-135 Stratotankers) and the 107th Fighter Squadron (A-10 Thunderbotl II), as well as a variety of Coast Guard and Homeland Security aircrafts (Heaton, 2014). Urbanization of southern Macomb County began in earnest in 1920's through the 1950's as workers looking for affordable housing moved out of the City of Detroit to cities like Warren and Sterling Heights which are now the 3rd and 4th largest cites by population in the State. The City of Warren is home to a large number of industrial and manufacturing businesses including the General Motors Technical Center, which employs over 8,000 automotive engineers and technicians, Fiat Chrysler Dodge City manufacturing complex, Nobel International, Art Van Furniture and Sennett Steel. (www.cityofwarren.org).

Land Use

Macomb County hosts a wide variety of land uses ranging from dense urban settings to expansive rural areas. Single Family Residential areas accounts for 126,925 acres (40.89%) of the total land area, the largest land use classification in the county. In total, residential uses cover more than 42% of Macomb County. Agriculture is the second largest land use category in Macomb County. Farms, orchards and other agricultural operations account for 71,690 acres of land (23%), most of which is located in the northern half of the county. Together, commercial and industrial uses make up 35,339 acres, (11.4%) of total land area. This includes regional shopping centers, major manufacturing facilities, as well as technological research, and development labs. Hospital campuses and government facilities make up 4.5% or 13,992 acres of total land area.

Macomb County is also home to an abundance of land zoned for parks, recreation, and open space, encompassing over 17,600 acres. State, regional, county, and local governments manage several sizable public spaces including Freedom Hill Park, Stony Creek Metropark, Lake St. Clair Metropark, Wetzel State Recreation Area, and the Macomb Orchard Trail.

The total area of St. Clair County is approximately 836.6 square miles, 724.4 square miles of which is land and 112.3 square miles of which is water. An agricultural/village pattern of land use exists in the western portion of the county, supporting a rural lifestyle that most residents embrace and hope to preserve. The predominant land use is agricultural, which covers almost 47% of the land area (Table 3.1). This is followed by a substantial amount of single-family residential land at 38.6%, then park, recreation, and open space is the next largest use with 4.9%. Rural northern St. Clair County offers more diversity, a change of view and a change of pace from more heavily populated communities that have proliferated along the County's eastern and southern waterfront. More intense land uses such as commercial, industrial, institutional and transportation are primarily found in the Port Huron area and to a lesser extent in village areas and in small parcels on major corridors throughout the county. St. Clair County has 34 units of government including St. Clair County government, 23 townships, eight cities, and two villages. The City of Port Huron is the County seat. In addition, the County has seven school districts within its borders, as well as St Clair Community College.

Table 3.1. Land use Data from the Southeast Michigan Council of Governments

Land Use	Macomb County	St. Clair County
Agricultural	23.1%	46.9%
Single-Family Residential	40.9%	38.6%
Multiple-Family Residential	1.3%	0.1%
Commercial	4.7%	1.6%
Industrial	6.7%	1.2%
Governmental/Institutional	4.5%	2.1%
Park, Recreation, Open Space	5.7%	4.9%
Airport	0.1%	0.2%
Transportation, Communication, and Utility	12.2%	3.8%
Water	0.9%	0.6%

(SEMCOG, 2008)

3.1.3 Climate, Geology, Topography and Land Cover

Climate

In managing any landscape, and with forests in particular, we are faced with the added challenge of climate change and climate adaptation. The following statements provide an assessment of where this region stands in regards to current and historic climate, without any predictions of future climate change. Climate change must weigh into decisions being made about land and water management.

Michigan is generally described as having a humid continental climate with well-defined seasons characterized by hot humid summers and cold winters. According to the USDA Plant Hardiness Zone Map, both Macomb and St. Clair are primarily in Zone 6b which has the lowest extreme temperature in the -5 to 0° F range.

Weather conditions affect the community's agriculture, recreation, and tourism, which are all vital to Macomb and St. Clair Counties economy. In Michigan, the Great Lakes are a major control factor on the climate; however, St. Clair and Macomb Counties are generally affected less by weather extremes because of their southeastern location in the state. The most obvious effect of the lakes on the region is the increased percentage of cloud cover in late fall and early winter, when prevailing westerly winds move cold air across the warmer lake water. In addition, the county's southeastern location within Michigan provides it with five to ten percent more sunshine than counties at the same latitude on the western side of the state. (St. Clair County Master Plan: http://www.stclaircounty.org/offices/parks/MasterPlan/01%20Introduction_ComDescription.pdf)

The climate of both Macomb and St. Clair County is temperate with cold winters, hot summers, and moderate springs and falls. The average low temperature in January is 17 degrees Fahrenheit, and the average high is 30 degrees Fahrenheit. The average low temperature in July is 62 degrees Fahrenheit, and the average high is 82 degrees Fahrenheit. The average annual rainfall for this area is 34 inches, and the average snowfall is around 36 inches. The growing season in this region usually lasts 170 days. (St. Clair County Master Plan: http://www.stclaircounty.org/offices/parks/MasterPlan/01%20Introduction_ComDescription.pdf)

Michigan State University has weather stations at several locations including Romeo (Macomb) and Emmett (St. Clair) as part of their Enviroweather network. This service provides real-time weather data as well as historical records of air temperature, precipitation, relative humidity, etc. They also host tools that calculate growing degree days and water use. (https://enviroweather.msu.edu/)

Geology

The bedrock geology of Michigan is dominated by the Michigan Basin, which encompasses all of the Lower Peninsula and the eastern half of the Upper Peninsula. Southeastern Michigan is predominantly shale bedrock formations. Quaternary geology refers to the geologic formations of the last 2.5 million years and primarily focuses on how glaciers affected the landscape. Macomb and St. Clair's quaternary geology is primarily a result of the lake plains that were present during the last Ice Age that contained melt water from the glaciers that created the many lakes and hills of neighboring Oakland County. Much of the area contains clay and silt deposits that are consistent with former lacustrine (lake) environments.

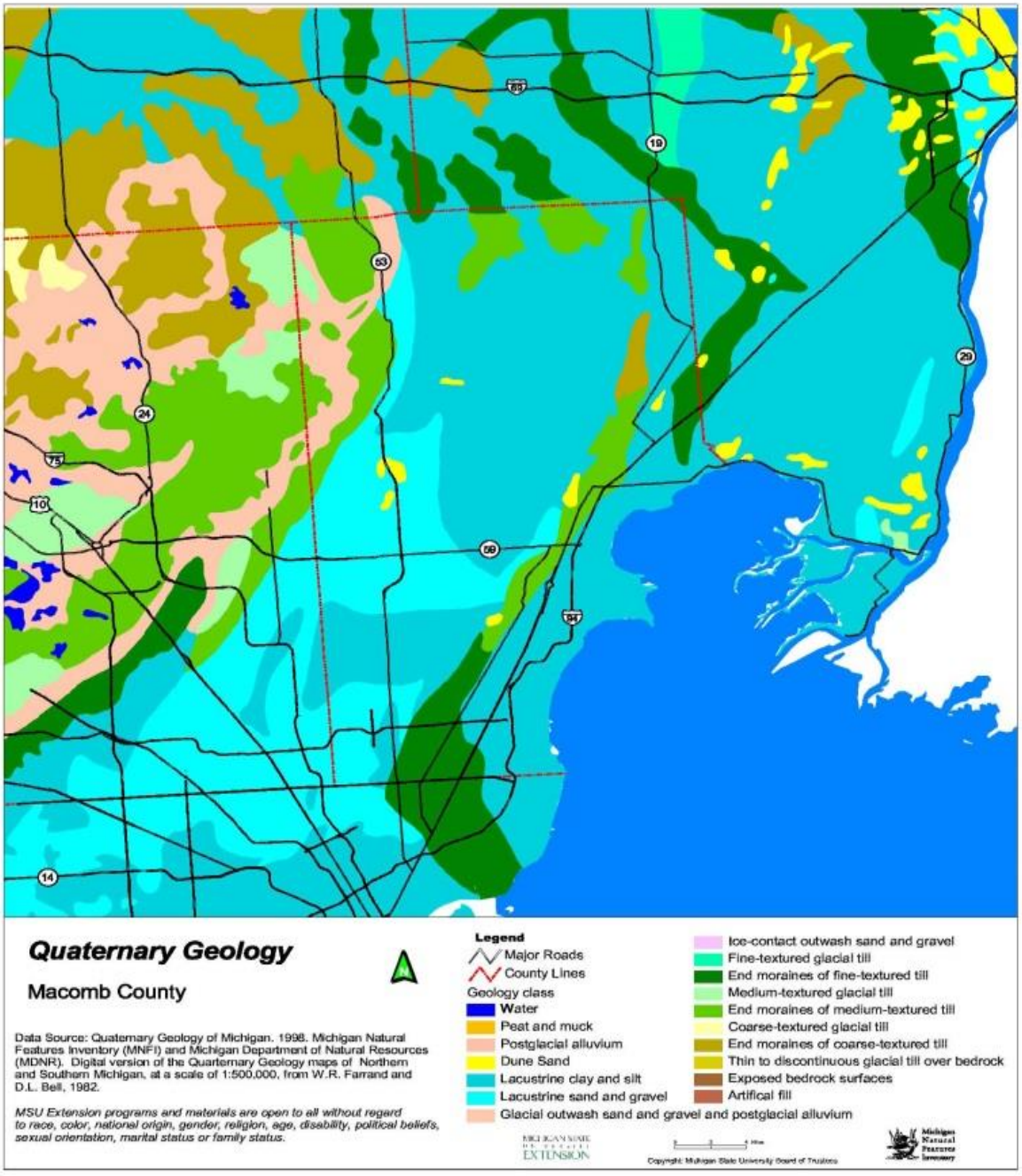


Figure 3.3 Quaternary geology map of Macomb County (MNFI).

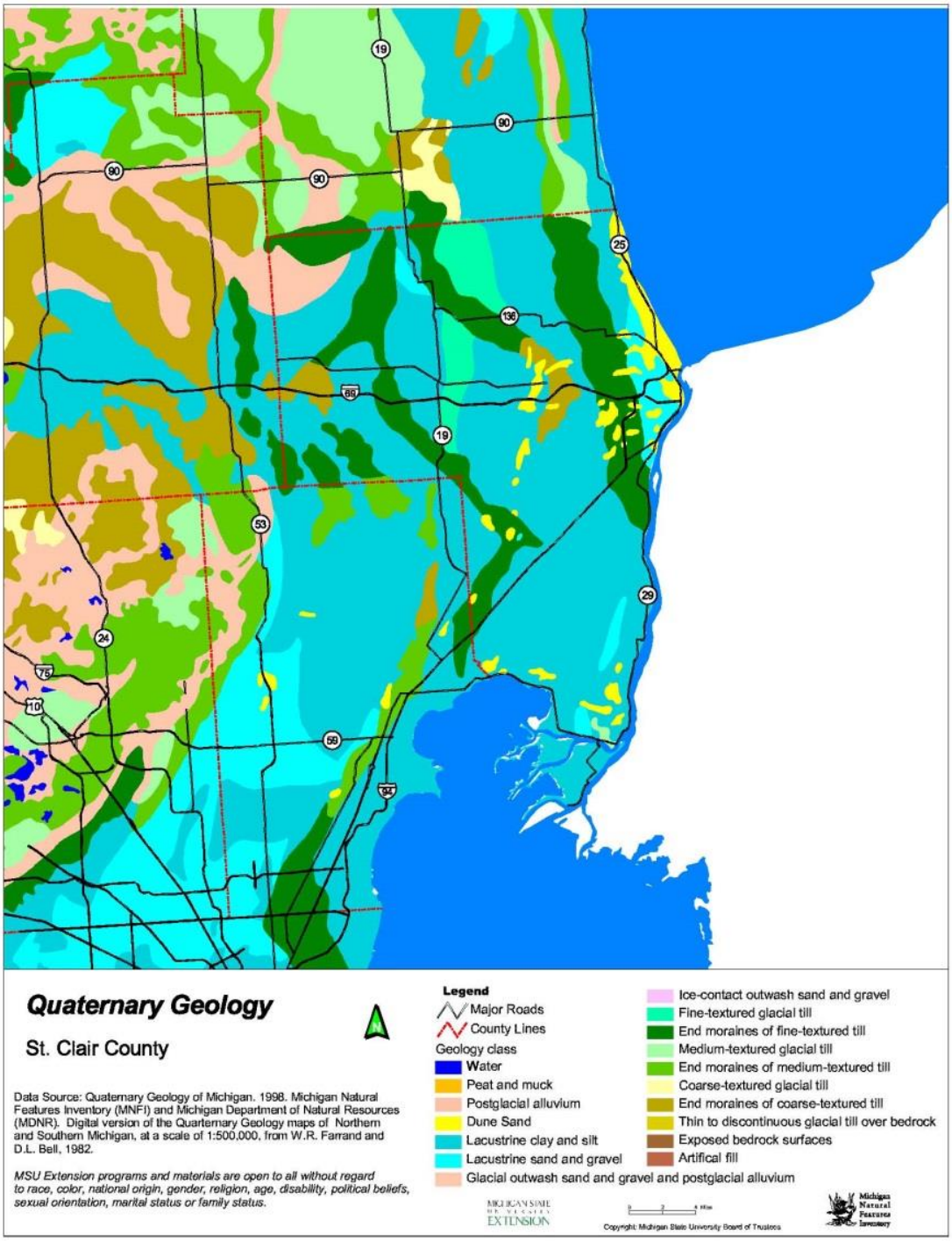


Figure 3.4 Quaternary geology map of St. Clair County (MNFI).

Topography
Topography refers to the elevations, relief features, or surface conditions of an area. Understanding the topography of a region enables the understanding of watershed boundaries, drainage characteristics, water movement, and impacts on water quality. The land surface of this region is glacial in origin, with characteristic slopes, soils, and drainage conditions, a result of these physical factors. According to the United States Geological Survey, Macomb and St. Clair Counties are part of the landform called Washtenaw-Maumee Lake Plain. The Maumee Lake Plain is comprised of a flat, primarily clay plain, that is dissected by broad glacial drainage ways of sandy soil (Albert, 1995). Beach ridges and small sand dunes are common on the sand channels, especially along the lake lakeshore such as is seen in Fort Gratiot Township and Lake St Clair Metropark (Paskus, 2003).

The highest point in Macomb County is Trombley Mountain, located in Bruce Township, in the northwestern part of the County. Its peak reaches 1,150 feet above sea level (www.summitpost.org). While relatively flat, the drainage of Macomb County generally runs south and east. The Clinton River, which has an elevation drop of approximately 450 feet from its headwaters to mouth, is made up of four sub-watersheds in the County (North Branch Sub-watershed, Clinton River East Sub-watershed, Red Run Sub-watershed and Stony Creek Sub-watershed). Together with the Lake St Clair Drainage and Anchor Bay Watershed, the Clinton River watershed drains the vast majority of the county with that water making its way to Lake St. Clair at 547 feet above sea level. (www.green.macomb.org)

Elevations throughout St. Clair county range from 580 feet to 800 feet above sea level with the highest points in the western part of the county, along the Black River in the northern part of the county, and along Lake Huron and the northern part of the St. Clair River. The lowest part of the county is in the south in an area known as St. Clair Flats, which is within the Lake St. Clair floodplain. (St. Clair County Master Plan: http://www.stclaircounty.org/offices/parks/MasterPlan/01%20Introduction_ComDescription.pdf) This county crosses five watersheds including the Black, St Clair and Clinton Rivers and the watersheds of Lake St Clair and Lake Huron.

Land Cover
Pre-1800s vegetation maps (Figures 3.6, 3.7, 3.8) show that much of Macomb County used to be primarily beech-sugar maple forests on well-drained sites, with areas of mixed hardwood swamp occupying the depressions. Areas of lake plain prairie were found throughout. Dry oak-hickory forests and oak savannas occupied the dry sandy ridges (Paskus, 2003). Subtle differences in elevation directly correspond to differences in soil drainage. The forests in the poorly draining areas in the Maumee Lake Plain strongly respond to these differences. Where this occurs, species typical of southern swamp and mesic southern forest, create a highly diverse forest composition that is unique to the lake plain. Forested areas known as Wet-mesic Flatwoods, are one of these unique forest types that are only found within the Maumee Lake Plain. While relatively rare, several good examples of Wet-mesic Fatwoods are found to occur in Macomb County on both private and public land. Other vegetation types present are wet

prairies, mixed conifer swamp, black oak barrens, and mixed oak forest along the eastern border of the county (Kost et al, 2006).

St. Clair County's pre-1800s vegetation was of a similar makeup with the exception of the large shrub swamp and marsh areas in the Algonac/Harsen's Island area. Today much of the land cover of Macomb County (Figure 3.5) is heavily populated with residential and commercial properties throughout much of the southern half and giving way to mainly agricultural land with small pockets of deciduous forest. St. Clair County is widely agricultural dotted with deciduous forest. St. Clair County has roughly twice as much agricultural land as Macomb County. St Clair County ranks relatively high in the State for the production of soybean, broiler chickens and aquaculture while Macomb ranks fairly high in the State in vegetable production, landscape nurseries, and cattle (USDA, 2017). In St. Clair County, residential or industrial areas are focused around the Port Huron area. Harsen's and Dickinson Islands at the southern tip of St. Clair County are largely emergent marsh and swamp with only light development and few residences.

Combined data for the two counties shows that the dominant land use is agricultural (39%) followed by low to high intensity development (21%). Forests occupy 19% of the area with most of that being deciduous trees. Three types of wetlands (woody, emergent herbaceous, and shrub-scrub) cover 9.3% of the combined county area and 7.5% of that is in the woody wetlands category. The MDNR manages a total of 52,237 acres in State Wildlife and Recreation Areas and there are 6,586 acres enrolled in Forest Stewardship Plans.

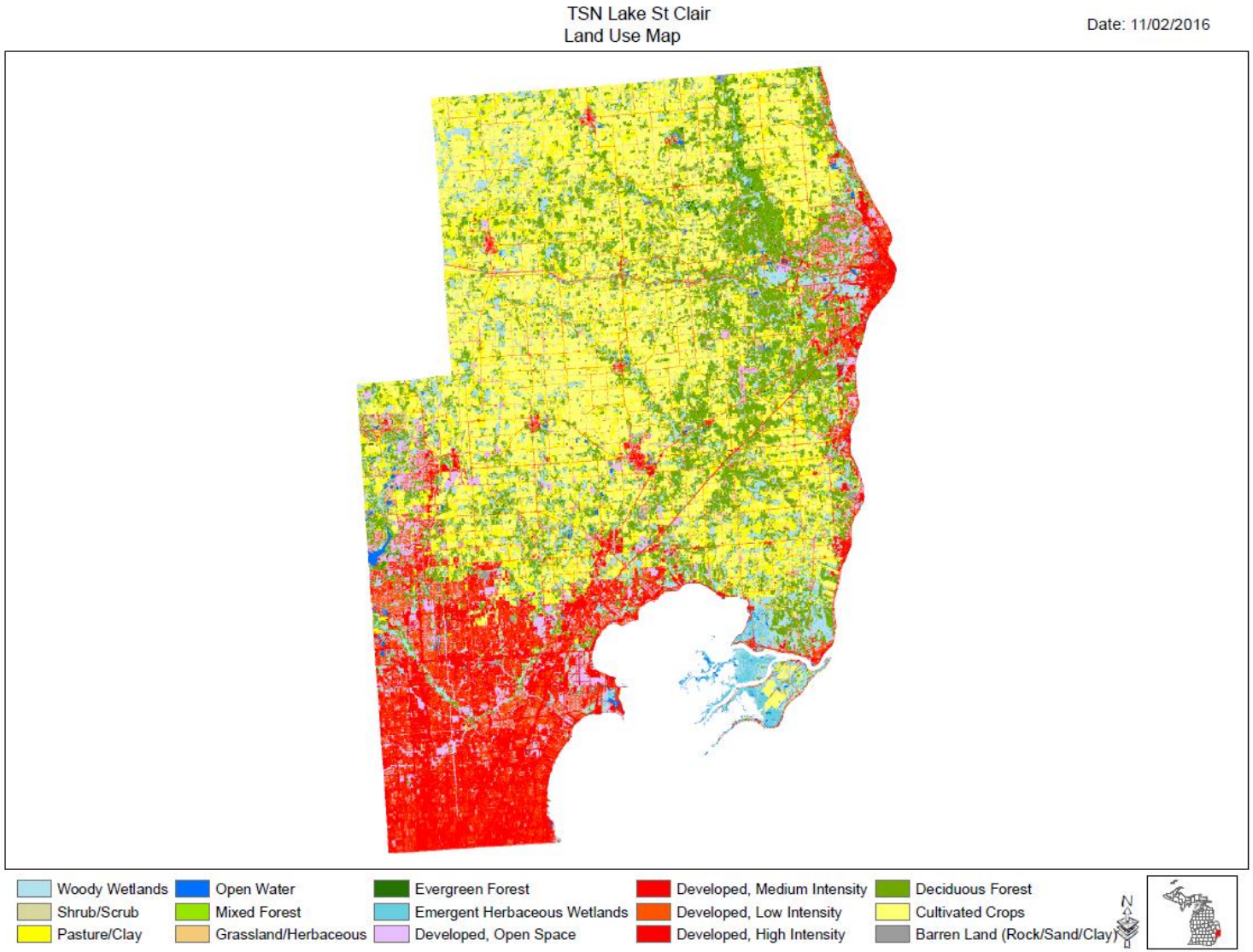


Figure 3. 5 Land Cover Map for Macomb and St. Clair Counties, 2017 (Michigan DNR)

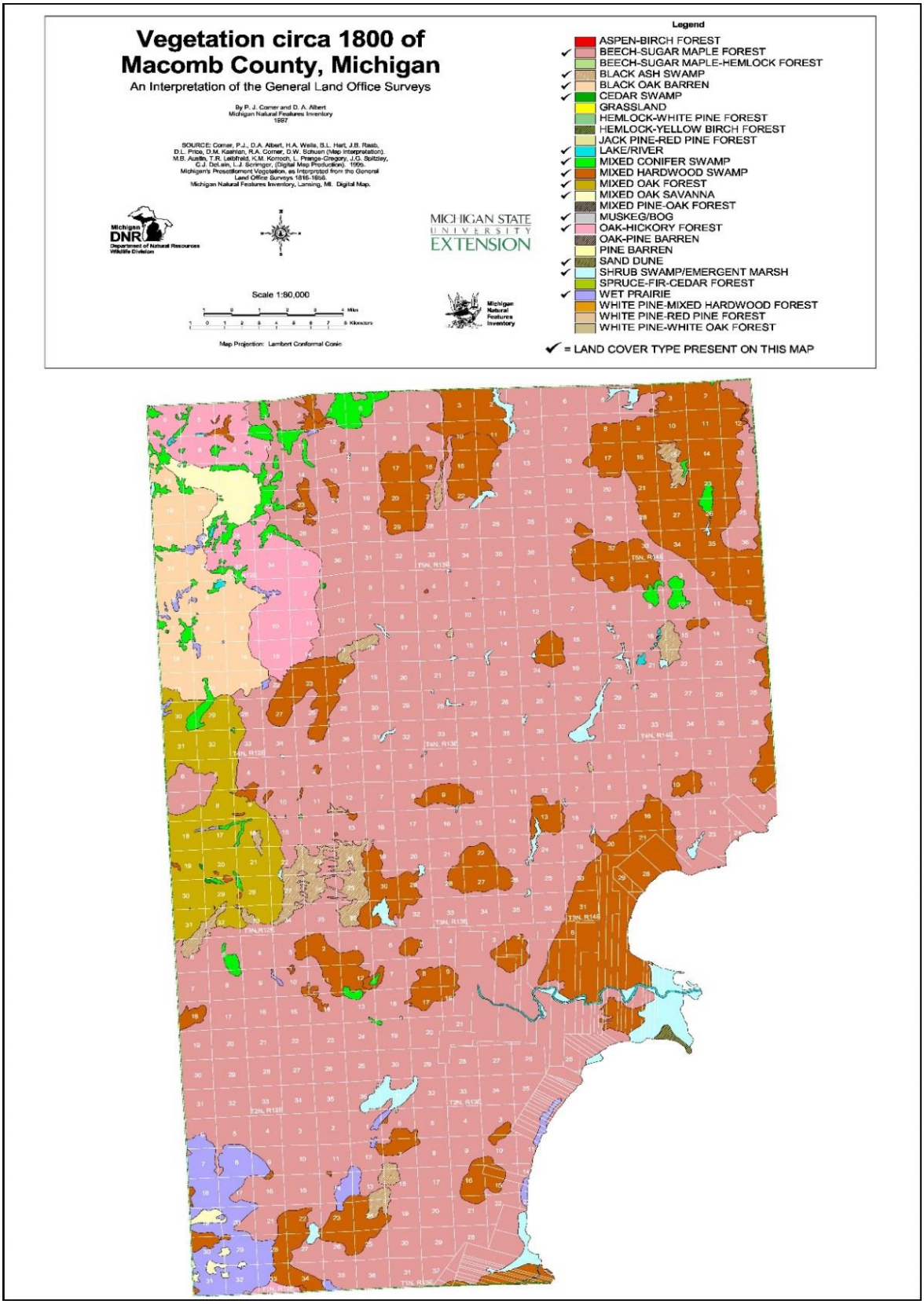


Figure 3.6 Vegetation circa 1800 for Macomb County (MNFI)

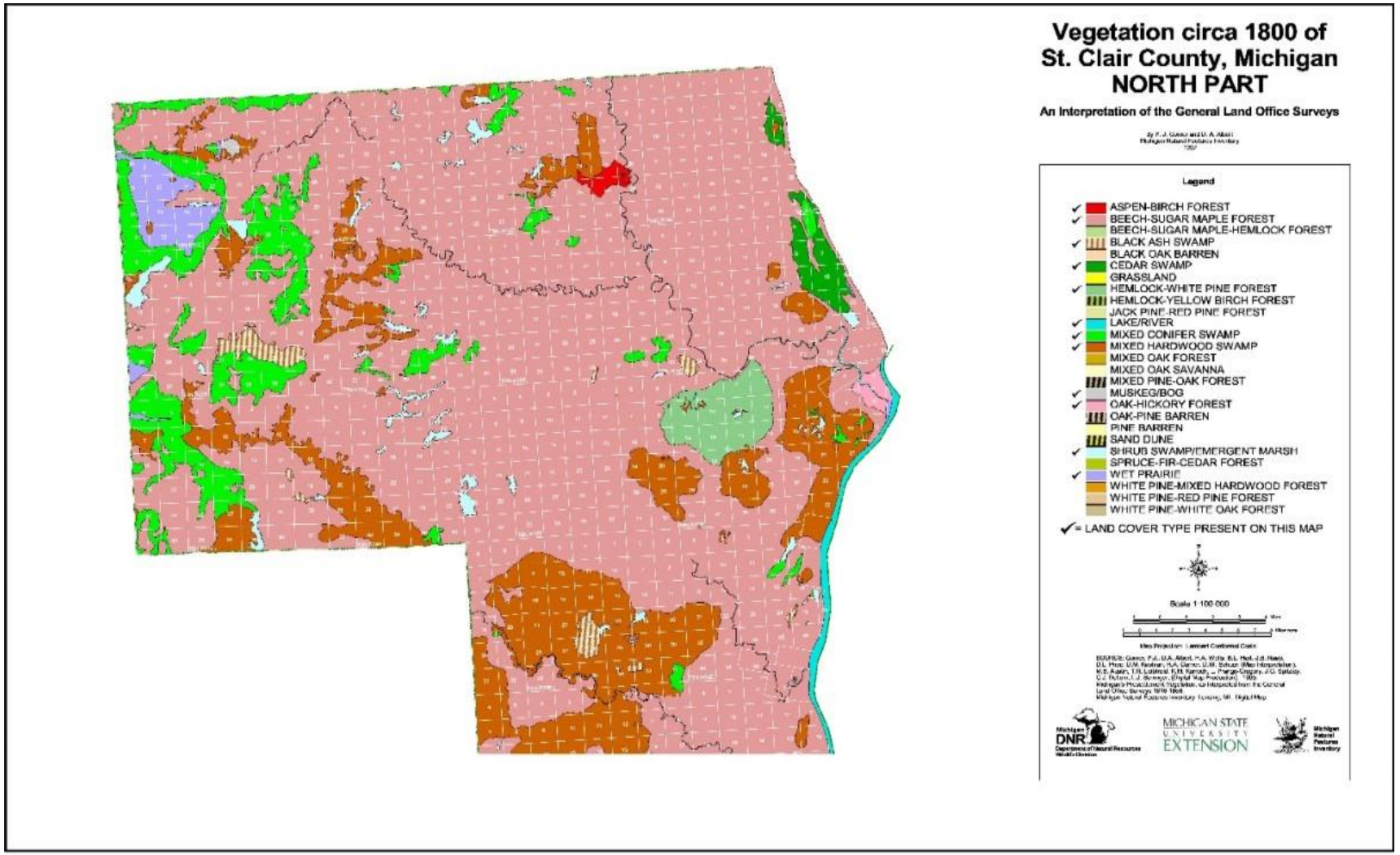


Figure 3.7 Vegetation circa 1800 for Northern St. Clair County (MNFI)

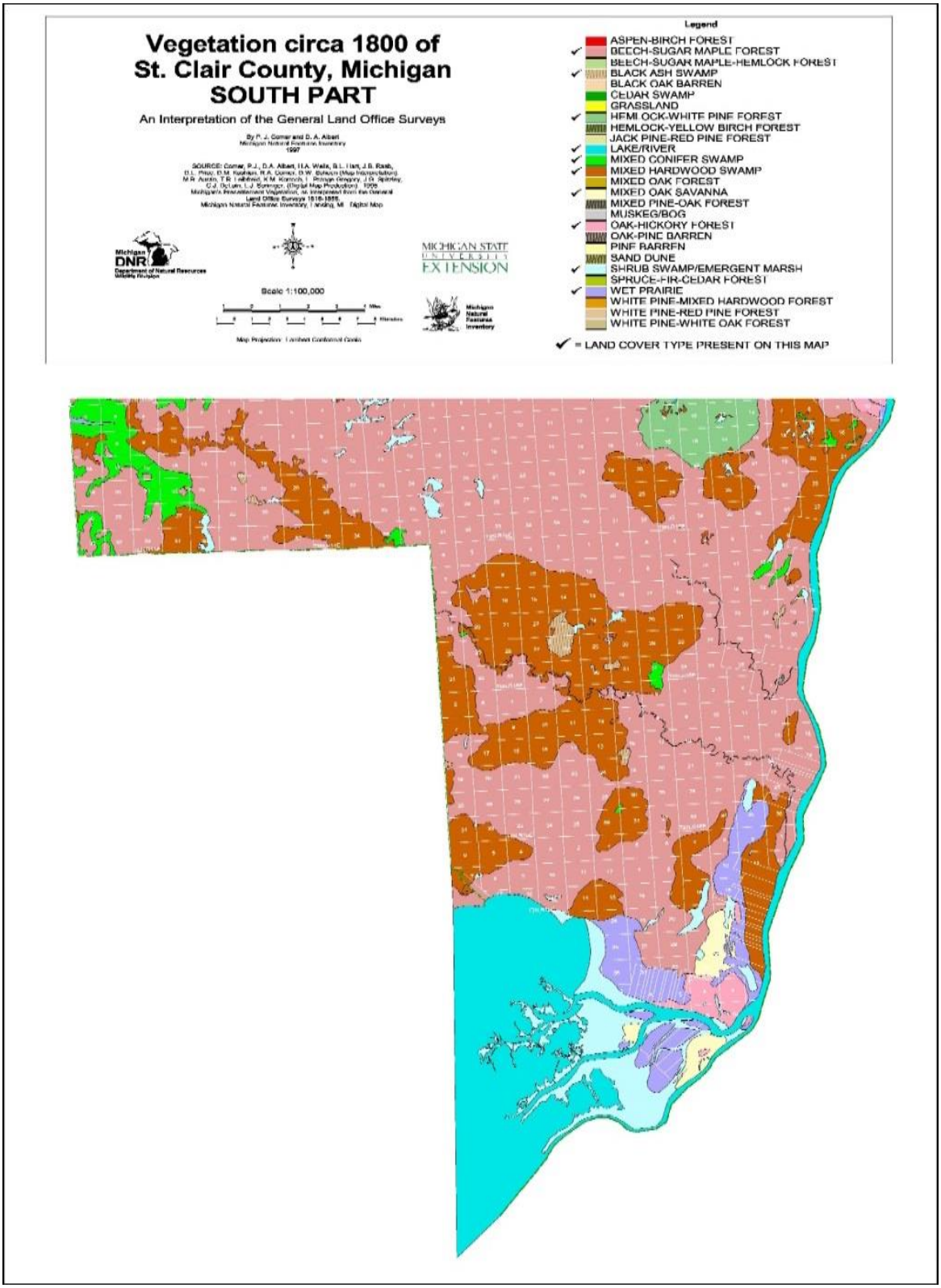


Figure 3.8 Vegetation circa 1800 for Southern St. Clair County (MNFI)

3.1.4 Soils

Soils can be classified most simply by texture based on particle size: sand, silt, and clay (from largest to smallest). The ratio of these particles present can determine basic features and functionality such as porosity, drainage, and retention of minerals and organic matter. For example, sandy soils do not retain water as well as clay soils which can sequester water for long periods of time. A soil that contains a balance of all three particle types is called a loam. Soil types, water, and climate are the major determinant of vegetation in a region. Soil sustains growth, holds and filters water, provides habitat for microbes and other living organisms, and recycles dead material, thus providing the nutrients needed to support future growth. Land management practices can greatly enhance soil health by increasing soil organic matter levels. Landowners can benefit from understanding the relationship between soil characteristics and appropriate land use.

In both St. Clair and Macomb County, the soils associated with lake plain are typically wet loams and clays of low permeability. Soil drainage strongly influences the region's vegetation. Flat, poorly-drained areas generally support lowland hardwood forest, while flat but moderately drained portions of lake plain are characterized by mesic forest. Where micro-topography varies at small scales, species typical of these communities intergrade with southern swamp and mesic southern forest species, creating Wet-mesic Flatwoods, a forest composition unique to the clay lake plain. In contrast, the soils on the upland ridges and dunes of the sandy glacial drainage ways, which are excessively drained, support oak savannas (Albert, 1995). The sandy glacial drainage ways also support wet prairies and marshes, which commonly occur in depressions on poorly to very poorly drained soils and along the Great Lakes shoreline (Kost et al, 2006).

