

TWO HEARTED RIVER WATERSHED MANAGEMENT PLAN



SUPERIOR WATERSHED PARTNERSHIP
2 Peter White Drive, Presque Isle Park
Marquette, Michigan 49855
(906) 228-6095
www.superiorwatersheds.org

Funded by the Michigan Department of Environment, Great Lakes, and Energy (Michigan EGLE)
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1.0 INTRODUCTION

1.1 Two Hearted Watershed Setting

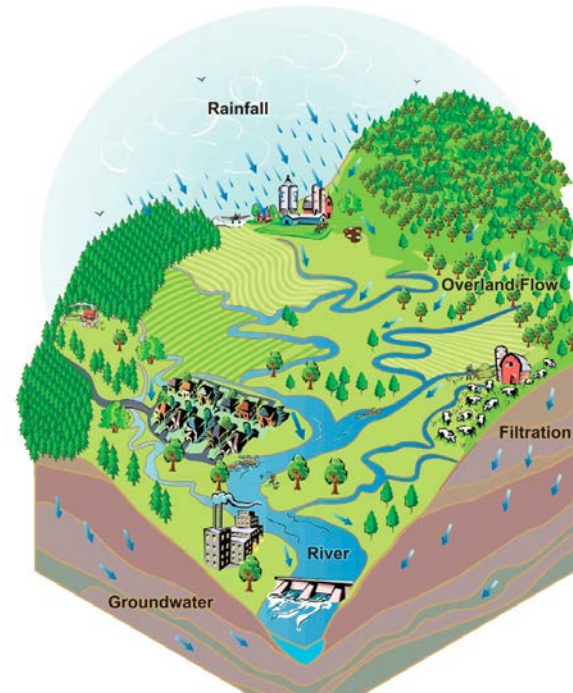
People live, work, and recreate in areas of land known as “Watersheds”. A watershed is best described as an area of land where surface water drains to a common location such as a stream, river, or lake. The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition for a watershed, they are complex systems with interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife as well as human interactions. Agriculture, mineral exploration, timber harvesting and urban development produce polluted stormwater runoff, increase impervious surfaces thereby altering stormwater flows, and degrade or fragment natural areas. Other common names given to watersheds, depending on size, include basins, sub-basins, subwatersheds, and Subwatershed Management Units (SMUs).

The following sections summarize the natural character and condition of the Two Hearted River watershed based on the results of past and recent inventories of natural features. Included are general descriptions of the location, climate, geology, topography and soils, hydrology and significant natural features.

Location

The Two Hearted River watershed (Hydrologic Unit 04020201 Betsy-Chocoday) lies within the Lake Superior drainage and encompasses over 130,000 acres (203 square miles). The Two Hearted River watershed refers to all the land area that is drained by the Two Hearted River and its tributaries. It is located in the eastern region of Michigan’s Upper Peninsula in Luce County with a small portion of the watershed located in Alger County (Figure 1). The majority of the watershed is located in McMillan Township

with portions of the headwaters located in Columbus Township and Burt Township (Alger County). There are no villages within the watershed and the nearest town is Newberry.



Hypothetical watershed setting (Source: USEPA)

According to EGLE’s Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report (EGLE, 2020), all of the streams and rivers in the Two Hearted River watershed are fully supporting for the use designations they were assessed for including other indigenous aquatic life and wildlife, and the cold water fishery. All other uses for all streams were not assessed. South Branch Two Hearted River, North Branch Two Hearted River, Pratt Lake, Mainstem Two Hearted

River, Dawson Creek, Windgeon Creek, East Branch Two Hearted River and West Branch Two Hearted River are fully supporting of the other indigenous aquatic and wildlife use designation. Bullhead Lake, Deer Lake, Dillingham Lake, Pratt Lake, Sid Lake and the West Branch Two Hearted River are fully supporting of the cold water fishery use designation. Pretty Lake (HUC 040202010302) is

not supporting for fish consumption due to mercury found in fish tissue. A Total Maximum Daily Load Assessment completion date has not been established in the report. Use designations for all waterbodies in the Two Hearted River watershed are summarized in Section 4.0 (EGLE 2020).

Two Hearted River Watershed

Luce County, Michigan

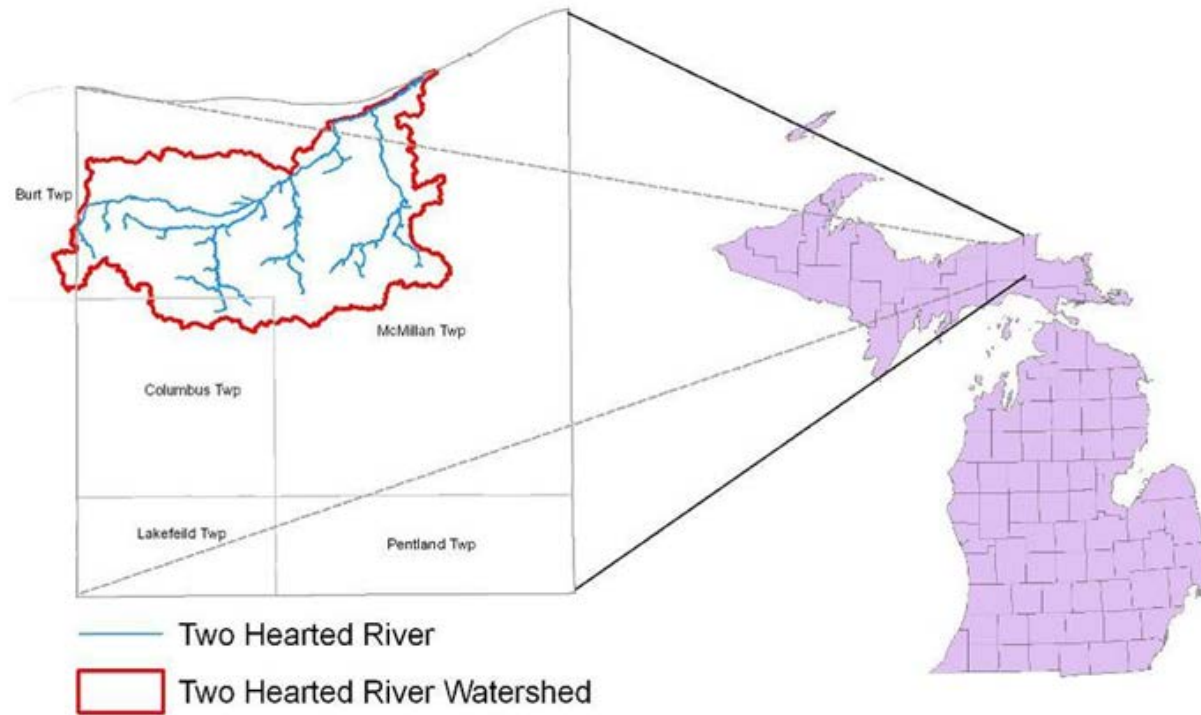


Figure 1 Watershed location map

Noteworthy- Watershed at a Glance

- The Two Hearted River Watershed is located in the Eastern Upper Peninsula of Michigan, lying largely within Luce County with the western edge in Alger and Schoolcraft Counties. There are no villages within the watershed and the nearest town is Newberry.
- The sparse population and associated lack of development contribute to maintaining the high-water quality of the river and the wilderness character of the watershed. (Luce County has one of the lowest populations in Michigan with an average 7 people per square mile, and a total of 6,229 (2019) and a loss of 6.1% in total population since 2010 (US Census Bureau 2019).
- In general, the river is medium-sized, has a low gradient, and contains cold water that flows into Lake Superior; it is largely wetland dominated (including patterned peatland).
- It is a “geologically young river, with a shallow channel profile, poorly defined floodplain and few side channels and oxbows” (Conservation Plan 1995).
- Subwatersheds of the Two Hearted include: North Branch, West Branch, South Branch, Dawson Creek, Wabash Creek, East Branch and the Main Stem.
- The Two Hearted attained a ***Natural River designation*** in 1973, which includes the main stem of the Two Hearted and its five major tributaries, North, South, East and West branches and Dawson Creek. The Two Hearted River Natural River District is a strip of land 400 ft. wide on each side and parallel to the designated portion of the river (this does not imply a taking of private lands by state or opening them up for public access). Private land remains private and existing structures are not affected nor is public use required. There are a number of other regulated land uses regarding vegetation buffer and building setbacks. (for more information see: https://www.michigan.gov/dnr/0,4570,7-350-79136_79236_82211-95817--,00.html)
- Tributaries in the watershed drain 115,200 acres of land in total drainage area.
- The Two Hearted River Watershed contains an estimated total of 108 river miles (including the main tributaries and main stem).
- The most significant sources identified are forest management practices and road construction (associated with forest management practices and development). Other sources of stress include: residential and associated development, cranberry farming, ORV recreation.
- Natural community types in the Two Hearted River Watershed include: peatlands, such as bogs, muskegs, poor conifer swamps, poor fens, intermediate fens, patterned fens, rich fens, and rich conifer swamps; intermittent wetlands, which are maintained by seasonal and year to year fluctuations in the water table; hardwood-conifer swamps, which are dominated by tree species such as Northern white cedar, black ash, balsam fir, yellow birch , hemlock, balsam poplar, tamarack, and white pine; Northern hardwoods; pine and pine-hardwoods, which are an amalgam of dry northern forest and dry-mesic northern forest; and the riverine community.

1.2 Project Scope & Purpose

The Superior Watershed Partnership and Land Trust is a 501(c)(3) is an award-winning Great Lakes nonprofit organization that has set national records for pollution prevention and implements innovative, science-based programs that achieves documented, measurable results. SWP, in partnership with The Nature Conservancy and other stakeholders, worked to undergo a watershed planning effort and produce a comprehensive “Watershed-Based Plan” for the Two-Hearted River watershed that meets requirements as defined by the United States Environmental Protection Agency (USEPA).

Ultimately, the intent is to develop and implement a Watershed-Based Plan designed to achieve water quality standards/criteria.

The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an

1.3 USEPA Watershed-Based Plan Requirements

In March 2008, the United States Environmental Protection Agency (USEPA) released watershed protection guidance entitled “Non-point Source Program and Grant Guidelines for States and Territories.” The document was created to ensure that Section 319 funded projects make progress towards restoring waters impaired by non-point source pollution. USEPA’s “Handbook

ecologically-based management plan for the Two-Hearted River watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Two Hearted River watershed to promote and initiate plan recommendations that will accomplish the goals and objectives of this plan. This plan was produced via a comprehensive watershed planning approach that involved input from SWP and analysis of complex watershed issues by watershed planners, ecologists, GIS specialists, water quality specialists, and environmental engineers. In addition, ideas and recommendations in this plan are designed to be updated through adaptive management that will strengthen the plan over time as additional information becomes available.

for Developing Watershed Plans to Restore and Protect Our Waters” (USEPA 2008) is consulted to create this watershed plan. Having a Watershed-Based Plan will allow Two-Hearted River watershed stakeholders to access 319 Grant funding and other funding for watershed improvement projects recommended in this plan. Under USEPA guidance, “Nine Elements” are required in order for a plan to be considered a Watershed-Based Plan.

USEPA Nine Elements

Element A: Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed-based plan;

Element B: Estimate of the pollutant load reductions expected following implementation of the management measures described under Element C below;

Element C: Description of the BMPs (non-point source management measures) that are expected to be implemented to achieve the load reductions estimated under Element B above and an identification of the critical areas in which those measures will be needed to implement;

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan;

Element E: Public information/education component that will be implemented to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing/maintaining non-point source management measures that will be implemented;

Element F: Schedule for implementing the activities and non-point source management measures the plan; identified in this plan that is reasonably expeditious;

Element G: Description of interim, measurable milestones for determining whether non-point source management measures or other control actions are being implemented;

Element H: Set of environmental or administrative criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards;

Element I: Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.4 Using the Watershed-Based Plan

The information provided in this Watershed-Based Plan is prepared so that it can be easily used as a tool by any stakeholder including elected officials, federal/state/county/municipal staff, and the general public to identify and take actions related to watershed issues and opportunities. The pages below summarize what the user can expect to find in each major “Section” of the Watershed-Based Plan.