Macomb County soils can be generalized as having two major soil texture associations: in the northern area has loams (primarily sandy loams) and farther south the soils become siltier, eventually giving way to clays. St. Clair County has predominantly sandy soils throughout the eastern area leading up to the shoreline of the St. Clair River. Farther west in the agricultural region, the soils become loamier and better suited for farming. Table 2 shows the relationship between soil textures and ecological habitats.

Table 2. Soil properties in relation to the continuum of ecological habitats

Properties	Ecological Habitats				
	Xeric	Dry-Mesic	Mesic	Wet-Mesic	Hydric
Average moisture	Very dry	Somewhat dry	Moist	Very moist	Very wet
Drainage	Excessively well	Very well	Well	Somewhat poorly drained	Very poorly or undrained
Surface soil textures	Sand to loamy sand	Loamy sand to sandy loam	Sandy loam to loam	Loam to clay loam	Sandy to clay loam or organic
Natural fertility	Infertile	Moderately infertile to fertile	Very fertile	Fertile to moderately fertile	Moderately fertile to very infertile

Adapted from Michigan Forest Communities: A Field Guide and Reference By Donald I. Dickmann, Department of Forestry, Michigan State University See: http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E3000.pdf

Soil investigations have been conducted by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and both counties have been mapped at a scale of 1:15,840 which is fine enough to represent areas larger than about two acres. The mapping is supported by a large data base that contains information about basic soil properties and the appropriate use of soil areas based on those characteristics. There are numerous interpretations that cover commodity crop production, hydric soils (those associated with wetlands), recreational development, soil health, etc. Under the land management heading, there are several interpretations that relate to forestry such as haul roads, erosion hazard, harvest equipment, seedling mortality and wind throw hazard.

Detailed soil information is provided by the USDA NRCS through printed soil surveys (available from county conservation district offices) and Web Soil Survey, an Internet site that shows recent aerial imagery and allows the user to select an area of interest to assess the soil map units present. Users can also search interpretations such as suitability for paths and trails. The print versions of Soil Survey show appropriate trees to plant on different soil types and the site index for a few of the most common trees that are adapted to the soil characteristics (drainage, depth, etc.) for the mapped area. Web Soil Survey: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Smart phone users can take advantage of the SoilWeb app, which uses the device's GPS location to display one or two common soils at that site. It has basic information that includes a soil profile, landscape position, and simple graphs that display sand, silt, clay, organic matter, and pH with depth.

Michigan State University houses a Soil and Plant Nutrient Laboratory that offers a variety of analytical services on samples of soil, composts, plant tissue, water and other materials related to the growing of plants. Determining pH and nutrient status of soil by soil testing is a key method of determining which amendments (lime and fertilizer) to add for optimal plant growth. Soil and Plant Nutrient Laboratory: http://www.spnl.msu.edu/

For more detailed understanding of the soils on your site, contact the NRCS or Michigan State University Extension. See Section 3.3 for details.

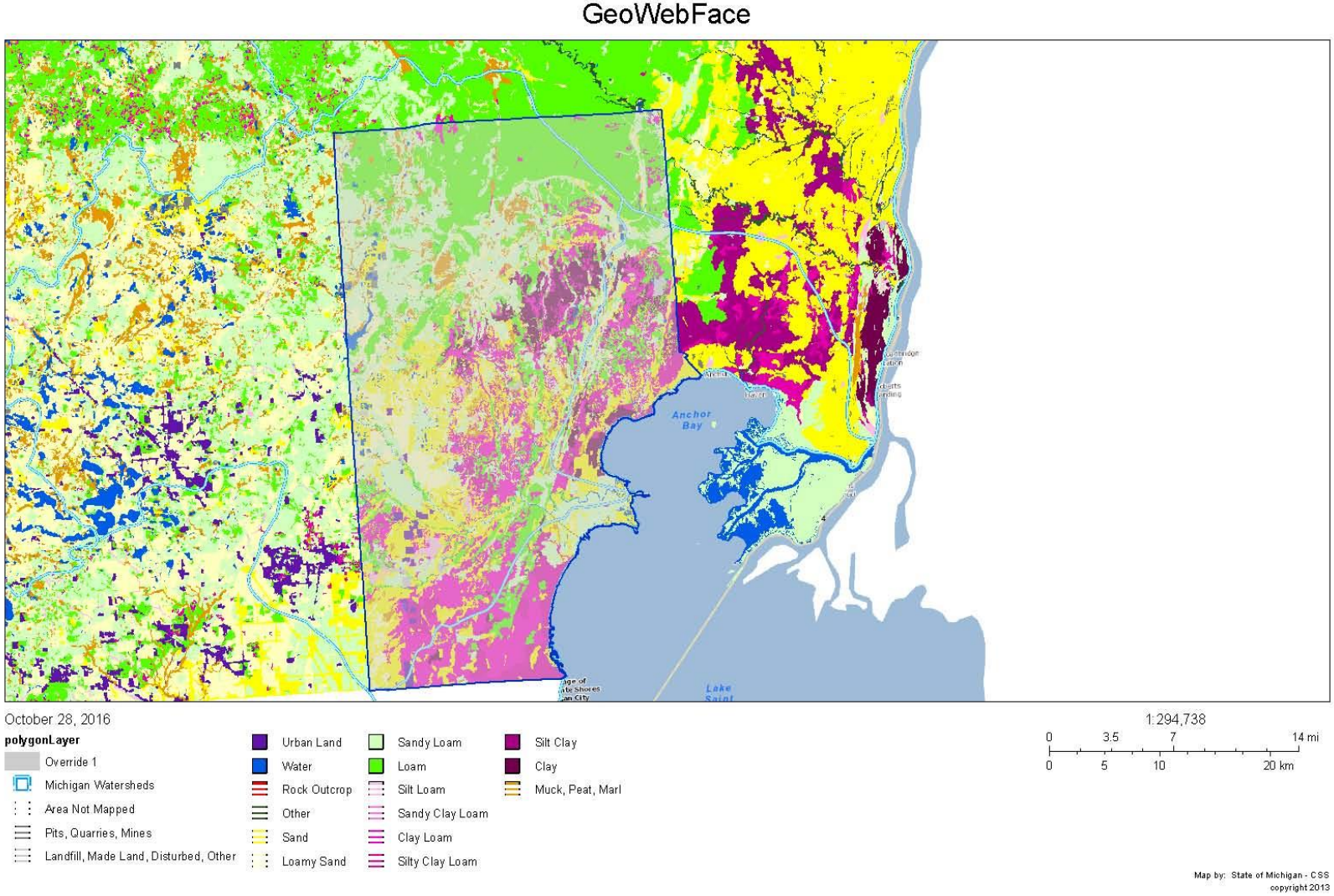


Figure 3.9 Soil Composition of Macomb County (State of Michigan)

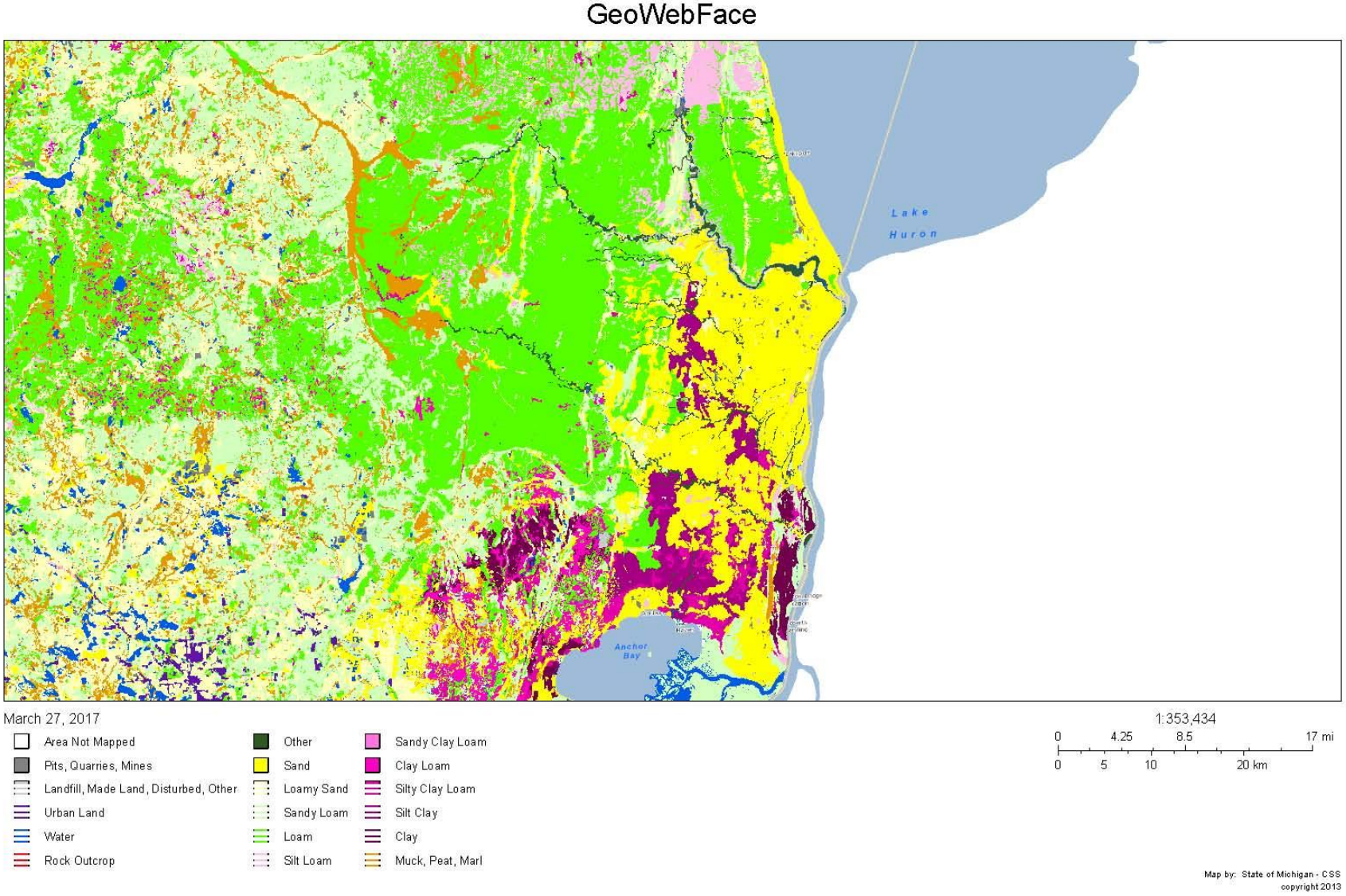


Figure 3.10 Soil composition of the St. Clair region. (State of Michigan)

3.1.5 Water

The largest water feature for Macomb and St. Clair Counties is Lake St. Clair, which extends from the St Clair River Flats near Harsens Island to the mouth of the Detroit River. It connects Lake Huron and Lake Erie via the St. Clair and Detroit Rivers. The lake is situated between the U.S. and Canada with the international border running through the middle. The lake is 430 square miles in area with an average depth of 11 feet and a dredged shipping channel of 27 feet. On the U.S. side of the lake, there are 59 miles of shoreline and 162 square miles of surface area. The drainage area for Lake St. Clair is 4,890 square miles in total.

Lake St. Clair is a recreational haven for boaters, anglers, and sightseers. The largest fleet of pleasure boats on the Great Lakes is on Lake St. Clair, and about one-third of all the fish caught on the Great Lakes are caught there. The largest remaining marshlands in the Great Lakes Basin are located in Clay Township and Walpole Island First Nation near Lake St. Clair. Environmental concerns abound in this area and are evidenced by beach closings due to bacterial contamination, visible changes in the lake, and changes to lake plants and animal populations.

Lake Huron creates a 12.5-mile shoreline boundary on the northeast corner of St. Clair County and is an integral part of the county's economy and recreation opportunities. The cities of Detroit (60 miles south), Flint (75 miles west), and 90 other communities pump 400 million gallons of water per day from Lake Huron to supply 1.5 million people with drinking water. Lake Huron has been impacted by human activity including loss or degradation of critical habitat, excessive nutrients from agriculture and other sources, exotic invasive species, and toxic contaminants from industry. Despite these impacts, the water quality of Lake Huron remains "relatively good" according to the Michigan Department of Environmental Quality (DEQ). The water quality of the great lakes has been of concern since the 1970's, when awareness of environmental issues increased in the general public.

There are over 300 lakes scattered across this region, the largest being Stony Creek at 700 acres (Lakeplace.com). The two counties also have a bounty of inland rivers. The predominant watersheds in Macomb and St. Clair are the Clinton River, Belle River, Pine River, Black River, and the direct drainage watersheds into Lake St. Clair and the St. Clair River. These include 149 miles of primary rivers and 810 miles of tributaries. Comparison of water quality in these rivers, as well as that of minor rivers in the Macomb and St. Clair Counties, showed that water quality in many of the tributaries (particularly the Clinton River) are degraded compared to the water quality of the St. Clair River/Lake St. Clair waterway. Levels of phosphorus, chloride, and pesticides exceed USEPA standards in several of the waterways, however the flow and volume of the St. Clair River and Lake St. Clair waterway are apparently able to assimilate the incoming elements with little effect on overall water quality. Localized water impairment within the watersheds remains of great concern for both residents and governing officials. Recent funding from Federal (EPA, NOAA), State (MDEQ, MDNR) and local agencies are being utilized to address many of the use impairments identified in these waterways.

St. Clair River

The 40-mile-long St. Clair River borders the east side of St. Clair County. The maximum depth ranges from 35 to 50 feet. Sixty-eight species of fish from 19 families have been recorded in the river and it is considered a premier fishing destination (Paskus, 2003). The river extends from Lake Huron in the north to Lake St. Clair at the south, where it has an average discharge rate of 182,000 cubic feet per second. The river has the largest freshwater delta in North America (St. Clair Flats) and six of its ten islands are on land owned by the Walpole Island First Nation. In addition to communities in Ontario, Canada- Port Huron, Marysville, Marine City, St. Clair, and Algonac all have water intakes that draw from the St. Clair River. (www.mi.water.usgs.gov)

The St. Clair River is listed as an Area of Concern (AOC) due to pollutants coming from municipal and industrial discharges, as well as from urban and rural runoff, combined sewer overflows (CSOs), and contaminated sediments. The St. Clair River AOC extends from the Blue Water Bridge at the north end, to the southern tip of Seaway Island, and west to St. Johns Marsh on Lake St. Clair, but does not include Anchor Bay. Through a Great Lakes Agreement, a Remedial Action Plan (RAP) was created in 1985 to initiate cleanup measures.

Lake St. Clair and the St. Clair River are the receptors of all drainage basins within both Macomb and St. Clair Counties and water level fluctuations of two to three feet are common. This fluctuation, along with rapid currents, can cause shoreline erosion, and potential alterations to the composition and habitat of adjacent marshes and wet prairies. Water levels in the St. Clair River are usually lowest in February, then rise through July and decline through the rest of the year. The St. Clair River's frequent passage of large lake freighters provide for unique sightseeing and tourism opportunities, however, shipping has brought infestations of non-indigenous aquatic species that are potentially detrimental to the environmental health of the river (USGS, 2011).

The Black River watershed in the northern part of St. Clair County flows southeast to empty into the St. Clair River in downtown Port Huron. The area of the watershed is 746 square miles with 205 miles of tributaries that feed the Black River (http://www.cis.stclaircounty.org/stormwater.asp). The Black River and its tributaries drain most of the northern and western parts of St. Clair County. The river's watershed is primarily a broad, flat plain bounded on three sides by hills ranging from 20 to 100 feet high. The Black River offers limited recreational use due to easily eroded clay soils. Historically, the river afforded high-quality fishing, but fish populations have diminished and become almost nonexistent in recent decades.

The Pine River is a 27-mile tributary of the St. Clair River and is the largest watershed (126,110 acres) contained within St. Clair County. It flows through relatively flat land from the central part of the county and through the City of St. Clair. The headwaters of the Pine River begin Emmett Township in the James and Alice Brennan Memorial Sanctuary. The overall biological integrity of the river is rated as fair, however, in 1885 the Michigan Natural Features Inventory

recorded 15 species of native mussels, four listed as state endangered as well as one state threatened fish, the eastern sand darter (Paskus, 2003).

With its headwaters in Lapeer County, the 74-mile-long Belle River is also a tributary of the St. Clair River. It flows through the west central part of St. Clair County, passes through a corner of Macomb County, then continues southeast through Marine City, draining 145,300 acres of relatively flat land. Wilson (1974) described the lower reaches of the Belle River as a slow sluggish stream flowing through an area of old lake plain of little gradient. Much of the adjacent soil types are organic peat and muck deposits. However, MNFI has also recorded a diverse mussel community of 16 species, including 5 that are currently listed by the state.

Clinton River

The Clinton River watershed is the largest watershed in Macomb County. It is about 760 square miles in area and has over a thousand miles of streams that feed into the 80 miles of the three main branches of the Clinton River: The North, Middle and Main. The Clinton River's headwaters begin in Oakland County to the northwest and empty into Lake St. Clair and Anchor Bay. The North Branch of the Clinton River drains 8,600 acres in the southwest part of St. Clair County, even though the river does not physically flow through the county.

The Clinton River and its tributaries flow through 60 communities, passing a population of roughly 1.4 million people. Major streams in the watershed include Paint Creek, Stony Creek, North Branch Clinton River, Coon Creek, and Middle Branch Clinton River. Land drainage for agriculture (which began as early as the 1840's) and post-World War II industrial growth probably increased the flashiness and sediment load of several downstream reaches which has had a major impact on the watershed. Development of headwater areas have decreased soil permeability causing increased flooding of areas downstream (Leopold, 1968). Flooding eventually became such as problem in Mt. Clemens that a 2.5-mile spillway (The "Cut Off Canal") was constructed between the city and Lake St. Clair in order to carry away the floodwaters (Zorn, et al, 1992). The entire Clinton River watershed has been designated as an Area of Concern (AOC) by the US EPA. A Remedial Action Plan (RAP) was completed in 1995 and was last updated in 2008. The priorities of the RAP include the elimination of CSO's, nonpoint source pollution control, waste site and contaminated sediment remediation, habitat restoration and elimination of illicit sewer connections and failing septic systems. Recent funding from Federal (EPA, NOAA), State (MDEQ, MDNR) and local agencies are being utilized to address many of the use impairments identified in these waterways.

The North Branch is the largest tributary of the Clinton River. A mussel survey in 1980 found 26 species of mussels, four of which are state listed species. The river has a healthy fish and macroinvertebrate community and is considered to have good overall biological integrity.

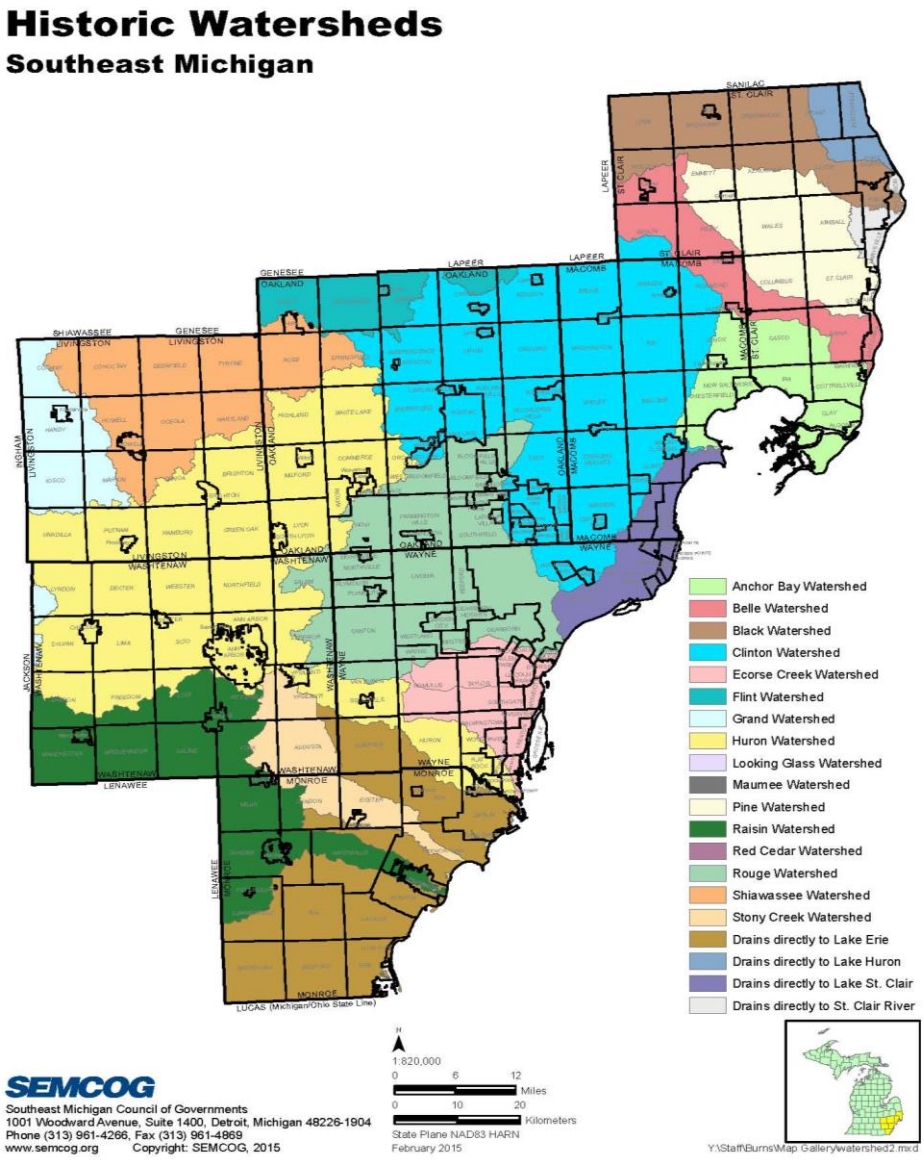


Figure 3.11 Watersheds in Southeastern Michigan (SEMCOG)

3.1.6 Wetlands

Wetlands provide many important functions in terms of ecological stability, biodiversity, pollution and contamination retention, and flood control. Unfortunately, most of these benefits were not realized until more recent years and not in time to save many pre-1800s wetlands from being drained for agricultural and human populations needs. Much of Macomb and St. Clair counties were forested wetlands and marshes prior to the 1800s, but nearly 4.2 million acres of wetlands have been lost to development. The majority of that loss is found in Southeastern Michigan as human population increased over the last century.

Much of the wetlands that remain are small and non-contiguous, often confined to the floodplains of the county waterways. The exception being the St. Clair flats/Harsen's Island in Clay Township at the confluence of the St. Clair River and Lake St. Clair, which is one of the largest freshwater deltas in the world.

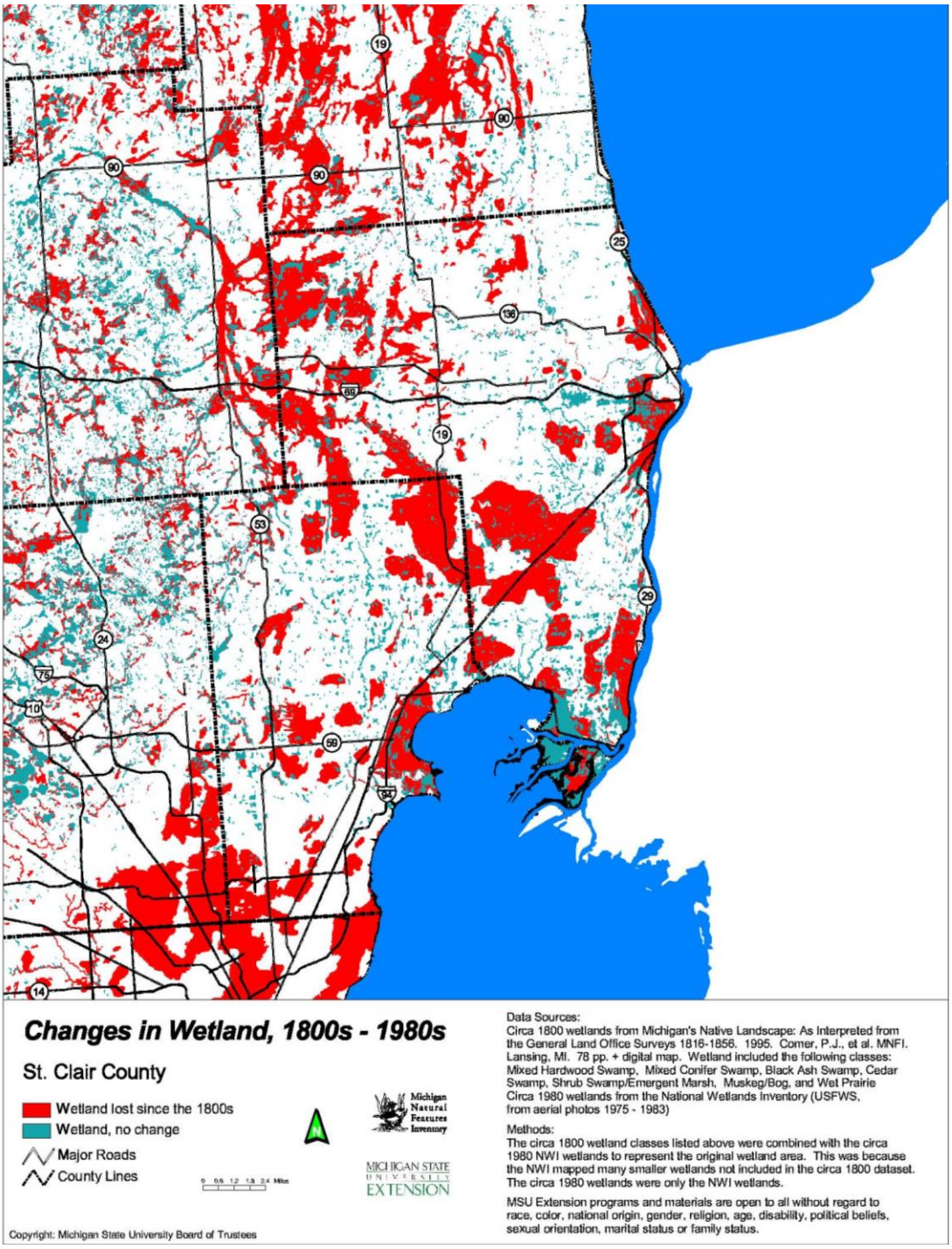


Figure 3.12 Changes in Wetland in St. Clair County, 1800s-1980s (MNFI)

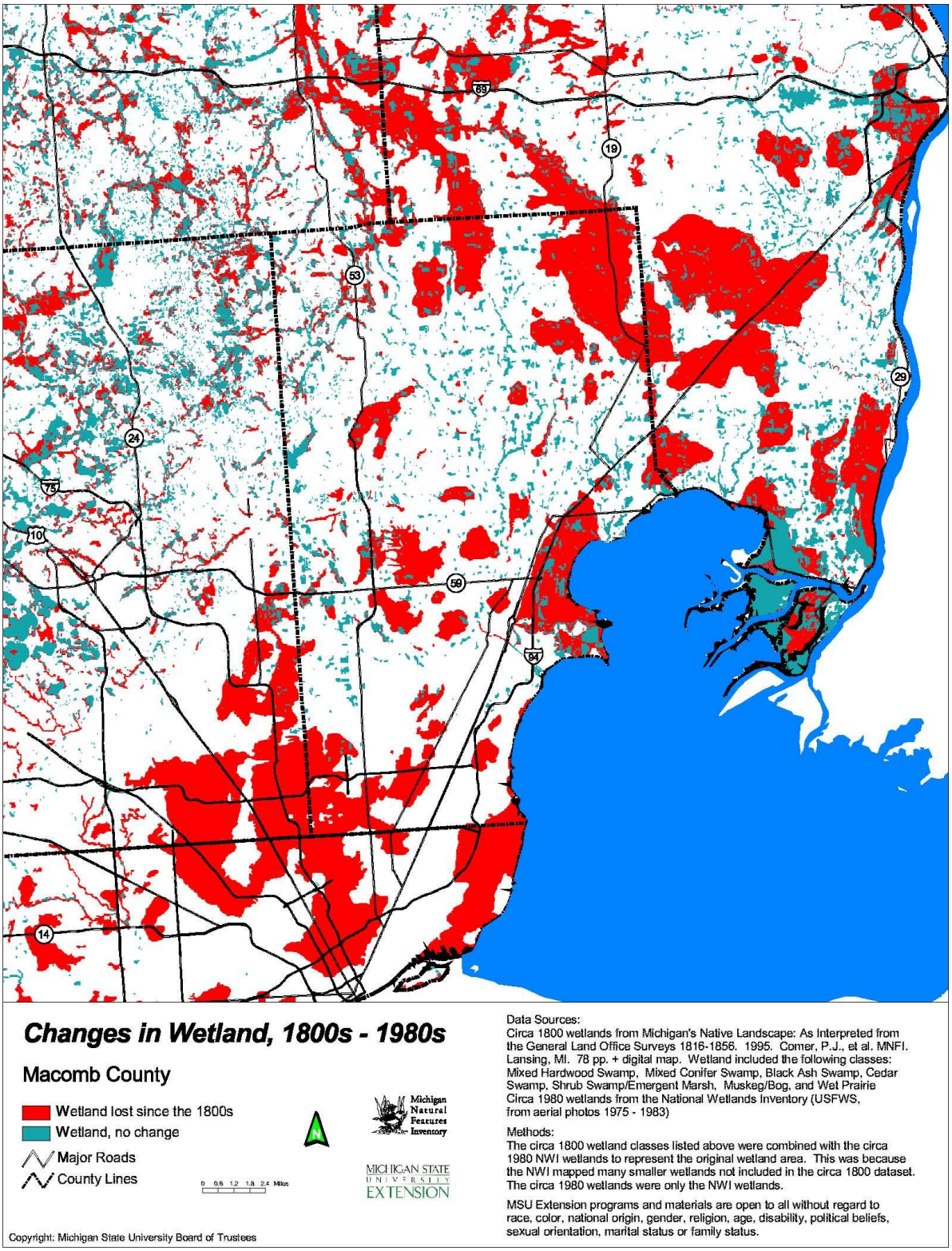


Figure 3.13 Changes in wetland areas for Macomb County (MNFI)

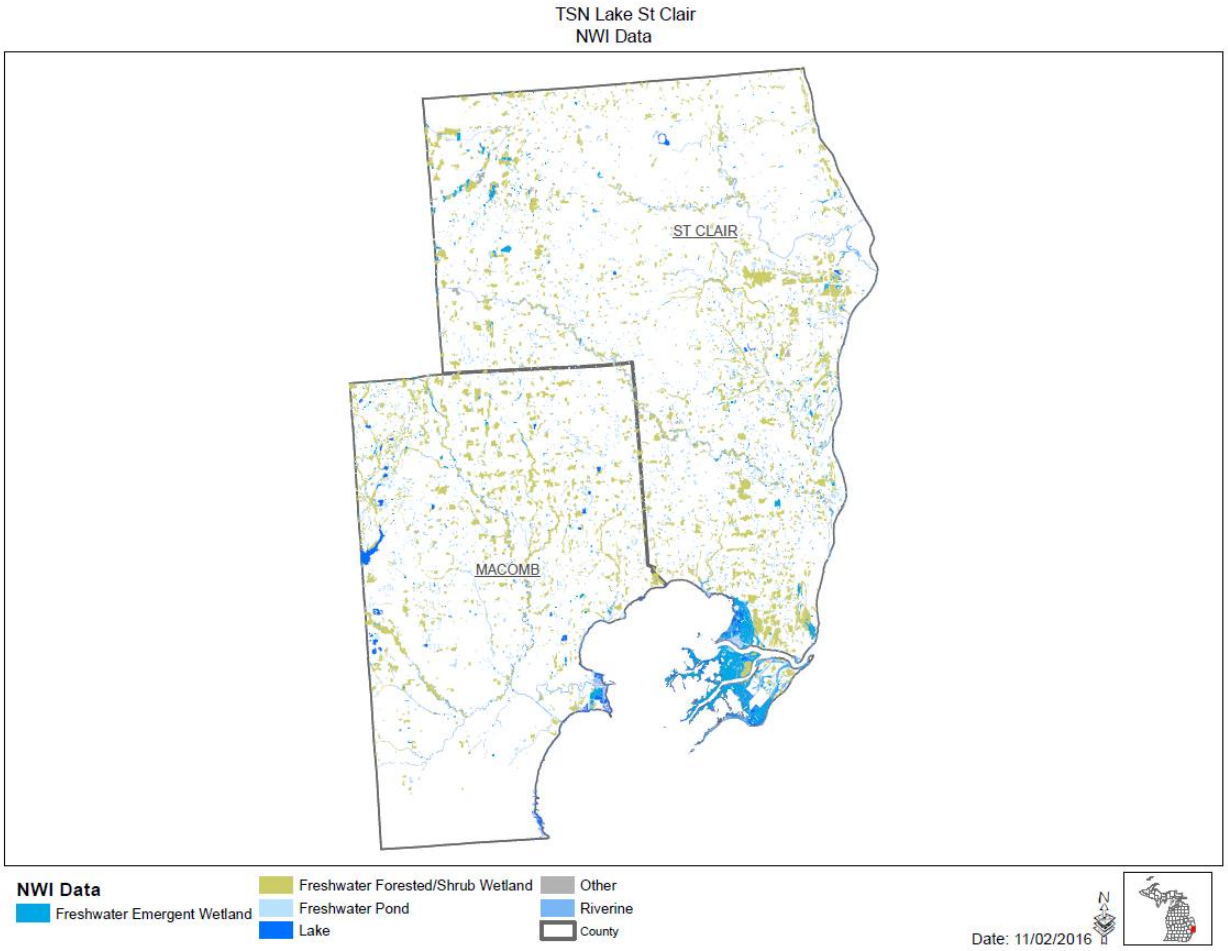


Figure 3.14 National Wetland Inventory Map of Macomb and St. Clair County (Michigan DNR)

There are many wetland types found in Macomb and St. Clair Counties. The Maumee Lakeplain is a relatively flat and poorly drained landscape and as a result, a variety of both forested and open wetland communities existed throughout the area. These include, mixed hardwood swamp, floodplain forest, and the once common but now scarce lakeplain prairie and wet-mesic flatwoods. Lakeplain prairies are among the most diverse landscapes in the state and is home to a high number of rare plants and animals. These unique natural communities consist of both prairie and wetland species that have adapted to seasonal water level fluctuations. Wet-mesic flatwoods are forested wetlands that contain a mix of both upland and wetland hardwood tree species that are also tolerant of seasonal flooding. Small seasonal pools, called vernal pools, are abundant in wet-mesic flatwoods and are critical habitat for aquatic invertebrates and amphibians. Detailed information about these and the other unique natural communities in Macomb and St. Clair County, including species characteristic of various types of woody wetlands, is available from the Michigan Natural Features Inventory website and publications (https://mnfi.anr.msu.edu/pub/abstracts.cfm#Communities).
The US Fish and Wildlife Service provides a mapping program called National Wetland Inventory. The Cowardin System of Classification is utilized and indicates the distinctions

among palustrine (inland wetland which lacks flowing water), lacustrine (associated with lakes), and riverine systems. The Wetlands Mapper integrates digital map data with other resource information to display wetland type and extent using a biological definition of wetlands. However, the Wetlands Mapper does not define the limits of proprietary jurisdiction of any federal, state, or local government, so landowners should consult with appropriate agencies (MDEQ and USDA) before conducting clearing, earth moving, or other operations that may affect potential wetlands.
https://www.fws.gov/wetlands/Data/Mapper.html
http://www.michigan.gov/deq/0,4561,7-135-3313_3687-10801--,00.html

Michigan's wetland protection laws and subsequent regulations sought to limit wetland degradation and loss, thus minimizing the decrease of ecological function and ecosystem services that wetlands provide. One of wetlands greatest functions is to help safeguard water quality in surface water (rivers and lakes) and serve as groundwater recharge areas to fill aquifers. They can slow runoff water and serve as a buffer to reduce flooding downstream, decreasing sedimentation in streams and rivers, and improving water quality. They can absorb excess nutrients (from fertilizers applied in nearby agricultural fields), which helps to slow or prevent eutrophication in lakes and ponds. They also filter pollutants out of runoff water and can bind to (or in some cases break down) toxic pollutants that would be very damaging to other ecosystems.

Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, administered by the Michigan Department of Environmental Quality (MDEQ) is the main State regulation that affects wetland use and alteration. In Michigan, the Section 404 federal authority associated with inland waters and wetlands was assumed by the State in 1984. The USDA Natural Resources Conservation Service regulates wetlands on agricultural land. Under the Wetland Conservation provisions, USDA program participants are prohibited from converting remaining wetlands on their agricultural operations to cropland or pasture, unless the wetland acres, functions, and values are compensated for through wetland mitigation. The Wetlands Reserve Easements program established in 2014 by the USDA, provides a financial incentive to private landowners to encourage the restoration of previously degraded or drained wetlands. NRCS pays a per-acre easement fee, plus 100 percent of the cost to restore the agricultural lands back to natural wetland ecosystems. The landowner retains title, control of access, and hunting rights, but must protect the restored wetland ecosystem for future generations. The landowner can sell the land, but the easement (and its protections) remain enforce for perpetuity.

In addition to their many water quality benefits, wetlands also provide habitat for a plethora of species, from waterfowl to wildflowers, and including fish, frogs, and other amphibian species. Even small seasonal wetlands, such as vernal pools or ponds benefit biodiversity, often serving as key breeding areas for amphibians and reptiles, snails and mussels, dragonflies and damselflies, and providing resources for numerous bird species (Thomas et al., 2010).

A helpful guide for understanding wetlands "Wetland Mitigation: Planning Hydrology, Vegetation, and Soils for Constructed Wetlands" (written by Dr. Gary Pierce, first Field Station Director at Pierce Cedar Creek Institute) is available from the Wetland Training Institute. http://www.wetlandtraining.com/wetland-mitigation/

Coastal Wetlands

Great Lake Marsh and Lakeplain prairie are two coastal wetland communities found along the Lake St. Clair shoreline and adjacent waters. These wetland systems are very rare and considered one of the most productive natural communities in the Great Lakes. They are an extremely dynamic system, ever influenced by the changing water levels of the Great Lakes. Great Lakes Marsh systems also include adjacent wooded wetlands located on the fringes of the marsh. During periods of high water, lakeplain prairies were inundated, allowing more water tolerant plant species to eventually establish themselves in the area. Typically, Great Lakes marsh extends from 5+ feet of water to saturated sand, and lakeplain prairie borders the inland portion of the marsh, however, Lakeplain prairie can also be found inland in depressions adjacent to hardwood swamps, mesic southern forest, dry mesic southern forest, and Lakeplain oak openings. These communities can be found adjacent to each other on Dickinson Island and St. John's Marsh.

Great Lake Marsh is not only affected by Great Lakes water levels, but more importantly, the development of shoreline areas, urban growth, industrialization, and agriculture, which contribute the degradation of the wetlands from polluted urban and agricultural storm water runoff, industrial discharges, and sewer overflows. In total, over 45% of the Great Lakes Marsh on Lake St. Clair has been lost. Despite this, the St. Clair River Delta is considered the largest and one of the highest natural quality Great Lakes marshes in Lower Michigan. According to The Nature Conservancy, this area also contains the largest and only intact Coastal Delta Marsh on the continent, and likely in the world. Remaining coastal marshes on the U.S. side of Lake St. Clair include: the mouth of the Clinton River - Lake St. Clair Metropark (500 acres); St. John's marsh (2,300 acres); Dickinson Island (2,100 acres); and Harsen's Island (10acres) (Paskus, 2003).

3.1.7 Biological Diversity and Wildlife Habitat

While a majority of both Macomb and St. Clair Counties is either agricultural or urbanized, there still exists a significant amount of land that contains noteworthy ecological communities, including globally imperiled ecosystems and a large number of threatened and endangered plant and animal species.

Threatened and Endangered Species

Biological diversity refers to the variety and abundance of species, communities and ecosystems is a specific area. Michigan is noted for having more vegetation types than any other Midwestern state. The Michigan Natural Features Inventory, which "conducts field surveys to locate and identify threatened and endangered species and communities throughout the state, and maintains a database of all relevant species and community locations" (MDNR, Natural

Features Inventory), has created a Natural Community Classification for Michigan that includes 77 communities grouped into 18 ecological groups, defined by their landscape occurrence and vegetation characteristics.

According to the Michigan Natural Features Inventory's Rare Species Explorer, there are 39 animals and 19 plants with endangered, threated, or species of special concern in Macomb County (12 of the animals and 4 of the plants are State endangered). For St. Clair County there are 54 animals and 57 plants with endangered, threated, or species of special concern status (13 of the animals and 11 of the plants are State endangered). The MNFI website can be searched by taxonomy (type of organism), habitat, state and federal status, and county. https://mnfi.anr.msu.edu/explorer/search.cfm (For a complete list of these species, see Appendix C.)

The U.S. Fish and Wildlife Service lists 4 Endangered species for Macomb County: The snuff box and rayed bean mussel, the American burying beetle and peregrine falcon. In addition, the eastern massasauga rattlesnake is listed as threatened. Three federally endangered species are listed for St. Clair County: The snuff box and rayed bean mussel, peregrine falcon, and the eastern prairie fringed orchid are listed as threatened. Spotted and Blanding's turtles are known to occur in both counties and are associated with many of the wetland systems found near the coast. Both turtles are currently being considered for federal listing. Threatened species are animals and plants that are likely to become endangered in the foreseeable future. Identifying, protecting, and restoring endangered and threatened species is the primary objective of the U.S. Fish and Wildlife Service's endangered species program. (https://www.fws.gov/midwest/endangered/lists/michigan-cty.html).

Wildlife Habitat

Wildlife habitat needs vary greatly for different animal species. Territories can range from less than an acre for small mammals to about ten square miles for predators such as bears and coyotes. Some species prefer edge habitat, while others require large blocks of grassland or forests. What is required by one species may be detrimental to another, so landowners who want to manipulate habitat need to decide which animals they want to favor. Another approach is to concentrate on improving or managing the native habitat or combination of habitat types (mature forest, early successional forest, prairie, wetlands, etc.) that currently occur on the property. This strategy most often satisfies the needs of most of the native species that naturally occur in those ecosystems and helps make those systems more resilient to system stressors like pests and diseases. This approach will typically allow for smaller targeted species specific habitat manipulation, such as food plots for deer, depending on the size of the area being managed, without compromising the integrity of the native system. While agricultural land does not have as much biodiversity as natural plant communities, it is a dominant land use in both Macomb and St. Clair Counties and there are practices that can improve the habitat value of working lands. Most stewardship plans address wildlife habitat and there are many practices that can be used to create or improve support for animals, which includes providing opportunity for obtaining food, water, cover and enough space to live and reproduce. These

resources can be provided by appropriate management of existing natural areas or restoration of plant communities that support the target species.

Resources for Landowners
The Michigan Department of Natural Resources has several programs such as the Private Lands Program and the Wildlife Habitat Grant Program for government, profit or non-profit groups, and individuals to assist in habitat and conservation efforts. The U.S. Fish and Wildlife Service has the Partners for Fish & Wildlife program which works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship programs for conservation.

Many nonprofit organizations such Audubon, Ducks Unlimited, National Wild Turkey Federation, Pheasants Forever, Ruffed Grouse Society, Quality Deer Management Association, and Trout Unlimited are dedicated to providing wildlife habitat and have programs to provide financial and technical assistance for enhancing wildlife. The Michigan United Conservation Clubs often form local units to help property owners manage habitat for animals such as deer and turkeys, and the local Conservation Districts work with all of these groups as well as landowners to provide wildlife habitat assistance.

Forest types
Before European settlement and the logging era, the landscape of this part of southeast Michigan consisted of hardwood forests, primarily beech-maple forest and mixed hardwood swamp, which dominated this extensive, flat landscape. Large beech-sugar maple forests were situated on well-drained sites, while large and small pockets of mixed hardwood swamp were scattered throughout the clay lake plain in depressions and sandy glacial drainage areas. Other scattered pockets of wooded and open wetlands such as tamarack swamp, black ash swamp, shrub swamp, and emergent marsh were also found.

The 19th and 20th century brought about significant changes for the landscape with a sharp increase in lumbering, agricultural development, and urban growth. The latter two particularly had an impact on the coastal wetlands along Lake St. Clair. The first sawmills of the Northwest Territory were located on the St. Clair River and its tributaries with at least 8 built before 1800 (Mitts, 1968). In fact, it is believed that there was a sawmill on the St. Clair River in 1690 (Jenks, 1912). In addition, the first steam sawmill in the Northwest Territory, the Black River Steam Mill, was built on the north bank of the Black River in 1832 in what is today Port Huron (Mitts, 1968). These sawmills played a very significant role in the development along the Great Lakes. In 1869, more than 64 million feet of logs floated down the Black River alone (Jenks, 1912). The lumbering era reached its peak in the St. Clair River area in the late 1870's, and forests were worked until they were depleted.

Dry-Mesic Southern Forest
Dry-mesic southern forests are forests located primarily in southern Michigan on very well drained, acidic, sandy beach ridges, and slightly higher elevations of the lakeplain. White, black, and red oak and pignut hickory are the typical dominant tree species in most dry mesic

southern forests found in Michigan. Historically, oak-hickory forests were never abundant in the Maumee Lakeplain ecoregion, primarily due to the high water table and clay soils at or near the surface. Most plants found in these forests tend to be adapted to fire and in fact, these forests depend on fire to maintain an open canopy, remove competition from shade tolerant species, release nutrients, remove the leaf litter, prepare a seedbed for acorns and nuts to germinate, and warm the soil in the spring to hasten germination. When fire is removed from the landscape, such as it is now in many places, these oak-hickory forests tend to be invaded by more shade tolerant species and converted to beech-maple forests.

Today it is estimated that approximately 5% of the state supports this type of forest. The difference is that the distribution has changed. Southern Michigan has actually lost two-thirds of its original dry forests, while dry forests in the northern lower peninsula have dramatically increased. In addition, many of the remaining oak-hickory forests in southern Michigan are contained in small fragmented woodlots of 20 to 40 acres (Paskus, 2003).

Lowland Hardwood Forest

Lowland hardwoods are found in areas that hold water at least some part of the year. Lowland hardwood forests occur throughout Michigan, primarily in southern lower Michigan. Historically, lowland forests were found throughout the Maumee lakeplain, in large blocks ranging from approximately 100 acres to over 30,000 acres.

In southern Michigan there are two different types of lowland hardwood forests: southern swamp and southern floodplain forest. Southern swamps typically grow in isolated, seasonally flooded, depressions that contain standing water at least part of the year, while Southern floodplain forests are forested wetlands found next to rivers and streams, commonly referred to as floodplain. Common trees of lowland hardwood forests include silver maple, cottonwood, red maple, black ash, and red ash. Yellow birch, swamp white oak, bur oak, pin oak, black willow, basswood, and American elm are also common. Trees at their northern limit in these forests are Ohio buckeye, paw-paw, red bud, blue ash, Kentucky coffee tree, honey locust, sycamore, hackberry, and red mulberry.

The southern floodplain forest is one of Michigan's most diverse natural communities as well as one of its most threatened. Damming, dredging, and channelization are all human induced threats to these forests. These forests are widely used by a surprisingly large variety of birds, mammals and herptofauna for both food and cover and rearing of young.

Today in Macomb and St. Clair Counties, lowland hardwood forests are primarily located along and in close proximity to the Belle and Pine Rivers, and the North Branch of the Clinton River. The largest patches of lowland hardwood forest are located in St. Clair County. The largest single block of lowland forest, about 640 acres, is located just south of Adair, and there is also a large cluster of lowland forests along the Belle River.

Wet-mesic Flatwoods

The persistence of wet-mesic flatwoods is limited to southeastern Michigan as a result of the glacial lakeplain landscape. Historically in Southeastern Michigan, forested stands on poorly

drained soils are wet-mesic flatwoods and hardwood swamps. At present there are only 6 documented occurrences of wet-mesic flatwoods in Michigan, found in Monroe, Wayne, and Macomb counties.

Wet-mesic flatwoods are characteristic of clay lakeplains with channels of lacustrine sand deposits of low ridges and small dunes that are seasonally wet. The slight changes in elevation common to these areas result in flat uplands and wet depressional areas. This community type receives moisture through surface water and loses it through evapotranspiration. Most the tree species present in these communities, such as lowland hardwoods, are adapted to flood – drought cycles and have developed adaptations specific to "inundation, rapid changes in water level, and low oxygen availability during the growing season" (Slaughter et al., 2010). Wet-mesic flatwoods lack sugar and beech maples which are characteristic of more common mesic southern forests.

The depressions found in this topography are seasonally wet, supporting lowland hardwoods including oak, maple, and ash species. Understories of wet-mesic flatwoods generally have low species richness due to regular inundation and a closed canopy. However, the windthrow that is common in these areas causes a "pit-and-mound topography" by uprooting trees which provides microhabitats for certain plant species allowing for increase diversity of ground cover (Slaughter et al., 2010). Regular disturbances are crucial to the persistence of these ecosystems. Many of the plant species present are disturbance dependent and rely on factors such as wildfires to thrive.

The remaining wet-mesic forest sites are fragmented woodlots found in a degraded agricultural landscape and have a poor viability due to fragmentation, altered hydrology, invasive species inundation, and excessive herbivory by white-tailed deer. Excessive herbivory has detrimental impacts on community structure, species composition, and successional trajectory in these forested areas (Slaughter et al., 2010). This type of community is historically associated with wetland complexes and occupied higher topography. The successional turnover of upland areas to wetland communities is often the result of altered hydrology caused by beavers for example. Hydrologic disruption resulting from urban and agricultural development have severely limited the presence of wet-mesic flatwoods and reduced them to fragmented woodlots.

Mesic Southern Forest

Mesic southern forests, commonly referred to as beech-maple forests, are found throughout Michigan, usually occurring in moist, rich, well-drained soils. They are also the most common forest type in the state. Historically, mesic southern forest also dominated the Maumee lakeplain and both Macomb and St. Clair Counties.

Mesic southern forests in the Maumee lakeplain are dominated by American beech, red oak, swamp white oak, and burr oak. Sugar maple, basswood, yellow birch, white ash, black cherry, shagbark hickory, black walnut, American elm, red maple, and tulip poplar may also be present. A diverse mesic hardwood stands offer varied habitats that are used by a wide variety of songbirds, invertebrates, amphibians, and mammals. Seasonal pools also attract many migrating and nesting birds due to the large amount of insects produced.

Today, in Macomb and St. Clair Counties, very little mesic southern forest exists, and what does remain are small-scattered woodlots. In these two counties, it is estimated that there has been over 90% loss of mesic southern forest, primarily due to farming (Paskus, 2003).

Forests of Recognized Importance

Forests of Recognized Importance (FORI) are defined by the American Tree Farm organization as "globally, regionally and nationally significant large landscape areas of exceptional ecological, social, cultural or biological values." FORI occur at the landscape level, not the individual stand or ownership level. In Michigan, FORI on private forest land are mostly associated with important wildlife habitat, rare forest types, corridors of unique rivers, and Great Lakes coastlines. In the Southern Lower Peninsula, large intact forests greater than 500 acres that provide habitat for state and federally listed species or for species that require core interior habitat can be considered FORI.

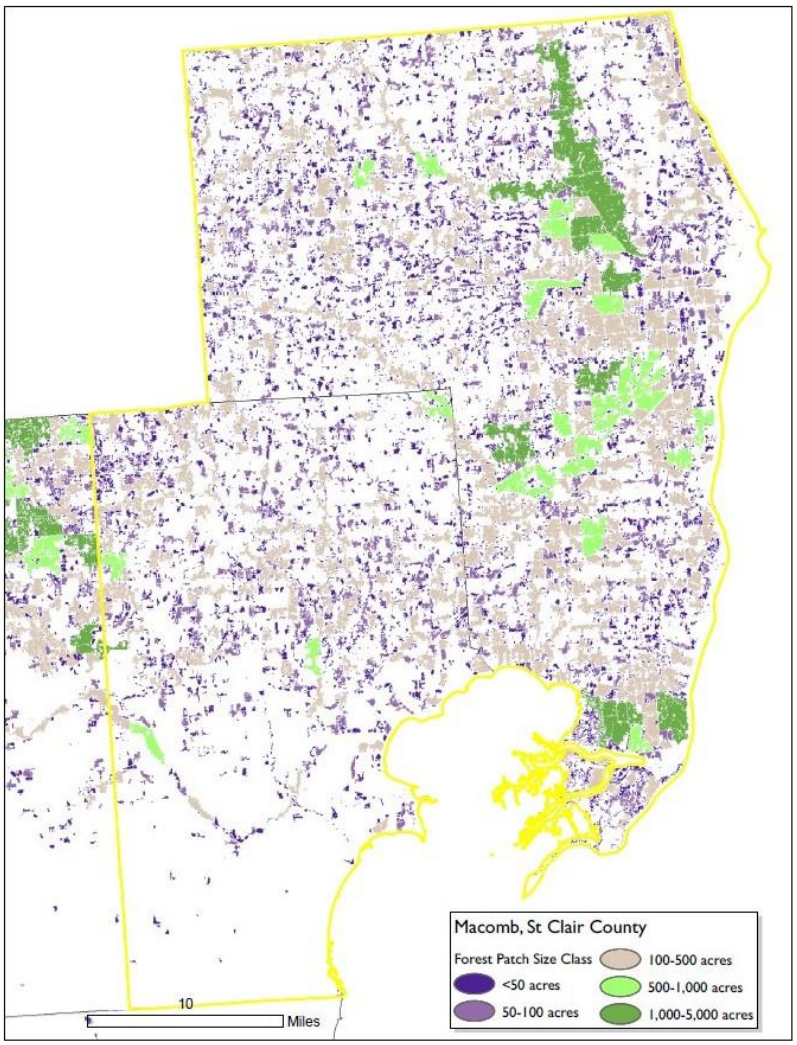


Figure 3.15 (Right) Forest Patches in Macomb and St. Clair Counties coded by size (MNFI)

3.1.8 Forest Resources

Most rural properties in Michigan have at one point or another utilized forests as a source of income, food, and other benefits (wildlife habitat, aesthetics, recreation, etc). While not as common, urban properties can often utilize forests resources in much the same way but on a more limited basis. The Soil Survey for Macomb County states that most soils in the county are suitable for growing trees, although there may be some limitations due to wetness. The publication offers information on soil suitability for specific tree species and productivity attributed to local soil types.

Landowners who are interested on increasing tree cover on their property have a variety of options to choose from:

1) Transplanting of commercially available nursery stock
2) Relocation from another site using a tree spade or other heavy equipment
3) Planting seedlings or directly from seed
4) Allowing natural regeneration to occur from adjacent trees

Each option has its pro's and con's. Options one and two typically have higher survival rates and the end goal of achieving tree cover is realized much faster, however the number and variety of tree species, especially native species, may be limited. The down side of transplants is that the process can be quite expensive, especially for a large parcel of property. The third option of planting seedlings is the most common approach of tree planting, and is suitable for all size of projects. The results are faster than planting from seed, survivability is typically good, it's relatively inexpensive to do and a wide variety of trees species, including native species, are usually readily available (many of the conservation districts and other resource organizations offer tree sales). The last option, natural regeneration, is initially the least expensive, however, it may not produce the most desirable of species, and the process of site clearing or thinning of undesirable or unwanted trees once established, can be time consuming.

Regardless of which method is chosen, the landowner will need to take into account their property's specific soil type and fertility, moisture availability, light conditions, and other factors in order to achieve good results. The use of native trees is highly preferred because they have evolved under local environmental conditions and provide more food for native birds and other wildlife than non-natives. Plantings should be monitored regularly, especially over the first several years, and may need to be watered and mulched to encourage good growth. Tree guards may also be necessary if the area has high populations of deer and rodents. The placement of new trees is also an important thing to consider. Property owners should avoid planting near utilities, especially power lines, and stay a reasonable distance from sidewalks, driveways and structures. The local conservation district can provide native tree recommendations and typically sells bare-root seedlings, usually in the spring.

Forest age and structure can vary widely depending on the environmental conditions of the selected site. Determining harvest goals and methods are often tied to forest structure. Even-aged stands are those with trees of similar age while uneven-aged stands can have a wide distribution of tree ages. The following general harvest methods are typically utilized to meet

specific landowners' goals. A single or selective cut is the removal of specific trees that will favor an uneven-aged stand. A shelterwood cut is accomplished in several phases with the first cut setting the stage for the establishment of a seed bed for a new age class and a later removal cut that releases the already established small trees. Clear cutting removes all trees in an area with site reforestation being accomplished by natural regeneration or by planting seeds or seedlings to create an even-aged stand. Some species (shade intolerant species in this case) such as aspen benefit from a clear cut because they regenerate by root sprouting and require full sunlight to encourage growth. Clear cuts can vary in size with small ones being called patch cuts and can be a variety of shapes such as a strip cut.

Justification of a commercial harvest typically requires enough trees to be logged at one time to make it economically worth the effort. Advice on the feasibility of tree harvest can be obtained from a certified forester. A professional forester will mark trees that have reached their optimal size and should be harvested, but, equally importantly, identify trees to be retained to optimize yield or be used as seed trees for the next generation. A professional forester is capable of bringing an understanding of how to maintain the productivity and health of the forest. In tree farm systems a sustainable yield of timber products can be obtained by harvesting less biomass than what is growing. In most areas, local conservation district forester can provide cost-free assistance to landowners interested in harvesting a woodlot.

Careful harvesting is often used to mimic natural disturbances (death due to diseases, insects, fire, or windthrow) that happen to forests. These disturbances may create a small opening or gap (such as is created by a single mature tree knocked over by wind) or may remove many trees from a large area (large-scale disturbance such as tornado or fire). These disturbances facilitate succession and produce the next generation of trees. Forests that lack a harvest program tend to favor shade tolerant species such as sugar maple and beech. Managing light availability can affectively dictate which species dominate in an area that has been harvested. There is a wide range of tree-harvesting techniques and equipment with the simplest tools being a chainsaw and a tractor. Individuals who wish to stick to traditional methods or wish to minimize damage to the forest floor often use draft horses. Commercial loggers may use skidders which gather and drag cut trees to loading areas or a forwarder that picks up and carries the cut timber to a loading area. Tree companies that cut large volumes of timber may use a harvester, a machine that cuts the tree off at the stump and then trims the log and cuts it into desired lengths, all in one operation. Tree shears are also used (some have jaws that can cut trees up to 15 inches in diameter) and a feller-buncher (cuts trees off with a saw or shears and then stacks for pickup). All of these machines can potentially cause significant damage to soil (compaction, rutting, or erosion) so it is preferable to harvest when soils are dry or frozen. Care should also be taken to avoid introduction of weed seed from other work sites.

The value of a timber harvest depends on many factors including the species logged, the end use of the log (veneer material, saw timber, pulpwood, pallet wood, etc.) and distance to the mill or processor. Private foresters, MSU Extension Service and Conservation District Foresters can all assist the property owner is assessing if a harvest may be worthwhile.

In addition to traditional logging, forest can yield a variety of other products, many of which can be commercial enterprises. Since Michigan has an abundance of sugar maple, the production of maple syrup is common. In this process, sugar maples can be tapped to obtain sap, which is boiled down to make maple syrup (about 40-50 gallons of sap for one gallon of syrup). Edible products such as nuts, berries, from a variety of forest plants as well as mushrooms can be harvested for family use or for sale.
http://www.edibleforestgardens.com/

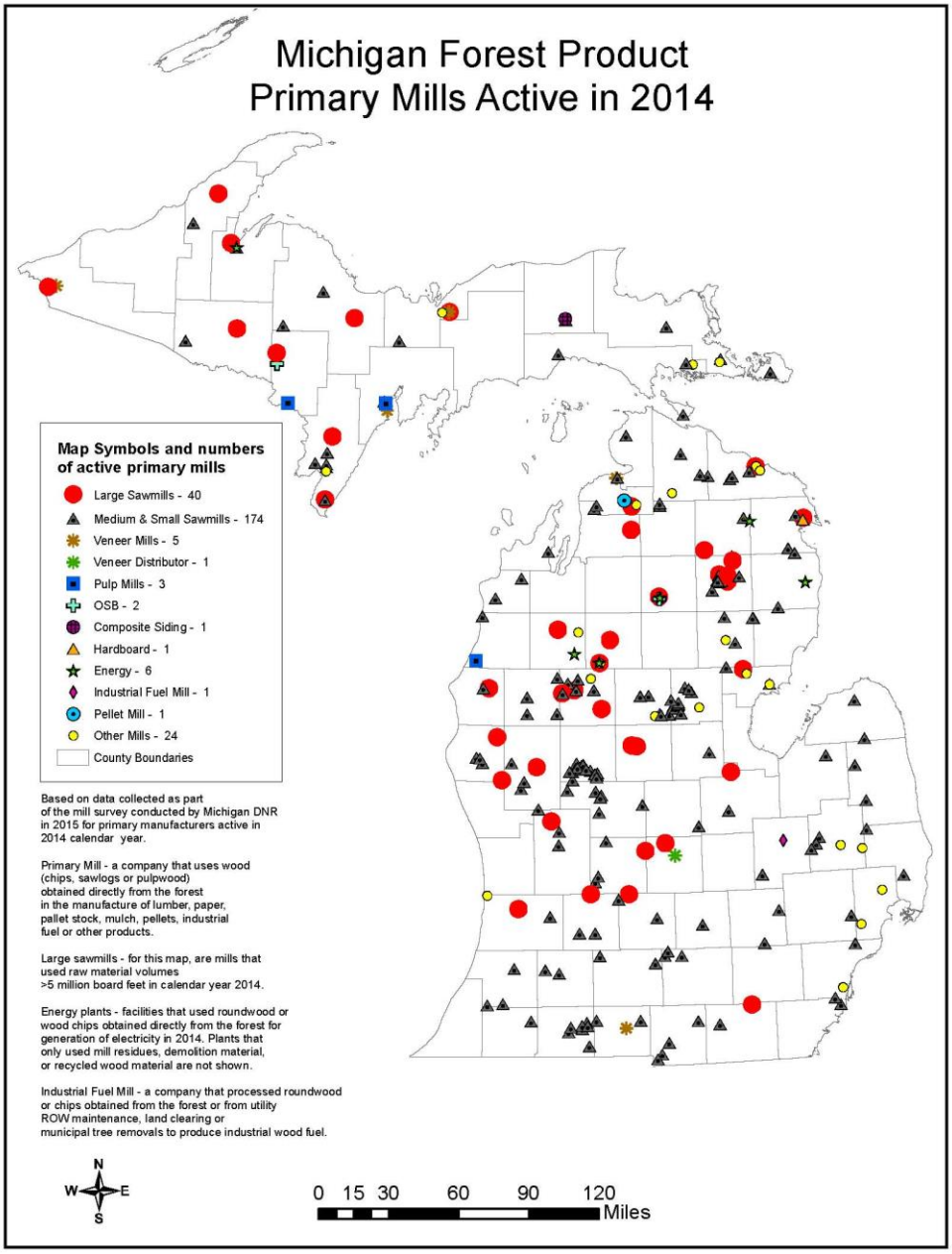


Figure 3.16 Forest Product Industries Map for Michigan (Michigan DNR).

In addition to the sawmills and other industries shown in Figure 3.16 the Michigan DNR's Forest Product Industries website (www.michigandnr.com/wood) shows 81 wood-related businesses in Macomb County, and 19 in St. Clair County.

Permaculture

Permaculture is agriculture with trees in which the production system is designed to be self-sustaining and regenerative. Permaculture was developed in Australia by Bill Mollison and David Holmgren in 1968, but has gained international acceptance. Design elements include layers (canopy to soil layer) and zones that typically concentrate labor intensive activities close to the dwelling with grazing, forestry, and other less active land uses farther out. Mollison said: "Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather than treating any area as a single product system."

Agroforestry

The Center for Agroforestry at the University of Missouri has published a manual that provides information on agroforestry (the combination of agriculture and forestry). This involves practices such as silvopasture (trees in grazing areas), alley cropping (having herbaceous plants between rows of trees), windbreaks, and forested riparian buffers.
Training Manual for Applied Agroforestry Practices. 2015. Edited by Michael Gold, Mihaela Cernusca & Michelle Hall. http://www.centerforagroforestry.org/pubs/training/index.php

Resources for Land Owners

There's a wide array of resources available to assist landowners with the creation of a forest stewardship plan and managing the forest for productivity and health. The Department of Natural Resources Forestry Division has a wealth of information on their website and they maintain a list of professional foresters (see Section 3.4.3). The Macomb Conservation District web site (www.macombconservationdistrict.org) and St. Clair and Sanilac Conservation District web site (www.sanilaccd.org/st.clair) are a good first place to stop with information and links to various web based assistance programs.

The US Forest Service has a "Managing the Land" section on their website (http://www.fs.fed.us/managing-land) that covers natural resources on public and private land. The MSU Extension Service has links to the Natural Resource Enterprises Program designed for landowners and community leaders to encourage informed decision-making regarding the management of land and enterprises.

http://msue.anr.msu.edu/program/info/natural_resource_enterprises
A highly recommended book is "A Landowner's Guide to Managing Your Woods" by A.L. Hansen, M. Severson, and D.L. Waterman published in 2011 by Storey Publishing. It covers how forests grow, successional processes, planning, inventorying, working safely in the woods, and how to do a timber sale.

3.1.9 Forest Health

St. Clair and Macomb County's forests have continued to go through dramatic changes since Europeans first settled here over 200 years ago. Cessation of fire as used by Native Americans, large-scale logging, and the ever increasing demands for agriculture and industry have all attributed to forever changing the landscape of Southeastern Michigan. However, these forces where not the only influences to shape todays forests. Since the early 1900s, Michigan's forests have been hit by successive waves of insect and disease outbreaks, often originating from non-native pests and pathogens. Attacks by chestnut blight; Dutch elm disease; gypsy moths; and Emerald Ash borer have killed millions of trees in southeast Michigan and have dramatically reshaped the regions forests. The introduction and proliferation of non-native invasive species like autumn olive, buckthorn, honeysuckle and garlic mustard all threaten forest health. These and other threats to forest health make the effort of every landowner important. The MDNR and local stakeholders offer guidance including web resources and classes to provide tools for responding to forest threats. This section outlines major threats to the areas woodlands.

Climate Change

Most climate models show Michigan getting warmer (average annual temperature has increased 1.5 F in the last 100 years) and to have more extreme weather events such as rainfall in excess of 2 inches. However, warmer summer temperatures and low summer rainfall may lead to an increase in drought. (https://www.epa.gov/climate-impacts/climate-impacts-midwest, http://www.globalchange.gov/explore/midwest)

The Great Lakes Integrated Sciences and Assessments Center (GLISA) has developed localized and easy to understand fact sheets summarizing the best available climate data for an area and explains potential impacts of climate change to key sectors. The report emphasizes that, although climate change presents challenges for forest stewardship and management, the importance of maintaining healthy forests in urban as well as natural areas is becoming increasingly important. (http://glisa.umich.edu/resources/summary)

According to the third U.S. National Climate Assessment, "The composition of the region's forests is expected to change as rising temperatures drive habitats for many tree species northward. The role of the region's forests as a net absorber of carbon is at risk from disruptions to forest ecosystems, in part due to climate change. Among the varied ecosystems of the region, forest systems are particularly vulnerable to multiple stresses. The habitat ranges of many iconic tree species such as paper birch (*Betula papyrifera*), quaking aspen *(Populus tremuloides*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*) are projected to decline substantially across the northern Midwest as they shift northward, while species that are common farther south, including several oaks and pines, expand their ranges northward into the region."
(NCA, Ch. 18: Midwest. www.globalchange.gov)

The Northern Institute of Applied Climate Science (NIACS) and Northern Michigan University have produce vulnerability reports for Michigan forests, identifying "winners" and "losers" among tree species and forest communities (www.nrs.fs.fed.us/pubs/45688). Another report on future tree species distribution under warmer temperatures, published by the US Forest Service,

expects most oaks to benefit from climate change in Michigan, but most conifers are negatively impacted. http://www.nrs.fs.fed.us/atlas/tree

Pests and Pathogens

Chestnut blight (*Cryphonectria parasitica*) was introduced in New York in 1904 and rapidly spread to decimate chestnut trees throughout the northeastern U.S. It reached Michigan in 1930 and virtually eliminated chestnuts from the state's forests. With the native American Chestnut almost wiped out, there have been many efforts to develop blight-resistant American chestnut (*Castanea dentata*) varieties (American Chestnut Foundation, https://www.acf.org/resources/faqs/,), as well as hybrids with various Asian species and cultivars. Landowners interested in planting chestnuts for nut production or forest restoration can find trees available online and can consult the Michigan Nut Growers Association, which has a special interest group devoted to chestnuts (https://michigannut.org/special-interest-groups/).

Dutch elm disease (*Ophiostoma ulmi* and two related species), a non-native fungal pathogen spread by bark beetles, arrived in New York on imported timber in 1928. It was first documented in Wayne County in 1950 and since then has killed tens of thousands of mature American elms (*Ulmus americana*) in Michigan. Although large elms have disappeared from most Michigan forests, smaller trees often survive and can be locally numerous, often reach 6–10 inches in diameter before they succumb to the disease. The disease is carried by both native and non-native bark beetles which carry the disease spores form tree to tree. Chemical and biological controls have been met with mixed success, and preventive treatment is costly for all but specimen trees. Efforts are currently underway at several facilities, including test plots at Michigan State University, to develop resistant cultivars of American-only genotypes, and hybrids. Those wanting to plant elms should research cultivars carefully: some "blight-resistant" types have succumbed to blight over time; and tree growers will need to decide whether they prefer fully American genotypes or will accept hybrids with Asian species. (http://msue.anr.msu.edu/news/improved_elms_for_michigans_urban_landscapes, http://msue.anr.msu.edu/news/return_of_the_american_elm, http://bspm.agsci.colostate.edu/national-elm-trial/, https://www.fs.fed.us/psw/topics/urban_forestry/products/psw_cufr688_American_Elm_Renaissance.pdf).

Gypsy moths (*Lymantria dispar*) were introduced on the east coast of the U.S. the 1860s and have killed tens of thousands of trees in the Northeast in periodic outbreaks. Michigan experienced the first major outbreak in 1986, when the caterpillars defoliated millions of trees on over 64,000 acres in the state. A 1992 outbreak resulted in 750,000 acres of Michigan trees defoliated, with other severe outbreaks in 1998 (Figure 3.17); with local outbreaks in 2008, 2013, and 2016. Many of the counties in Southeast Michigan participated in the Michigan Department of Agriculture's Gypsy Moth Suppression Program. The program assessed gypsy moth damage, provided landowners with information and treated areas where landowners permitted with aerially applied Bt and Gypcheck, which successfully supplied relief to the infestation. Defoliation may not outright kill trees but leaves them vulnerable to drought, disease, and future insect outbreaks, and may continue to cause occasional tree mortality in the oak-dominated forests throughout Lower Michigan.

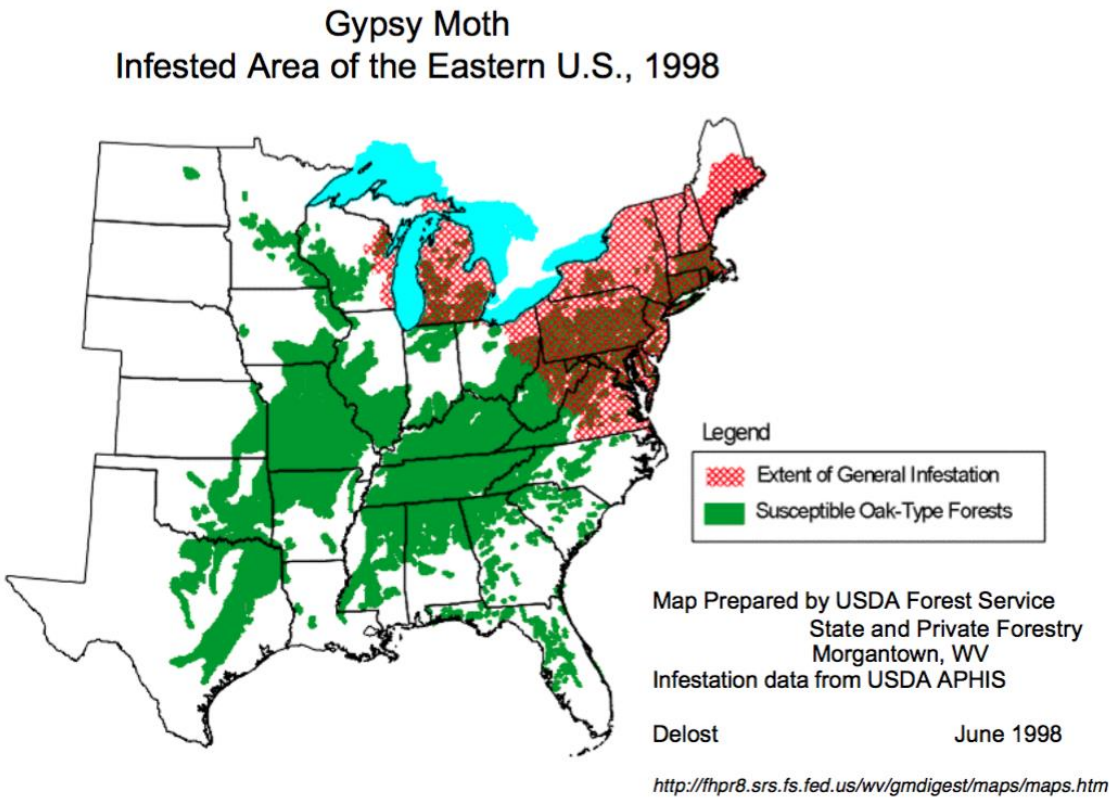


Figure 3.17 Gypsy moth infestation and forests at risk, 1998 (USFS)

Over recent years, gypsy moth outbreaks have declined in frequency and severity as natural and introduced biological controls, including a naturally occurring virus, nucleopolyhedrosis virus (NPV) and a naturally occurring fungus (*Entomophaga maimaiga*) reduced and helped regulate gypsy moth populations for a number of years in Southern Michigan. Various websites offer guidance to landowners about gypsy moth identification and treatment. Landowners should remain observant of moth populations on their land and contact their local Conservation District or MSU Extension if they observe populations reaching a nuisance level.

Emerald Ash Borer, EAB (*Agrilus planipennis*) is an invasive beetle whose larvae feed on the tissue in the bark of ash trees. It was accidentally brought to the US from Asia and was first documented in Michigan in the early 2000's. Due to the beetle's specificity in targeting only ash trees, it has had a significant impact on the wooded areas prominent throughout southern lower Michigan. (Slaughter et al. 2010). By 2007, EAB had killed tens of millions of white, green, and black ash trees (*Fraxinus americana, F. pennsylvanica*, and *F. nigra)* trees in southeastern Michigan. (http://emeraldashborer.info/state/michigan.php). Control of emerald ash borer is currently limited to prevention of human introduction of this species to new locations through transport of infected firewood, raw wood products, and living trees (Slaughter, 2009).

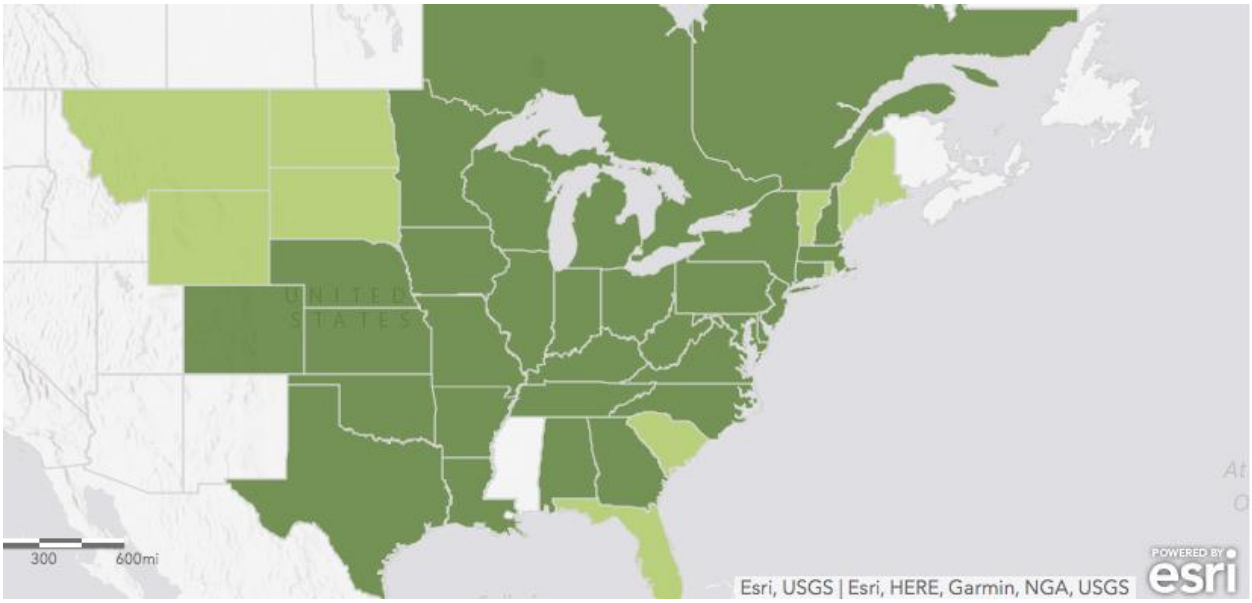


Figure 3.18 Emerald Ash Borer range in the U.S. and Canada, 2017. From http://www.emeraldashborer.info/index.php

Asian long-horned beetle (ALB) (*Anoplophora glabripennis*) has the potential to become a serious threat to Michigan forests because its preferred host is maple; more than one billion maple trees that occur in the state could be at risk. It is also known to attack dozens of other tree species (from 12-15 plant genera), including poplar, willow, sycamore, and horse chestnut. This large, showy beetle was accidentally introduced into the U.S., probably in wood crating or pallets shipped from Asia. Larvae feed in tunnels (called galleries) in the wood of tree branches and trunks. The galleries cause branches or entire trees to break and infestation eventually kills the tree. North American trees have little or no resistance to infestation, which is nearly always fatal.

ALB populations are known to be present in areas of southern Ohio, Massachusetts and New York but has not yet been detected in Michigan, so early detection and eradication are key to controlling this pest in the state. As with other pests, ALB can be transported into new areas in logs and firewood. If ALB is not eradicated and populations spread across North America, the economic and ecological impacts would be enormous. The Michigan Department of Agriculture and Rural Development (MDARD) urges landowners to pay attention to trees, especially maples, with dying branches, and to report any suspect trees or beetles: take photos; record the location; try to collect suspect beetles in a jar; and report to MDARD:

- Email: MDA-Info@michigan.gov
  Phone: MDARD Customer Service Center (800) 292-3939
  Midwest Invasive Species Information Network: www.misin.msu.edu
- Learn more: www.michigan.gov/exoticpests, www.asianlonghornedbeetle.com, https://www.dontmovefirewood.org/pest_pathogen/asian-long-horned-beetle-html/

[Text in this section excerpted and modified from MDARD's Forest Pest Alert: http://www.michigan.gov/documents/mdard/AsianLonghornedBeetle_3-14_453144_7.pdf.]

Beech bark disease occurs when an invasive sap feeding insect, beech scale (*Cryptococcus fagisuga*), injures American beech trees (*Fagus grandifolia*), allowing them to become infected with two species of fungus (*Nectria* spp.). The fungus kills areas of woody tissue, which may girdle and kill the tree if the affected are becomes large enough. Up to 75% of trees appear to be killed within three to six years following the start of the infection. During the infestation period, infected trees have abundant dead branches that are easily blown off in windstorms (a condition known as "beech snap"). The beech scale was brought into Nova Scotia, Canada in 1890 and has gradually moved east. It was first documented in Michigan in 2000 and has since spread widely in the state although it has not yet been reported in Southern Lower Michigan which has fewer Beech in the forest makeup.

Although there appears to be some natural resistance among beech trees to beech bark disease, there are few control options in natural forest stands. Thinning is recommended to reduce beech density, as lower density stands may be less susceptible to the spread of the scale and fungus, along with removing trees that are affected (McCullough et al., 2005).

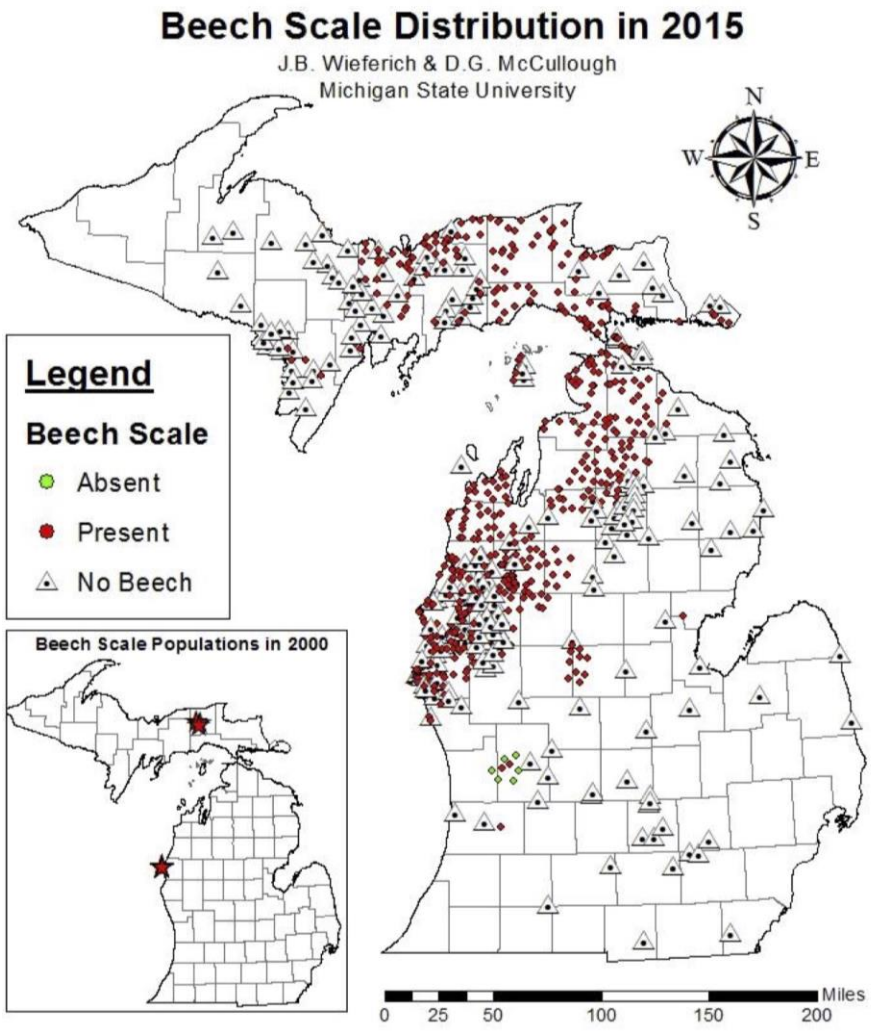


Figure 3.19 (Left) Beech scale distribution in Michigan 2015 (J.B. Wieferich & D. G. McCullough)

Oak Wilt *(Ceratocystis fagacearum)* is a fungal disease that has become a growing threat in the area over the past two decades. Since oak trees are a major component of the state's landscape, the disease has the potential to have devastating effects on forests, as well as residential and urban areas. Red Oak seem to be more susceptible to this vascular disease, but no oak species is known to be immune and the disease is highly transferrable. Oak wilt kills healthy red oaks (*Quercus rubra)*, often within a few months, and all species in the red oak group (including black oak and northern pin oak, *Q. velutina* and *Q. ellipsoidalis*) are susceptible. White oaks may also be affected but appear to be more resistant and less vulnerable to mortality from the disease. Once infected, mortality of red oaks with oak wilt is nearly 100%, and there is no treatment to save the infected tree. Oak wilt moves slowly through root systems and can move from tree to tree via root grafts, which connect the roots of adjacent trees. The fungus also travels short distances overland when new spores are moved by beetles from an infected tree to a freshly pruned or injured tree. Currently, the best management practice for containing Oak Wilt is to trench an infected tree by digging around the tree, cutting off the roots to damage any grafts between neighboring oak trees. This eliminates the pathway for which the disease spreads protecting neighboring oaks from contracting the disease. Once an infected tree is trenched in it can be cut and removed. In this region homeowners and municipalities often plant oak species, which are highly successful and desired in this area. Red oaks are an abundant—often canopy dominant—tree species in southeastern Michigan, an important producer of acorns relied on by dozens of wildlife species, and are common urban and suburban landscape trees.

The estimated value of red oak timber in Michigan is approximately 1.6 billion dollars (based on Forest Inventory Analysis data from 2011 and current timber prices). The potential widespread mortality of oaks could have enormous negative impacts in Michigan, ecologically, economically, and aesthetically. Oak Wilt is an issue that will likely become more prominent throughout Southeast Michigan in the very near future and will require attention from all types of landowners and managers. Report suspected cases of oak wilt:

- Email: DNR-FRD-Forest-Health@michigan.gov
  Phone: (517)284-5895
  Midwest Invasive Species Information Network: www.misin.msu.edu
- Learn more: http://michigansaf.org/ForestInfo/Health/E3169-OakWilt.pdf
  http://msue.anr.msu.edu/news/oak_wilt_disease_1,
  http://na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

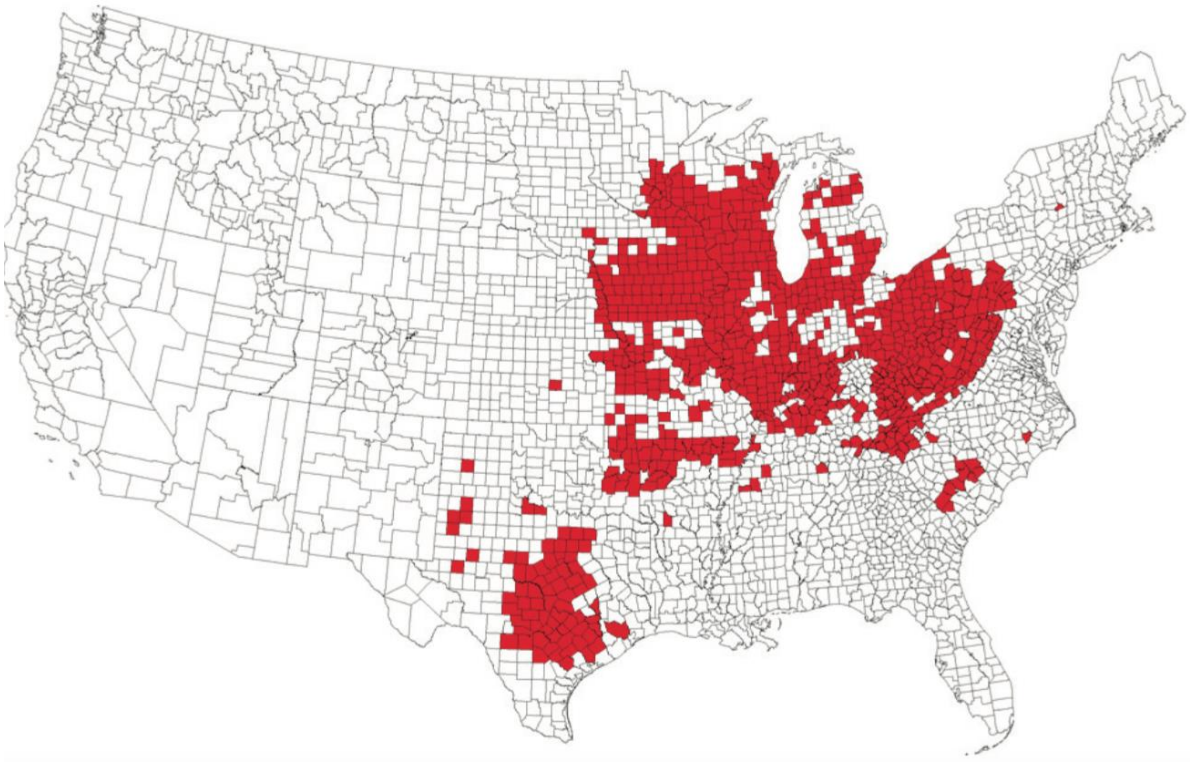


Figure 3.20 Distribution of Oak Wilt in the U.S. From U.S. Forest Service, *How to Identify and Prevent Oak Wilt.* https://www.na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

Thousand Cankers Disease (TCD): A newly identified fungal pathogen *(Geosmithia morbida*) being spread by an insect native to the southwestern U.S. *(Pityophthorus juglandis)* is a relatively recent but potentially serious concern for black walnut trees (*Juglans nigra*). When the tiny walnut twig beetles drill tiny holes to feed on tree branches, they introduce the TCD fungus, which kill small areas of tissue, forming cankers. In time, more cankers form, branches die, and the entire tree succumbs, although it may take 10 years before the tree dies entirely.

TCD has not yet been found in Michigan but has been killing black walnut trees in California and other western states since the 1990s. By 2015, it had been found in six eastern states, including Indiana, Ohio, and Pennsylvania. An effective biological or chemical control for TCD has not yet been identified. A high proportion of black walnut trees will likely die if it becomes established in Michigan. Rapid early detection and removal and destruction of infected trees, are recommended to prevent the disease from spreading.

As noted in a Forest Pest Alert, "Michigan's forests are home to approximately 8.5 million black walnut trees with an economic value of more the $86 million and ecological value as a food source for birds, mammals and other wildlife. There are also more than 80 walnut growers in Michigan with approximately 4,000 trees in nut production…. Black walnut is a valuable timber species and important for wildlife."
(http://www.michigan.gov/documents/mdard/Final_TCD_WTB_MDARD_Forest_Pest_Alert_9_25_13_435045_7.pdf)

TCD can be transported into new areas via firewood, logs, and woodworking staves. A quarantine in Michigan restricts transport of these materials, as was done for EAB.
The Michigan Department of Agriculture urges landowners to learn signs of potential infestation and monitor black walnut trees. Report suspect forest infestations:

- Email: MDA-Info@michigan.gov
  Phone: MDARD Customer Service Center (800) 292-3939
  Midwest Invasive Species Information Network: www.misin.msu.edu
- Learn more: www.michigan.gov/exoticpests, www.thousandcankers.com, https://www.dontmovefirewood.org/pest_pathogen/thousand-canker-disease-html/

Evergreen Diseases

In recent years, Michigan residents have been observing a die off in many spruce trees. Of the spruce varieties often planted for landscaping, Colorado Blue Spruce being one of the most common species chosen in Michigan. Because Colorado Blue Spruce is not native to Michigan, they are suffering from more pathogens due to the fact that they have not evolved with the area's environmental changes. The humid Michigan summers create ideal conditions for pathogens to flourish. Spruce species that are not native to Michigan become stressed as they attempt to adapt and survive in different site conditions. This makes them more vulnerable to fungal diseases. There are at least 4 common fungal pathogens identified to cause disease problems in spruce species planted in Michigan. Often there can be more than one issue that is causing a decline in tree health. Identifying a problem and contacting an arborist or tree care professional to diagnose the problem is crucial to preventing the spread and further decline in tree health. Fungicide may prove effective on new growth if applied with appropriate timing. Diversifying landscaping and planting certain species in areas with desired conditions can increase the resilience of tree species to pests and diseases.

3.1.10 Invasive Species

Invasive species can be defined as a non-native (or alien) to the ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health (https://www.invasivespeciesinfo.gov/whatis.shtml). Invasive species threaten natural communities across the state, and in Macomb and St. Clair counties, some of the biggest threats to native ecosystems comes from invasive plants. One of the most ubiquitous invasive plants found throughout the region is the Common Reed or *Phragmites australis.* This large grass grows in dense stands to a height of 15 feet and crowds out native species. They are found along wetlands, shorelines, ditches and other low lying moist areas. The reproduce by seeds and rhizomes, which can spread underground to a distance up to 60 feet, growing sometimes at a rate of 6 feet per season. Their rapid spread and stand density significantly reduces drainage flow, native habitat for fauna, and can become a fire hazard as the dead stalks accumulate in the dormant season. Phragmites control efforts are widespread throughout Michigan. Primary management methods are foliar spraying of herbicide combined with mechanical control via cutting or prescribed burning.

Another species found throughout the two counties is garlic mustard, *Alliaria petiolata.* This herbaceous perennial can be found in forested uplands, floodplains, and disturbed areas. It can rapidly spread via seeding and due to its early germination will outcompete native species for water and soil nutrients. Garlic mustard also releases phytotoxins in the soil that inhibit growth of other species. Garlic mustard control methods are primarily via hand pulling the entire plant and root system and disposal. The plant produces an incredible amount of tiny seeds, so landowners should be careful to pull the plants before they release those seeds. Garlic mustard seeds have been known to stay viable for years- even when exposed to extreme conditions.

Flowering Rush, *Butomus umbellatus* is an emergent aquatic invasive that can slow drainage in ditches and streams and other flowing waterbodies, as it can grow in water depths of up to 20 feet. This invasive species is difficult to positively identify outside of its flowering season as the stems resemble many other sedges and grasses. Flowering rush can be difficult to manage due to its ability to rapidly regrow from fragments, so control methods can require the entire plant, including roots and rhizomes be dug out and removed. A two-step approach of chemical and mechanical methods may be required over several seasons to properly control flowing rush.

Woody invasive shrubs are a pervasive challenge in this region, with dense thickets of non-native shrubs invading natural areas, open fields, and forests. They are a particularly important problem because they completely alter the forest community and, in many cases, prevent the growth of native species. Some key species of concern are:

- Autumn olive (*Elaeagnus umbellata*)
- Buckthorn: common (*Rhamnus* cathartica) glossy (*R. frangula*)
- Bush honeysuckles (*Lonicera* spp.)
- Japanese barberry (*Berberis thunbergii*)
- Multiflora rose (*Rosa multiflora*)
- Privet (*Ligustrum vulgare*)

Many of these invasive shrubs out compete native varieties by leafing out earlier, often in March, and retain leaves later into the fall, making it difficult for other plants to survive in their shade. Many are forest invaders, thriving in or tolerating shade. All these species fruit abundantly, producing thousands of seeds that are transported by birds and mammals. Control can be achieved by several methods, and often, a combination of methods is most effective. Fire will set the plant back, but will not usually kill the shrub, especially larger plants. Because the plant stump sprouts after fire or cutting, it is usually treated with herbicide (triclopyr appears to be an effective chemical). The herbicide can be sprayed on a cut stump (avoid spring when sap is rising), applied to foliage (normally done in late fall when other plants are dormant), or as a basal bark treatment (apply to lower 18 inches of trunk except when sap is rising).

Black locust (*Robinia pseudoacacia*), Norway maple (*Acer pseudoplatanus)*, and tree of heaven *(Ailanthus altissima*) are the key invasive tree species found in both Macomb and St. Clair County. These tree species can be locally abundant but are typically not as widespread a

problem as invasive shrubs. Black locust can spread clonally and can become an aggressive invader on sandy post-agricultural areas, but its rot-resistant timber is considered useful for fencing materials. Landowners should be aware of how to identify and treat these species if needed.

Fast-growing non-native vines (oriental bittersweet, English ivy, Japanese honeysuckle, Chinese yam, black swallow-wort, pale swallow-wort, mile-a-minute weed, and kudzu) are increasing problems in Michigan. Oriental bittersweet (*Celastrus orbiculatus*) is a particular challenge, as they grow in dense and impenetrable thickets. These vines can shade the tree's leaves and the competition can reduce tree growth or kill young trees. They can cause structural problems due to the added weight of the vine, which can break branches or topple the tree. A few vines even grow thick enough to "strangle" the tree. Some vines that start as a groundcover and form a dense mat of leaves, smothering wildflowers and other flora of the forest floor. These dense mats grow around the tree's base trapping moisture against the trunk which can result in fungal and bacterial diseases. Native grape vines can also cause damage, but poison ivy and Virginia creeper usually don't damage trees and serve as a food source for wildlife. (https://midwesternplants.org/2015/02/25/vines-growing-on-trees-good-or-bad/)

Invasive species can negatively impact ecosystems in complex ways. They can outcompete and displace native species; reduce or alter wildlife habitat (although several invasive species were intentionally introduced and planted for wildlife); reduce forest health, productivity, and regeneration; and alter ecosystem processes including nutrient cycling, beneficial soil fungus (mycorrhizae), and leaf litter dynamics. These species need to be actively managed, and if left unchecked, they can take over an entire area by out-competing native plants and invade fields and forest openings so densely that recreation and trails are affected. Not only do they have a significant negative impact on the native plants, but they also effect native wildlife as well. Many of these invasive species are not a food source for wildlife. By outcompeting native plants, and not meeting the resource needs of native wildlife they disrupt the food webs of terrestrial ecosystems and deplete the necessary resources for native plants and animals to survive.

A key to avoiding infestation by invasive plants is to have a healthy community of native or intentionally introduced plants (crops, orchards, etc.). The more robust the desired vegetation is, the less likely that invasive species will proliferate. Soil-disturbing activities such as plowing, land clearing, and vehicle use can create favorable conditions for invasive plant establishment. Disturbed areas should always be followed up quickly by reseeding or planting to limit invasive species competition and monitored thereafter for possible infestation.

Timber harvests and other activities that disturb soil and affect canopy trees can have serious unintended negative effects on a forest ecosystem if the landowner does not realize that there are invasive species present. Landowners should be aware of invasive species in the area and plan to treat such infestations prior to a harvest.

Private landowners should learn to identify these species and become familiar with how to appropriately treat them to be sure that they know how to manage their land and prevent the degradation of their resources. Since cutting or mowing is not always effective on many of these species (and can actually make some of them more of a problem) or the task of eradicating these invasive species to too much for a landowner to take on, there are numerous resource providers and contractors in this region that can provide technical assistance to landowners. Landowners are encouraged to seek treatment recommendations from Michigan DNR, The Stewardship Network, or your local conservation district (See section 3.4 for more information). Information, including photos and identification modules for invasive plants, can be found at misin.msu.edu.

The USDA also offers links to numerous invasive plant fact sheets for many species: https://www.invasivespeciesinfo.gov/plants/factsheets.shtml)
For a full list of invasive species in Michigan and to report sightings of invasives visit:
https://www.stewardshipnetwork.org/lake-st-clair-cisma : Lake St. Clair CISMA
https://mnfi.anr.msu.edu/ - Michigan Natural Features Inventory
http://www.misin.msu.edu/page/2/ - Midwest Invasive Species Information Network
http://www.mipn.org/ - Midwest Invasive Plant Network
http://www.michiganinvasives.org/ - Michigan Invasive Species Coalition

3.1.11 Tourism and Recreation

The Michigan DNR manages two State Parks, one Recreation Area, and several State Game/Wildlife Areas in the two-counties. Algonac State Park in Clay Township is a 1,500-acre park along the St. Clair River featuring camping, hiking, hunting, winter actives, fishing. Within the park is the 1,244-acre Algonac Prairie & Savanna, a Legally Dedicated Natural Area. This natural area was dedicated to protect two of the rarest natural communities found in Michigan: lakeplain prairies and savannas (also known as oak openings). Prairies are areas of flat or hilly land covered chiefly by tall grasses and wildflowers, while savannas are areas of widely spaced trees with grasses, wildflowers and shrubs growing underneath. Lakeplain prairies and savannas are those that grow in the clay soils that were once inundated by large lakes that covered much of southeastern Michigan, which were themselves created by the meltwater of a great glacier.

Lakeport State Park is a 565-acre state park in St. Clair County, Michigan located on the shore of Lake Huron. The park is split into two sections on either side of the Village of Lakeport.

W.C. Wetzel State Recreation Area in Lenox Township is a 900-acre multiuse area with 120 acres of wetlands and 5 miles of trails. The area allows hiking, hunting, and cross country skiing.

MDNR State Game and Wildlife Areas in the two counties include:

- Chesterfield Township State Game Area - Macomb
- Salt River Marsh Wildlife Area – Macomb

- Port Huron State Game Area – St. Clair
- St. Clair Flats State Wildlife Area – St. Clair
- St. Clair Township State Game Area – St. Clair
- St. Johns Marsh State Wildlife Area – St. Clair

Local Parks

The Huron-Clinton Metroparks consist of 13 beautiful parks, covering over 25,000 acres in Southeast Michigan, encompassing Wayne, Oakland, Macomb, Washtenaw and Livingston counties. http://www.metroparks.com/about-us/planning-department/
Metroparks in Macomb and St. Clair Counties include:

- Lake St. Clair Metropark, Harrison Township – 770 acres along Lake St. Clair with beaches, trails, pools, nature trails, marinas, and bike trails
- Wolcott Mill Metropark, Ray Township – Features a historic farm, 10 miles of trails, equestrian trails
- Stony Creek Metropark, Shelby Township – 4,461-acre park with 700-acre Stony Creek Lake. Fishing, hiking, biking, nature center, swimming and golf

In addition, there are many other parks managed by local units of government (counties, townships, cities, etc.).

The St. Clair County Parks and Recreation Commission operates the 327-acre Goodells County Park, 385-acre Columbus County Park, 30-acre Fort Gratiot County Park, 45-acre Woodsong County Park, 5-acre Fort Gratiot Light Station and the 12-mile long Wadhams to Avoca Trail. The Commission also assists local units of government with the development and promotion of the Bridge to Bay Trail. St. Clair County Parks offers a wide range of recreational opportunities including, but not limited to: biking, horseback riding, canoeing/kayaking, swimming, bird watching, fishing, and hunting.

Trails

- Macomb Orchard Trail is a 24-mile-long hike and bike paved trail that runs from Shelby Township to Richmond with restrooms, bike repair stations, parking and picnic pavilions
- St. Clair County Wadhams to Avoca Trail – a former rail line, this trail is 12 miles of partial paved hike and bike trail that runs from the southeast in Kimball Township through the Mill Creek Valley to Avoca.
- St. Clair County Bridge to Bay Trail – proposed 54 miles of trail along the shores of Lake Huron and the St. Clair River. The Trail is currently 20 miles and connects many municipal parks, commercial centers and shoreline communities

Water Trails

- Blueways of St. Clair – recently recognized as a National Water Trail and Michigan's only such designated water trails the Blueways of St. Clair comprises 16 different routes through 8 water bodies in the communities of eastern coastal St. Clair County. The trails extend from Harsen's Island to the Blue Water Bridge and around Anchor Bay and up the Pine, Belle, and Black Rivers.

- Lake St. Clair Water Trail – 41.7 miles of Lake St. Clair coastal paddling that circles Anchor Bay and down the coast to Harrison Township.
- Clinton River Water Trail – 81.5 miles of paddling trail on the Clinton River from Lake St. Clair to Clarkston in Oakland County.

3.1.12 Archaeological, Cultural and Historic Sites

Archaeological Sites

The archeological records reveal that the Native American population in the Lake St. Clair region was relatively high compared to other coastal areas in Michigan. Sixty-three prehistoric sites occur in Macomb County, the highest number in any county in the state. Between 1400 and 1600 AD, the area was dominated by the woodland Iroquois association. By 1720, Missasauga and Ojibway (Algonquin origin) tribes had villages in the vicinity of the St Clair River Delta. As early as 1840, Pottawatomi and Ottawa tribes arrived in the area as a result of displacement after the French and Indian Wars. Currently, Walpole Island, Ontario, is inhabited by three tribes of the Algonquin Nation: Pottawatomi, Ojibwa, and Ottawa (Paskus, 2003).