Watershed Resource Inventory Topics Included in the Plan

- 3.1 Geology, History & Climate
- 3.2 Topography, Watershed Boundary, & Subwatershed Management Units
- 3.3 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups
- 3.4 Jurisdictions, Roles, & Protections
- 3.5 Existing Policies and Ordinances Review
- 3.6 Demographics
- 3.7 Transportation Network
- 3.8 Existing & Future Land Use/Land Cover
- 3.9 Sensitive Areas
- 3.10 Significant Natural Resources
- 3.11 Watershed Drainage System
 - Hydrology*
 - Tributary Streams*
 - Riparian Area Condition*
 - Wetlands*
- 3.12 Groundwater Aquifers and Recharge, Contamination Potential, and Water Supply

Section 2.0: Mission, Goals, and Objectives

Section 2.0 of the plan contains the Superior Watershed Partnership’s mission and goals/objectives. Goal topics include Education & Stewardship, Surface Water Quality,

Communication & Coordination, and Groundwater Quantity & Quality. In addition, “Measurable Objectives” were developed where possible for each goal so that the progress toward meeting each goal can be measured in the future by evaluating information included in Section 9.0 (Measuring Plan Progress & Success).

Section 3.0: Watershed Resource Inventory

An inventory of the characteristics, problems, and opportunities in Two-Hearted River watershed is examined in Section 3.0. Resulting analysis of the inventory data led to recommended watershed actions that are included in Section 6.0 (Management Measures Action Plan). Inventory results also helped identify causes and sources of watershed impairment as required under USEPA’s *Element A*.

Section 4.0: Water Quality & Pollutant Modeling Assessment

A summary and analysis of available water quality data for the watershed and pollutant modeling assessment is included in its own section because of its importance in the watershed planning process. This section includes a detailed summary of physical, chemical, and biological data available for Two-Hearted River watershed. Water quality data combined with pollutant loading data provides information that sets the stage for developing pollutant reduction targets and identifying “Critical Areas” as outlined in Section 5.0 (Causes & Sources of Impairment & Reduction Targets).

Section 5.0: Causes & Sources of Impairment & Reduction Targets

This section of the plan includes a list of causes and sources of watershed impairment as identified in Section 3.0 (Watershed Resource Inventory) and by watershed stakeholders that affect Michigan Department of Environment, Great Lakes, and Energy (EGLE) “Designated Uses” for water quality and other

watershed features. As required by USEPA, Section 4.0 also addresses all or portions of *Elements A, B, & C* including an identification of the “Critical Areas”, pollutant load reduction targets, and estimate of pollutant load reductions following implementation of recommended Critical Area Management Measures identified in Section 6.0.

Section 6.0: Management Measures Action Plan

A “Management Measures Action Plan” is included in Section 6.0. The Action Plan is divided into a Programmatic Action Plan and a Site Specific Action Plan. Programmatic recommendations are described in paragraph format; site specific recommendations are presented in paragraph, figure, and table formats with references to entities that would provide consulting, permitting, or other technical services needed to implement specific measures. The site-specific tables also outline project priority, pollutant reduction efficiency, implementation schedule, sources of technical and financial assistance, and cost estimates. This section also contains a watershed-wide summary table of specific information for all recommended site-specific management measures combined including “Units,” “Cost,” and “Estimated Pollutant Load Reduction”. This section addresses all or a portion of USEPA *Elements C & D*.

Section 7.0: Information & Education Plan

This section is designed to address USEPA *Element E* by providing an Information/Education component to enhance

public understanding and to encourage early and continued participation in selecting, designing, and implementing recommendations provided in the Watershed-Based Plan. This is accomplished by providing a matrix that outlines each recommended education action, target audience, package or vehicle for implementing the action, who will lead the effort, what the expected outcomes or behavior change will be, and estimated costs to implement.

Sections 8.0 & 9.0: Plan Implementation & Measuring Plan Progress & Success

A list of key stakeholders and discussion about forming a Watershed Implementation Committee that forms partnerships to implement watershed improvement projects is included in Section 8.0. Section 9.0 includes two monitoring components; 1) a “Water Quality Monitoring Plan” that includes specific locations and methods where future sampling should occur and a set of water quality “Criteria” that can be used to determine whether pollutant load reduction targets are being achieved over time and 2) “Report Cards” for each plan goal used to measure milestones and to determine if Management Measures are being implemented on schedule, how effective they are at achieving plan goals, and need for adaptive management if milestones are not being met. Sections 8.0 and 9.0 address USEPA *Elements F, G, H, and I*.

1.5 Prior Studies and Projects

Existing Projects and Initiatives

The Two Hearted River Watershed Management Plan was first approved by state and federal agencies in 2008, and was provided by the Superior Watershed Partnership in cooperation with The Nature Conservancy. The 2008 plan also contains a supporting Two Hearted River Riparian Analysis and a Two Hearted River Watershed Hydrologic Study. Since that time, all 27 site improvements outlined in the plan were implemented by November 2014. The implemented projects reduced an estimated annual loading total of 657.52 tons of sediment, which is more than 23 dump truck loads. Furthermore, the implemented projects improved connectivity to 35 river miles (reconnecting 25% of the river) (TNC 2014).

In the past, members of the Two Hearted River Watershed Advisory Council have been involved in a number of local and regional projects and initiatives related to protecting and enhancing the quality of water, natural character and the quality of life in Luce County and the Upper Peninsula of Michigan. These projects and initiatives are closely linked with the goals for protection and enhancement of the Two Hearted River watershed. They are mentioned here because they provide a foundation for future implementation of the recommendations of this plan.

Great Waters

The *Great Waters* is a unique sustainable economic development program developed by Northern Initiatives and the Eastern Upper Peninsula Nature Tourism Alliance to highlight nature-based tourism opportunities in the eastern Upper Peninsula. A series of trail maps and guides and an interactive web site are available to assist visitors in planning their vacation based on local points of interest and available services. A visitor can go to

www.greatwaters.net and learn about 33 different waypoints to visit, including the mouth of the Two Hearted River and Rainbow Lodge. These waypoints are accessed by 3 primary driving trails along Lakes Michigan, Huron, and Superior. In addition, the Superior Watershed Partnership (SWP) has partnered with Northern Initiatives to provide visitors with an opportunity to get involved with the preservation of their favorite destination. Visitors can log onto www.superiorwatersheds.org and share their experiences, conduct basic stream monitoring, share a photo, and help SWP protect the watersheds of the Upper Peninsula.

The SWP also developed the Great Waters, “*Doing Our Part*” campaign where lodging facilities and other tourism businesses can participate to conserve energy, minimize water use, reduce waste and become a certified *Green* establishment. The *Doing Our Part* campaign features an energy and waste reduction checklist plus a series of water conservation materials for hotel and motel guest rooms. With these materials, businesses can take simple, low cost steps to conserve energy and minimize water use and solid waste at their business. According to the Travel Industry Association of America, 43 million people in America are self-proclaimed “eco-tourists” and are willing to pay 8.5% more to stay at a “*Green*” lodging facility. The SWP also provides *Great Waters* service outings for the local public and tourists where participants can assist with watershed protection projects such as habitat restoration and trail reconstruction. Funding for the *Great Waters* project was provided by People and Land and the Kellogg Foundation. The SWP is currently seeking additional funding to expand this successful project to other parts of the Upper Peninsula.

Great Waters Trail Map with waypoints



Great Waters “Doing Our Part” campaign logos for participating businesses



Lake Superior Coastal Management Plan

In 2008, Luce County Planning and Development and the Chippewa, Luce, Mackinac Conservation District developed the *Lake Superior Coastal Management Plan* with funding from the Michigan Coastal Management Program, the Michigan Department of Environment, Great Lakes and Energy (EGLE) and the National Oceanic Atmospheric Administration. The purpose of this plan was to allow Luce County to manage the resource and steer development and future use through education, community outreach and participating in the EGLE permitting

process to preserve the natural habitat, resources and beauty of the Lake Superior Shoreline. As a part of this project, the Superior Watershed Partnership assisted with development of the Lake Superior Coastal Shoreline Viewer for Luce County. The Lake Superior Coastal Shoreline Viewer consists of unique oblique angle photographs of every inch of the Lake Superior shoreline in Luce County and provides a valuable land use planning tool for landowners, local units of government and regulatory agencies. The viewer can be accessed at www.superiorwatersheds.org and is also available on CD.

Lake Superior Coastal Management Plan for Luce County

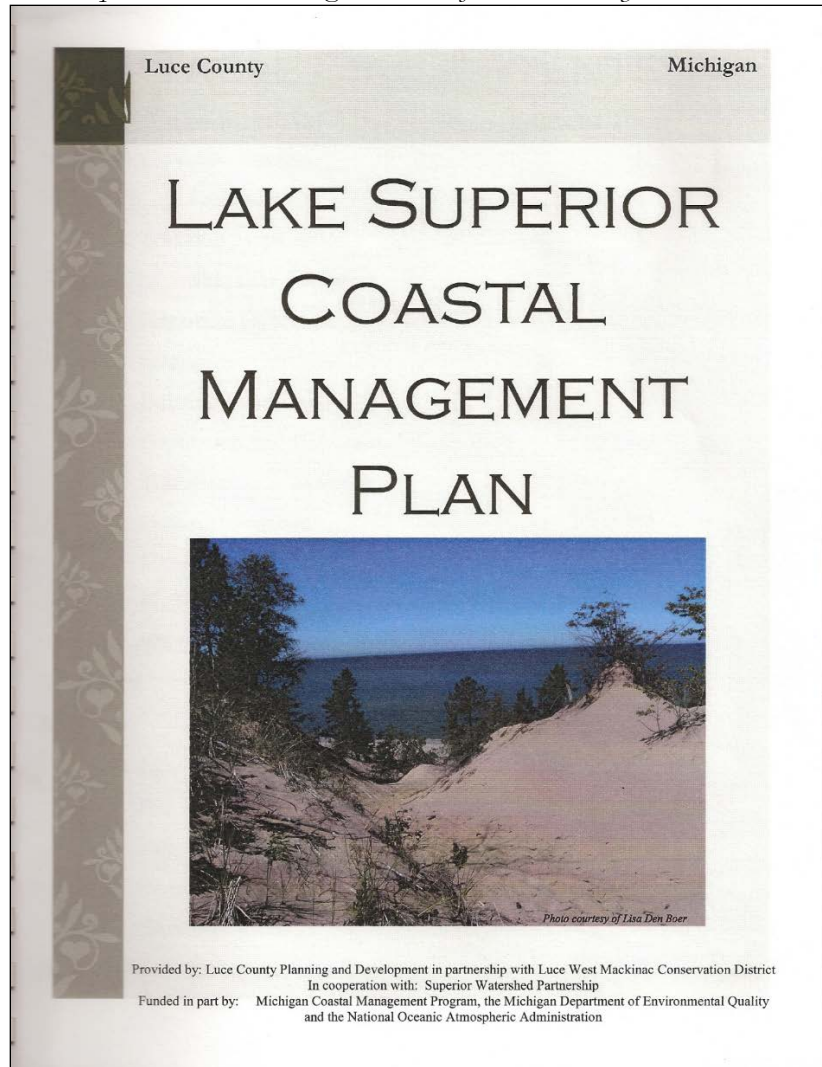
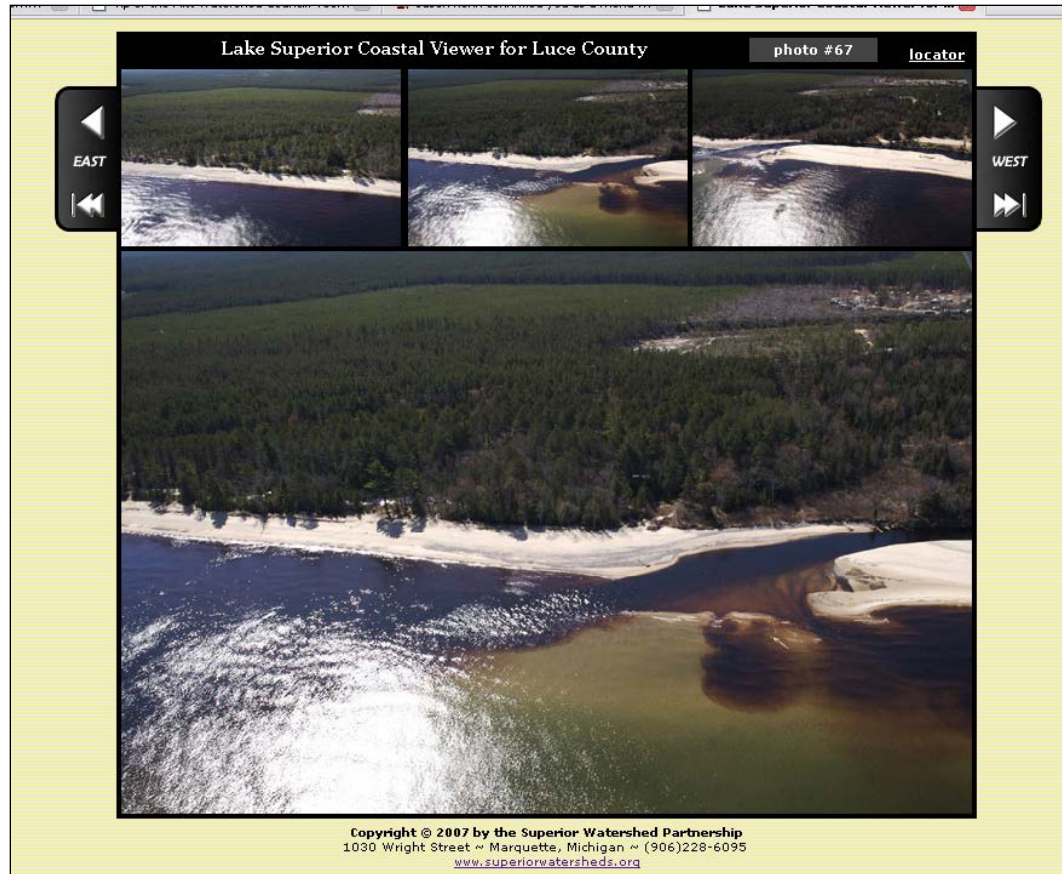