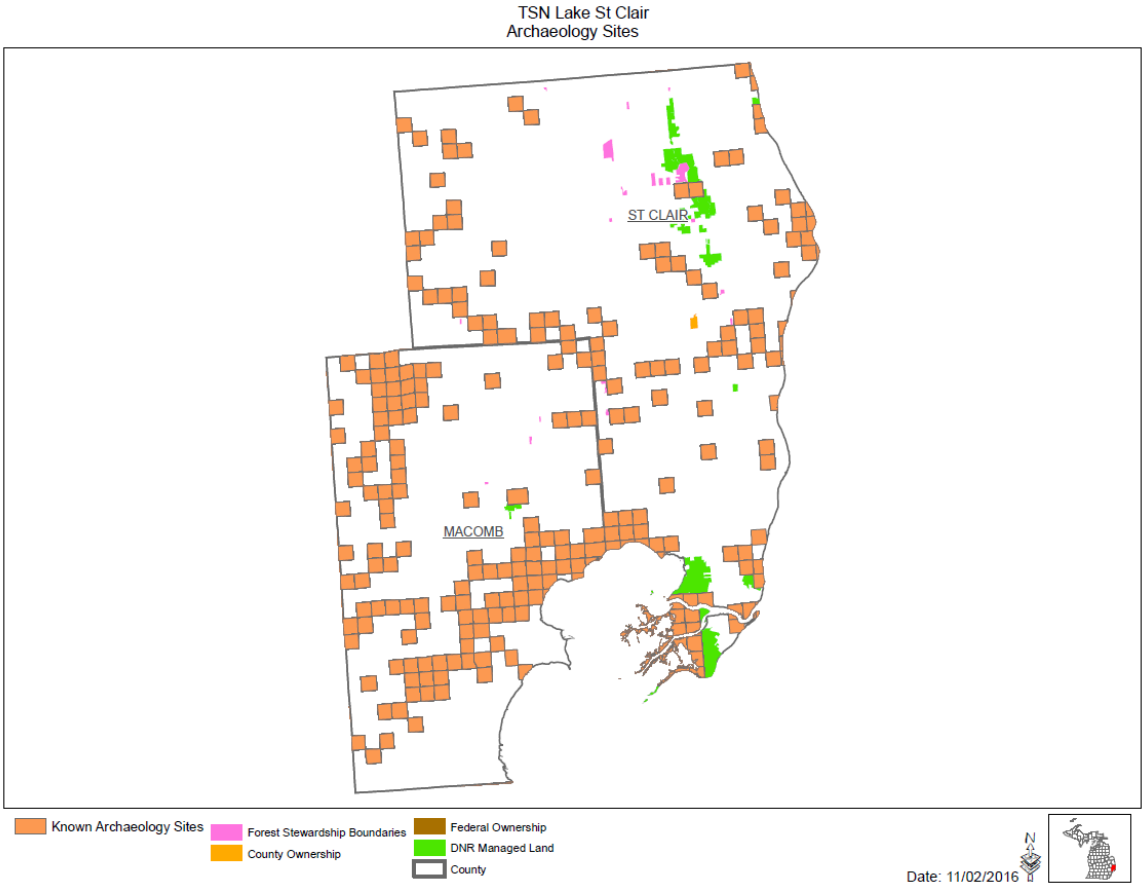


Figure 3.21 Map of Archeological Sites in Macomb and St. Clair (Michigan DNR).

Landowners who believe they have found Native American artifacts in their forests should contact the State Archaeologist's office at the State Historic Preservation Office, and record and report the artifacts (reporting form available at http://www.michigan.gov/mshda/0,4641,7-141-54317_19320_54320---,00.html, with explanations at http://www.miarch.org/site-recording.html). The State Archaeologist can also offer advice about consulting archaeologists who can help assess the site. Any site that appears to be a burial ground must not be disturbed. According to SHPO guidance, "It is illegal to intentionally disturb human remains and associated artifacts. If you accidentally discover human remains, immediately stop any activities in the area and contact the police and the State Archaeologist. Respect the dignity of burial sites by protecting and reporting them. Do not disturb them." (http://www.michigan.gov/documents/mshda/mshda_shpo_20140211_archaeology_brochure_447191_7.pdf)

3.2 Acoustic Monitoring

Land managers, researchers, and educators have typically utilized standardized protocols in the collection of biological data to create an ecological integrity assessment of their property or study site. Traditionally, visual field observations of vegetation, animal, and invertebrate populations are collected to help better understand biological makeup, conservation status, and potential changes to ecological health.

Today, an emerging assessment tool, acoustic monitoring, is a potential game changer for researchers and landowners looking to record and analyze information in their forests and other properties that can't necessarily be collected by visual means or with people present. This acoustic assessment expands on the traditional audible data collection of bird and frog calls to include the entire soundscape of a particular ecosystem.

A "soundscape" is a term aptly used to describe a recording of all the sounds within a landscape. This includes:

- Geophony: Sounds created by non-biological sources (rivers, wind, precipitation, etc.)
- Biophony: Sounds created by organisms within a habitat (the calls of birds, frogs, mammals, etc.)
- Anthropophony: Sounds created by humans, both intentionally and unintentionally (Music, walking, the sounds of machinery, etc.)

An undisturbed habitat would play host to both geophony and robust amount of biophony, with organisms creating noise for a plethora of reasons including calling potential mates, confusing predators, and warning competitors to avoid their territory. By carefully dissecting and analyzing recordings, researchers can separate out different sounds and calls to get a sense

of the diversity and density of the sound-making species present in the area of study. Soundscapes undoubtedly fluctuate throughout seasons with species migration, seasonal mating vocalization, or in response to natural events such as instances of severe weather. But researchers are finding that resource extraction, climate change, and the effects of humans living and recreating within close proximity of forests are also having an impact on ecosystems; impacts that otherwise may not have seemed significant through optical observation, if apparent at all.

In addition to hearing stories about the focus areas for this project from land managers, it is important to allow the ecosystems to tell their own stories through acoustic monitoring. Dr. Stuart Gage, Professor Emeritus from Michigan State University has spent much of his career developing principles, methods, and applications behind ecoacoustics, or the assessment of biodiversity based on sounds emanating from the environment. Under Dr. Gages' direction, sound recorders were placed within each of the Landscape Stewardship Plan areas. Audio data was collected from a preserve in the St. Clair and Macomb County landscape from October 7th, 2016 to November 7th, 2016. A battery powered recorder was attached to a tree in the James and Alice Brennan Memorial Nature Sanctuary. One minute of soundscape was recorded every half hour. This data was stored on an SD card and sent to Dr. Gage's REAL (Remote Environmental Assessment Laboratory) group for storage and analysis. The REAL website (www.real.msu.edu) has a section devoted to the Landscape Stewardship Plan project, in addition to many other projects and information on acoustic monitoring. Visitors have access to the background information of the project, monitor locations, and the ability to listen to sound clips from each site. Select recordings will be made available on this project's online story map. For more information on the experience of setting up the acoustic monitors, see section 4.10 of this document.

For landowners, scholars, and researchers who are interested in doing acoustic monitoring on their land *Ecoacoustics: The Ecological Role of Sounds*, Almo Farina and Stuart H. Gage (Editors) Wiley Press July 2017, provides additional information, tools and references based on the current state of this field of research.

Also, many ornithologists and herpetologists are well versed in the calls of the organisms they study. For a more species specific method of learning about the organisms present on the land, individuals may contact their local Audubon chapter, Michigan Society of Herpetologists, Michigan Partners in Amphibian and Reptile Conservation or the Michigan Department of Natural Resources, to learn about the experts, enthusiasts, and resources in their area who may be able to help identify species.

3.3 Existing Stewardship Plans

Planning can occur at multiple scales, from multi-state areas to pocket habitats on residential yards in a city. The following section outlines preexisting plans that are available to private landowners for guidance, reference, or inspiration. Elements of these plans may not apply to every project due to differences in ecosystems, scale, or region, but they can serve as models for people looking to write their own plan and show the value of collecting management information and organizing it in one place. To date, 21 landowners in St. Clair and Macomb Counties have created stewardship plans for their properties, which covers 2,784 acres of this landscape.

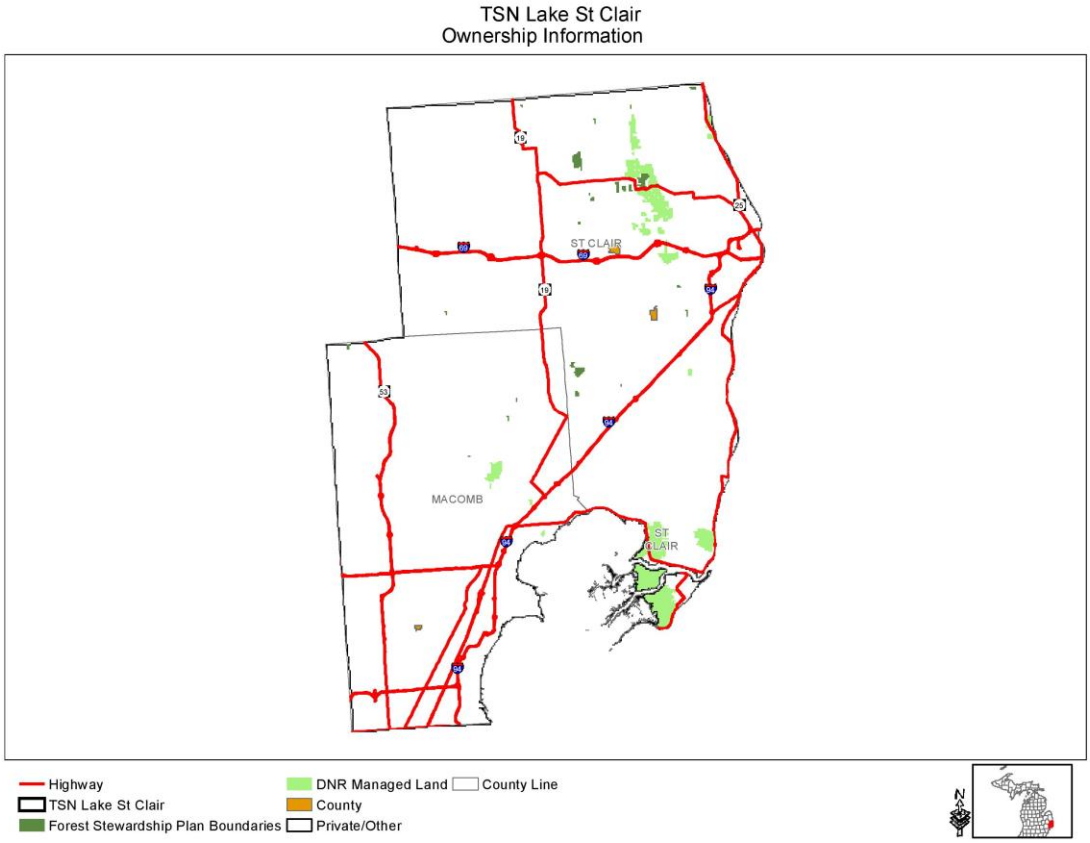


Figure 3.22 Shows the ownership information for areas currently engaged in Forest Stewardship Plans and Land Managed by Michigan's Department of Natural Resources. (MDNR, 2017)

3.3.1 Government plans

Michigan Department of Natural Resources

Statewide forest surveys by the USFS has estimated that Michigan supports approximately 19.3 million acres of forest, (*Michigan Forest Resource Assessment and Strategy, MDNR Forest Management Division, June 2010)* of which 18.6 million acres considered timberland, making Michigan's timberland acreage the 5th largest in the United States. *(www.michigan.gov/documents/dnr/1.2Introduction_242962_7.pdf)*

Today, over 60% of forestland in Michigan is privately owned, with the majority (53%) of the private ownership held by non-industrial landowners, or family forests. *www.macd.org/forest_conservation*. Michigan's remaining 40% of forestland is owned by the Federal government (3 million acres), (*USDA Forest Service Land Areas Report, Sept. 1999)* and by the State of Michigan. Of the almost 4.6 million acres of land owned by the State of Michigan, the majority (3.8 million acres) is under the management of the DNR Forest Resources Division and managed primarily for forest products, but has complementary benefits for wildlife and recreation. These state managed forests make up the largest state forest system in the nation. *(Managing Michigan's State-owned Forests: Harvest Levels, Market Trends and Revenue Realities, Michigan Environmental Council, May 1, 2013 Rev.)* Michigan ranks first nationally in state-owned timberland and 8th in publicly owned timberland, which includes all federal, state, and local governments. (*USDA Forest Service FIA database).*

MDNR State Forest Management Plans:

The MDNR administers state forest resources for economic, recreational, and environmental values and is committed to the sustainable management of this valuable commodity. "Sustainability assures the viability of biological communities and their economic vitality by protecting and maintaining the natural environment upon which the citizens and economy of Michigan depend". (*Michigan Department of Natural Resources, Forest, Mineral, and Fire Management and Wildlife Divisions, April 10, 2008, Michigan State Forest Management Plan, David L. Price, Editor).* In order to achieve their management goal, the MDNR Forest Resources Division has developed a five-year strategic plan *(Seeing the Forest, The Trees & Beyond, Forest Resources Division Strategic Plan, 201-2018, MDNR)* to help guide decision making regarding the health of Michigan's state forest resources. The strategic plan lays the groundwork for meeting the division's mission and strategic direction.

Michigan's **State Forest Management Plan – 2008 (10-year plan)** is a strategic planning document, intended to be a framework containing the goals and objectives for resource uses and values of state forestlands. The document reflects the challenges of managing forests for multiple benefits, achieving sustainability objectives, and integrating ecosystem management practices. The plan was amended in 2014. *(www.Michigan.gov/forestmanagement)*

The **Regional State Forest Management Plans**, which were approved in 2013, are more prescriptive and designed to inform landscape-level decision making and provide operational direction for the management of state forest resources for all 101 management areas throughout

the entire state. *(www.Michigan.gov/forestmanagement)* Each Regional State Forest Management Plan is organized into Management Areas —groupings of roughly 30 forest compartments in each region (Western Upper Peninsula, Eastern Upper Peninsula and Northern Lower Peninsula) that range in size from approximately 17,000 to 105,000 acres. (*Managing Michigan's State-owned Forests: Harvest Levels, Market Trends and Revenue Realities, Michigan Environmental Council, (May 1, 2013 Rev.)*

Michigan's **Forest Action Plan** is a statewide assessment of forest conditions and forest resource strategy to be addressed over a 10 year period (2010-2012). Since over 60% of forestland in Michigan is privately owned, the Forest Action Plan was developed to focus on assisting private landowners through cooperative programs for forest stewardship, urban and community forestry, forest health, wildfire management, and forest legacy. The planning period for the Forest Action Plan is 2010-2020. The Michigan Forest Resource Assessment and Strategy (Forest Action Plan) strives for greater integration of cooperative forestry programs, wildlife management goals and comprehensive outdoor recreation planning for the long-term, sustainable stewardship of the private forest resources of Michigan. *(State and Private Forestry, Michigan Forest Resource Assessment and Strategy (Michigan's Forest Action Plan), Mid-Term Five-Year) Review, Michigan Department of Natural Resources, Forest Resources Division, 2015)*

3.3.2 Non-Governmental Conservation Organization Plans

Natural Resource Inventory and Recommendations for Wolcott Mill and Metro Beach Metroparks
This report from Michigan Natural Features Inventory contains recommendations for the management of native ecosystems existing in two Huron-Clinton Metroparks in Macomb County. Readers can get a sense of the characteristics of the unique and valuable natural communities in this region, and the species to look for on their own property that may share similarities. Ecosystems include southern floodplain forest, southern swamp, southern floodplain forest, mesic southern forest, and Great Lakes marsh.
https://mnfi.anr.msu.edu/reports/2006-03%20HCMA%20Report%202005.final.pdf

A number of reports developed by Michigan Natural Features Inventory (MNFI) that may also be of interest to property owners are available on the MNFI website: https://mnfi.anr.msu.edu. These reports do an exceptional job of explaining Michigan's natural communities and the unique plants and animals that inhabit them.

Great Lakes Restoration Initiative (GLRI) Action Plan (II) was a catalyst for the coordination of federal agencies to address concerns related to the health of Great Lakes' ecosystems. Many of this plan's goals are directly related to forestry and support efforts to prevent and control

invasive species, along with restoring habitat to protect populations of native species. Threats to the Great Lakes ecosystems are prioritized and then funded accordingly.

Identifying risks and preventing the spread of harmful invasive species are addressed through early detection monitoring and public education. Federally funded projects are implemented in the identified area at risk, and afterward, local partners continue to care for the area with less costly maintenance and stewardship activities to insure long-term health.

Priority areas are protected to "sustain diverse, complex, and interconnected habitats for species reproduction, growth, and seasonal refuge." Many species that are listed by the State or federal government are under threat because of habitat loss. The GLRI Plan provides strategies to restore habitats and increase the chance for some threatened and endangered species to reach self-sustaining populations. https://www.glri.us/actionplan/pdfs/glri-action-plan-2.pdf

Make No Little Plans: Developing Biodiversity Strategies for the Great Lakes
Conservation strategies have been developed by The Nature Conservancy (TNC) for each of the Great Lake's watersheds to assess threats to biodiversity in this region. In the TNC plan, climate change and terrestrial invasive species were identified as two of the biggest threats to ecosystem health in these watersheds. Complexities generated by the sheer size of these issues make the significant need for collaboration and implementation strategies apparent.

As developed and utilized by the TNC, Conservation Action Planning (CAP) is an effective ten step approach to projects which is accomplished by defining conservation targets, identification of critical threats (social, biological, political, economic) to the project, and the development of management and monitoring programs based on the targets and collected information. Once regional priorities are determined, Conservation Action Planning can be utilized to determine a plan of action for the priorities. Then, as actions are taken and the outcomes monitored and measured, planning can be revised to incorporate new knowledge.
https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/wholesystems/greatlakes/Pages/synthesispaper.aspx

Environmental Protection Agency (EPA) Lake-wide Action and Management Plans (LAMP) are bi-national action plans and are thought to have some of the greatest potential for ecosystem restoration and management because they bring many stakeholders together and require coordinated collaboration that leads to greater collective impact. By engaging a diverse set of stakeholders, there is potential to broaden participation, limit the costs of education and outreach, have greater access to experienced specialists and technical assistance, and have a greater chance of sustaining stewardship efforts in the future. These practices have evolved to incorporate biodiversity conservation strategies, sometimes referred to as "blueprints."

Duck's Unlimited International Conservation Plan

The conservation vision of Ducks Unlimited (DU) revolves around preserving and restoring ecological integrity of integrated landscapes so that they have the capability of providing necessary resources to preserve sustainable waterfowl populations. Ducks Unlimited achieves its conservation goals through long-term, regional conservation strategic planning. All regional plans are developed around guiding principles that encompass Ducks Unlimited's conservation approach.

These principles are derived from the organization's international standards and are used by regional offices to guide waterfowl conservation efforts. They provide direction for the identification and conservation of existing and essential waterfowl habitat, including adaptive resource management and appropriate management intervention, as well as increased communication through the expansion of extension initiatives and increased public policy initiatives to support conservation efforts. The use of these principles to guide the strategic planning of conservation programs helps to ensure that the organization's objectives are "successfully addressing the waterfowl and wetlands conservation goals."

The DU conservation plan covers the US. Great Lakes System Waterfowl Conservation Region, as designated by the Commission for Environmental Cooperation, and consists of five ecoregions in the Great Lakes watershed. Historically, this area was a transitional zone between prairie and eastern woodland ecosystems. In this region, the Central Hardwoods contained some of the most significant wetlands due to the expansive "prairie pothole type wetlands, shallow lakes, coastal estuaries, and eastern woodlands created by glaciation. A historically significant ecosystem, named the Great Black Swamp, stretched throughout much of southeast Michigan with its farthest northern border being Detroit, MI. This ecosystem was dominated by forested wetlands, coastal marshes along the coast of Lake Erie, and scattered wet prairies and oak savannahs. This ecosystem was dramatically altered by logging and the draining of wetland for agricultural use. Traces of these unique ecosystems-currently remain as fragmented remnants across the landscape. In total this region have lost over 75% of their wetlands and the remaining sites have been severely impacted by degraded water quality, development, and recreation. Due to these dramatic changes in this region, DU recognizes that the Remaining wetlands need to be managed for a high level of productivity to compensate for the substantial wetland losses.

One of Ducks Unlimited overarching goals is to restore and increase the remaining wetlands in this region and to protect the resources that they provide as breeding and wintering habitat for waterfowl that migrate through the Mississippi flyway. Southeast Michigan often has high levels of breeding mallard and wood duck populations. Important habitat in this region includes "portions of sheltered, vegetated littoral zones of the Great Lakes, coastal marshes, and riverine and palustrine marshes, and adjacent upland habitats of low-gradient river tributaries that empty into lakes."

In general, declines in populations of migrating waterfowl can be observed as a result of lack of suitable habitat. The marshes found in the western Lake Erie basin are considered to be the most important wetlands in the Great Lakes region. "The Lake Erie marshes annually host hundreds of thousands of waterfowl in spring and fall, and are the most concentrated staging areas for black ducks in North America" (Tori et al, 1990). Restoration of wetland, grassland, and forest complexes improves conditions for breeding sites and stop overs for many waterfowl species, but also supports the preservation of a diverse group of wildlife species that rely on that same habitat.

DU believes that The most important conservation goal for this region is to preserve and enhance high priority coastal areas through watershed-based restoration activities focused on wetlands and adjacent upland area. To achieve their goal, they strive to provide sufficient habitat in both quantity and quality to meet the resource needs of waterfowl for breeding, wintering, and migration. It is believed that conservation activities in these areas will result in improved food resources for waterfowl because of improved water quality and that management activities will reduce invasive species, minimizing their negative impacts to critical these ecosystems. Strategies to accomplish this goal is the emphasis on the restoration of wetlands on both public and private land, to promote intensive management in areas with extremely expansive hydrologic modification to compensate for extreme wetland loss, provide preferred breeding habitat through the maintenance of "shallow water, forested and scrub-shrub wetlands", protect important habitats that are highly threatened by development, and to utilize farm bill programs in order to increase desired wetland habitat on private land. https://www.ducks.org/media/Conservation/Conservation%20Plan/_documents/a_ICP2004%20final%208.05.pdf

3.4 Resources and Programs for Landowners

3.4.1 Government Agencies

Michigan's Forest Legacy Program
Michigan Forest Legacy Program (FLP) is a partnership with USDA Forest Service with a goal of protecting privately owned and environmentally significant forest lands from being converted to non-forest uses. This voluntary program acquires land through purchase of fee simple title or by conservation easements, legally binding agreements that transfer a negotiated set of property rights without removing the property from private ownership. Conservation easements purchased using FLP funds restrict development, require sustainable forestry practices, and protect a variety of other values. Michigan's FLP encourages partnerships with local governments and land trusts, recognizing the important contributions landowners, communities and private organizations make to conservation efforts. The program requires public access for fee lands but not for conservation easements.

The MDNR state forest resources have been recognized by the Forest Stewardship Council® (FSC®) and the Sustainable Forestry Initiative® (SFI®). Independent auditors have reviewed the MDNR's on-the-ground forest practices against biological, social, and economic requirements in the FSC and SFI standards and certified those practices as sound and comprehensive.

MDNR Forest Stewardship Program (MDNR-FSP) offers resources to private landowners to support forest stewardship efforts, in recognition of the fact that a majority of the state's forests are on private property. MDNR-FSP certifies forest stewardship plan writers to assure that they can offer sound information on best forest stewardship practices, maintains a listing of plan writers in different regions, and offers cost-sharing to landowners to assist them in forest stewardship planning.

Helping Private Forest Landowners Develop Plans for Sustainable Forest Management: A Landowner's Guide. www.michigan.gov/foreststewardship

Michigan Landowner Forest Stewardship Plan (Sample)
www.michigan.gov/.../FSP_Plan_Example_September2014_468852_7.pdf

Plan Writers: www.michigan.gov/dnr/0,4570,7-153-30301_34240_68762---,00.html

A useful publication for management of deer as well as many other game and non-game species is provided by the DNR Landowner's Guide. This 1999 publication also offers instructions on land management planning for forests, grasslands, wetlands, cropland, and backyard habitats.
http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/

US Forest Service
The US Forest Service is a multi-faceted agency that manages and protects 154 national forests and 20 grasslands in 43 states and Puerto Rico. In Michigan, there are three National Forests: Huron-Manistee (Northern Lower Peninsula) and Hiawatha and Ottawa (both in the Upper Peninsula). The agency's mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. They have an elite wildland firefighting team and the world's largest forestry research organization. Their experts provide technical and financial help to state and local government agencies, businesses, private landowners and work government-to-government with tribes to help protect and manage non-federal forest and associated range and watershed lands. They partner with public and private agencies that help plant trees, improve trails, educate the public, and improve conditions in wildland/urban interfaces and rural areas, and promote sustainable forest management and biodiversity conservation internationally.
https://www.fs.fed.us/

Fish and Wildlife Habitat Programs
Most stewardship plans address wildlife habitat and there are many practices that can be used to improve conditions for animals. Support for wildlife habitat is available from both public and nonprofit entities. The MDNR has several programs such as the Private Lands Program and the Wildlife Habitat Grant Program for government, profit or non-profit groups, and individuals interested in conservation. The US Fish and Wildlife Service has the Partners for Fish & Wildlife program which works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship programs for conservation. There are also several nonprofit organizations dedicated to providing wildlife habitat including: Audubon, Ducks Unlimited, National Wild Turkey Federation, Pheasants Forever, Ruffed Grouse Society, the Quality Deer Management Association and Trout Unlimited. Many of these organizations have programs to provide financial and technical assistance for enhancing wildlife.

Contact: Jim Hudgins
U.S. Fish & Wildlife Service (Michigan)
2651 Coolidge Road East Lansing, MI 48823
517-351-4230
Email: Jim_Hudgins@fws.gov

US Fish and Wildlife Landscape Conservation Cooperatives (LCCs)
Landscape Conservation Cooperatives (LCCs) address large scale natural resource challenges that transcend political and jurisdictional boundaries and require a networked approach to conservation—holistic, collaborative, and grounded in science – to ensure the sustainability of America's land, water, wildlife and cultural resources. Michigan is in the Upper Midwest and Great Lakes Landscape Conservation Cooperative. www.GreatLakesLCC.org

Contact: Bradly Potter
Acting Coordinator, U.S. Fish and Wildlife Service
Bradly_Potter@fws.gov
2651 Coolidge Rd, East Lansing, MI 48823

Michigan Department of Environmental Quality
The Michigan Department of Environmental Quality regulates air, land, water, and waste generation activities in the state. The MDEQ endeavors to protect water from both point and nonpoint pollution sources by partnering with watershed groups and others. They issue National Pollutant Discharge Elimination System (NPDES) and storm water discharge permits. Large scale water withdrawals are limited by law and the Water Withdrawal Assessment Tool is designed to predict the effect of groundwater use. Under the land category, earth change activities on areas greater than one acre or located within 500 feet of a lake or stream require a Soil Erosion and Construction Storm Water permit. Other programs cover regulation of wetlands, handling of septage, and use of flood plains.

MDEQ's Water Resources Division administers MiWaters, a web-based database that provides a streamlined electronic permitting process to fulfill federal electronic reporting requirements and gives online access to public information. The focus of MiWaters is permitting and compliance, including National Pollutant Discharge Elimination System (NPDES), storm water, groundwater discharge, aquatic nuisance control, Part 41 construction, and land and water interface.

Permit Coordination is available through the Environmental Assistance Hotline at (800) 662-9278. (https://miwaters.deq.state.mi.us/miwaters/#/external/home)

Michigan Natural Shoreline Partnership
The Department of Environmental Quality's Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership (MNSP) to promote natural shoreline landscaping to protect Michigan's Inland Lakes. Their mission is "Promoting Natural Shorelines through the use of green landscaping technologies and bioengineered erosion control for the protection of Michigan inland lakes." One of the goals of the Michigan Natural Shoreline Partnership is to educate property owners about natural shorelines and technologies that benefit lake ecosystems. It provides support for practices that restore or preserve the ecological function of the shoreline and stabilize shorelines by reducing erosion. They offer educational resources and the website lists contractors who are certified by the program.
www.mishorelinepartnership.org/

Michigan's Water Strategy
Michigan's Water Strategy is a 30-year plan for Michiganders to protect, manage, and enhance Michigan's water resources for current and future generations. It is organized around nine goals and outcomes designed to ensure the viability and sustainability of Michigan's water resources over time, placing Michigan on a path to achieving its water vision in a way that builds economic capacity while sustaining ecological integrity of this globally-significant resource.
http://www.michigan.gov/deq/0,4561,7-135-3313_3677_76614---,00.html

Southeast Michigan Council of Governments
Working with local watershed groups and member governments, Southeast Michigan Council Of Governments (SEMCOG) provides technical assistance on watershed management issues and regulatory requirements within their jurisdictions. A watershed is an area of land that captures rainwater and eventually carries it to the nearest lake, river, or stream. Michigan has numerous watersheds and Watershed Management Plans serve as guides for communities to protect and improve water quality and related natural resources. These plans consider all uses, pollutant sources, and impacts within a drainage area. More than 150 Watershed Management Plans exist at the local level across the state, many funded through MDEQ nonpoint source grant opportunities. A Watershed Management Plan was required for communities using Michigan's unique watershed-based Phase II permit. Many of these plans also meet Federal EPA Section 319 requirements.

Common elements of watershed plans across Southeast Michigan include goals, objectives, and actions to address water quality and water quantity (i.e., stream flashiness) challenges in addition to identifying protection and restoration opportunities. This led to development of the Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.

Additionally, SEMCOG led the development of the Green Infrastructure Vision for Southeast Michigan. The vision brings together a holistic, coordinated plan that addresses all unique elements of green infrastructure, including natural areas, wildlife habitat, parks, hiking/biking trails, water trails, tree canopy, agricultural lands, conservation property, vacant property, and many others. It also focuses on the relationship of green infrastructure to our water resources. http://semcog.org/Watersheds

Environmental Protection Agency
The Environmental Protection Agency's website has an environmental information page that lists air, water, and cleanup concerns in Michigan and can be mapped by zip code, county, etc. https://www.epa.gov/mi/environmental-info-michigan

USDA Natural Resources Conservation Service and Farm Service Agency
The Natural Resources Conservation Service has tools and other technical resources to assist in Conservation Planning, Conservation Compliance on highly erodible land, nutrient and pest management, and Rapid Watershed Assessment. The agency also conducts the Soil Survey Program, the National Resource Inventory and the Conservation Effects Assessment Project. Some of the key financial assistance programs (see Section 5.5) are Environmental Quality Incentives, Conservation Stewardship, and Agricultural Conservation Easement. Conservation Stewardship is a program that provides technical and financial assistance to qualified farmers whose applications rank high enough (on the Conservation Measurement Tool) to be accepted into the program.

The Farm Service Agency's Conservation Reserve Program (CRP) pays a yearly rental in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

The Agricultural Conservation Easement Program has several components including Agricultural Land Easements and Wetlands Reserve Easements. These both provide financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Some easements are permanent while others are 30 year contracts.
St. Clair & Macomb NRCS
2830 Wadhams Rd,
Smiths Creek, MI 48074
Phone: (810) 984-3865

District Conservationist Christina Nickola: christina.nickola@mi.usda.gov

Michigan Department of Agriculture and Rural Development
Michigan Agriculture Environmental Assurance Program
Each of the Conservation Districts is participating in the Michigan Agriculture Environmental Assurance Program (MEAP) which is a voluntarily, proactive program that helps farmers minimize risks from agricultural pollution. This program is designed to reduce farmers' legal and environmental risks through a three-phase process: 1) education; 2) farm-specific risk assessment; and 3) on-farm verification that ensures the farmer has implemented environmentally sound practices. The program's systems are Farmstead, Cropping, Livestock, and the newly developed Forest, Wetlands and Habitats System. http://www.maeap.org/
Note: Mailing addresses for MEAP are the same as the Conservation Districts.

Farmland Preservation Office
Richard Harlow, Program Manager
Environmental Stewardship Division
P.O. Box 30449 Lansing, MI 48909
Phone: 517-284-5663
Email: MDARD-PA116@michigan.gov
http://www.michigan.gov/mdard/0,4610,7-125-1599_2558-14018--,00.html

Macomb County Planning and Economic Development
The Urban Forest Partnership is working to expand public awareness of the benefits of urban forests, develop technical tools and resources for sustainable local forestry programs, and advance creative partnerships to increase tree canopy in Macomb County through planting the Right Tree in the Right Place for the Right Purpose. http://green.macombgov.org/Green-UrbanForestPartnership
Macomb County received a grant from the US Forest Service and the Great Lakes Restoration Initiative to reduce stormwater runoff and nonpoint source pollution impacts through targeted increases in tree canopy as green infrastructure. Learn more here.
http://green.macombgov.org/Green-ProjectsGrants

Macomb County Planning and Economic Development
Administration Building
1 S Main, 7th Floor,
Mount Clemens, MI 48043
(586) 469-5285
planning@macombgov.org

Conservation Districts
The Conservation Districts work with the agricultural and environmental communities by coordinating conservation projects and programs that benefit residents and the community as a whole. Guided by a locally elected Board of Directors staff focus on ground and surface water issues, sustainable agricultural practices, environmental stewardship, education, wildlife habitat, aquatic ecosystems, forestry management, and community projects. Some specific programs that they assist include USDA Farm Bill, Hunting Access, and the Michigan Pheasant Restoration Initiative.

Macomb Conservation District
72955 Van Dyke Avenue
Bruce Township, Michigan 48065

St. Clair Conservation District
2830 Wadhams Road
Kimball Township MI 48074
810-984-3001 x5
joe.kautz@macd.org

3.4.2 Non-Governmental Agencies

The Stewardship Network
The Stewardship Network (TSN) is a 501(c)(3) corporation with a mission to connect, equip, and mobilize people and organizations to care for land and water in their communities. TSN is dedicated to training, developing, and supporting a vibrant group of volunteer and professional stewardship leaders. TSN builds the capacity of partner organizations and individuals through development of model projects and implementation of region-wide initiatives. TSN helps groups and individuals tap into the Network's wealth of knowledge and experience in preserving and protecting our native biodiversity. The Stewardship Network trains volunteers in scientifically-based, field-proven conservation techniques they put into practice on partner organizations' properties.

The Stewardship Network is the recognized national and international award-winning leader in this approach. Founded and headquartered in Ann Arbor, TSN supports 16 local collaborative conservation clusters (CCCs) in Michigan, Ohio, Indiana, Minnesota, and New Hampshire. In honoring TSN with its 2015 Science & Practice of Ecology and Society award, the journal *Ecology and Society* commended "the local roots" of TSN, writing "Different from other organizations, TSN asks communities the critical question, 'What do you need to care for land and water?'" TSN then helps each local cluster determine its geographic boundaries and program priorities; recruit, train and engage volunteers; and secure the resources and expertise to act as stewards for its local land and water.