Image from Lake Superior Coastal Shoreline Viewer for Luce County – showing image of the mouth of the Two Hearted River



ORV/ATV Information and Education Campaign

As a result of the problems and damage that has occurred as a result of ORV/ATV use, the Luce County Board of

Commissioners created a campaign to inform and educate recreational users and the public about safe and responsible riding practices.

Luce County Board of Commissioners ORV/ATV Educational Flyer

Read Before You Ride!
AVOID FINES!

ORV/ATV Riders - You NEED to know:

It is **unlawful** to ride an ORV/ATV in **ANY** wetlands, swamps or on **ANY** beaches or shorelines. Violators riding on beaches or wetlands have been, and will continue to be, held liable for all restoration costs and fines. In order to protect this beautiful environment, court judgements in the thousands of dollars are being rendered against offenders.

In LUCE COUNTY you also NEED to know:

Riding on county roads must be done single file and is **restricted to the outer 5 feet** at the right-hand side of the road. On paved roads that means to the right of the fog line!

The maximum ORV/ATV speed limit is **25 MPH** on **ANY** Luce County road unless posted lower.

These **County Roads** are **off limits** to ORV use:
County Road 392 (Industrial Park)
County Road 478 (Luce County Park Road)
County Road 439 Pretty Lake Area

Also **off limits**:
Luce County Fair Grounds
All Luce County Recreational Facilities
All State Parks

It is **illegal** to ride on or along these state roads:
M-28 M-123 M-117
They may be crossed at a right angle only!

Snowmobile trails and ORV/ATV trails are NOT the same!! Many snowmobile trails are OFF LIMITS to ORV/ATV riders because they cross private property leased by snowmobile associations and not by ORV groups. Crossing Private Property is **TRESPASSING** and could jeopardize those leases!

Michigan Law **requires** Helmets when riding an ORV/ATV.
Did you know?... If you are riding an ORV/ATV, and have a traffic accident with a car/truck, **you** are automatically assumed at fault. Now you know!

Luce County Welcomes Safe and Responsible ORV and ATV Riders!



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In 2010, The Nature Conservancy (TNC) in cooperation with the Superior Watershed Partnership (SWP) received Great Lakes Restoration Initiative funding to improve 12 of the highest priority sites in the Two Hearted River Watershed (Figure 2). Additional funding was awarded in 2011 to address the remaining priority sites. From 2006 to 2014, TNC and partners identified 27 crossings and man-made eroding streambanks, and stabilizations, repairs and replacements have been implemented at all 27 locations (TNC 2014). Table 1 includes a brief description of SWP-TNC restoration sites and estimated benefits.

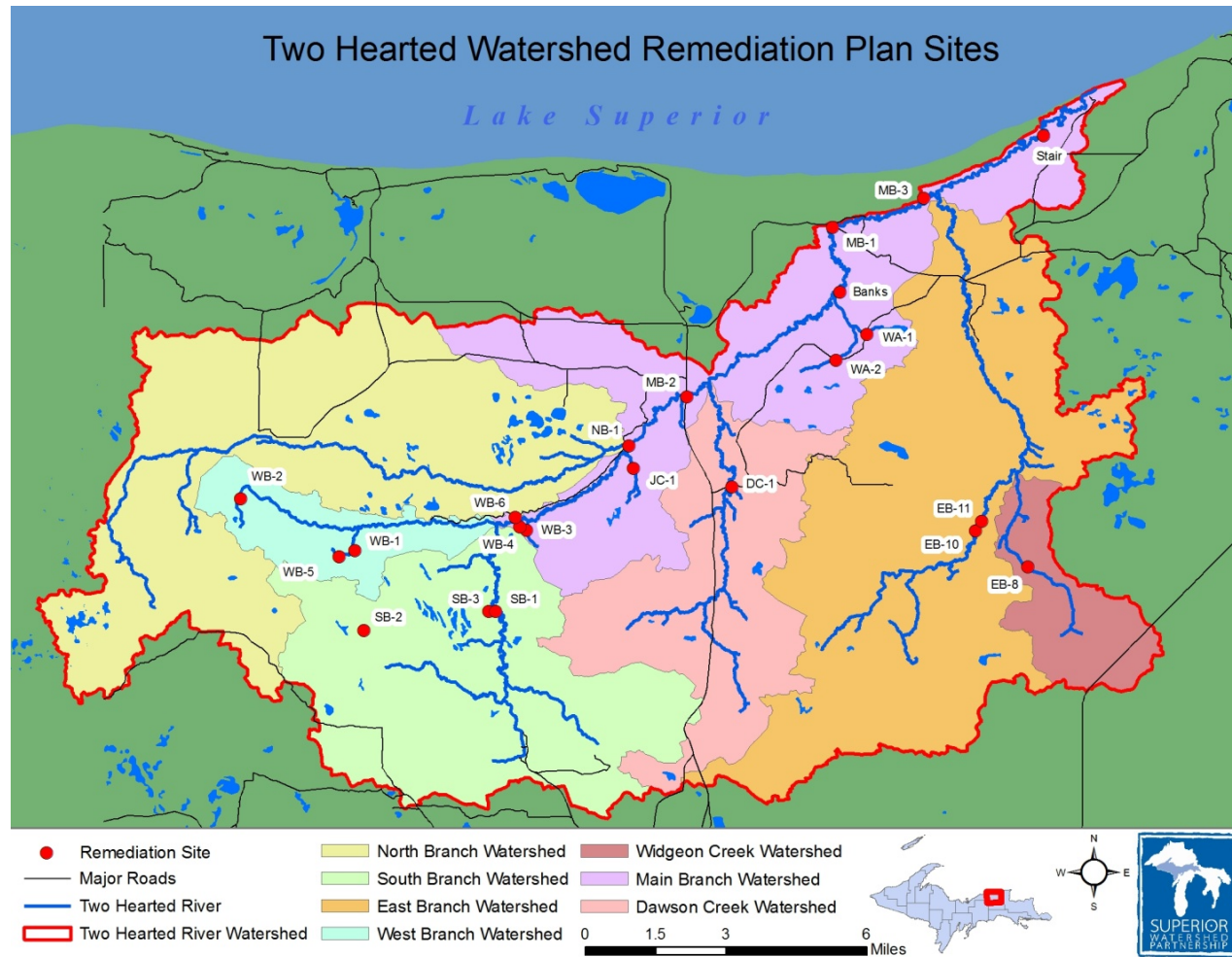


Figure 2- Implemented Site Remediations

Table 1- Implemented site remediations, estimated benefits, and pollutant reductions in partnership with The Nature Conservancy.

Site Name	Site Description	Benefits	Date Completed	Site Name	Site Description	Benefits	Date Completed
JC-1	Perched culvert at CCI Road crossing of John's Creek, tributary to West Branch	Fish access to 2.7 miles of stream habitat restored, 7 tons sediment controlled/year	9/30/2014	Fisherman's Stairs	Main Branch stream bank erosion near Fisherman's/canoe access stairs installed by MDNR and Two Heart Chapter TU	33.52 tons of sediment controlled/year	10/28/2012
SB-1	Undersized culverts with major source of sedimentation, South Branch; requires new bridge	Fish access to 20 miles of stream habitat improved, 9.87 tons sediment controlled/year	2011 - 2012	High Banks	Main Branch at High Banks Trail, old RR grade/trail leading down to river	90.20 tons of sediment controlled/year	10/28/2012
SB-2	Dairy Creek and Dairy Lake Road, culvert severely undersized and erosion on both embankments	Fish access to 1.0 mile of stream and a 13-acre lake restored, 0.56 tons of sediment controlled/year, (see portable bridge info)	11/26/2014	WB-1	Unauthorized stream ford crossing of unnamed tributary to West Branch (see portable bridge info)	6.95 tons of sediment controlled/year	Site work 10/7/2011, Portable bridge completed 10/8/2013
SB-3	Jane's Creek and CCI Road stream crossing is located less than ¼ mile west from the SB1 crossing. Existing culvert had rusted through causing sedimentation.	Replaced culvert and stabilized bank, 9.57 tons of sediment controlled/year	8/29/2011	WB-2	Unauthorized stream ford crossing of West Branch (see portable bridge info)	1.63 tons of sediment controlled/year	Site work 10/14/2011, Portable bridge completed 10/8/2013
SB-4	Dairy Creek and Unnamed Road, crossing is located just downstream of the SB2 site. It is a very poorly constructed and unusable "bridge" like structure.	Removed the unstable structure, restored the channel, and stabilized the bank, 0.15 tons sediment controlled /year	11/26/2014	WB-3	Undersized/perched culvert on unnamed Tributary to West Branch near Evergreen Lake	0.5 mile of stream habitat restored, 1.09 tons of sediment controlled/year	9/29/2011
SB-5	Tributary to Dairy Creek and Dairy Lake Road, crossing is located just north of the SB2 site. The crossing was comprised of two perched, undersized, rusting 36" culvert and several hollow logs.	Removed the unstable structures, restored the channel, and stabilized the bank, 0.19 tons sediment controlled/year	11/26/2014	WB-4	Two undersized culverts located at a tributary to the West Branch and at Evergreen Lake Road	5.18 tons of sediment controlled/year	9/28/2011
WA1	Crushed culvert at County Road 412 crossing of Chris Brown Creek, tributary to Main Branch	Fish access to 1.0 mile of stream and a 55-acre lake restored, 44.62 tons of sediment controlled/year	8/20/2012	WB-5	Tributary to West Branch and CCI Road, culvert perched and undersized, near a road blowout in Fall 2010 with erosion in the road	Fish access to 0.5 mile of stream, 8.46 tons of sediment controlled/year	11/4/2014
WA-2	Wabash Creek and County Road 414, culvert severely undersized and located at a low point in the road, minor erosion on embankments	Fish access to 1.0 mile of stream and an 8-acre lake restored, 9.38 tons of sediment controlled/year	10/25/2013	WB-6	West Branch and County Road 418, large bank erosion on the south side of road	215.08 tons of sediment controlled/year	11/19/2014

DC-1	Dawson Creek and County 420, erosion reaching stream from the downstream embankment	7.4 tons of sediment controlled/year	11/15/2012	EB-8	Widgeon Trail crossing of Widgeon Creek – old bridge was washed out (no structure), tributary to Each Branch; requires bank stabilization.	Estimated 60 tons of sediment controlled/year	Bridge was restored by the East Branch Sportsman's Club in 2010
NB- 1	North Branch and County Road 418, erosion on approaches to crossing and running into stream through the bridge decking	69.98 tons of sediment controlled/year	8/3/2012	EB-10	East Branch stream bank erosion site downstream from EBSC Bridge	8.25 tons of sediment controlled/year	10/28/2012
MB-1	Main Branch steam bank erosion at Reed & Green Bridge canoe launch	14.31 tons of sediment controlled/year	10/28/2012	EB-11	Near Dead end on Trout Lane in East Branch Sportsmen's Club, large bank with severe erosion, implemented a control structure and bank stabilization	35.06 tons of sediment controlled/year	8/20/2014
MB-2	Main Branch storm water ditches leading down to river at High Bridge	27.33 tons of sediment controlled/year	6/19/2013				
MB-3	Erosion on bank form camp site use on state land near the end of Coast Guard Road	52.33 tons of sediment controlled/year	8/22/2014				
Total Benefits				657.52 tons of sediment controlled/year, access to 35 miles of stream habitat and 76 acres of lake habitat restored			

Sources: *The Nature Conservancy of Michigan 2010, 2011, and 2014*

2.0 MISSION, GOALS, AND OBJECTIVES

2.1 Superior Watershed Partnership

The Superior Watershed Partnership and Land Conservancy is a 501(c)(3), award-winning, Great Lakes nonprofit organization that has set national records for pollution prevention and implements innovative, science-based programs that achieve documented, measurable results. The Superior Watershed Partnership implements a variety of conservation and public education projects including:

- Great Lakes habitat protection and restoration
- Community pollution prevention
- Climate change adaptation planning and implementation
- Invasive species removal and prevention
- Water quality and stormwater management
- Native plant restoration
- Land protection
- Youth programs and public education
- Alternative energy and energy conservation
- UP community assistance

The Superior Watersheds Partnership also provides technical, educational, and monitoring assistance on a variety of Great Lakes protection initiatives with emphasis on Lake Superior, Lake Michigan, and Lake Huron. The Superior Watershed Partnership

has received numerous state and national awards and has been recognized by Michigan's Governor Granholm, the US Environmental Protection Agency, Environment Canada and the Lake Superior Bi-national Program as a leader in watershed protection for the Lake Superior Basin and the headwaters region of the Great Lakes ecosystem.

2.2 Goals and Objectives

The main goal of the Two Hearted River Watershed Management Plan is to promote and facilitate coordinated, collaborative action among stakeholders in order to protect and preserve water quality and the unique nature of the watershed. The watershed inventory and analysis identified and prioritized the causes and sources of pollution affecting or having the potential to affect water quality and designated and desired watershed uses. The following goals, objectives and management strategies provide guidance for implementation of actions that will reduce these affects and provide a basis for protection from further impacts.

The following goals and objectives were developed as strategies to address known and potential pollutants and threats to water quality and designated and desired uses in the Two Hearted River watershed (Table 2). They provide a basis for protection of significant natural resources and reflect the desires of the stakeholders for the future state of the watershed.

Table 2- Goals and Objectives

Goal	Objectives
1. Protect and improve the quality of water in order to support all designated and desired uses	<ul style="list-style-type: none"> A. Reduce non-point source pollution from manmade sources B. Monitor trends in water quality and aquatic habitat conditions C. Increase awareness of non-point source pollution and potential impacts to water quality
2. Protect the integrity of aquatic and terrestrial ecosystems	<ul style="list-style-type: none"> A. Reduce impacts from land uses including recreation, forest management and development B. Preserve and protect environmentally sensitive areas from invasive species and land use pressures
3. Increase stewardship practices of corporate and private landowners, recreational users and the public	<ul style="list-style-type: none"> A. Increase awareness of environmentally sensitive areas and impacts of non-point source pollution B. Promote environmentally sound and economically feasible land use management practices C. Promote protection/conservation of environmentally sensitive areas D. Provide opportunities for involvement in watershed programs and activities
4. Increase nature-based tourism opportunities that protect natural features and preserve the natural character of the watershed	<ul style="list-style-type: none"> A. Link to regional programs and initiatives B. Improve trail systems to accommodate desired low-impact recreational uses C. Promote new/improved recreational opportunities through marketing and outreach

Goal #1

Protect and improve the quality of water in order to support all designated and desired uses

Designated Uses Addressed:

Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:

Protect the native fishery, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:

All

- Utilize the well-established Great Lakes Conservation Corps (GLCC) program for 18-25-year-olds to provide career experience, collect watershed monitoring data, and provide valuable boots-on-the-ground for project implementation

Objective C:

Increase awareness of non-point source pollution and potential impacts to water quality

- Designate biologically important or sensitive areas within the watershed such as riparian corridors, recharge areas, wetlands, and slopes
- Provide detailed watershed information to landowners, land managers and decision makers
- Negotiate conservation easements where possible and applicable within the watershed
- Avoid development that encroaches on sensitive or biologically important areas
- Preserve high quality natural communities
- Protect critical riparian areas
- Properly manage working lands (forest lands)

Objective A:

Reduce non-point source pollution from manmade sources

- Reduce sedimentation from priority sources
- Improve passage for fish and aquatic organisms (road/stream crossings)
- Promote proper riparian land use practices including the use of buffers (reduce sedimentation, protect sensitive areas)

Objective B:

Monitor trends in water quality and aquatic habitat conditions

- Continue watershed monitoring, public education, regional outreach, and planning efforts

Goal #2

Protect the integrity of aquatic and terrestrial ecosystems

Designated Uses Addressed:

Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:

Protect the native fishery, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:

All

- Encourage appropriate provisions for water quality and sensitive areas in the approval process for new development or redevelopment
- Avoid development that encroaches on sensitive or biologically important areas

Objective A:

Reduce impacts from land uses including recreation, forest management and development

- Provide guidance and tools for planning, ordinance development, and zoning enforcement
- Preserve high quality natural communities
- Protect critical riparian areas
- Properly manage working lands (forest lands)

Objective B:

Preserve and protect environmentally sensitive areas from invasive species and land use pressures

- Maintain effective riparian buffers
- Encourage the use of land use restrictions in areas sensitive to environmental degradation

Goal #3

Increase stewardship practices of corporate and private landowners, recreational users and the public

Designated Uses Addressed:

Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:

Protect the native fishery, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:

All

Objective A:

Increase awareness of environmentally sensitive areas and impacts of non-point source pollution

- Use social surveys to identify what information should be sent to landowners and the public
- Use tactical and targeted outreach and communications plan that is tailored to specific user groups
- Use multiple mediums to communicate information, connect with, and inform landowners

Objective B:

Promote environmentally sound and economically feasible land use management practices

- Form and/or maintain local and regional partnerships and identify shared goals and objectives

- Where applicable, use and share place-based curriculum *Resource Management for Resilience* developed for educators in collaboration with the Model Forest Policy Program in 2018.
- Connect with the community to form citizen science opportunities for gathering data and providing meaningful hands-on experiences

Objective C:

Promote protection/conservation of environmentally sensitive areas

- Use strategic and informative signage to inform the public about projects, biologically important areas, sensitive areas, and watershed concerns in publicly accessible areas
- Address watershed concerns and goals with focused communication campaigns through a variety of print and digital mediums

Objective D:

Provide opportunities for involvement in watershed programs and activities

- Participate in regular communication with local governmental decision makers
- Provide detailed watershed information to landowners, land managers and local governmental decision makers

Goal #4

Increase nature-based tourism opportunities that protect natural features and preserve the natural character of the watershed

Designated Uses Addressed:

Coldwater fishery, other indigenous aquatic life and wildlife, and public water supply

Desired Uses Addressed:

Protect the native fishery, limit development to areas outside the riparian corridor, and promote sound land use practices

Pollutants Addressed:

All

Objective A:

Link to regional programs and initiatives

- Link to the Lake Superior Lakewide Action and Management Plan (LaMP) objectives focused on coastal wetlands, aquatic communities, riparian areas, coastal terrestrial communities, and tributaries.
- Use baseline data in comparison with current data collection to analyze and monitor changes to ecosystem conditions
- Implement stream restoration projects and activities as prioritized by planning efforts and approved by local and state jurisdictions

Objective B:

Improve trail systems to accommodate desired low-impact recreational uses

- Communicate between the municipalities located within the Two Hearted River watershed
- Provide watershed information to allow for discussion and analysis of existing land use
- Discuss the impacts of future development

Objective C:

Promote new/improved recreational opportunities through marketing and outreach

- Provide guidance and tools for planning, ordinance development, and zoning enforcement
- Provide detailed watershed information to local units of government

3.0 WATERSHED RESOURCE INVENTORY

Further south the bedrock formed in marine sediments during the Early Ordovician Period. The dolomitic sandstone and dolomite of the Trempealeau Formation and Prairie du Chien Group were formed during this time period. During the Middle Ordovician Period dolomite and limestone bedrock of the Black River and Trenton Group were formed (USDA 2006).

3.1 Geologic History & Climate

Geology

The geology of the Two Hearted River watershed consists of six (6) sedimentary bedrock formations (Figure 1.2). The oldest of these is the Jacobsville Sandstone Formation, which was formed during the Early to Middle Cambrian age. It consists of red and white-streaked sandstone due to the oxidation, reduction, and leaching of iron. This sandstone occurs along Lake Superior in Alger, Luce, Chippewa, Marquette, Baraga, Houghton and Keweenaw Counties (USDA 2006).

By the Middle Cambrian Period inland seas were covering much of North America. During the Late Cambrian Period the Munising Sandstone Formation was formed. This sandstone generally consists of white to light gray, dolomitic and glauconitic sandstone, red, green and gray shale, and a basal conglomerate. Dramatic exposures of the Munising Sandstone can be seen in the cliffs along the nearby Pictured Rocks National Lakeshore and at many of the waterfalls throughout the area including the Upper Tahquamenon Falls in Luce County. The Munising Formation is a narrow band that spans the eastern half of the Upper Peninsula (USDA 2006).