The Network hosts a series of initiatives that support their on-the-ground CCCs, including monthly webcasts; the Science, Practice & Art of Restoring Native Ecosystems Conference; the Spring Clean-up Challenge (removal of invasive species, starting with Garlic Mustard); the October Volunteer Restoration Challenge (starting with biodiverse tree planting, native prairie grasses, wetlands restoration); websites; newsletters; and turnkey systems for database management, e-communication, registration, and contributions.

416 Longshore Dr., Ann Arbor, MI 48105
(734) 996-3190
staff@stewardshipnetwork.org
www.stewardshipnetwork.org

The Lake St. Clair Cluster of The Stewardship Network
The Lake St. Clair Cluster covers Macomb, St. Clair, and Wayne Counties and works collaboratively to address critical land and water issues in this service area. Their initiatives fall into the following inter-related categories: Capacity-Building, Climate Resilience, Citizen Science & Research, Education & Outreach, Garlic Mustard Challenge, Habitat Restoration, Invasive Species, Land Protection, Nutrient Management, Restoration Agriculture, Threatened & Endangered Species, Water Quality, and Wildlife Management. The Cluster is administering the Lake St. Clair Cooperative Invasive Species Management Area (see next section).

The Lake St. Clair Cooperative Invasive Species Management Area (CISMA)
The Lake St. Clair CISMA was formally established in 2015 to manage the spread of invasive species around Lake St. Clair. Approximately 25 local, county, state, federal government agencies, and non-profit organizations comprise the Lake St. Clair CISMA. The CISMA has five priority invasive species, on which it focuses its efforts. Seventeen partners of the CISMA will monitor, map, and/or treat over 950 acres in Focused Management Areas (FMAs). FMAs are smaller geographic areas in which numerous agencies and organizations strategically leverage their efforts to create a noticeable decline in the invasive species population. The objective is to keep FMAs free and clear of invasives, build community awareness of solutions, and then move out to other areas.

Contact Lake St. Clair Cluster
CISMA Coordinator: Michael Sobieski
Email: msobieski@stewardshipnetwork.org

Michigan State University Extension Service
Michigan State University's Extension Service offers information on natural resources, agriculture, lawn and gardens and other topics. They also have a Conservation Stewards Program: http://msue.anr.msu.edu/program/info/conservation_stewards_program

Macomb County MSU Extension Office
21885 Dunham Road
Verkuilen Building #12
Clinton Township, MI 48036
Msue.macomb@county.msu.edu
(586) 469-5180
http://msue.anr.msu.edu/county/info/macomb

St. Clair County MSU Extension Office
200 Grand River Ave. #102,
Port Huron, MI 48060
msue.stclair@county.msu.edu
810-989-6935
http://msue.anr.msu.edu/county/info/st._clair

Michigan Nature Association
The Michigan Nature Association (MNA) is dedicated to the conservation of rare, threatened, and endangered species, imperiled natural communities and unique geological features throughout the state of Michigan. Established in 1952, MNA is Michigan's oldest land conservancy. Today MNA protects over 170 nature sanctuaries encompassing over 12,500 acres across Michigan.
http://www.michigannature.org/

Andrew Bacon
Stewardship Coordinator,
abacon@michigannature.org.

The Southeast Michigan Land Conservancy
The Southeast Michigan Land Conservancy conserves natural land and open space -- including forests, wetlands, meadows, agricultural lands, and places of scenic beauty -- to provide habitat for wildlife and to enrich the lives of people. "Southeast Michigan: a beautiful place where people and nature coexist in healthy, sustainable balance." SMLC's vision statement expresses how we feel about this special place we call home. Preserving natural areas and farmlands is good for all of us. SMLC protected more than 3,400 acres in this region.

Southeast Michigan Land Conservancy
8383 Vreeland Road
Superior Township, MI 48198-9619
(734) 484-6565
jlewis@smlcland.org
www.smlcland.org

Master Gardener Program
Michigan State University Extension conducts a Master Gardener Program to train adults in horticulture education and as volunteer leaders. The Master Gardener Helpline is set up to answer questions about gardening (plant identification, disease or pest questions, or basic garden-care). You can find a current list of county master gardener contacts on the following website:
http://msue.anr.msu.edu/program/master_gardener_volunteer_program/contact_us/michigan_master_gardener_groups

Michigan Audubon Society
Michigan Audubon has no sanctuaries in Macomb and St. Clair Counties. There are two local chapters: Blue Water Audubon Society and Macomb Audubon Society.
http://www.michiganaudubon.org/our-conservation-impact/bird-sanctuaries/

- Blue Water Audubon Society Chapter
  https://www.facebook.com/groups/261255820627222/
- Macomb Audubon Society http://www.macombaudubon.org/

The Nature Conservancy
The Nature Conservancy, the largest nonprofit land conservancy in the United States, has the mission "Conserving the lands and waters on which all life depends." To accomplish their mission, they have an extensive planning process (Conservation by Design) supported by scientists and other resource professionals. They work to inform policies and practices in the following strategic areas: Agriculture, Forestry, Coasts, Native Fisheries, Watershed Connectivity, and Aquatic Invasive Species. The Nature Conservancy has no preserves in the two-county area, but the Michigan office has projects in Eastern Lake Michigan and Southern Fens. The Nature Conservancy has a Resilient Forest project that has developed tools such as Key Ecological Attributes and Climate Informed Metrics to help inform forest management. They are also involved in one of the Landscape Stewardship Plans for the eastern Upper Peninsula.

Main Office:
101 East Grand River,
Lansing, MI 48906
Phone (517) 316-0030
Nature Conservancy Ecoregional Plans
www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/michigan/projects/

Habitat Network
The Nature Conservancy and the Cornell Lab of Ornithology launched Habitat Network, a free online citizen science platform that invites people to map their outdoor space, share it with others, and learn more about supporting wildlife habitat and other natural functions across the country. Forty million acres of U.S. land are covered by lawn—short grass that has minimal ecological function and costs property owners more than $30 billion to maintain each year. Habitat Network offers alternate solutions for yards, parks and other urban green spaces to support birds, pollinators and other wildlife, plus manage water resources, and reduce chemical use of pesticides and fertilizers to keep nature in balance. "Science shows us that small changes in the way properties are managed can make a huge impact towards improving our environment," said Megan Whatton, project manager for Habitat Network at The Nature Conservancy. "Creating and conserving nature within cities, towns and neighborhoods are key to global conservation."
http://content.yardmap.org/learn/ (also has supporting articles)

Michigan United Conservation Clubs
Michigan United Conservation Clubs partner with Pheasants Forever, Quality Deer Management Association, and the Department of Natural Resources to deliver the Michigan Wildlife Cooperatives program which was created to improve habitat and hunting experiences on private lands by providing resources, supplying information, and supporting collaboration among individuals and groups. The Michigan Wildlife Cooperatives program provides wildlife and habitat management training and resources to grow and promote cooperative development and expansion. Collective management works especially well for game that has a large home range such as white-tailed deer, pheasants, and turkeys. For wildlife cooperatives, see:
http://www.mucc.org/cooperatives
Anna Mitterling: amitterling@mucc.org (517) 346-6454
Amy Trotter: atrotter@mucc.org (517) 346-6484

Clinton River Watershed Council
For over 44 years, the Clinton River Watershed Council (CRWC) has provided opportunities for citizens, schools, governments, businesses, and other community groups to get involved and active in ensuring a healthy Clinton River for us all through education, stewardship, and watershed management—to make a difference in your community…today and for future generations. The watershed covers 760 square miles in 4 Counties with 72 Communities and 1.5 million people. Their 2012 strategic plan is posted on the website. http://www.crwc.org

Friends of the St. Clair River
The mission at Friends of the St. Clair River is to provide fun, educational experiences that engage the community in the protection of their water resources. They promote scientific, volunteer-based water monitoring and watershed stewardship for the restoration and

protection of the St. Clair River. This council welcomes anyone interested in learning more about the St. Clair River watershed. Meetings are scheduled quarterly and rotate between Sarnia, Canada and Port Huron, Michigan. http://scriver.org/

Sources of Michigan Native Plants

This list of suppliers is meant to provide a start in your search for native plant suppliers near you. Note: The Michigan Department of Environmental Quality's bio-engineering permit does require the use of Michigan native plants below the ordinary high water mark when doing work that requires a permit.

Michigan Native Plant Producers Association (www.mnppa.org/)
The Michigan Native Plant Producers Association comprises 7 independently owned nurseries located throughout the state of Michigan. Together they grow and sell over 400 species of Michigan native plants and seeds, including, trees, shrubs, wildflowers, grasses, and ferns.

Wildflower Association of Michigan (www.wildflowersmich.org/)
The Wildflower Association of Michigan encourages the preservation and restoration of Michigan's native plants and native plant communities. They provide education on native plants and native landscaping through their conference, website, grant program, and quarterly newsletter. They also have sources of native plants and a business directory listed on their website.

Michigan Association of Conservation Districts
Many of Michigan's 78 Conservation Districts host native plant sales in the spring and fall.

Oakland Wildflower Farm
Oakland Wildflower Farm is a "Grower and Educator" of Michigan native plants located in Brandon Township in northern Oakland County. They grow a variety of native wildflower, grasses, sedges, ferns, shrubs, and trees. All seed sources are documented and seeds are Michigan geno-type, unless otherwise noted (they strive to collect seed from as close to the nursery as possible). Their website hosts a Culture Guide to help you choose the right plant for your place. http://www.oaklandwildflowerfarm.com/

3.4.3 Private Sector Natural Resource Professionals

Note: The lists provided are for reader's use but do not constitute an endorsement or guarantee of the quality of service. Other contractors not listed may also be available in your area.

MDNR List of Certified Forest Stewardship Plan Writers for Southeastern Lower Michigan
Source: http://www.michigan.gov/dnr/0,4570,7-153-30301_34240-298690--,00.html

Nikita Brabbit (Consulting Forester)
917 West Genesee Street, Lansing MI 48915
nbrabbit@gmail.com; 507-458-4947
Related Programs: Tree Farm, Commercial Forest

Dan Brown (Consulting Forester)
2167 Gunnell Road, Eaton Rapids, MI 48827
brownd94@msu.edu; 517-898-5670
Related Programs: Tree Farm, Commercial Forest

Burhop Forestry Consulting
Carl Burhop (Consulting) Forester
PO Box 362, Dexter, MI 48130
burhopforestry03@yahoo.com; 734-904-5233
Related Programs: Tree Farm, Commercial Forest, TSP
Credentials: Registered Forester, Certified Forester, Association of Consulting Foresters

Darling Forestry LLC
Jason Darling (Consulting Forester)
1111 West Barnes Road, Mason, MI 48854
www.DarlingForestry.com
jason@darlingforestry.com; 517-243-2000
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest
Credentials: Registered Forester

Ecosystems Management LLC
Jack Boss (Wildlife Biologist)
3210 Bewell Avenue SE, Lowell, MI 49331
ecosystemsmgt@att.net; 616-897-8575
Related Programs: TSP, Qualified Forest, Commercial Forest, QDMA
Credentials: Certified Wildlife Biologist

Jacques Forest LLC Forester Type: Consulting Foresters
1251 Spartan Road, Tawas City, MI 48763
Office: 989-362-6245
Tom Jacques (Consulting Foresters) jacquesforest@yahoo.com; 989-329-8079
Jenilee Jacques (Consulting Foresters) jenileerae@gmail.com; 734-272-2365
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest

Spencer Kellum (Biologist)
2318 Parkwood Avenue, Ann Arbor, MI 48104
spencer.kellum@gmail.com; 734-794-3879
Related Programs: Commercial Forest

The Land Steward LLC
Rick McAvinchey (Consulting Forester)
300 Woodbridge Lane, Ortonville, MI 48462
thelandsteward@frontier.com; 248-627-7109
Related Programs: Tree Farm, Commercial Forest
Credentials: Registered Forester, Association of Consulting Foresters

Lee Forestry Services
Doug Lee (Consulting Forester)
404 John K Drive, Auburn, MI 48611
foresterdoug@charter.net; 989-662-0139
Related Programs: TSP, Qualified Forest, Commercial Forest
Credentials: Certified Forester

Dave Mathis (Consulting Forester)
PO Box 28, Chelsea, MI 48118
dmmathis@yahoo.com; 734-395-4113
Related Programs: Tree Farm, Qualified Forest, Commercial Forest

Natural Community Services LLC
John DeLisle (Ecologist)
30775 Longcrest, Southfield MI 48076
j_delisle@hotmail.com; 248-672-7611

Post Hardwoods
Justin Brabon (Industry Forester)
3544 38th Street, Hamilton, MI 49419
jbrabon91@gmail.com; 616-799-0262 or 269-751-7307
Related Programs: Qualified Forest, Commercial Forest
Credentials: Registered Forester

Progressive Forest Management
Pete Klink (Consulting Forester)
PO Box 521, Coldwater, MI 49036
marklink@dklb.net; 517-238-4048
Related Programs: Qualified Forest, Commercial Forest

Quality Hardwoods Inc
Abe Kempf (Industry Foresters)
396 East Main Street, Sunfield, MI 48890
abraham@qualityhardwoodsinc.com; 517-566-8061 or 231-735-3470
www.QualityHardwoodsInc.com
Related Programs: Tree Farm, Qualified Forest, Commercial Forest
Credentials: Registered Forester

River Bend Willow Forestry
Lisa Parker (Consulting Forester)
116 East Willow Street, Lansing, MI 48906
parke204@msu.edu; 517-763-8637
Related Programs: Tree Farm, Qualified Forest, Commercial Forest
Credentials: Registered Forester

David Syckle (Wildlife Biologist)
1410 Charles Avenue, Alma MI 48801
syckl1de@cmich.edu; 989-533-8447

Jeff Tuller (Consulting Forester)
5433 Colby Road, Owosso, MI 48867
tuller@straightturn.com; 810-841-4414 or 989-723-9522
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest
Credentials: Registered Forester, Association of Consulting Foresters

Weber Brothers Sawmill
Amy Salisbury (Industry Forester)
2863 West Weidman Road, Mt Pleasant, MI 48858
amysalisbury@live.com; 989-330-0421
www.WebersSawmill.com
Related Programs: Tree Farm, Qualified Forest, Commercial Forest

Credentials
Registered Forester – www.Michigan.gov/Foresters
Certified Forester - www.safnet.org/certifiedforester
Association of Consulting Foresters - www.acf-foresters.org

Professional Forester Classifications

Consulting Foresters
Consulting foresters are independent businesses that work directly for the landowner. Consulting foresters administer timber sales, write Forest Stewardship Plans, manage wildlife habitat, plant trees, and offer other services for forest landowners. There are about 125 consulting foresters in Michigan.
Association of Consulting Foresters : www.acf-foresters.org
Forest Stewardship Plan Writers – www.Michigan.gov/ForestStewardship

Industry Foresters
Industry foresters work for local forest products companies to buy timber from private landowners or to manage forest land owned by their company. Industry foresters buy timber from private landowners and write forest management plans. There are about 100 industry foresters in Michigan.
Michigan Association of Timbermen : www.timbermen.org
Michigan Forest Products Council : www.michiganforest.com
Great Lakes Timber Professionals Association : http://gltpa.org

Government Foresters
Government foresters, funded by your tax dollars, provide general forestry information to landowners. Government foresters conduct workshops, hold field days, write articles, and make professional referrals. There are about 35 government foresters who help private landowners (and another 200 working on public land).
Conservation Districts – 20 foresters in the Forestry Assistance Program – www.Michigan.gov/mifap
MSU Extension – 5 educators statewide: http://msue.anr.msu.edu/topic/info/forestry
MDNR – 5 foresters statewide – www.Michigan.gov/PrivateForestLand
USFS : www.fs.fed.us/spf

Southern Lower Michigan Restoration Contractors (from The Stewardship Network)
The Stewardship Network has compiled a directory of contractors who perform an array of services related to ecosystem restoration and stewardship in Southern Lower Michigan. Visit http://stewardshipnetwork.org/resources/southern-michigan-restoration-contractors for the most recent version of this document. If you would like to add your own company or suggest a contractor that you have had success with, suggestions may be emailed to staff@stewardshipnetwork.org.

Michigan Certified Natural Shoreline Professionals
Certified Natural Shoreline Professionals have demonstrated competency in shoreline and near shore soils, plant communities, aquatic habitats, water law and permitting, wave energy assessment and the methods and techniques involved in designing natural shoreline landscaping and bio-engineered erosion control on inland lakes. Certification is provided by the Michigan Natural Shoreline Partnership (MNSP) and is updated every three years through continuing education. (from http://www.mishorelinepartnership.org/)

To find a Natural Shoreline Professional in your area, visit http://www.mishorelinepartnership.org/find-a-shoreline-contractor.html Professionals can be found easily by name or county (there are also many who work state-wide) on spreadsheets created and maintained by MNSP.

4. Landscape Stewardship Stories

A unique component of this project was to interview public and private landowners who actively manage their forested property. This piece highlights the stewardship efforts of private landowners that often go unnoticed. The stories presented in this plan include numerous accounts of restoration efforts on both public and private lands in Macomb and St. Clair Counties. By speaking with neighbors and sharing stories about the experience of managing forest lands, we hope to inspire other landowners to become actively engaged in managing their own land and encourage them to share their own stories in the future.

4.1 Adopt a Stream

Clinton River Watershed Council

You may have been driving along Michigan highways and seen signs for adopting a highway, but did you know if you live in the Clinton River watershed you could also Adopt-A-Stream? The Clinton River Watershed Council has been facilitating the Adopt-A-Stream program in communities throughout the watershed for a decade now and it has not only grown in size and scope, but also has increased awareness and participation in stewardship among residents who are concerned about the health of streams and rivers.

The Clinton River Watershed Council is a non-profit organization that partners with local government, businesses, and private citizens to protect the watershed and improve water quality for the Clinton River watershed located throughout Macomb, St. Clair, and Oakland counties in southeastern Michigan. The watershed for the Clinton River encompasses approximately 760 square miles and includes not only the 80 miles of the Clinton River but 1,000 miles of streams that feed it.

The Adopt-A-Stream program began 10 years ago to assist local governments to provide education and stewardship to residents as components of municipal storm water permits. Similar programs are found throughout the state as a part of a MiCorps Program. Watershed ecologist Matt Einheuser said, "We wanted to provide a program to the residents within the watershed to have active stake in their watershed and an opportunity to learn about the ecology of the watershed, watershed conditions, water quality and to become a part of a citizen science movement and to get out and enjoy their resources."

Another goal of the program is to collect data at various locations in order to assess the health of the watershed, "The state doesn't have the resources to visit every stream site, so volunteers are needed to collect data from stream monitoring to get baseline conditions, identify areas for restoration, and identify areas of issue", Matt said. The data generated by volunteers is collected by the Watershed Council and then submitted to the Michigan Department of Environmental Quality and MiCorps so that the agencies can identify any potential areas of water quality concern.

Adopt-A-Stream volunteers are sent out in teams to various stream sites throughout the watershed twice a year in May and October. At each site, volunteers will describe their section of stream as far as what kind of vegetation is present, what the banks look like (looking for evidence of erosion), the flow of the stream, and any blockages that can be observed. Volunteers are encouraged to draw, photograph, or record a video of the stream and its features.

The other task of the site visit is to collect benthic macroinvertebrates, more commonly known as aquatic bugs. The collection of bugs provides crucial information about the health of the stream. Certain species of macroinvertebrates are very tolerant of pollution, some are moderately tolerant, and some are highly intolerant of pollution. By recording the species that are present in the stream and categorizing them by tolerance, the Watershed Council can apply a formula to determine a water quality score. A higher ratio of pollution intolerant bugs indicates that the stream is healthy with little pollution present. If volunteers can only find pollution tolerant bugs, there is a significant chance that pollutant levels in the stream may be high. This data is crucial for tracking stream health and identifying trends of issues. "The aquatic bugs act as indicators of water quality- the canary in coal mine so to speak. Certain bugs, when you start to see them start to disappear from the site, that gives you indication that something is going on." Matt said, "The population of the community of aquatic bugs can tell you the overall conditions of the stream" Volunteers can take a short training course provided by the council on how to collect and identify the macroinvertebrates.

Some of the biggest threats to water quality in the Clinton River watershed is the increased urbanization of the surrounding land; more impervious surfaces lead to more runoff into rivers and streams that carry pollutants and chemicals, and runoff can also increase erosion of banks. "In the highly urban setting, we tend to see our poorer sites, but as we get out into the headwaters we see more groundwater influence and more riparian vegetation. We find more diverse aquatic bugs and better habitats." continues Einheuser.

But it's not all bleak, the continued work of the watershed council and the Adopt-A-Stream program are creating some tangible success stories. "We have some really high quality tributaries to the Clinton River. The watershed in general is in pretty good shape" said Matt, "We're seeing a lot of participation in the Adopt-A-Stream, a lot of younger people coming to the program. We have about 40 sites we monitor and we get about 150 volunteers every year for Adopt-A-Stream."

The response to the program from the local communities has been very positive. "We hear nothing but good things about the program. Local municipal governments are happy because they like to see their residents get out there into the streams. The data we collect also helps to write grants for further preservation and conservation projects."

"The Adopt-A-Stream program is kind of a gateway for people to engage in other conservation efforts. They come to Adopt-A-Stream because it sounds fun and then they realize they're part of a volunteer base and look into other ways to get involved and learn more. We have some people who start with the program and then go home and begin to look at say, bugs in their backyard or in their local stream which may not be an AAS monitoring site but now that they know about it, they want to see what's going on in their area."

If you would like to know more about the Adopt-A-Stream program and the Clinton River Watershed Council go to http://www.crwc.org/programs/adoptastream/

4.2 Green Macomb

Macomb County Planning & Economic Development

Macomb County in southeast Michigan is a study of contrasts. From its northern border that is largely farmland and open, to newly developed pockets of suburbs and small towns, to heavily suburban and industrial areas at its southern boundary neighboring Detroit, there is a wide variety of landscapes, ecosystems, and communities throughout the county. Prior to European settlement, most of Macomb was forest and wetlands, but nearly all of these ecosystems were cut down or drained to make way for farmland, which later replaced by small towns, and eventually was converted to suburbs and commercial use. Trees were planted in the residential areas, but over time a vast number of those trees were lost to disease and pests such as Dutch elm and the emerald ash borer. The increase of industrial or commercial land use and impervious infrastructure such as roads and parking lots has caused a further decline of tree canopy in the region. This decrease in tree canopy can increase the likelihood of stormwater runoff into waterways, a decline in property values, and a decrease in the quality of the aesthetics preferred by the community.

But the Macomb County Planning and Economic Development department has a plan to turn this around. As part of a U.S. Forest Service Great Lakes Restoration Initiative grant and in partnership with SEMCOG (Southeast Michigan Council of Governments), Macomb County has introduced the Green Macomb Urban Forest Partnership that will work towards the goal of increasing green infrastructure throughout the county by strategically planting trees. The Green Macomb program is designed with the goals of improving water quality, aesthetics and property values, reduce flooding potential and support public health and existing infrastructure.

Brent Guerink, planner with the Macomb County Planning and Economic Development's Land and Water Division, said "Macomb County has lost over 86% of wetlands since 1800, one of the highest losses by county in Michigan. As natural areas and wetlands diminish, the ecosystem services they provide – clean water, clean air, flood control, species habitat, and resiliency to climate variation through local attenuation of extreme temperature and precipitation events – are lost as well."

The first step in this program was to identify the areas lacking tree canopy. Through cooperation among the municipal governments, non-profit organizations, and concerned citizens and by using extensive GIS analysis, a census of tree canopy was developed. After analysis, it was determined that the communities south of the Clinton River Main Branch to the border with Wayne County were in the most need of increased canopy. Several interactive map tools and data sets were created to assist cities in the target area to pinpoint streets, neighborhoods, roadways, parks, and commercial areas that would most benefit from increased tree plantings. "Green Macomb has largely been working with representatives from local communities, with outstanding response and participation. All 12 targeted communities have

participated in the Urban Forest Partnership, with great momentum developed from the local municipal level" said Geurink.

Then, community profiles for each city were developed to assist city leadership to create a strategic plan for increasing tree cover and addresses the goals, challenges, strengths, and opportunities tailored for each city based on the data collected. If you live in one of the cities in the program area you can view your community profile at http://green.macombgov.org/Green-CommunityResources

With funding through the GLRI program and partnership with volunteer groups, cities are implementing the program to plant trees in each municipality with plans for long term stewardship, including education and outreach to engage citizens to do further tree plantings on private property. "Green Macomb received at US Forest Service Great Lakes Restoration Initiative (GLRI) grant to plant 1,000 trees in 2017-18 in collaboration with local municipalities. Approximately half of these trees will be planted by volunteers with our non-profit partner ReLeaf Michigan" continued Geurink.

Early success stories are already being reported. "Two fall demonstration tree plantings, one in Utica along the Clinton River Hike and Bike Trail near the Clinton River, and one in Warren at Macomb Community College's 12 Mile campus to at the pedestrian crossing and bus shelters." "While the tools and resources, and some larger-scale funding, has come from Green Macomb, the ultimate success of the program is driven by local stories of progress and momentum as individual communities continue to improve their urban forestry programs to plant more trees, increase the diversity of the urban forest, and continue to develop and share education and outreach with the general public so that Green Macomb is not just a top down project by the county, but a countywide program grown from the ground up through tree plantings by private residents, businesses, schools, non-profits, and local municipalities."

If you are interested in knowing more about the Green Macomb Urban Forest Initiative, please visit
http://green.macombgov.org/Green-Home

4.3 James & Alice Brennan Memorial Sanctuary

Michigan Nature Association

The Michigan Nature Association (MNA) is a major force for the acquisition and protection of natural spaces throughout Michigan. They have over 170 nature sanctuaries, totaling over 12,000 acres all over the state representing nearly every type of landscape and habitat feature of Michigan, both common and rare. The caretaking of these sanctuaries could not be possible without a corps of dedicated stewards who perform regular visits, maintain trails, and provide educational opportunities.

One of the largest sanctuaries in St. Clair County is the James and Alice Brennan Memorial sanctuary located within the rural center of St. Clair. The sanctuary, donated to MNA in 1987, is over 115 acres and is part of the headwaters of the Pine River which flows into Lake St. Clair. One of the highlights of the Brennan sanctuary is "Inspiration Grove": a stand of pines, planted by the original owners, that provides habitat for owls and songbirds. The sanctuary offers two miles of trails that weave through the property through evergreen and deciduous trees, across streams, along the River and its floodplain and wetland areas.

The Brennan Memorial sanctuary is looked after by Christine and Jeff Woods who live just up the road from it. They began volunteering with the Michigan Nature Association 20 years ago. "I've always been interested in nature and MNA was looking for a steward." said Christine, "I was so happy that there was an area that someone hadn't tried to develop and I thought it was a good thing to do." A lot of the work Christine and her husband Jeff do is maintain the marked trails in the sanctuary. "There was a lot of wind today so Jeff will be out later checking for trees across the paths and clearing them." she said. A challenge for the stewards of such a large sanctuary was delineating and posting the boundaries, "We had a lot of people creating their own trails through it."

Every steward of a sanctuary submits monitoring reports to the MNA regarding the condition of the property. "We let them know about problems we might find like illegal hunting, ATV and snowmobile riding, littering etc." Christine adds, "We let them know about upkeep of the sanctuary." Christine and Jeff go out at least once a month but in the summer they're there once or twice a week and they'll make note of anything they see as they're enjoying the property.

A big help in the care of the sanctuary is the relationship with the neighboring properties. "Most of the people are really good and we have a gentleman across the road will call us if he sees something not right. He's called me to say he thought he saw someone building a deer blind on the property, which turned out to be not on the property but it's really nice that he cares." she said. As for the community at large, the response to learning about the sanctuary has been very positive. "We've had tables at events and it was nice, a lot of people were interested and pick up literature and kids ask questions about it." Christine said, "We also lead walks through the property and it's educational for everyone". She said over the recent years

more people in the community have become more aware and are more interested in the sanctuary and there's definitely more visitors.

What keeps Christine and Jeff inspired to continue their work in stewardship for the Brennan Sanctuary after 20 years? "We like our nature; we like the fact it's preserved for the future." said Christine. Jeff added, "It's somewhere you can go and walk and you leave your motors and everything out of it and just go enjoy it".

If you would like to know more about the Michigan Nature Association, the sanctuaries or to become a sanctuary steward please visit www.michigannature.org

4.4 Friends of Wetzel State Recreation Area

The Wetzel State Recreation Area is one of the 'hidden gems' of Macomb County; located in the northeast corner of Macomb in Lenox Township, it is the only state park or recreation area in the county. At 960 acres of wetlands, prairie, streams, and woodland areas, it is the largest natural space of such wide diversity to be found in Macomb.

But this wasn't always the case: in the mid-90s Wetzel was a rarely utilized barren field that had suffered neglect and misuse for years. Litter and illegal dumping took a heavy toll on the property. By 1997, the park was being considered to be sold for development into condos and golf courses. By all indications it appeared that the park was going to disappear for good until help came from an unlikely source; one of the few groups that was actually still utilizing the park's wide open spaces – the Radio Control Club of Detroit, a group of model aviation enthusiasts. "The Radio Control Club put out a call on the Ted Nugent radio program in 1997", said Lenox Bowman, "A bunch of us got together, we had maybe 50 people that first night. My wife said 'Put your hand up' and that's how I became co-chair with Mike to get this off the ground".

Lenox and Mike Jennett were now co-chairs of the newly formed Friends of Wetzel State Recreation Area, a group of concerned residents who wanted to get involved in helping the beleaguered park. "The public outcry was what really stopped the sale. The neighbors were all concerned as to what the park would turn into. We formed the group to see what we could do for the park, and what we could do with the park as well" said Mike. The Friends of Wetzel applied for a 501(c)(3) to become a nonprofit group and started planning a strategy to save the park, and to bring it back as a viable recreation destination and natural landscape.

The first job was cleaning up the park. "The land had become a dump site, because of all the dead end roads leading into it and it was the perfect place to go unload your pickup full of junk" Mike said. "I don't know how many tons of junk there was." Lenox continues, "The first year we took six abandoned cars out of there." As the group began to do clean up events every year, involvement of the community increased. The local police and sheriff's department began to patrol the park to prevent further illegal dumping.

The next question the Friends had to figure out what was to do with the park now? "We wanted it to be more user friendly" said Mike. Lenox adds, "We wanted to make it a multi-use park, open to hunting, hiking, fishing, and general use as a recreation area." One of the biggest contributions to protecting the park was the implementation of mitigation wetlands. A developer who had built on wetlands was required to replace those acres lost, and with the help of a MDNR park administrator, they were able to develop that inside Wetzel. "We saw that as great help," said Lenox "the park was protected because we had wetlands now." Approximately 120 acres of wetlands were constructed in the park. In addition to the wetlands, 4.5 miles of trails were created, along with a handicap accessible trail, a parking lot, and rest room facilities. "It took us ten years of monthly meetings from 1997 until 2005 before we had

anything to really talk about. It took someone high up in the MDNR to take an interest to help put something out there and it changed the whole dynamic", said Mike.

With the patient and perseverant work of Friends of Wetzel, the park began to be a diverse and dynamic natural area. The wetlands attracted waterfowl that had previously avoided the area. An Audubon ornithologist counted 214 species of birds in the park. Conservation clubs soon began to take an interest, and MDNR Parks and Recreation and Wildlife Divisions increased their involvement in the park's management.

One of the biggest success stories the Friends of Wetzel had was hosting school field trips for urban/suburban schools. Fourth graders learned from naturalists about the natural features of Wetzel. Lenox said, "The kids had a ball, some of them have never even seen a dirt road, some were scared to go out into the wild but by the end of the day they were carrying cattails and mushrooms and looking for snakes and frogs."

Future goals of the group are continuing to raise awareness of the park, and to create an educational pavilion, and add interpretative signs. "We'd like it to be an extension of the educational experience of the school trips" said Mike. In addition to education, the group would like to enhance and expand diversity of the habitats for native species. The challenges that persist for the Friend of Wetzel are to address the spread of invasive species, mainly autumn olive and *Phragmites australis*. They're currently working with the local CISMA and conservation groups to control about 25 acres of phragmites along the wetlands.

The Friends of Wetzel State Recreation Area continue to work diligently to promote the park and its attractions for recreation activities, and to raise awareness of the incredible diversity to be found there. After 20 years of persistence and perseverance, the group proves that anyone with a passion for conservation and stewardship for nature can take a distressed and neglected area and help make it not only a destination spot, but a wonderful asset of native ecosystems and habitats. Sometimes these areas just need a "Friend."

If you would like to know more about Friends of W.C. Wetzel State Recreation Area or volunteer to help please visit their website at http://www.fowsra.org/ or find them on Facebook @FOWSRA or follow on Twitter @friendsofwetzel

4.5 North Branch of the Clinton River

The North Branch of the Clinton River (North Branch) is a 43-mile long tributary of the Clinton River extending from its headwaters in northern Macomb and Lapeer Counties, south to its confluence with the main branch of the Clinton River near Mt. Clemens, and finally discharging into Lake St. Clair in Harrison Township. Approximately 4 miles of the North Branch are within Wolcott Mill Metropark in central Macomb County. Land use within Wolcott Mill Metropark consists of a historic grist mill, an educational farm, a small 18-hole golf course, passive recreation such as nature and equestrian trails, open space, natural areas, and several large tracts of property leased to local farmers for active agriculture.

In 2008, the Metroparks engaged scientists from Lake Superior State and Oakland Universities to look at how current vegetative cover and Metropark land use practices effect the water quality of the North Branch as it passes through the park. Several years of monitoring confirmed that the North Branch was indeed being negatively impacted by sediment and nutrient loading, primarily from nearby agriculture, however the monitoring also showed that as the river flowed through the park with its extensive vegetation and tree cover, that water temperatures fell and biotic conditions of the riverine system improved. Faced with this information, as well as the desire to participate in the objectives of the Clinton River Watershed Management Plan, and other planning efforts affecting the watershed, (Lake St. Clair Comprehensive Management Plan, Clinton River Watershed Remedial and Preventative Action Plan, Water Quality Management Plan for Southeast Michigan), the Metroparks began to assess land use practices within Wolcott Mill Metropark, including those properties currently being leased for agriculture, with the goal of developing a long term strategy of restoring sections of floodplain along the North Branch back to native grassland and forested wetland systems in order to improve water quality and wildlife habitat.