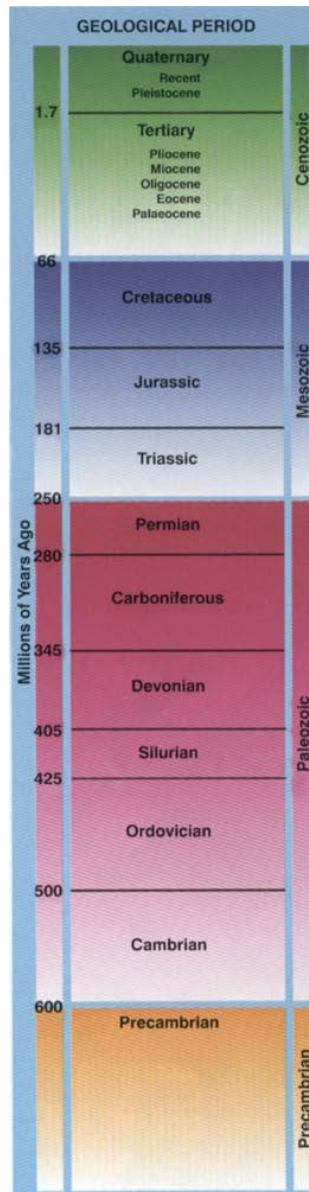


Figure 3- Geological Period (Source:
<http://www.ukfossils.co.uk/timeline/charts/Timeline.gif>)

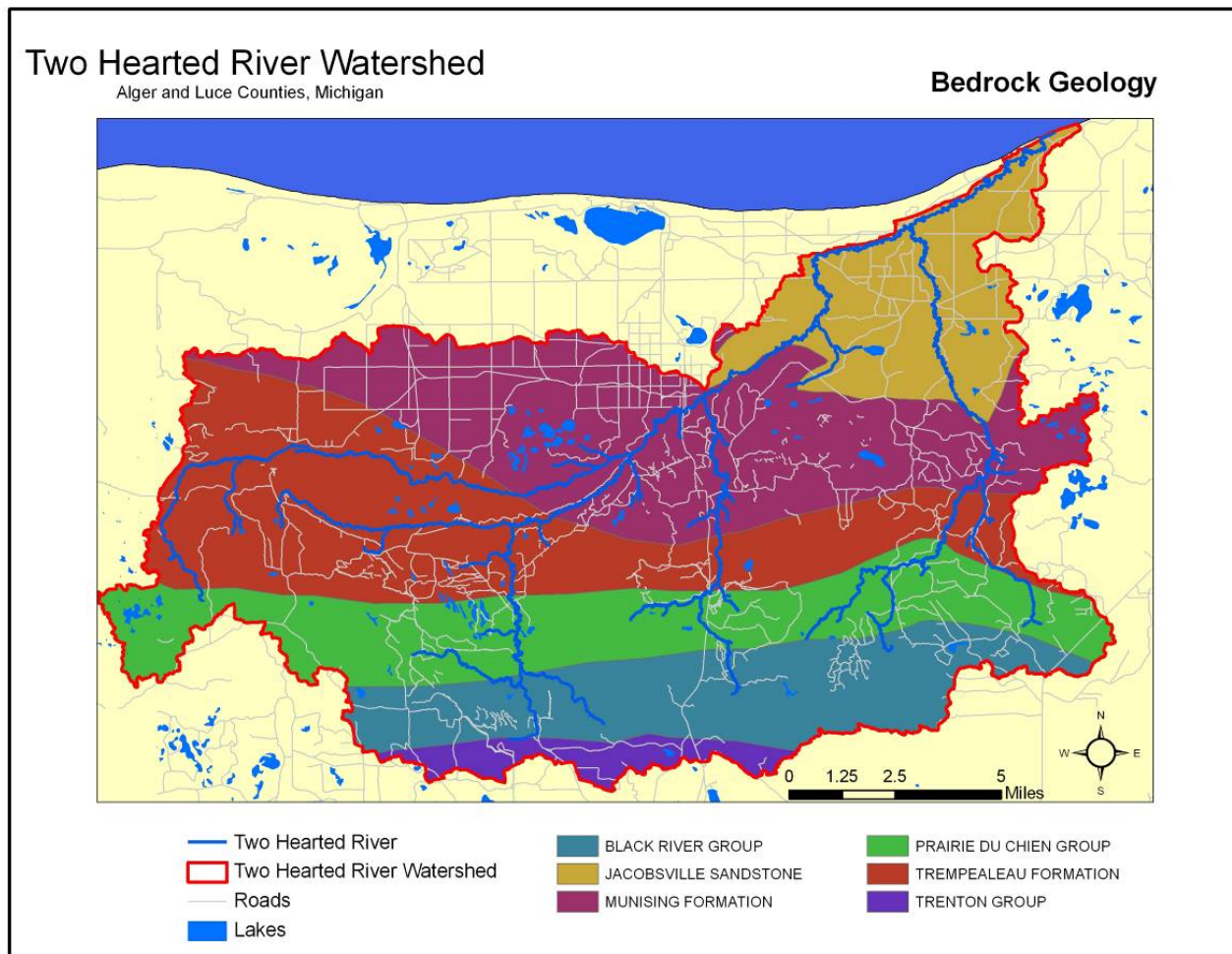


Figure 4- Bedrock Geology of the Two Hearted River Watershed

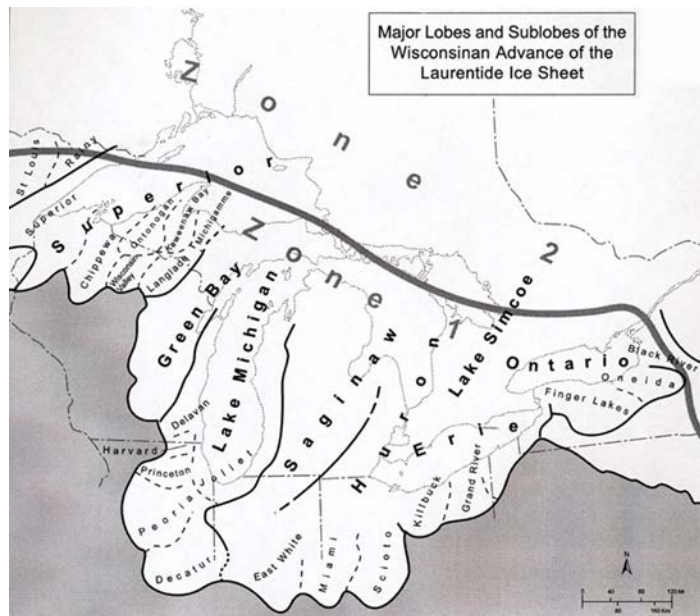


Figure 5 Lobes and Sublobes of the Laurentide Ice Sheet

The landforms of the Upper Peninsula of Michigan are a product of the glaciers that occupied the region during the Pleistocene Epoch. During the Wisconsin glacial stage the entire Upper Peninsula was covered with a thick sheet of ice that went as far south as southern Indiana and Ohio (Figure 5). A massive deposition of glacial drift and the subsequent melting of the glacial ice combined to create a variety of landforms. Most of these landforms are a result of the last major glacial stage known as the Greatlakean (formerly Valderan). Glacial depositions throughout the Upper Peninsula of Michigan range from 0 to over 500 feet thick. The variety of soils found on each landform formed in material deposited 4,000 to 10,000 years ago (USDA 2003). There are seven distinct landform types in the Two Hearted River watershed. They are shown in Figure 6.

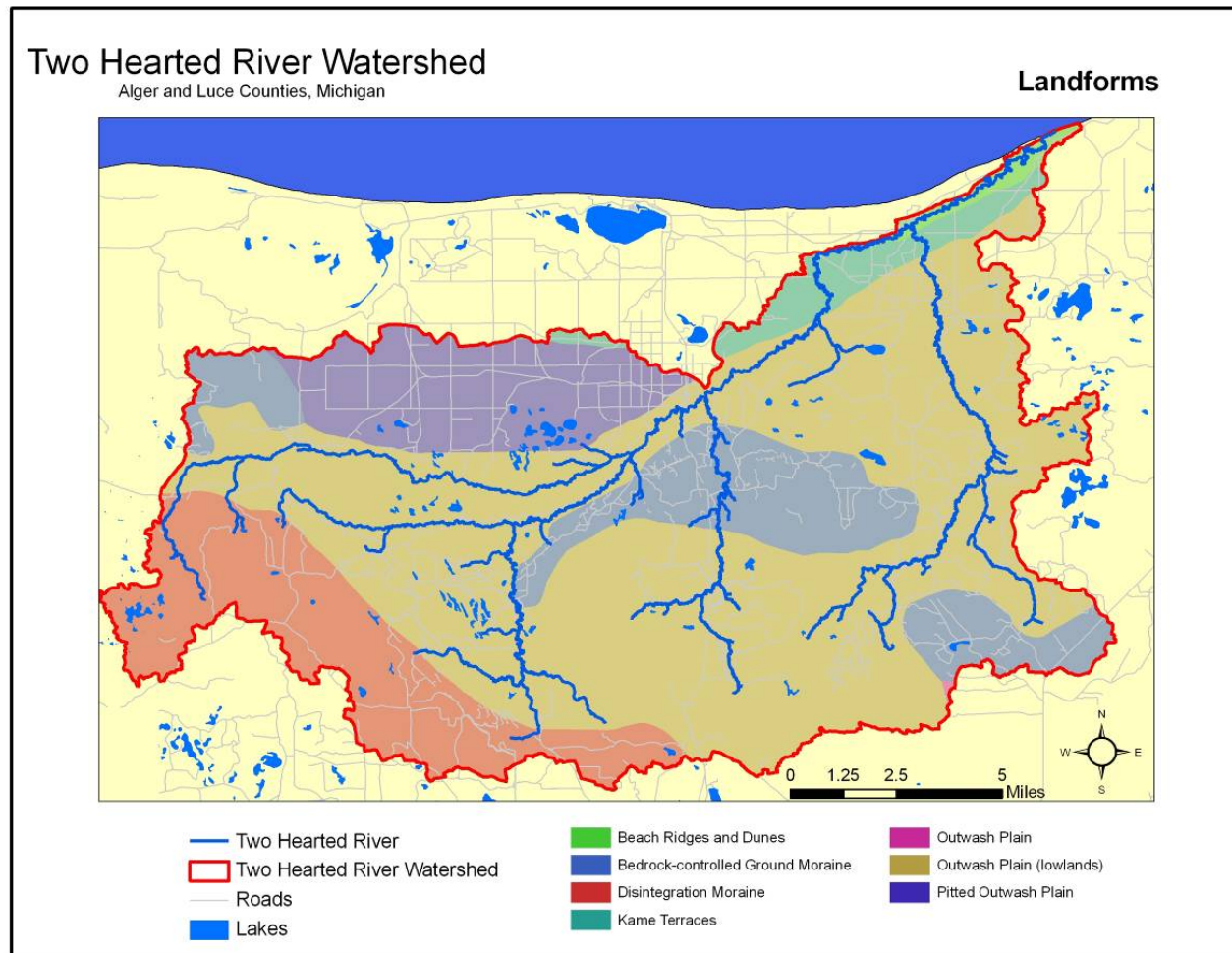


Figure 6- Landforms of the Two Hearted River Watershed

Climate

The climate of the Two Hearted River watershed is affected by its close proximity to Lake Superior, which moderates the temperatures of the surrounding land resulting in cooler summers and warmer winters. In summer, the average temperature is between 62.2 and 73.7 degrees F. The highest recorded temperature, which occurred at Newberry on July 13, 1936, was 103 degrees F. In winter, the average temperature is between 9.4 and 17.3 degrees Fahrenheit (F). The lowest temperature on record for Luce County, which occurred at Newberry on January 26, 1927, was -30 degrees F (USDA 2003).

The average annual total precipitation is 32.36 inches. Of this total, 13.21 inches, or about 41 percent, usually falls in June through September. The heaviest 1-day rainfall during the period of record was 4.18 inches on July 22, 1994. Thunderstorms occur on about 29 days each year, and most occur between June and September. The average seasonal snowfall is 112.6 inches. The greatest snow depth at any one time during the period of record was 49 inches, recorded on January 27, 1994. On an average, about 117 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 23.0 inches, recorded on January 4, 1982 (USDA 2003).

Climate Change

The variable effects of climate change are altering Northern Michigan forests and other ecosystems, and can be attributed to changes in important cultural, economic, and environmental factors. In Michigan, the four heaviest rain events per year contain 35% more water than they did 50 years ago (US EPA 2016). These heavy rains lead to increased sedimentation, nitrates, phosphates, E. Coli, and other pollutants entering waterways leading to beach closings and algae blooms. In addition, northern forest compositions are changing. In particular, the Upper Peninsula of

Michigan may see declining paper birch, quaking aspen, balsam fir, and black spruce populations and increasing populations of oak, hickory, and pine trees (US EPA 2016). Furthermore, the central and eastern regions of the Upper Peninsula are projected to experience more extreme temperature changes than other parts of Michigan (GLISA 2014).

The Climate Change Response Framework conducted a series of vulnerability assessments for the Northwoods region supported by 27 science and management experts from across the area aka the “Northwoods Framework.” The experts agreed that current and anticipated climatic changes suggest the following main points for the Laurentian Mixed Forest Province of the eastern Upper Peninsula and northern Lower Peninsula of Michigan found: 1). Increased precipitation 2). Increased daily maximum temperatures, particularly in winter 3). Potential increase in mean annual temperature of 2.2 to 8.1 °F for the region 4). The most vulnerable forest communities in the assessment area include upland spruce-fir, jack pine, lowland conifers, and red pine-white pine forest communities (Handler et al. 2014).

Projected climate trends anticipated for the next 100 years were determined using downscaled global climate model data. The suggested management implications in the Northwoods Framework report include (summarized) 1). Following state/federal guidance and developing wildlife action plans to protect and support wildlife, and specifically rare, threatened, and endangered species. 2). Adapt fire and fuel policies specific to land use in particular regions to address ecosystem and human health concerns exacerbated by drought conditions. 3). Replace water infrastructure such as culverts, bridges, and shoreline roads following 100-year flood plans. Use hydrologic modeling where possible to identify high runoff zones. 4). Prioritize the preservation of stream margins, as reduced shading could cause the

effects of warming temperatures to compound with severe consequences for fish populations and other aquatic life. 5). Adapt forest harvest and management practices for anticipated changes in tree species diversity related to heat-stress and tolerance levels. 6). Manage forests for non-timber products such as food, medicine, and craft. In addition, protect cultural, archeological and historical resources. 7). Adapt forest harvest and management practices for shorter seasons of frozen ground and reduced harvest windows. 8). Manage forests using strategies for increasing carbon storage with enhanced regeneration, competition control,

fertilization, and superior stock 9). Plan for increased infrastructure maintenance on trails, campsites, structures and hazard tree removal in wilderness areas due to increased storm events. 10). Plan to adapt to challenges and increased infrastructure maintenance at cultural heritage sites. 11). Plan to shift tourist and local recreational focus from winter-sports to warmer-weather activities. 12). Plan, adapt, and inform the public about regional increases in human diseases and vectors of transmission 13). Plan, adapt to challenges and plant a variety of highly tolerant species at urban and community forest sites (Handler et al. 2014).

Sleeper Lake Fire

Only about 2 percent of all wildfires in Michigan are caused by lightning strikes and the rest are caused by human activity (MDNR accessed 2008). One of these rare events occurred in the early morning hours of Thursday August 2, 2007, when a lightning strike started a wildfire in the Two Hearted River watershed. The fire was discovered later that day near Sleeper Lake approximately 6.5 miles north of the Village of Newberry and east of County Road 407.

A severe drought during 2007 had resulted in optimal conditions for wildfire. The Michigan Department of Natural Resources (MDNR) have a drought code to help monitor potential conditions for a wildfire. The drought code is zero when the ground is saturated with snow melt. A code of 500 indicates serious drought conditions and a high potential for a wildfire. During the summer of 2007, the area where the Sleeper Lake Fire began reached a record drought code of over 600 (TNC 2007).

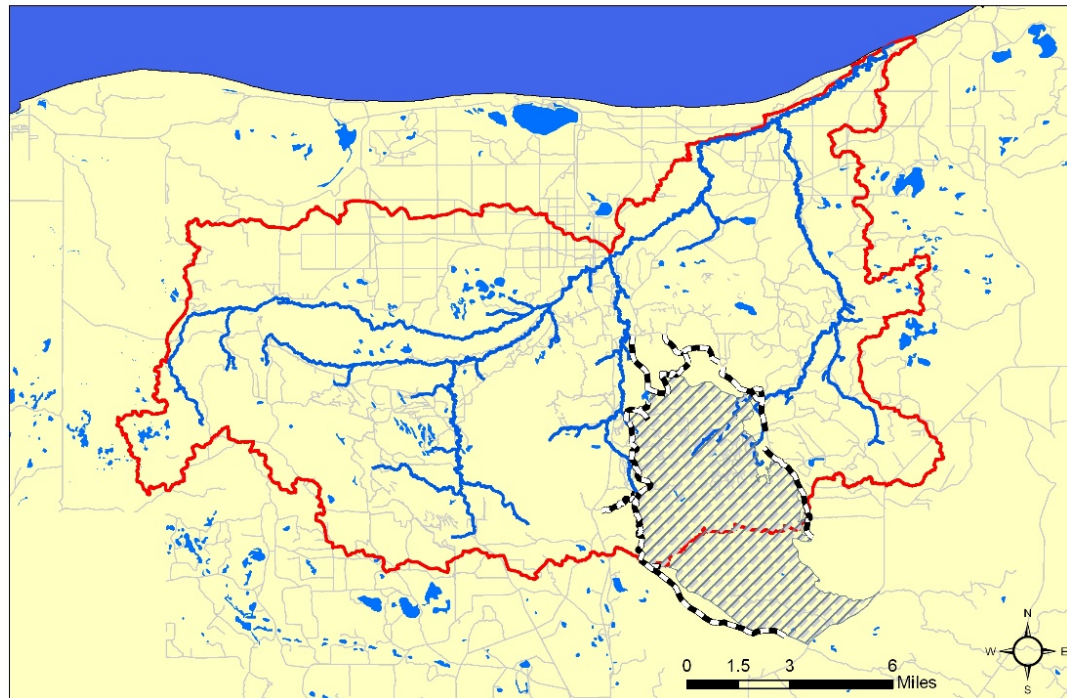
The fire presented immediate challenges for containment due to the extreme drought conditions, strong winds (reaching up to 30 miles per hour) and its remote location. By Tuesday August 7, more than 15,000 acres had burned and the fire was considered only 10% contained (TNC 2007).

Over 200 personnel from numerous agencies responded, bringing land and air support including six helicopters with 700 and 2000 gallon water buckets, a CL 215 water bomber, 6 tractor plows with pumpers, and tracked marsh vehicles. Many local citizens of Luce County provided additional support for the fire suppression efforts by feeding and caring for firefighters and keeping moral high by showing their local support on local signs along roadways (Lisa DenBoer, Luce County Planning personal communication). Approximately 26 miles of dozer lines were constructed to provide access for containment efforts (Figure 7).

Two Hearted River Watershed

Alger and Luce Counties, Michigan

Sleeper Lake Fire



- Two Hearted River
- Two Hearted River Watershed
- Roads
- Lakes
- Dozer Line
- Fire Boundary

Figure 7- Sleeper Lake Fire Burn Area and Dozer Lines

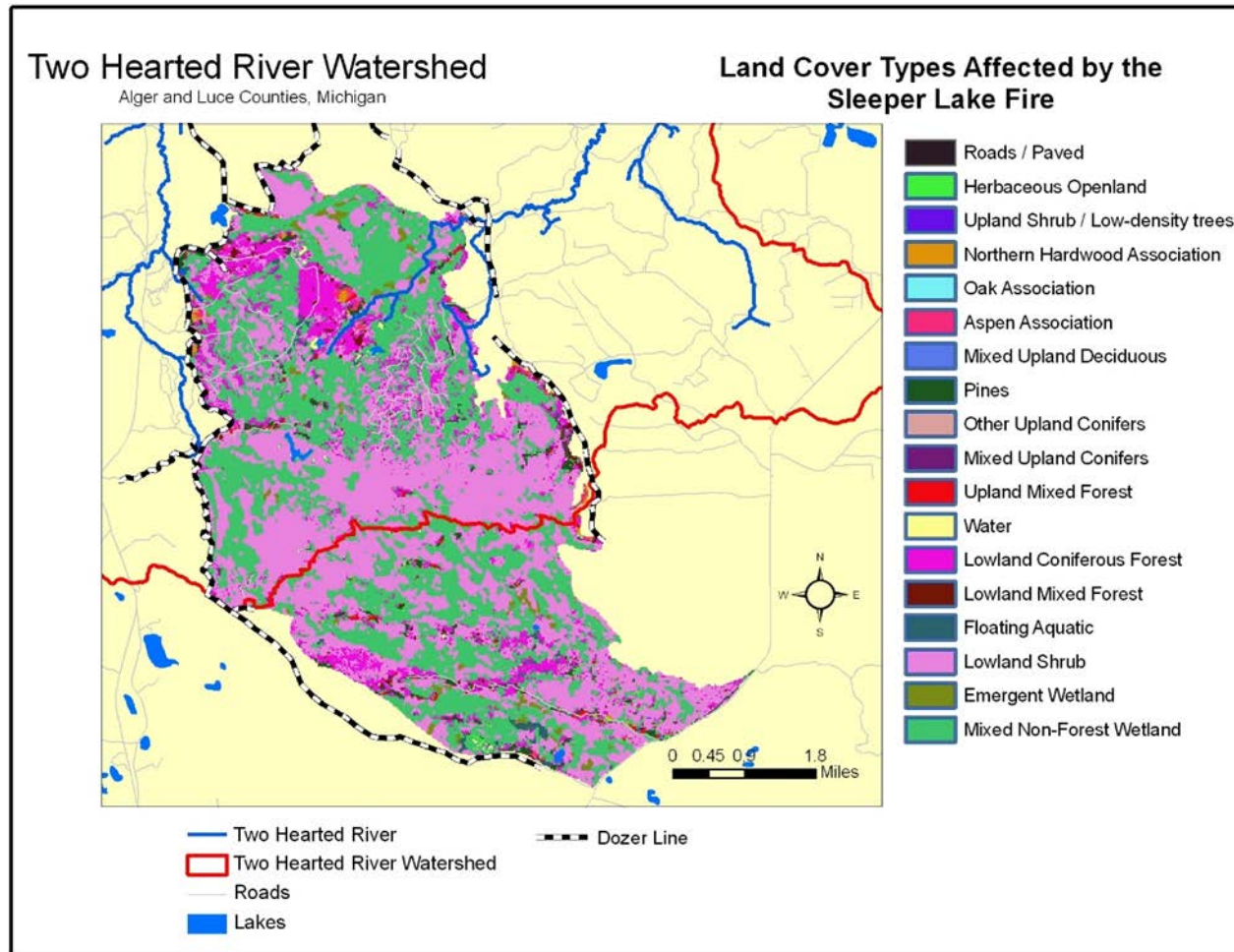


Figure 8 - Land Cover Types Affected by the Sleeper Lake Fire

By August 29, 2007, the fire was considered 95% contained and the last of the firefighting crews were dismissed as of Labor Day weekend (Lisa DenBoer, Luce County Planning personal

communication). The Sleeper Lake fire was considered the third largest wildfire recorded in the history of Michigan. Approximately 18,185 acres burned in total, including over 1,000 acres of

commercial forest lands and 17,000 acres of swamp and marshlands (Mining Journal 2007). Remarkably, while a few firefighters sustained minor injuries, there was no loss of life and only one structure was lost. The last time pilots spotted any smoke from the more than 28-square mile charred footprint was mid-September (Mining Journal 2007). The total cost to contain the fire was estimated at approximately \$6 million. A summary of the land cover types affected by the fire is provided in Figure 8 and Table 3.