The series of planned projects were intended to:

1) Re-establish floodplain wetlands to help reduce runoff and capture sediment from adjacent farming activity
2) Increase the forest canopy through planting trees in existing farm fields which will help shade and cool the river water, and increase connectivity between forest patches to improve habitat for species reliant on large tracts to complete their life cycles and to promote plant and animal diversity
3) Restore native grassland habitat in adjacent farm fields to help reduce runoff and create

habitat that will benefit wildlife species currently in decline such as pollinators and grassland birds

4) Create improved recreational and educational opportunities for the citizens of Macomb County and Southeast Michigan.

With the assistance of project partners: Macomb County Public Works, U.S Fish and Wildlife Service, Michigan Department of Environmental Quality, and Oakland University, and funding from the Michigan Department of Environmental Quality, U.S. Environmental Protection Agency, U.S Fish and Wildlife Service, and the Metroparks, over one hundred acres of farm land and old field are being transformed back to the native riverine ecosystems that once occupied that space.

Over a two-year period, dozens of volunteers have helped to plant over 6000 native trees on both floodplain and upland portions of the project site to help reconnect the river corridor forest. These trees were chosen based on soil and moisture suitability and appropriate varieties for restoration based on historic conditions. Additionally, over 80 acres of wetland and native grasslands have been created or restored along the river corridor to create a variety of diverse habitats for wildlife and to help alleviate nutrient and sediment runoff from adjacent agricultural fields.

The project is also giving students and faculty from Oakland University an educational and research opportunity to monitor and study these native systems as they develop, and the now the general public who visit Wolcott Mill Metropark have an opportunity to experience these new and varied habitats for hiking, trail riding, bird watching, and enjoying a tranquil moment along the banks of the North Branch.

4.6 Cuttle Creek Restoration

By Bill Parkus

Background

Cuttle Creek is located in Marysville, Michigan − St. Clair County. The creek is a tributary to the St. Clair River and is located within the Area of Concern. The St. Clair River − which forms the upper-most part of the Lakes Huron to Erie Corridor − is 40 miles in length and flows in a southerly direction into Lake St. Clair. The boundaries of the Area of Concern include the entire River from the Blue Water Bridge south to and including the river delta and west to St. Johns Marsh.

The St. Clair River and its delta provide extensive and diverse fish and wildlife habitat. At least 91 species of fish have been recorded with at least 46 species utilizing the area for spawning and nursery habitat. Common members of the fish community include the following: rainbow and brown trout, Chinook and coho salmon, rainbow smelt, sturgeon, northern pike, muskellunge, walleye, yellow perch, longnose gar, bowfin, smallmouth bass, largemouth bass, channel catfish, suckers and several species of minnows and sunfishes.

The wetlands and associated open waters of the lower St. Clair River and Lake St. Clair is one of the most important wetlands systems in the Great Lakes region for ducks, geese and swans. The Area of Concern provides habitat for at least 20 species of amphibians, 25 species of reptiles, 250 species of birds and 60 species of mammals.

Much of the St. Clair River shoreline has been hardened or armored with sheet metal seawall. This has removed from use, a large section of the St. Clair River's shoreline as habitat for fish and wildlife.

Physical character of Cuttle Creek

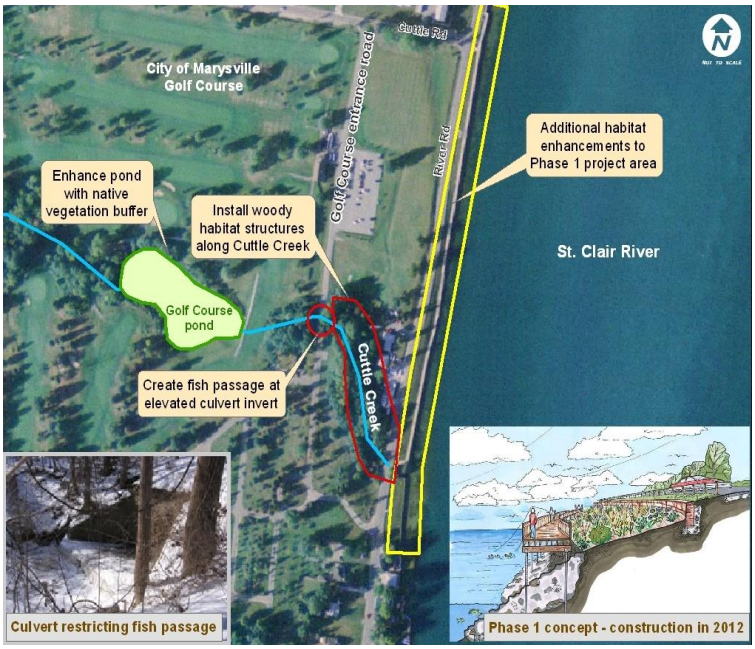
Cuttle Creek, located within the jurisdiction of the City of Marysville, runs 3.4 miles southeast through varying landscape conditions. The upper part of the creek flows through a subdivision, the middle section is a dredged ditch adjacent to a road, and the lower portion runs through the Marysville municipal golf course on its way to the St. Clair River. The stream averages from 10 to 15 feet in width and from four-inches to three-feet in depth. The substrate ranges from cobble, gravel, clay and sand. Stream habitat includes pond, riffle and run. The riparian habitat where present – can be forested.

A 2009 Department of Natural Resources fish survey of the Cuttle Creek caught 644 fish representing 17 species. The predominant species consisted of: emerald shiners, creek chub, fathead minnows, striped shiners. The fish community is degraded primarily to two fish passage barriers: a perch culvert and a dam –both located between the municipal golf course and the St. Clair River. However, their presence confirms that Great Lakes fish species are using small tributaries like Cuttle Creek during various stages of their life cycle.

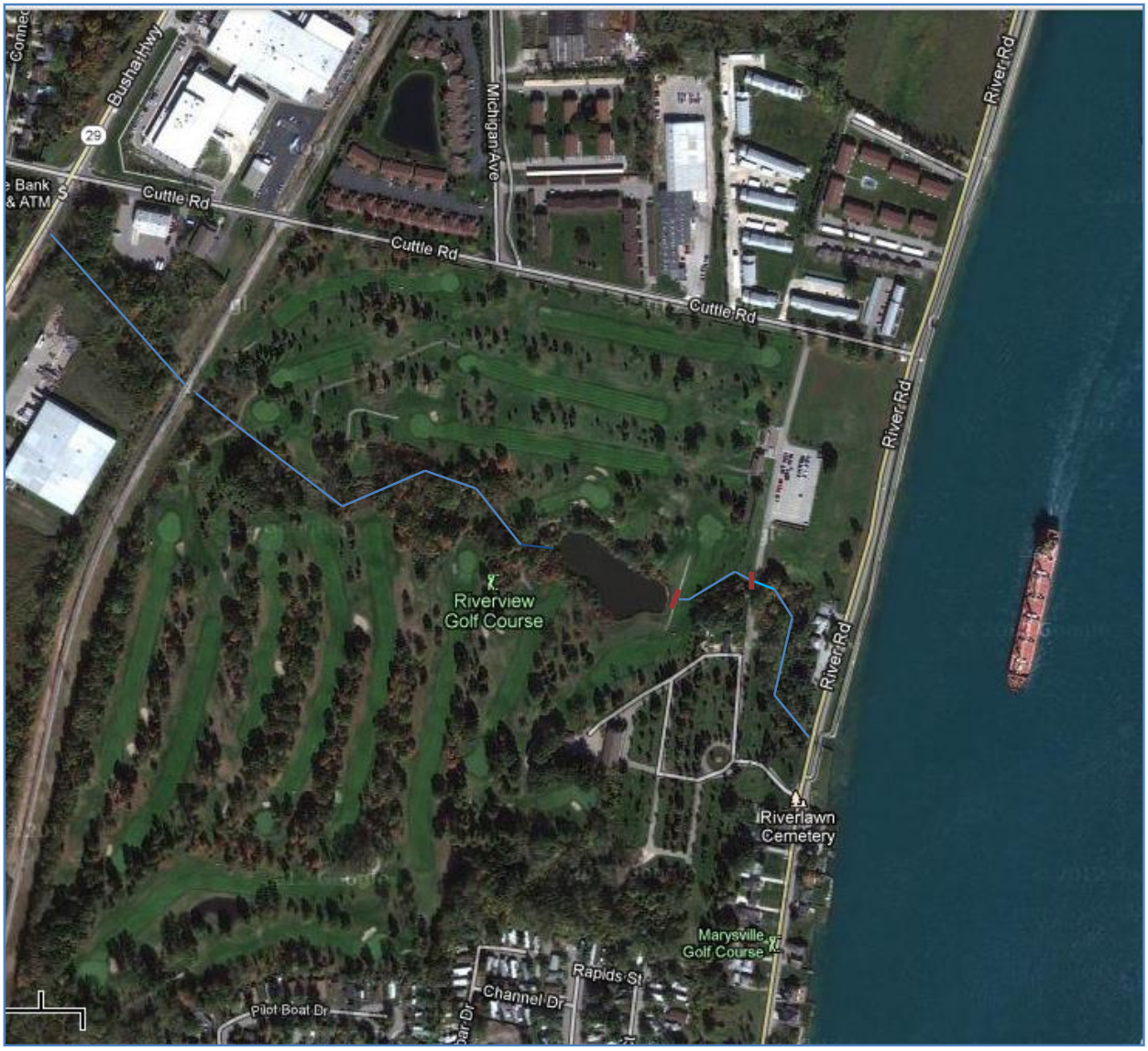
The City of Marysville has undertaken a two phase project to A) restore over 2000 feet of its St. Clair River shoreline with enhanced fish and wildlife habitat and improved opportunities for public access and recreation, and B) restore fish and wildlife habitat, fish access and improve water quality of the Cuttle Creek – a tributary to the St. Clair River.

Cuttle Creek Restoration

The purpose of this project is to continue St. Clair River shoreline restoration, as well as restore fish and wildlife habitat, fish passage and improve the water quality of Cuttle Creek which discharges to the St. Clair River inside the project area of Phase I. The two phases are connected and elevate the level of benefit of the entire project to the Lake St. Clair watershed and Lake Erie.



This is a priority project for the implementation of the *St. Clair River and Lake St. Clair Comprehensive Management Plan* (the Management Plan) and the St. Clair River Remedial Action Plan.



Cuttle Creek Channel

Barriers to fish passage

4.7 An Eco-tourism Vision for the use of the Inland Waterways of Harsens Island

By Bill Parkus

Background

Harsen's Island is located at the mouth of the St. Clair River within the Delta. It is 18 square miles in size and contains world class wetlands and bottomlands along its western coast known as the St. Clair Flats, and significant remnant natural communities of Great Lakes Marsh, Lakeplains Oak Openings, Southern Shrub-Carr, Lakeplain Wet-Mesic Flatwoods, Lakeplain Wet-Mesic Prairie, Lakeplain Wet Prairie

With the advent of farming, residential development and the loss of fire within that landscape, nearly all the native wet prairie disappeared – not only from Harsens Island – but also from the State of Michigan as well. The Michigan Natural Features Inventory estimates that less than 1 percent (1%) of the original wet and wet-mesic prairie remains in Michigan.

The Harsens Island Conservation Area has been used as a private hunting club for several years and consists of two major parcels, a 440-acre North Property and a 107-acre South Property. Only the North Property is included in this application to the MNRTF.

There are a number of inland waterways and drains that cross the island. These waterways still receive significant use for boating and fishing recreation. In addition, large portions of the island marshy areas have been diked with the ability to raise and lower water levels to promote duck hunting recreational opportunities.

A large portion of the island's low-lying marshy areas and its inland waterways are now being invaded by the highly invasive Phragmites *australis* or Common reed. The Phragmites advance will have to be controlled, in order to develop recreational opportunities along the waterways and inland dike.

Clay Township officials are developing a vision to establish eco-tourism activities, such as kayaking and canoeing on the inland waterways (Stewart Creek Drain and Harsen's Island Creek) and biking and hiking on the Hunt Club property (five miles of trails currently) and other inland areas during certain periods of the year. See attached image with waterways identified. In order to realize this vision, the Phragmites must be managed and removed from the vicinity of the inland waterways and the hike/bike trails.

Vision

Develop the inland waterways for recreation activities: Harsens Island inland waterways – Harsens Island Creek Drain and Stewart Creek – have good width, depth and meander through interesting and natural settings– such as the Hunt Club property – with rare and endangered natural communities. Two miles of kayaking/canoeing are currently envisioned along the Harsens Island Drain. (See Figure 1, Vision Map). There are a number of cultural features along

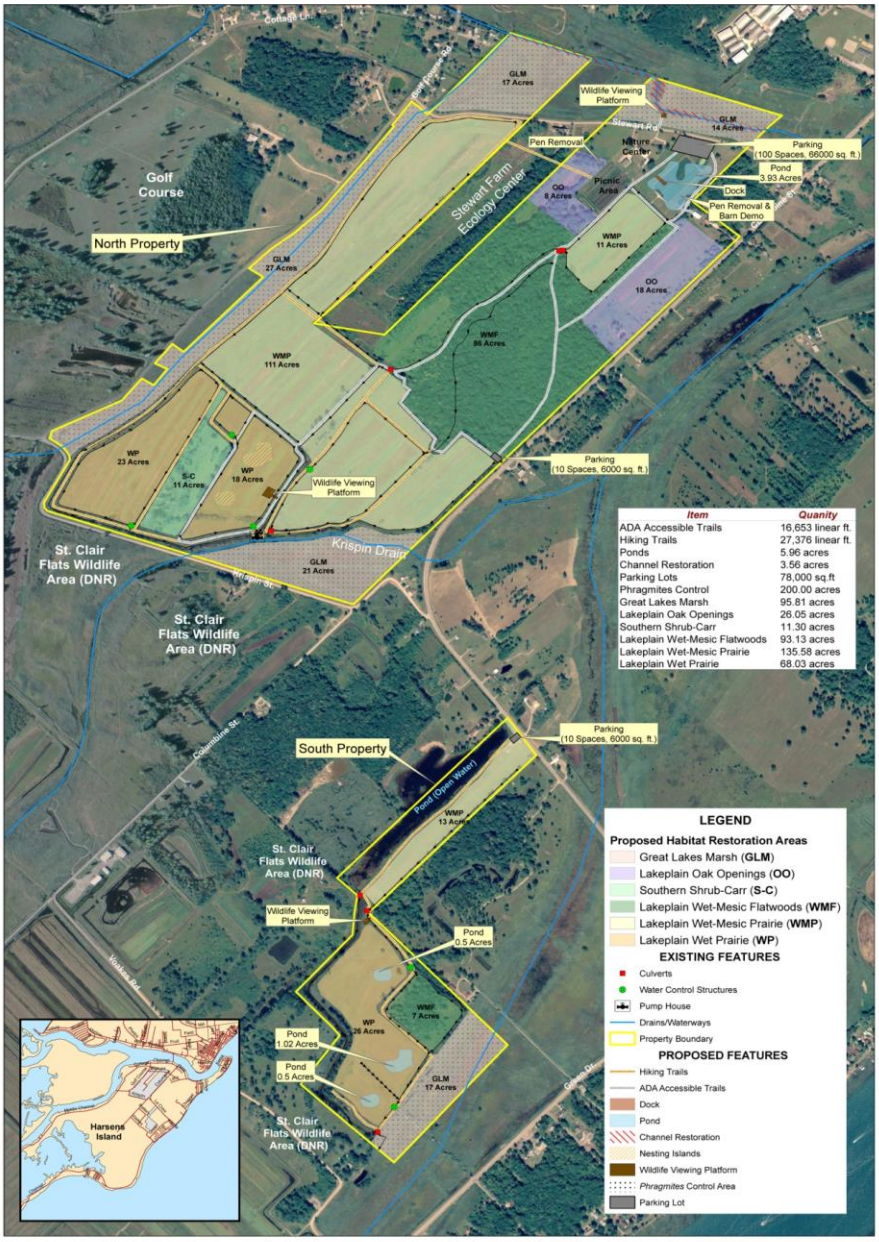
the route such as the Schoolhouse Grille that will add interest and potential to the outing. Also, a number of rest stops for eating and as well as access sites will be included in the route.

Hiking and biking opportunities: Hiking and biking activities are envisioned at the Hunt Club property and along inland dikes at several locations around the island. (see Figure 2 Hunt Club Map)

Managing Phragmites to Improve the resource: An initial project to manage Phragmites on an estimated 75 acres of land along over 3 miles of the Krispin Drain from North Channel Road through the Hunt Club property is now completed. The Krispin Drain runs through Harsens Island and out to Lake St. Clair. Decades of sediment and invasive species had severely degraded the habitat of the drain. The Krispin Drain restoration project included 3 miles of strategic dredging to re-shape the drain along with treatment and removal of Phragmites. The Drain is now St. Clair County's newest Blueways paddle route. The project was funded by the U.S. EPA ($4,000,000) to help delist the Fish and Wildlife Beneficial Use Impairment.

Potential partners of Clay Township include: St. Clair County Drain Commissioner, St. Clair County Metropolitan Planning Commission, St. Clair County Parks and Recreation Commission, Michigan Departments of Natural Resources and Environmental Quality, Ducks Unlimited, and Southeast Michigan Council of Governments, and prominent landowners of the island.

Figure 1 Vision Map



Harsens Island Conservation Area

St. Clair County, MI

0 200 400 800 1,200 1,600 2,000 Feet

ASTI Environmental

Created for: Harsens Island Conservation Area
Created by: AGS, April 1, 2009, ASTI Project 6991

Figure 3 - Restoration Plan

Figure 2 Hunt Club Map

Figure 3 Phase I of Harsens Creek Drain Phragmites Management Project

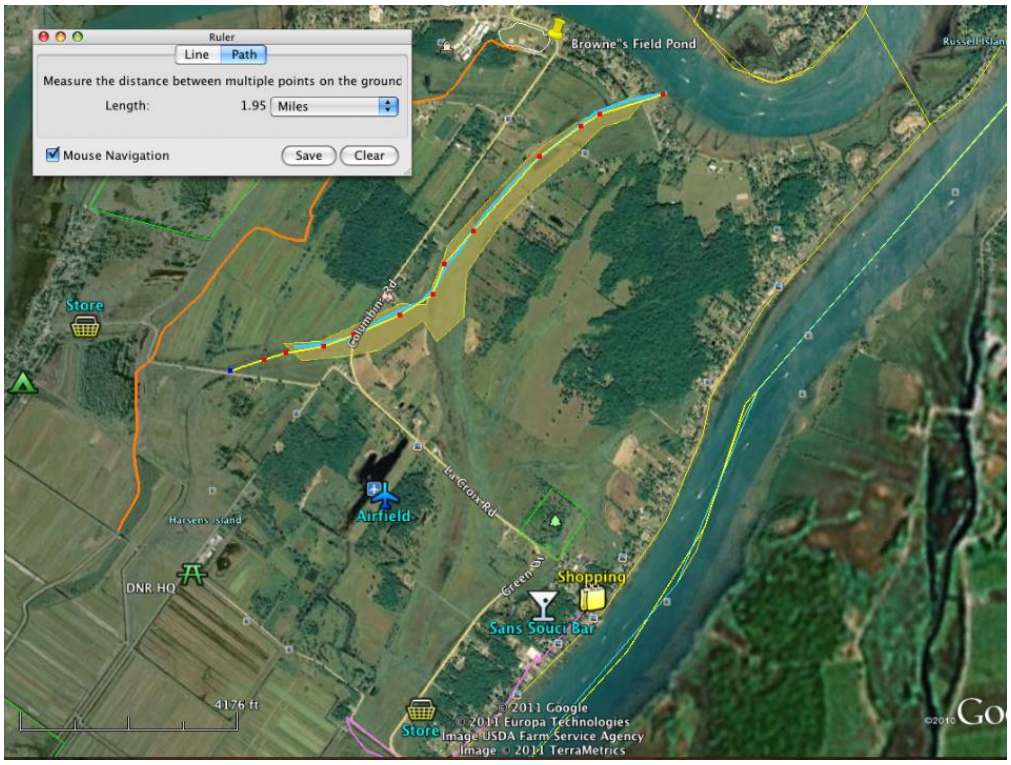
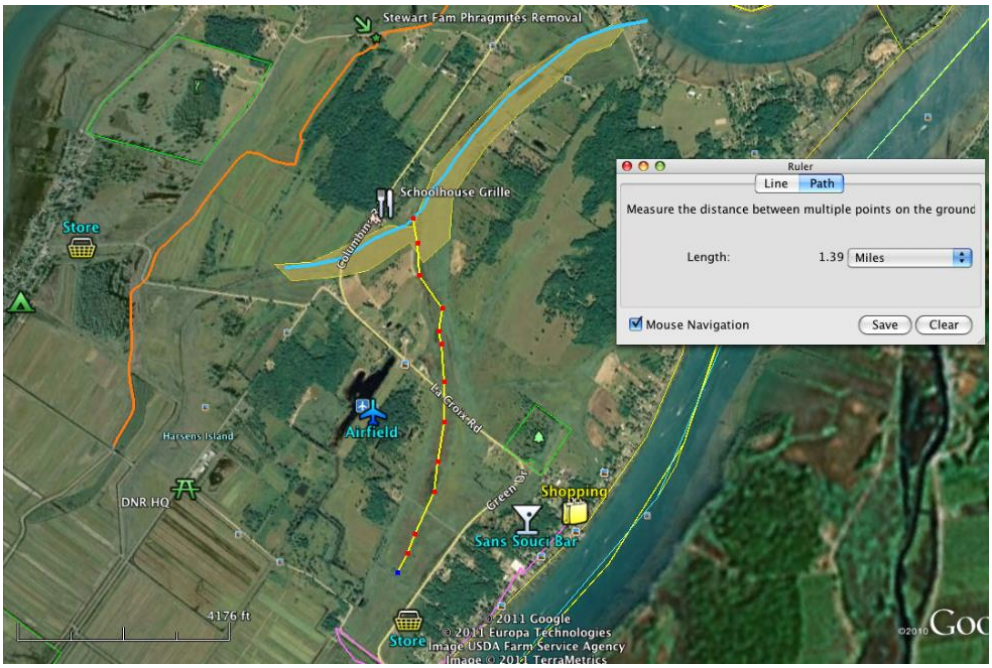


Figure 4 Phase II of Harsens Island Creek Phragmites Management Project



4.8 I-75 Corridor Conservation Action Plan Monroe County

By Bill Parkus

Background

The I-75 Southeast gateway corridor into the Lower Peninsula of Michigan provides transportation services critical to the economic health of the state. Over the past 200 years years, the natural lands and waters near the I-75 Corridor have experienced a tremendous amount of stress. However, this region still harbors several globally imperiled natural communities (lake plain prairie, oak openings, wet mesic flat woods, and Great Lakes Marsh, a very productive Lake Erie coastal zone that support world-class fresh water fisheries and some of the most significant stopover habitat for migratory birds in the Great Lakes region.

Due to the age and condition of the freeway, I-75 in Monroe County needs complete rebuilding. Over the next several decades (beginning in 2015), the Michigan Department of Transportation (MDOT) has targeted portion of I-75 (from I-275 to Ohio border) for a multi-million-dollar full reconstruction. Given its close proximity to Lake Erie, planners recognized the importance of considering natural resources impacts and mitigation as part of the project development process.

In 2013, MDOT, in partnership with the Southeast Michigan Council of Governments (SEMCOG), and the Michigan Natural Features Inventory (MNFI), received a grant from the Federal Highway Administration's (FHWA) Strategic Highway Research Program (SHRP2) to apply FHWA's transportation planning framework – Eco-logicical, to the I -75 Corridor reconstruction in Monroe County. The goal of the Eco-logical framework is to develop a

collaborative-based, landscape scale, conservation plan that guides transportation planning while protecting the environment.

Decision –Making Process

To facilitate the development of the conservation plan, a Technical Advisory Committee (TAC) was convened consisting of local, state, and federal agencies and the Nature Conservancy. In addition to the TAC, engagement of local stakeholders was integral to developing the I-75 Corridor Conservation Action Plan. Stakeholder meetings and workshops were held throughout the process to gather information and data.

Geographic Scope

The Eco-logical planning process strongly encourages a landscape-scale approach that considers the natural assets surrounding the transportation project. The geographic scope of the project includes two conservation zones that encompass Monroe County and parts of several other counties. The Primary zone lies along the Lake Erie coast. It is located between the coastline and US-24 and includes approximately 90,000 acres. The secondary zone is comprised of 250,000 acres and is located immediately west of the primary zone starting at US-24. The entire study area comprises approximately 340,000 acres.

The Partner Conservation Targets and Stressors

The TAC consulted other conservation plans such as the Lake Erie Biodiversity Conservation Strategy and the Michigan Water Strategy for insight and understanding of other similar efforts. This led to the establishment of six conservation targets: coastal tributaries, migratory fish,

herpetofauna connectivity, aerial migrants, globally rare natural communities and coastal wetlands. Goals, or future outcomes were developed for each of the six conservation targets having a 20-year implementation horizon.
Stressors or challenges to achieving the conservation goals were then developed. This consisted of a ranking exercise using the following three criteria: 1) Scope, 2) Severity and 3) Irreversibility. The stressors with the highest impact across the target area were: invasive species, agricultural drainage, and runoff, urban development and runoff and poorly functioning road stream crossings.

I- Potential 75 Corridor Strategies
The I-75 Corridor and its right-of-way is at the center of its conservation planning process. There are numerous opportunities for MDOT to directly benefit several of the conservation targets as it reconstructs I-75. For example, MDOT can:

- Focus on meaningful wetland mitigation
- Apply best management practices (BMPs) for managing stormwater runoff
- Meet road stream crossings design standards for fishes and herpetofauna
- Coordinate invasive species control efforts with cooperative Weed Management Areas (CWMAs).
- Transplant rate species in the right-of-way to appropriately managed sites.
- Install educational information at I-75 rest stop

Next Steps
Overall, the I-75 Corridor Conservation Action Planning process has provided an opportunity to enhance ecological outcomes related to the reconstruction of I-75. Now that the conservation planning has been completed at the landscape level, the next step is to implement the actions identified under each strategy and measure their impacts.

4.9 Stewart Farm Prairie Restoration Project

By Bob Williams

In 2004 a project was begun to restore some of the natural habitat of Harsens Island, a small island in Lake St. Clair, between Michigan and Ontario. It's called the Lakeplain Wet Mesic Tallgrass Prairie Restoration Project. We just call it "The Prairie."

What is a Lakeplain Prairie?

It is a unique ecosystem which developed on ancient glacial lakebeds that are now above water. Over thousands of years, as the waters of the Great Lakes receded, specially adapted plants colonized these unique new physical environments, creating new flora-fauna combinations. Soil differences ranging from sand to clay along with subtle changes in elevation created significant variations in plant communities and thereby different types of lakeplain prairies; tallgrass, wet, mesic, wet-mesic, etc. Plants found in these areas include a variety of grasses and forbs (wildflowers).

The history of Lakeplain Prairies in Michigan

Lakeplain prairies formed a significant part of the natural landscape of southern Lower Michigan at the time of European settlement. Over 80% of historical lakeplain prairie acreage was found in the southeast region of the state, especially in the counties of Monroe, Wayne and St. Clair. The amount of lakeplain prairie has decreased greatly as a result of conversion of prairie to agriculture, in addition to the suppression of natural ecosystem processes such as wildfire and hydrological fluctuations and, more recently, conversion of lands to residential and commercial development. At present the amount of lakeplain prairie is approximately 800 acres, comprising only ½ of 1 percent of the original prairie present at the time of European settlement and scattered throughout the southern Lower Peninsula of Michigan. Our project will restore an additional 15 acres thereby increasing the current lakeplain prairie by about 2%. Historically, fire functioned to impede or reduce the establishment of woody plants in these systems that would otherwise result in the succession from lakeplain prairie to a different community type. Fire also functioned to create germination sites, release nutrients, and maintain the structure and diversity of the open prairies.

Some insects are not fire tolerant during any part of their life cycle, thus the use of prescribed fire must be carefully considered and implemented when such insects are a conservation target. This is the primary reason that we left about 15 acres of the fields unburned at this time. Those might be part of the restoration project in the future, after some insects from those areas migrate back into the recently burned areas.

Why do we burn The Prairie?

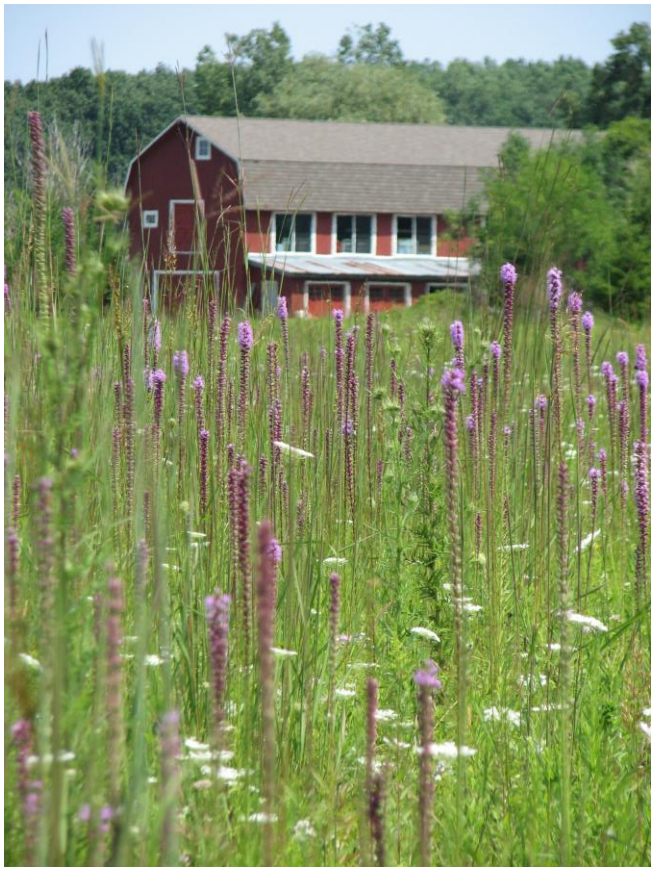
Prescribed burning has been used as a tool by people for hundreds of years. Native Americans are credited with using fire to maintain clearings in which to base their encampments, to encourage growth of plants for later harvest, to rally game as an aid in hunting, to aid in attacking enemies and to aid in defense from enemy attack. Farmers have used fire to revitalize

pastures, to prepare fields for planting, to maintain fence rows and ditches in an herbaceous state, to reduce numbers of undesirable insects and to reduce fuel loads around buildings susceptible to fire. Forest managers have used prescribed fire to discourage growth of fire-intolerant plants and to encourage growth and reproduction of fire-tolerant plants.

Prescribed burning has long been recognized by land managers as a management tool capable of bringing about a complex array of outcomes, depending on how it is applied. These include both encouraging and discouraging plant growth, reducing thatch or duff, increasing nutrient availability, increasing rates of solar soil warming, and exposing mineral soils for better seed germination. More recently, land managers have come to understand the ecological outcomes of burning, particularly the increases in biological diversity. When a site is burned, nutrients, metals and minerals are mobilized both directly and indirectly by the process of fire. These leach through the soil horizons and are chemically or physically trapped by soil particles, thereby restructuring the soil. Changes in soil site conditions, especially changes in nutrient availability, moisture retention and shading change the competitive balance among plants. Fire-adapted species are favored, and fire-intolerant species are discouraged. Commensal relationships between organisms are also often temporarily interrupted, changing the competitive relationship between them.

Project history and status

Since the late 1700's the project area had been crop lands, grazing lands and an airport landing strip. Since the late 1980's those fields had been left for nature to take its course. In 1999 Bob and Sue Williams purchased the farm for a summer home. The idea of restoring some of Stewart Farm's fields to Lakeplain Prairie was presented to them by Naturalists Lisa Appel and Suzan Campbell. They were doing a plant inventory for the Farm in the summer of 2004 and were excited to see that many species of a Lakeplain Prairie still existed right here in the Stewart Farm fields. They suggested that the Williams' investigate burning the field to cut back on woody shrubs and to encourage the growth of the natural grasses and wildflowers. In the months to follow they met with Dan Kennedy of the Michigan Department of Natural Resources Landowner Incentive Program and were provided with technical and financial assistance to make this project a reality. They discovered an article in "The Michigan Botanist" magazine from May 1964 called "An Ecological Study of a Wet Prairie on Harsens Island, Michigan." It was an invaluable resource in determining what additional species might be found during the restoration. Mr. Kennedy prepared a management plan to guide their way, and in the spring of 2005 David Borneman of Ann Arbor, along with his crew, burned 15 acres of the fields. In future years, additional professional burns were done and now after attending and helping with many burns the owners are able to safely conduct the burns themselves with the help of friends on the island. Over the last 13 years 95% of the autumn olive and phragmites which had invaded the site has been removed. While in the process of controlling their phragmites neighbors were interested in finding out how it was done. The islanders had been losing their views of the water and did not realize there was anything they could do about it. Over the years to come the township began a Phragmites Control Program and Bob trained hundreds of neighbors in the process of control and has presented his workshop, "Practical Phragmites Control" at The Stewardship Network Annual Conference the Science, Practice & Art of Restoring Native Ecosystems and as part of their monthly webcast series.



The prairie restoration project area and Historic Stewart Farm are open by appointment to visiting scout groups, schools and nature organizations.

4.10 Acoustic Monitoring in the James and Alice Brennan Memorial Sanctuary

By Mike Sobieski

I stopped on the trail and turned to my friend, "This looks good, let's walk in and find a spot." I was finally going to set up the monitor that was entrusted to me for the bioacoustics project, part of the Landscape Stewardship Plans and Stories. My excitement was coupled with apprehension: What if the monitor stops working? What if it falls down? What if it is damaged or lost? I had double and tripled checked the monitor. I had packed the right gear for installation: a light chain, a padlock, and some tools, but my diligent preparation did little to assuage my worry. Back on the trail, I took a compass reading and recorded the GPS coordinates so that I could navigate back to the exact spot where we diverged from the trail. I took several photos of the trail and noticeable trees that would indicate that I was in the right spot when I came back in a month. Motioning to my buddy, we headed in…
I found the concept of acoustic monitoring fascinating and was excited to be a part of this project. My job was to find an appropriate area within my purview of Macomb and/or St. Clair counties that would be representative of the landscape and wildlife found there. The acoustic data we collect would enable the Remote Environmental Assessment Laboratory at MSU to continue to study the correlation between acoustic and environmental indicators.

I first began by looking at maps of Macomb and St. Clair counties to determine what kind of landscape would be best suited for an acoustic monitor. Much of southern Macomb county is developed with suburban, industrial, and hardscape land use, so I would have to look to the north end of the county which is much more rural. However, much of the land on the north side is privately owned, meaning that the logistics of finding a willing landowner, searching for an adequate spot on their property, and securing permission to access that area both now, and in a month, would most likely be a very time-consuming process. So I looked to St. Clair County which is also less developed, but the same issue of access to private land persisted. The ideal location would be accessible to the public, yet not so close to developed neighborhoods, businesses, and roads so that ambient noise from human-made sources would be picked up by the microphones of the monitoring device. I realized that the Lake St. Clair CISMA partner, the Michigan Nature Association (MNA), might provide the solution. One of the sanctuaries from MNA's extensive list of properties that are under their care might have the right combination of factors.