Table 3- Acres of Land Cover Types Affected by the Sleeper Lake Fire

Land Cover Types Affected by the Sleeper Lake Fire	Area (acres)
Roads / Paved	10
Herbaceous Open land	101
Upland Shrub / Low density trees	2
Northern Hardwood Association	61
Oak Association	2
Aspen Association	87
Mixed Upland Deciduous	11
Pines	317
Other Upland Conifers	19
Mixed Upland Conifers	75
Upland Mixed Forest	90
Water	56
Lowland Coniferous Forest	1823
Lowland Mixed Forest	134
Floating Aquatic	128
Lowland Shrub	7971
Emergent Wetland	224
Mixed Non-Forest Wetland	7064
Total	18176

The effect of fire on the survival of wetland and forest communities depends on the intensity, frequency, and extent of fire and the ecological requirements of particular species. Most vertebrate groups can escape low intensity fires by sheltering until the fire front has passed, or by avoiding the fire edge. Low frequency, high intensity, broader scale summer fires have the most dramatic impact on the survival of local species (WRC 2000).

A summary of potential ecological advantages and disadvantages of wildfires is provided in Table 4.

Post-fire assessments were conducted by the MDNR Eastern Lake Superior Management Unit of the Fisheries Division during late September of 2007 in tributaries with the highest potential for impact as a result of the Sleeper Lake fire. The surveys indicated no impact to the fish community (James Waybrant, MDNR personal communication). Additional field investigations should be conducted to determine the extent of impacts to aquatic communities and the local flora and fauna as a result of the Sleeper Lake Fire.

During the spring of 2008, less than one year after the fire, the marsh lands of the Two Hearted River watershed and other areas impacted by the Sleeper Lake fire appeared to be substantially re-vegetated and the fire boundary was no longer visible by air.

Table 4 Ecological Advantages and Disadvantages of Wildfires (WRC 2000)

Advantages	Disadvantages
May trigger seed release and germination in some species	Loss of seed as a consequence of inappropriate timing of fires
Stimulates the development of new green shoots, roots and rhizomes of grasses, and sedges producing food sources for wildlife	Degradation or loss of peat soils (organic-rich soils)
May create pools for nesting and feeding water birds and amphibians	Increased predation of seed by insects
Can provide favorable habitat for wildlife by eliminating impenetrable growth of plants	Increased potential for fungal attack on seeds
	Changes in vegetation composition and structure including increased potential for invasive species invasion
	Exposure of roots and rhizomes
	Loss of vegetation, resulting in reduced bio-filtering of incoming surface water flows
	Erosion of soil and increased turbidity in wetlands and surface waters
	An increase in water temperature as a result of the loss of vegetation and shade

Sleeper Lake Fire Cooperating Agencies

- Michigan Department of Natural Resources
- Minnesota Department of Natural Resources
- Wisconsin Department of Natural Resources
- Bureau of Indian Affairs
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- Ontario Ministry of Natural Resources
- Michigan National Guard
- Air Guard
- Michigan State Police
- Luce County Sheriff's Department
- National Weather Service
- The Nature Conservancy
- Numerous Volunteer Fire Departments
- Salvation Army
- American Red Cross
- Local Keyman Firefighters working for MDNR

3.2 Topography, Watershed Boundary, & Subwatershed Management Units

Topography and Soils

The topography of the Two Hearted River watershed can be viewed on the Muskallonge Lake East, Betsy Lake NW, Betsy Lake SW, Muskallonge Lake SE, Muskallonge Lake SW, Grand Marias SE, Roy Lake, Buckeye Lake, and Auger Lake U.S. Geological Survey (USGS) 7.5 minute series topographic maps.

The watershed as a whole has very little topographic relief with the highest elevations only about 350 feet above Lake Superior. Sixty-five percent (65%) of the watershed has a slope of 0-5% (Table 5). Locations with the greatest percent slope (30-100%) include the headwaters of the North Branch and West Branch and along portions of the West Branch, Dawson Creek, East Branch, and Main Branch (Figure 9).

Table 5-Topographic Relief in the Two Hearted River Watershed

Percent Slope	Acres	Percent of Watershed
0 to 5	85,645	65
5 to 10	18,556	14
10 to 20	16,143	12
20 to 30	6,014	4
30 to 100	6,120	5
Total	132,478	100

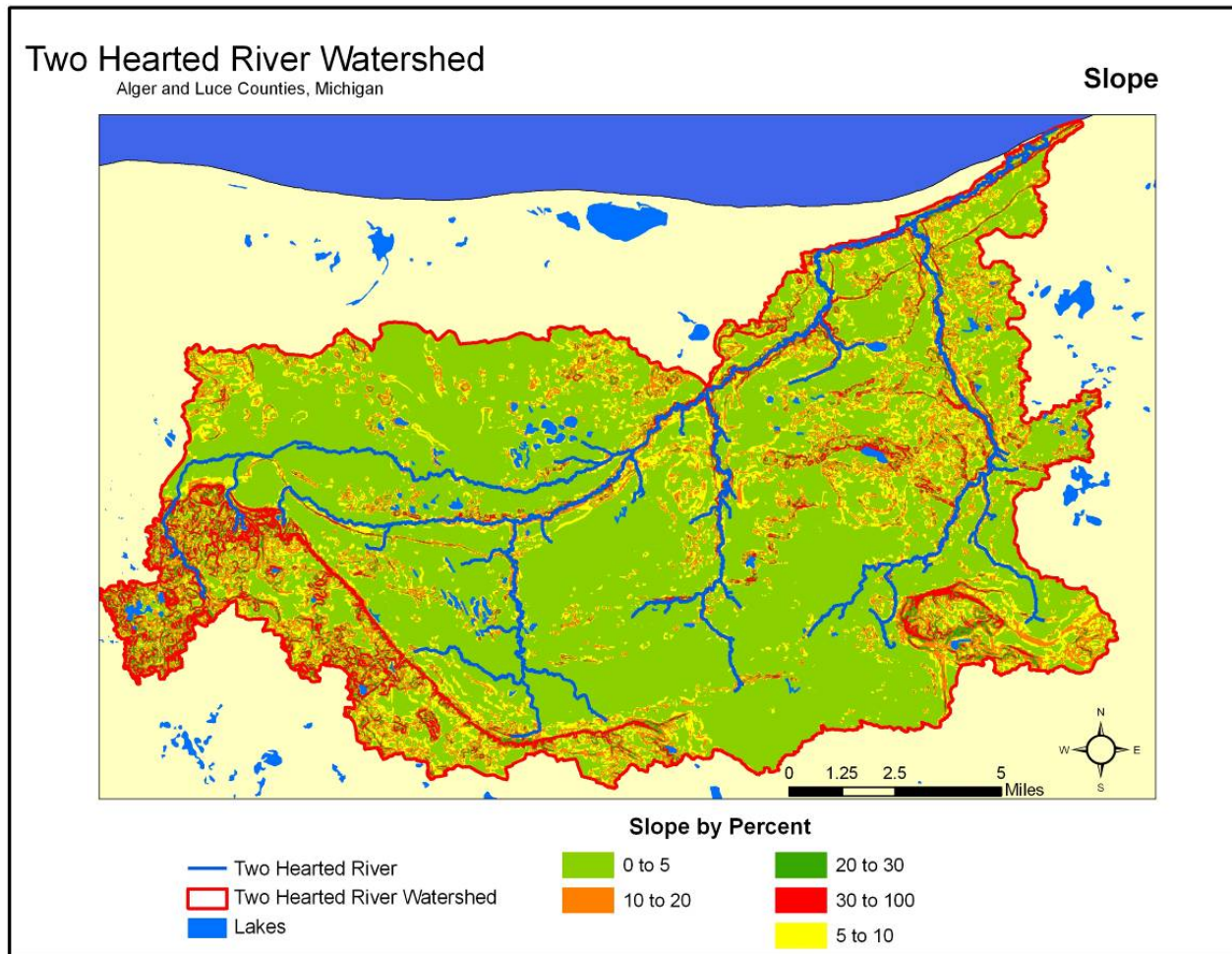


Figure 9- Topographic Relief in the Two Hearted River Watershed

Riparian Topography

Similar to the watershed as a whole, the riparian area of the Two Hearted River has little topographic relief, especially within the extensive wetland areas. More than 80% of the riparian area has a slope of 0 – 5% (Table 6). Locations with the greatest percent slope (30 – 100%) include the extreme headwaters of the North Branch and West Branch and along portions of the West Branch, Dawson Creek, the East Branch, and the Main Branch.

Table 6 Percent Slope in Acres

Percent Slope	Acres
0 to 5	46,493
5 to 10	3,712
10 to 20	1,181
20 to 30	1,163
30 to 100	5,354

Subwatershed Management Units (SMUs)

The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined watershed and subwatershed sizes appropriate to meet watershed planning goals. In 1998, the CWP released the “Rapid Watershed Planning Handbook” (CWP 1998) as a guide to be used by watershed planners when addressing issues within urbanizing watersheds. Broad assessments of conditions such as soils, wetlands, and water quality are generally evaluated at the watershed level and provide some information about overall conditions. The Two Hearted River watershed is about 203 square miles and therefore this plan allows for a detailed look at watershed characteristics, problem areas, and management opportunities. However, an even more detailed look at smaller drainage areas must be completed to find site specific problem areas or “Critical Areas” that require immediate attention.

A watershed can be divided into subwatersheds called Subwatershed Management Units (SMUs) to address issues at a smaller scale. The Two Hearted River watershed includes 7 subwatersheds and over 118 miles of river (Figure 10). Information obtained at the SMU scale allows for detailed analysis and better recommendations for site specific “Management Measures” otherwise known as Best Management Practices (BMPs). Delineation into SMUs also allows for better identification of areas contributing to water quality problems as summarized in Section 4.0.