I visited the Anna Wilcox and Harold Warnes Memorial Nature Sanctuary on my first scouting mission. It was a beautiful area, but even after hiking to the most secluded part of its 44 acres, I could still hear the traffic and road noise from nearby 26 Mile Rd. The next sanctuary I visited with my new scouting partner (my wife) was the Elmer P. and Irene Jasper Woods Memorial Nature Sanctuary, located in St. Clair County near Kimball Township. As we drove down the dirt road to the property, it seemed promising; there were no houses that could be seen and the property spanned nearly 50 acres. But as we as we were exploring the trails, the sound of a shotgun rang out. It was far enough away to not be of any danger to us, but close enough to

indicate that this may not be the best place for acoustic monitoring. The next sanctuary on the list to visit was the James and Alice Brennan Memorial Sanctuary, located near Emmett in central St. Clair County.

The Brennan Sanctuary is the largest MNA property in St. Clair County at 118 acres. It boasts nearly two miles of trails that wind through upland forest, wet mesic forest, and wetland that includes the headwaters of the Pine River. As we parked at the trail head, we noted that the neighboring properties were farmland and sparsely populated. We spent the afternoon hiking the entirety of the trails and I would stop every so often just to listen to the soundscape. It was very promising; no cars or road noise, no sounds from the farms that bordered the property. There were only the sounds of wind, birds, and the Pine River as it flowed alongside the trail. We didn't encounter anyone else on the trails that day. After looking at the map of the trails provided by the MNA, I made note of a spot off the trail that would suit our needs. The Brennan Sanctuary would be the location for the monitoring device! The spot I picked (see map) was located within in upland forest area, not very far away from the Pine River wetland area, in hopes that the microphone would pick up the sounds of wildlife that inhabited both unique habitats.

I spoke with Andy Bacon of MNA to get permission to go off-trail and set up the monitor in the sanctuary. I explained the project (which he was already familiar with) and I assured him that I'd secure the device in a way that wouldn't harm the tree to which it would be attached. After being granted permission, I made plans to make another trip to install the device.

At home I ran through the directions from Dr. Gage to set up the monitor. The on board computer needed to be set to record for one minute every half hour. I made sure that the programing was correct and took a few sample recordings just in case. Everything was working as it should. The monitor had to run for a month so I made sure to install new batteries. I bought a new SD card that would store the sound files as they were collected. The device was mounted to a wooden frame with eye bolts that would allow it to be strapped to a tree, so I bought some light chain, a small padlock, and bolt cutters to cut the chain to length. All that was left was to go back out to Brennan.

At the site, I made sure to take note of the two trail markers on either side of the spot where I intended to walk into the interior of the sanctuary. I figured taking some pictures would help as well, since I probably wouldn't remember that particular spot on the trail in a month's time, especially since it would be November by then, and Fall still had some changes in store for the forest. At the side of the trail was a memorable three trunk beech tree that I used that as a guide to walk due south into the woods. I wanted to go far enough in to make the monitor invisible from the trail, but not so far that I could miss it when it was time to retrieve it. After walking about 200 yards, I could still see the trail, but it was far enough away that no one would notice the box attached to the tree that faced away from them, deeper into the woods. It was quick work to wind the chain around the tree; holding it tight enough to keep the box at about head height, and click the padlock shut. I double checked the internal settings and took

some pictures of the site. And that was that. I could only hope that in 30 days everything would still be there and running as expected.

Thankfully, it was. In November, I went back to the Brennan Sanctuary to retrieve the monitor after 30 days in the field. The pictures I took to aid navigation back to the spot were helpful because most of the leaves had fallen from the trees. Using my GPS, I went straight to the monitor. It was still recording as I walked up. Relieved that it had not suffered damage or malfunctioned, I unhooked it from the tree and brought it home. There, the SD card that was full of data could be downloaded to a thumb drive and handed over to Dr. Gage and the acoustics laboratory. This tiny chip would become part of the story of the bioacoustics of Michigan.

5. Develop Your Own Story: Resources and Services for Landowners

A variety of programs and informational resources are offered by state and federal resource agencies and nonprofit conservation organizations to help you take the next steps toward meeting your own land stewardship goals.

5.1 Forest Stewardship Program

The Forest Stewardship Program was created by the USFS in 1991 to encourage long-term stewardship of family forest land by providing professional planning and technical assistance to private landowners. Ultimately, the purpose of the program is to enhance and sustain the long-term productivity of forest resources and produce healthy and resilient forest landscapes. As part of the process, landowners work with a certified Forest Stewardship Plan Writer to develop a custom plan that describes your personal land stewardship goals, unique forest resources and suggested management activities.

There are many benefits to developing a Forest Stewardship Plan, including enhanced access to USDA conservation programs, forest certification programs and forest product and ecosystem service markets. For example, you can use your Forest Stewardship Plan to prepare for a timber sale, improve wildlife habitat, or to enroll in other programs that require a forest management plan. Participation in the Forest Stewardship Program is voluntary and landowners can obtain information and cost-share assistance throughout the year.

Administration of the Forest Stewardship Program varies by state. In Michigan the program is administered by the Michigan DNR, who trains and certifies 130 professional foresters and 15 wildlife biologists in the private sector to write simple yet comprehensive Forest Stewardship Plans. Since 1991, almost 5,000 Michigan landowners have used their Forest Stewardship Plan to help them to protect, manage, and enjoy their forest.

Visit www.michigan.gov/foreststewardship to connect with a certified plan writer and take your next step toward managing your land to meet your stewardship goals. More information about the program can also be found at http://www.fs.fed.us/spf/coop/programs/loa/fsp.shtml/.

5.2 American Tree Farm System

The American Tree Farm System is a certification program of the American Forest Foundation that acknowledges land management practices meeting certain Standards of Sustainability. As part of this program, a network of more than 82,000 family forest owners sustainably managing 24 million acres of forestland across the country. The American Tree Farm System is recognized by the Program for the Endorsement of Forest Certification, which is an international forest

certification system. Landowners following the Standards of Sustainability can feel proud to be recognized as ambassadors for sustainable woodland stewardship.

The eight Standards of Sustainability that must be met in order to gain recognition as a certified tree farm under the American Tree Farm System program are listed below. An approved Forest Stewardship Plan completed through the Forest Stewardship Program or a qualifying NRCS incentives programs can be written to also serve as a qualifying forest management plan under the American Tree Farm System. There is no additional cost to be enrolled in the American Tree Farm System certification program. For more information please visit www.treefarmsystem.org.

Commitment to Practicing Sustainable Forestry: Landowner demonstrates commitment to forest health and sustainability by developing a forest management plan and implementing sustainable practices.

Compliance with Laws: Forest-management activities comply with all relevant federal, state, and local laws, regulations, and ordinances.

Reforestation and Afforestation: Landowner completes timely restocking of desired species of trees on harvested sites and nonstocked areas where tree growing is consistent with land-use practices and the landowner's objectives.

Air, Water and Soil Protection: Forest-management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.

Fish, Wildlife and Biodiversity: Forest-management activities contribute to the conservation of biodiversity.

Forest Aesthetics: Forest-management activities recognize the value of forest aesthetics.

Protect Special Sites: Special sites are managed in ways that recognize their unique historical, archaeological, cultural, geological, biological, or ecological characteristics.

Forest Product Harvests and Other Activities: Forest product harvests and other management activities are conducted in accordance with the landowner's objectives and consider other forest values.

5.3 Qualified Forest Program

The purpose of the Qualified Forest Program, administered by MDARD, is to encourage landowners to actively manage their privately owned forests for commercial harvest, wildlife habitat enhancement, and improvement of other non-forest resources. In exchange for managing their forests in a sustainable fashion, enrolled landowners will receive an exemption from the local school operating millage. In order to qualify for the program, landowners must have between 20 and 640 acres, have an approved forest management plan, and must comply with the prescriptions included in that plan. See www.michigan.gov/qfp for more information or to begin the enrollment process. The application deadline in order to receive tax benefits the following year is September 1.

5.4 Commercial Forest Program

The Commercial Forest Act gives property tax breaks for forest owners in Michigan that voluntarily enroll in the Commercial Forest Program. Under this program, landowners pay a specific rate of $1.25 per acre for property taxes and the State of Michigan pays counties another $1.25 per acre. Landowners must have at least 40 acres of contiguous forest, an appropriate forest management plan, and conduct commercial harvests as prescribed in their plan. Land that is included under the Commercial Forest Program must be open to the public for non-motorized recreational use. More information about this program, which is administered by the MDNR, is available online at www.michigan.gov/commercialforest. The application deadline in order to receive tax benefits the following year is April 1.

5.5 Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by the USDA Natural Resources Conservation Service. It supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers, ranchers, private forest land owners and federally-recognized American Indian tribes may receive financial and technical assistance to implement structural and land management conservation practices on eligible agricultural land.

Program priorities aim to address resource concerns including soil erosion, soil quality, water quality degradation, plant productivity, habitat fragmentation, invasive plants, and forest health. Conservation practices related to forestry may include forest trails and landings, stream crossings, riparian forest buffers, forest stand improvement, tree and shrub establishment, brush management, early succession habitat, wetland wildlife habitat, and upland wildlife habitat. EQIP activities are carried out according to a site specific conservation plan developed in conjunction with the producer. Forest Stewardship Plans are accepted by the NRCS when applying for EQIP funding. All conservation practices are installed according to NRCS technical standards.

Contact your local District Conservationist or forester for information and enrollment forms for EQIP or other USDA-NRCS assistance programs. For more information please visit www.nrcs.usda.gov/wps/portal/nrcs/main/mi/programs/.

5.6 Best Management Practices for Forest Health, Water Quality and Wildlife

Best Management Practices (BMPs) are stewardship activities that are generally accepted by resource professionals to be the most effective and up-to-date management practices available for protecting forest health, water quality and wildlife habitat. Local agencies and organizations can help you select appropriate BMPs to meet your land management objectives. Financial and

technical assistance may be available to help you implement certain BMPs on your land, while other BMPs are simple things you can do on your own to become a better steward of your land.
Resources and Services for Landowners

A variety of programs and informational resources are offered by state and federal resource agencies and nonprofit conservation organizations to help you take the next steps toward meeting your own land stewardship goals.

5.7 Capital Gains Tax Information

Profits from timber sales are taxed as capital gains, rather than ordinary income, if you own the timber for more than twelve months. Expenses, including the cost of a management plan or a consulting forester's fees for a timber sale, can be deducted from profits. There are many great tax related resources available on www.timbertax.org, including the most recent edition of the annual "Tax Tips for Forest Landowners."

5.8 Opportunities for Partnerships between different types of landowners

As we think about stewardship in each of the focal landscapes for The Stewardship Network, partnerships across boundaries are key to the successful stewardship of our forest resources. As noted in many places of this plan, ecosystems don't respect political, jurisdictional, or property boundaries. Much like natural ecosystems, human diversity throughout a landscape can create strength, foster resiliency, and promote efficiency. Caring for large swaths of land and water that contain a plethora of biotic organisms and abiotic factors whose health and survival are intricately interwoven with the natural system is an immense task that can undoubtedly be daunting to a single landowner. But just as communities come together to celebrate culture, work on local improvement projects, and sustain institutions that support the common good, harnessing the power of human relationships can be a powerful force in preserving the natural world.

These plans have shared the great diversity of resources – public, private and non-profit – available to individual property owners to help them become more engaged in forest management and stewardship. We encourage readers of these plans to become more familiar with these programs and tap into the ones that meet your needs. We encourage you to think about your municipal, state, federal, and tribal governments; non-profits; private businesses; volunteers; foundations and funding mechanisms; and your fellow private landowners as resources you can reach out to and learn from. We encourage you to reach across your property line to let your neighbor know how you are (or would like to) manage your property, and to learn from them and their approaches. We know property owners who have pooled resources to hire a stewardship crew; to share tools; to share their successes and lessons learned as they engage in forest stewardship. The process of getting to know your property is a lifelong one as you watch, listen, and feel to how your land responds to your management activities. Attend workshops, online webinars, conferences. You can find many activities in your community at

The Stewardship Network's searchable calendar of events: www.stewardshipnetwork.org/event-calendar. Reach out to us to ask a question; share your idea; tell your stewardship story. We would love to include your story in our ongoing commitment to collecting and sharing stories of stewardship.
Email us or give us a call: staff@stewardshipnetwork.org 734-996-3190. We look forward to hearing from you!

Appendix A: Glossary of Common Forestry Terms

The following glossary is adapted from www.dnr.state.md.us/forests/gloss.html.

Agroforestry: A land-use system that combines both agriculture and forestry in one location.

Alley Cropping: Widely spaced rows of trees with annual crops growing in between the rows.

Basal Area (Tree): Cross-sectional area of a tree at 4.5 feet off ground in square feet.

Basal Area (Forest): Basal area of all trees per acre summed up, in units of square feet/acre; measure of density.

Biomass: Harvesting and using whole trees or parts of trees for energy production.

Board Foot: A measure of volume 1 foot by 1 foot by 1 inch or 144 cubic inches of wood.

Bolt: 8-foot-long log.

Browse: Parts of woody plants, including twigs, shoots, and leaves, eaten by forest animals.

Carbon Cycle: The biogeochemical cycle to exchange carbon between the biosphere and atmosphere by means of photosynthesis, respiration and combustion.

Clear-cut: The harvest of all the trees in an area to reproduce trees that require full sunlight.

Cord: A unit of wood cut for fuel that is equal to a stack 4 x 4 by 8 feet or 128 cubic feet

Cordwood: small diameter or low quality wood suitable for firewood, pulp, or chips.

Crop Tree: A young tree of a desirable species with certain desired characteristics.

Crown: The uppermost branches and foliage of a tree.

Cruise: A forest survey used to obtain inventory information and develop a management plan.

Cull: A saw timber size tree that has no timber value as a result of poor shape or damage.

Diameter at Breast Height (DBH): Diameter of a tree trunk taken at 4.5 feet off the ground.

Diameter-Limit Sale: A timber sale in which all trees over a specified DBH may be cut. Diameter-limit sales often result in high grading and is a very poor forestry practice.

Endangered Species: A species in danger of extinction.

Even-Aged Stand: Stand with minimal age difference between the oldest and youngest trees (e.g. <10 years).

Forestland: Land at least one acre in size that is at least 10 percent stocked with trees.

Forest Farming: Cultivating high value specialty crops in the shade of natural forests.

Forest Stand Improvement (FSI): Any practice that increases the health, composition, value or rate of growth in a stand. Called Timber Stand Improvement when focused on timber**.**

Group Selection: Harvesting groups of trees to open the canopy and encourage development of uneven aged stands.

Habitat: The ecosystem in which a plant or animal lives and obtains food and water.

Hardwoods: A general term encompassing broadleaf, deciduous trees.

High Grading: To remove all good quality trees from a stand and leave only inferior trees.

Landing: Cleared area where logs are processed, piled, and loaded for transport to a sawmill.

Log Rule: A method for calculating wood volume in a tree or log by using its diameter and length. Scribner, Doyle and the International 1/4-inch rule are common log rules.

Lump-Sum Sale: A timber sale in which an agreed-on price for marked standing trees is set before the wood is removed (as opposed to a mill tally or unit sale).

Mast: Nuts and seeds such as acorns, beechnuts, and chestnuts that serve as food for wildlife.

Overmature: Trees that have declined in growth rate because of old age and loss of vigor.

Overstocked: Trees are so closely spaced that they do not reach full growth potential.

Pole Timber: Trees ranging from 4 to 10 inches Diameter at Breast Height.

Pre-Commercial Operations: Cutting to remove wood too small to be sold.

Prescribed Fire: An intentional and controlled fire used as a management tool used to reduce hazardous fuels or unwanted understory plants (invasive, undesirable species, etc.).

Pulpwood: Wood suitable for use in paper manufacturing.

Range: Cattle grazing in natural landscapes.

Regeneration: The process by which a forest is reseeded and renewed.

Riparian Forest Buffers: Strips of land along stream banks where trees, shrubs and other vegetation are planted and managed to capture erosion from agricultural fields.

Salvage Cut: The removal of dead, damaged, or diseased trees to recover value.

Sapling: A tree at least 4.5 feet tall and between 1 inch and 4 inches in diameter.

Sawlog: Log large enough to be sawed economically, usually >10" diameter and 16' long.

Saw timber stand: A stand of trees whose average DBH is greater than 11 inches.

Sealed-Bid Sale: A timber sale in which buyers submit secret bids.

Seed-Tree Harvest: Felling all trees except for a few desirable trees that provide seed for the next forest.

Selection Harvest: Harvesting single trees or groups of trees at regular intervals to maintain uneven-aged forest.

Shade-Intolerance: Characteristic of certain tree species that does not permit them to survive in the shade of other trees. Shade-intolerant trees require full sunlight.

Shade-Tolerance: The capacity of a tree species to grow in shade.

Shelter wood Harvest: Harvesting all mature trees in two or more cuts, leaving trees to protect seedlings.

Silvopasture: Growing trees and forages to provide suitable pasture for grazing livestock.

Silviculture: The art and science of growing forest trees.

Site Index: Measure of quality of a site based on the height of a dominate tree species at 50 years old.

Site Preparation: Treatment of an area prior to reestablishment of a forest stand.

Skidder: A rubber-tired machine with a cable winch or grapple to drag logs out of the forest.

Slash: Branches and other woody material left on a site after logging.

Snag: A dead tree that is still standing and providing food and cover for a variety of wildlife.

Softwood: Any gymnosperm tree such as pines, hemlocks, larches, spruces, firs, junipers, etc.

Species of Special Concern: Not a designated threatened or endangered species yet, but has low or declining populations.

Stand: A group of forest trees of sufficiently uniform species composition, age, and condition to be considered a homogeneous unit for management purposes.

Stand Density: The quantity of trees per unit area, evaluated in basal area, crown cover or stocking.

Stocking: The number and density of trees in a forest stand. Classified as under-, over-, or well-stocked.

Stumpage Price: The price paid for standing forest trees and paid prior to harvest.

Succession: the replacement of one plant community by another over time in the absence of disturbance.

Sustained Yield: Ideal forest management where growth equals or exceeds removals and mortality.

Thinning: Partial cut in an immature, overstocked stand of trees to increase the stand's value and growth.

Threatened Species: A species whose population is so small that it may become endangered.

Timberland: Forest capable of producing 20 cubic feet of timber per acre per year.

Under-stocked: Trees so widely spaced, that even with full growth, crown closure will not occur.

Understory: The level of forest vegetation beneath the canopy.

Uneven-Aged Stand: Three or more age classes of trees represented in a single stand.

Unit Sale: A timber sale in which the buyer makes regular payments based on mill tally and receipts.

Veneer Log: A high-quality log of a desirable species suitable for conversion to veneer.

Well-Stocked: Stands where growing space is effectively occupied but there is still room for growth.

Windbreaks: Rows of trees to provide shelter for crops, animals or farm buildings.

Appendix B: Michigan Laws Related to Forestry

- Natural Resources and Environmental Protection Act, Public Act 451 of 1994
- Right to Forest Act, Public Act 676 of 2002
- Commercial Forest Act, Parts 511 and 512 of Public Act 451, 1994, as amended
- Qualified Forest Program, Public Acts 42 and 45 of 2013

Please note that this list is not comprehensive and other laws may apply to your situation. Consult an attorney or resource professional for additional assistance.

Appendix C: Threatened, Endangered, and Special Concern Species

The following tables reflects presents the Endangered (E), Threatened (T), and Presumed Extirpated (X) animal species of Macomb and St. Clair Counties, which are protected under the Endangered Species Act of the State of Michigan (Part 365 of PA 451, 1994 Michigan Natural Resources and Environmental Protection Act). For more information visit: https://mnfi.anr.msu.edu/data/county.cfm

Plants **County Presence**

Scientific Name	Common Name	State Status	Macomb	St. Clair
Agalinis gattingeri	Gattinger's gerardia	E	✔	✔
Agalinis skinneriana	Skinner's gerardia	E		✔
Aristida longespica	Three-awned grass	SC		✔
Asclepias purpurascens	Purple milkweed	T		✔
Asclepias sullivantii	Sullivant's milkweed	T		✔
Astragalus canadensis	Canadian milk vetch	T		✔
Baptisia lactea	White or prairie false indigo	SC		✔
Beckmannia syzigachne	Slough grass	T		✔
Boechera missouriensis	Missouri rock-cress	SC	✔	
Callitriche heterophylla	Large water starwort	T		✔
Cardamine maxima	Large toothwort	T		✔
Carex davisii	Davis's sedge	SC	✔	
Carex festucacea	Fescue sedge	SC		✔
Carex lupuliformis	False hop sedge	T	✔	
Carex platyphylla	Broad-leaved sedge	E		✔
Carex richardsonii	Richardson's sedge	SC	✔	
Castanea dentata	American chestnut	E		✔
Cerastium velutinum	Field Chickweed	X		✔
Cirsium hillii	Hill's thistle	SC	✔	✔
Cuscuta indecora	Dodder	CS		✔
Cypripedium candidum	White lady slipper	T		✔
Dalea purpurea	Purple prairie clover	X		✔
Diarrhena obovata	Beak grass	SC		✔
Dichanthelium leibergii	Leiberg's panic grass	T		✔
Draba reptans	Creeping whitlow grass	T		✔
Euonymus atropurpureus	Wahoo	SC		✔
Fimbristylis puberula	Chestnut sedge	X		✔
Fraxinus profunda	Pumpkin ash	T	✔	
Galearis spectabilis	Showy orchis	T	✔	✔

Gentiana alba	White gentian	E		✔
Gentiana puberulenta	Downy gentian	E	✔	
Gentianella quinquefolia	Stiff gentian	T	✔	✔
Gymnocarpium robertianum	Limestone oak fern	T		✔
Helianthus mollis	Downy sunflower	T		✔
Hieracium paniculatum	Panicled hawkweed	T		
Hydrastis canadensis	Goldenseal	T	✔	✔
Hypericum gentianoides	Gentian-leaved St. John's-wort	SC		✔
Jeffersonia diphylla	Twinleaf	SC		✔
Juncus brachycarpus	Short-fruited rush	T		✔
Juncus scirpoides	Scirpus-like rush	T		✔
Lipocarpha micrantha	Dwarf-bulrush	SC		✔
Lithospermum incisum	Narrow-leaved puccoon	X		✔
Lithospermum latifolium	Broad-leaved puccoon	SC		✔
Lycopodiella margueritae	Northern prostrate clubmoss	T		✔
Lycopodiella subappressa	Northern appressed clubmoss	SC		✔
Mimulus alatus	Winged monkey flower	X	✔	
Panax quinquefolius	Ginseng	T		✔
Penstemon calycosus	Beard tongue	T		✔
Persicaria careyi	Carey's smartweed	T		✔
Plantago cordata	Heart-leaved plantain	E	✔	✔
Platanthera ciliaris	Orange- or yellow-fringed orchid	E	✔	✔
Platanthera leucophaea	Prairie white-fringed orchid	E		✔
Poa paludigena	Bog bluegrass	T		✔
Polygala cruciata	Cross-leaved milkwort	SC		✔
Polygala incarnata	Pink milkwort	X		✔
Pterospora andromedea	Pine-drops	T		✔
Quercus shumardii	Shumard's oak	SC	✔	
Ranunculus ambigens	Spearwort	T		✔
Ranunculus rhomboideus	Prairie buttercup	T		✔
Rorippa aquatica	Lake cress	SC	✔	
Scleria pauciflora	Few-flowered nut rush	E		✔
Scleria triglomerata	Tall nut rush	SC		✔
Silphium integrifolium	Rosinweed	T	✔	
Solidago bicolor	White goldenrod	E		✔
Trichophorum clintonii	Clinton's bulrush	SC	✔	✔
Trillium undulatum	Painted trillium	E		✔
Triplasis purpurea	Sand grass	SC		✔
Vitis vulpina	Frost grape	T		✔
Zizania aquatica	Wild rice	T		✔

Fish			County Presence	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Acipenser fulvescens	Lake sturgeon	T	✔	✔
Ammocrypta pellucida	Eastern sand darter	T	✔	✔
Hiodon tergisus	Mooneye	T	✔	✔
Macrhybopsis storeriana	Silver chub	SC	✔	✔
Moxostoma carinatum	River redhorse	T		✔
Notropis anogenus	Pugnose shiner	E	✔	✔
Noturus miurus	Brindled madtom	SC	✔	✔
Noturus stigmosus	Northern madtom	E		✔
Percina copelandi	Channel darter	E	✔	✔
Percina shumardi	River darter	E	✔	
Sander canadensis	Sauger	T		✔

Birds			County Presence	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Ammodramus henslowii	Henslow's sparrow	E		✔
Ammodramus savannarum	Grasshopper sparrow	S		✔
Asio otus	Long-eared owl	T	✔	
Botaurus lentiginosus	American bittern	SC	✔	✔
Buteo lineatus	Red-shouldered hawk	T	✔	✔
Chlidonias niger	Black tern	SC	✔	✔
Circus cyaneus	Northern harrier	SC	✔	
Cistothorus palustris	Marsh wren	SC		✔
Falco columbarius	Merlin	T		✔
Falco peregrinus	Peregrine falcon	E	✔	✔
Gallinula galeata	Common gallinule	T		✔
Haliaeetus leucocephalus	Bald eagle	SC		✔
Ixobrychus exilis	Least bittern	T		✔
Parkesia motacilla	Louisiana waterthrush	T		✔
Protonotaria citrea	Prothonotary warbler	SC	✔	
Rallus elegans	King rail	E	✔	✔
Setophaga cerulea	Cerulean warbler	T		✔
Setophaga citrina	Hooded warbler	SC		✔
Sterna forsteri	Forster's tern	T	✔	✔

Sterna hirundo	Common tern	T	✔	✔

Mollusks			**County Presence**	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Alasmidonta marginata	Elktoe	SC	✔	✔
Alasmidonta viridis	Slippershell	T	✔	✔
Cincinnatia cincinnatiensis	Campeloma spire snail	SC		✔
Cyclonaias tuberculata	Purple wartyback	T	✔	✔
Epioblasma triquetra	Snuffbox	E	✔	✔
Lampsilis fasciola	Wavyrayed lampmussel	T	✔	✔
Ligumia nasuta	Eastern pondmussel	E	✔	✔
Ligumia recta	Black sandshell	E	✔	✔
Mesodon mitchellianus	Sealed globelet	SC	✔	
Obliquaria reflexa	Threehorn wartyback	E		✔
Obovaria olivaria	Hickorynut	E	✔	
Obovaria subrotunda	Round hickorynut	E	✔	✔
Oxyloma peoriense	Depressed ambersnail	SC	✔	
Pisidium idahoense	Giant northern pea clam	SC		✔
Pleurobema sintoxia	Round pigtoe	SC	✔	✔
Potamilus ohiensis	Pink papershell	T		✔
Ptychobranchus fasciolaris	Kidney shell	SC	✔	✔
Simpsonaias ambigua	Salamander mussel	E		✔
Toxolasma parvum	Lilliput	E	✔	
Truncilla truncata	Deertoe	SC	✔	✔
Villosa fabalis	Rayed bean	E	✔	✔
Villosa iris	Rainbow	SC	✔	✔

Insects			**County Presence**	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Dorydiella kansana	Leafhopper	SC		✔
Flexamia delongi	Leafhopper			✔
Flexamia reflexa	Leafhopper	SC		✔
Nicrophorus americanus	American burying beetle	X	✔	
Papaipema beeriana	Blazing star borer	SC		✔
Papaipema sciata	Culvers root borer	SC		✔
Papaipema speciosissima	Regal fern borer	SC		✔

Amphibians			County Presence	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Acris blanchardi	Blanchard's cricket frog	T		✔

Reptiles			County Presence	
Scientific Name	**Common Name**	**State Status**	**Macomb**	**St. Clair**
Clemmys guttata	Spotted turtle	T	✔	✔
Emydoidea blandingii	Blanding's turtle	SC		✔
Pantherophis gloydi	Eastern fox snake	T	✔	✔
Sistrurus catenatus	Eastern massasauga	SC	✔	

Appendix D: Additional Resources for Landowners

Internet Sources (Alphabetically)

Audubon Society: www.MichiganAudubon.org

Conservation Easements: www.landtrustalliance.org/topics/taxes/income:tax-incentives-land-conservation

Field Identification Guides to Invasive Plants in Michigan:
www.mnfi.anr.msu.edu/invasive-species/InvasivePlantsFieldGuide.pdf
www.michigan.gov/dnr/0,4570,7-153-10370_12146---,00.html
Foresters for the Birds: http://vt.audubon.org/foresters-birds
Forestry Taxes: www.timbertax.org

Heart of the Lakes (Collective of Michigan's land conservancies): www.heartofthelakes.org

Leafsnap: An Electronic Field Guide: www.leafsnap.com

MDNR Forest Resources Division: www.Michigan.gov/Forestry
MDNR Hunting Access Program: www.michigan.gov/hap
MDNR Private Forest Land: www.Michigan.gov/PrivateForestLand
MDNR Urban and Community Forestry: www.michigan.gov/ucf
MDNR Wildlife Division: www.Michigan.gov/Wildlife
MDNR Wildlife Landowner Incentive Program: www.michigan.gov/dnrlip
Michigan Association of Conservation Districts: www.mcad.org
Michigan Chapter of the Soil and Water Conservation Society: www.miglswcs.org
Michigan Environmental Education Curriculum Support: www.michigan.gov/meecs
Michigan Forest Association Foresters List: www.michiganforests.com/forester.htm
Michigan Forest Pathways: http://miforestpathways.net
Midwest Invasive Species Network: www.misin.msu.edu
Michigan Nature Association: https://www.michigannature.org
Michigan Society of American Foresters: http://michigansaf.org
Michigan State University Department of Forestry: www.for.msu.edu
Michigan State University Diagnostics Laboratory: www.pestid.msu.edu
Michigan State University Extension Forestry: http://msue.anr.msu.edu/topic/info/forestry
Michigan State University Soil Testing Laboratory: www.spnl.msu.edu
Michigan Sustainable Forestry Initiative: http://sfimi.org
Michigan Technological University School of Forest Resources & Environmental Science:
www.mtu.edu/forest
Michigan United Conservation Clubs: www.mucc.org
My Land Plan: www.mylandplan.org

National Wild Turkey Federation: www.nwtf.org

National Woodland Owners Association: www.woodlandowners.org
NRCS Financial Assistance:
www.nrcs.usda.gov/wps/portal/nrcs/main/mi/technical/landuse/forestry
NRCS PLANTS Database: www.plants.usda.gov
http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx
NRCS Technical Service Providers:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/tsp/

Pheasants Forever: www.pheasantsforever.org
Project Learning Tree: www.michiganplt.org
Project WILD: www.michigan.gov/michiganprojectwild

Quality Deer Management Association: www.qdma.com

Ruffed Grouse Society: www.ruffedgrousesociety.org

Sample Timber Sale Contract:
www.nhdfl.org/library/pdf/Forest%20Protection/timbersaleagreement.pdf

Ties to the Land (succession planning to pass forest to next generation): www.tiestotheland.org
Tree Sales:
www.michigan.gov/documents/dnr/DirectoryOfMichiganSeedlingNurseries:IC4175_258828_7.pdf?20141113140132
Trout Unlimited: www.michigantu.org

USDA Soil Web Survey: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
USFS Ecosystem Services: www.fs.fed.us/ecosystemservices/index.shtml
USFS Private Woodland Owners: http://na.fs.fed.us/pubs/misc/flg
USFS State and Private Forestry: www.fs.fed.us/spf
USFS Wetland Mapper https://www.fws.gov/wetlands/Data/Mapper.html

Whitetails Unlimited: www.whitetailsunlimited.com
Woodland Stewardship: www.woodlandstewardship.org

Books for Landowners

1. Woodland Stewardship: A Practical Guide for Midwestern Landowners (2nd Edition). 2009. This book, written by a team of educators and foresters from Minnesota, Wisconsin, and Michigan is an excellent manual on how to manage your forest for a wide variety of goals. (A free pdf of the entire book is online at): http://woodlandstewardship.org

2. Owning and Managing Forest: A Guide to Legal, Financial, and Practical Matters (Revised). 2005. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It contains excellent advice on the legal and financial issues of owning and managing a family forest.

3. A Landowner's Guide to Managing Your Woods. 2011. This book is authored by a landowner, forester, and logger to give a balanced view of forest management and how to maintain a small forest for long-term health, biodiversity, and high-quality timber production.

4. Michigan Trees: A Guide to the Trees of the Great Lakes Region (Revised). 2004. This book is the classic text on tree identification in Michigan authored by two U of M professors. It has drawings instead of photos, but the book has more complete information than the ID books with prettier photos.

5. Michigan Forest Communities: A Field Guide and Reference. 2004. This book, by Dr. Don Dickmann at MSU, describes 23 forest communities in Michigan. The book is available from MSU Extension. A free pdf is at http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E3000.pdf.

6. The Forests of Michigan (Revised). 2016. This book by two MSU forestry professors is an interesting history of Michigan's forests over the last few centuries and is available at the University of Michigan Press.

7. Positive Impact Forestry: A Sustainable Approach to Managing Woodlands. 2004. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It is a great introduction to silviculture, the science and art of growing and managing forests.

8. Estate Planning for Forest Landowners: What Will Become of Your Timberland? 2009. Nothing is more dreadful than death and taxes, but this book helps landowners prepare for both. To ease your pain, it is free at http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs112.pdf. See also www.timbertax.org

9. Trees Are the Answer (Revised). 2010. This book is written by Dr. Patrick Moore, one of the founders of Greenpeace. His perspective on forestry will appeal to both tree huggers and loggers.

10. Managing Michigan's Wildlife: A Landowner's Guide. 2001. This book, edited by two biologists for the Michigan Department of Natural Resources, is the classic text in Michigan for landowners on wildlife habitat and managing forests for preferred game species. This book about wildlife habitat management is only available at: www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/index.htm

11. A Sand County Almanac. 1949. This book by Aldo Leopold is one of the foundations for environmental ethics that continues to inform forest stewardship of both private and public lands. This book will help you to articulate your own ethical approach to managing your forest.

12. Last Child in the Woods. 2008. This book by Richard Louv is a strong argument that our nation's children are suffering from "nature deficit disorder." This book will give you great ideas about how you can bring school groups, scout groups, church groups, or even your own children out into your forest to experience and enjoy nature.

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