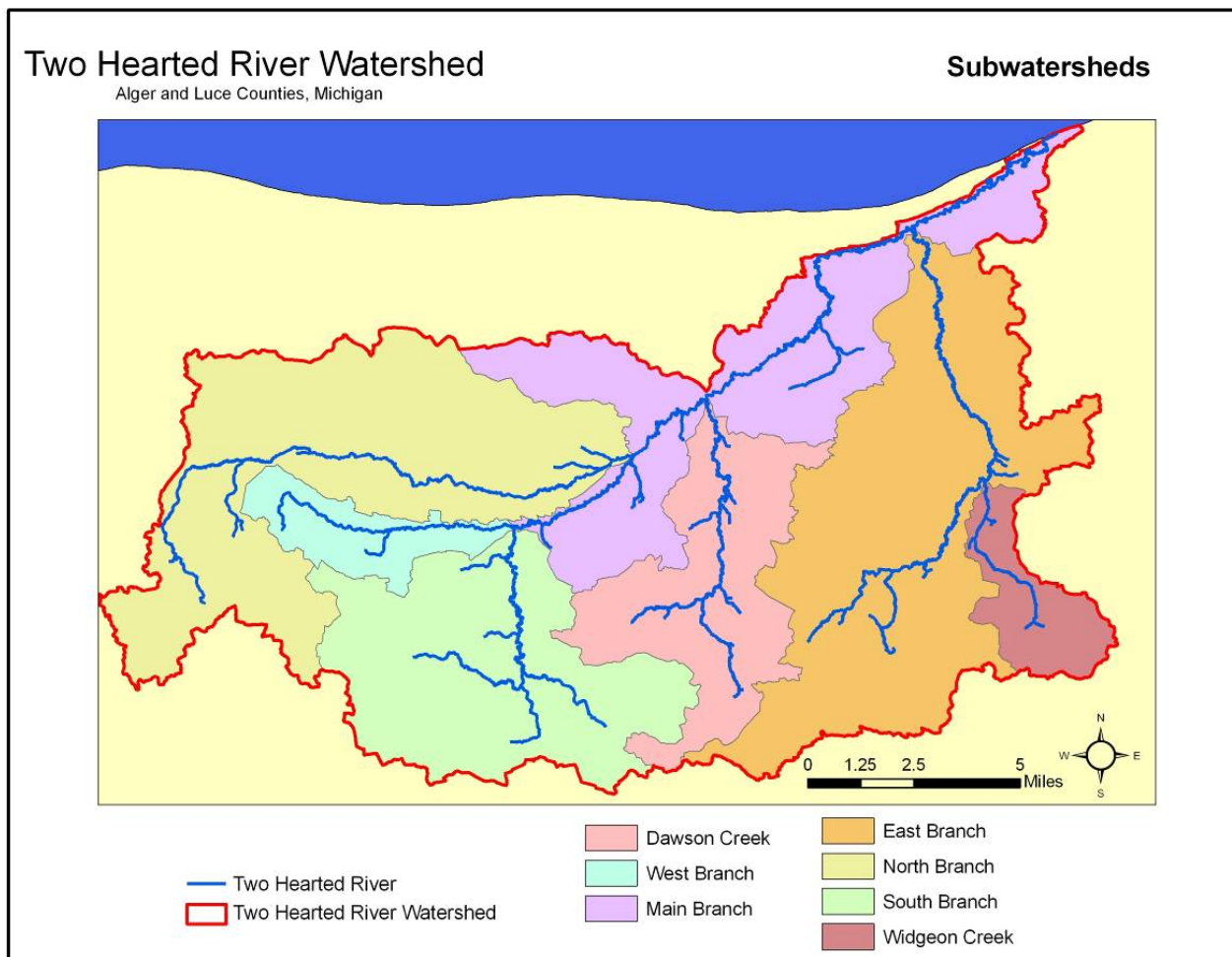


Figure 10- Subwatersheds and Main Tributaries of the Two Hearted River Watershed

3.3 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups

Soils

The U.S. Department of Agriculture Natural Resources Conservation Service Soil Survey Geographic (SSURGO) database for Luce County (USDA 2003), Michigan indicates the presence of 46 soil types within the boundary of the Two Hearted River watershed (Figure 11). These soil types range from well drained sandy soils to poorly drained muck. SSURGO soil data was not available for Alger County. Of the 46 mapped soil types in the Two Hearted River watershed, eight (8) meet the definition of hydric

soils. Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic (wetland) vegetation (USDA 2003). Hydric soils occupy 86,194 acres (65%) of the watershed and support the wetland communities found in the headwaters of Dawson Creek, the East Branch, South Branch, and the North and West Branches (Figure 12).

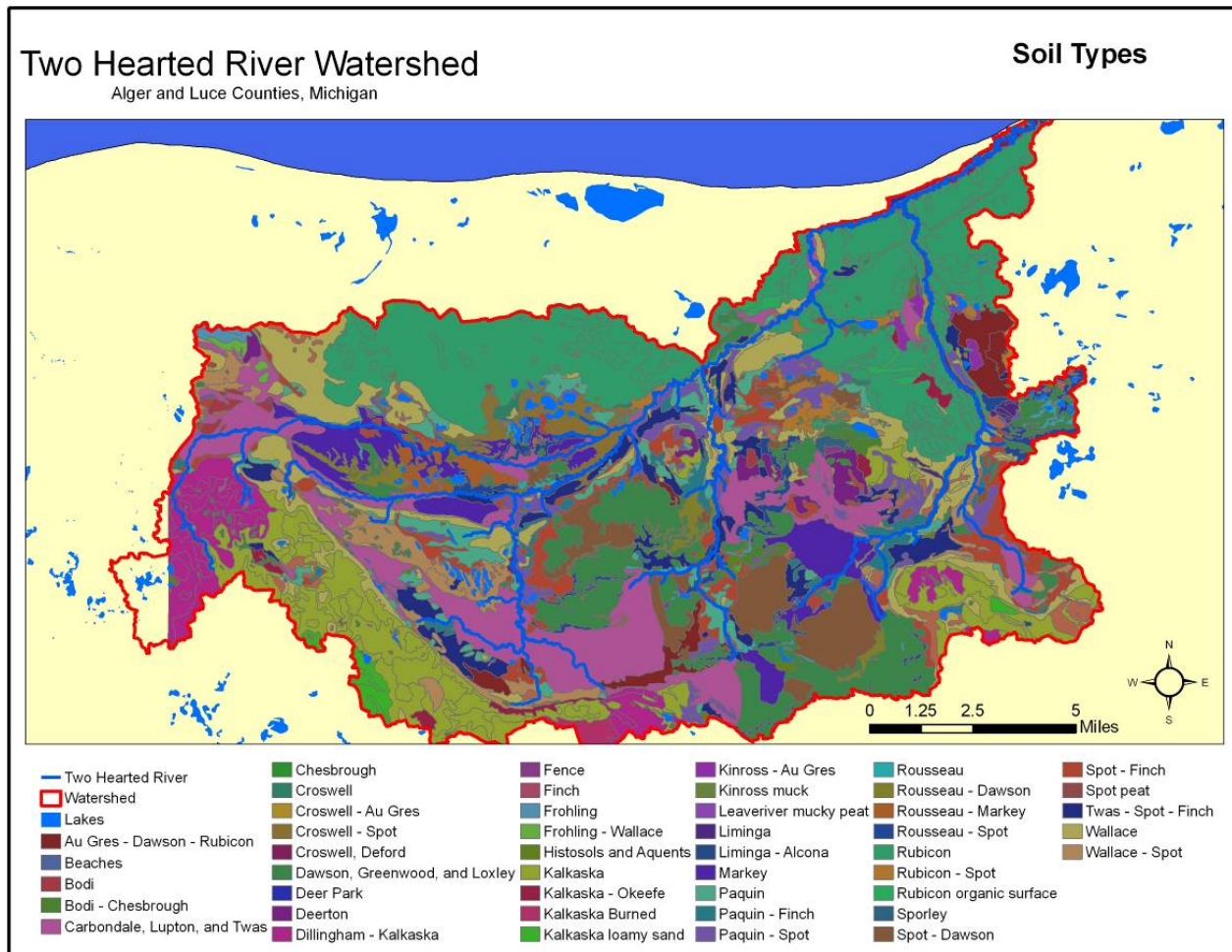


Figure 11 Soil types in the Two Hearted River Watershed

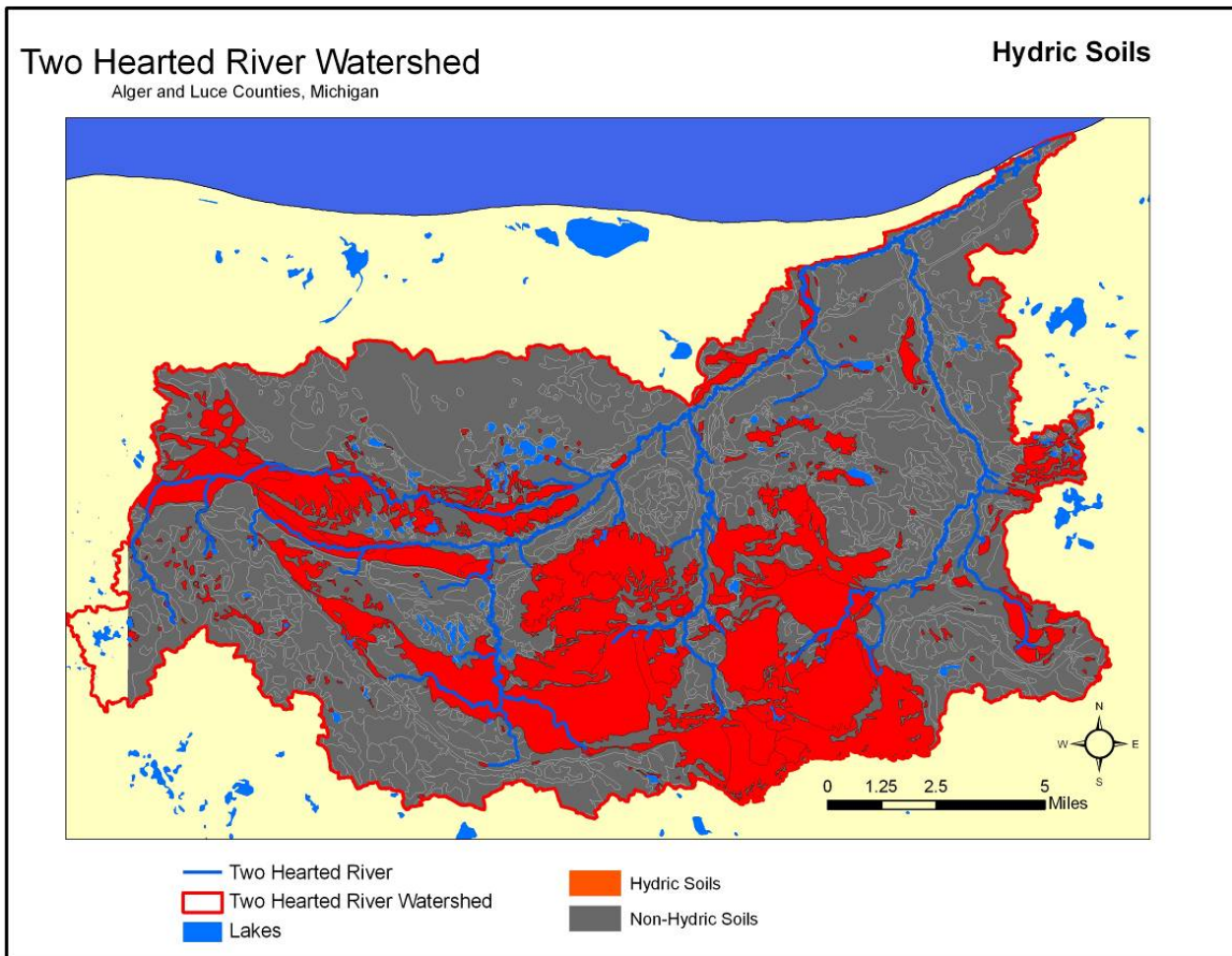


Figure 12- Hydric and Non-hydric soils in the Two Hearted River Watershed

Soil survey information can be used to adjust land uses to the limitations and potentials of natural resources and the environment. In preparing a soil survey, soil scientists collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. This information can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties (USDA 2003).

Interpretive ratings are used to identify the limitations that affect specific uses and to indicate the severity of those limitations. Rating classes are expressed in terms that indicate the extent to which the soils are limited by all of the soil features that affect a specified use or in terms that indicate the suitability of the soils for the use. Terms for the limitation classes include: not limited, somewhat limited, and very limited; or slight, moderate and severe. The suitability ratings are expressed as well suited, moderately

suited, poorly suited, and unsuited or as good, fair, and poor (USDA 2003). The following sections describe soil limitations for various uses in the Two Hearted River watershed.

Soil Erosion Potential

Soil erosion potential is based on the probability that damage will occur where soils are exposed as a result of management activities. This attribute is directly connected with slope and other attributes of the soil type. The ratings slight, moderate, and severe indicate the degree at which erosion-control measures should be taken with the severe rating requiring the most precautions (USDA 1997).

The majority of the land in the Two Hearted River watershed (78%) is characterized as having a slight erosion potential rating (Table 7, Figure 13). The locations with a severe erosion potential rating mostly correspond with locations that have greater percent slopes such as the headwaters areas of the North and West Branches (see Figure 13).

Table 7-Erosion Potential in the Two Hearted River Watershed

Erosion Potential Rating	Acres	Percent of Watershed
Slight	103,288	78
Moderate	16,530	12
Severe	9,244	7
Not Rated	3,416	3
Total	132,478	100

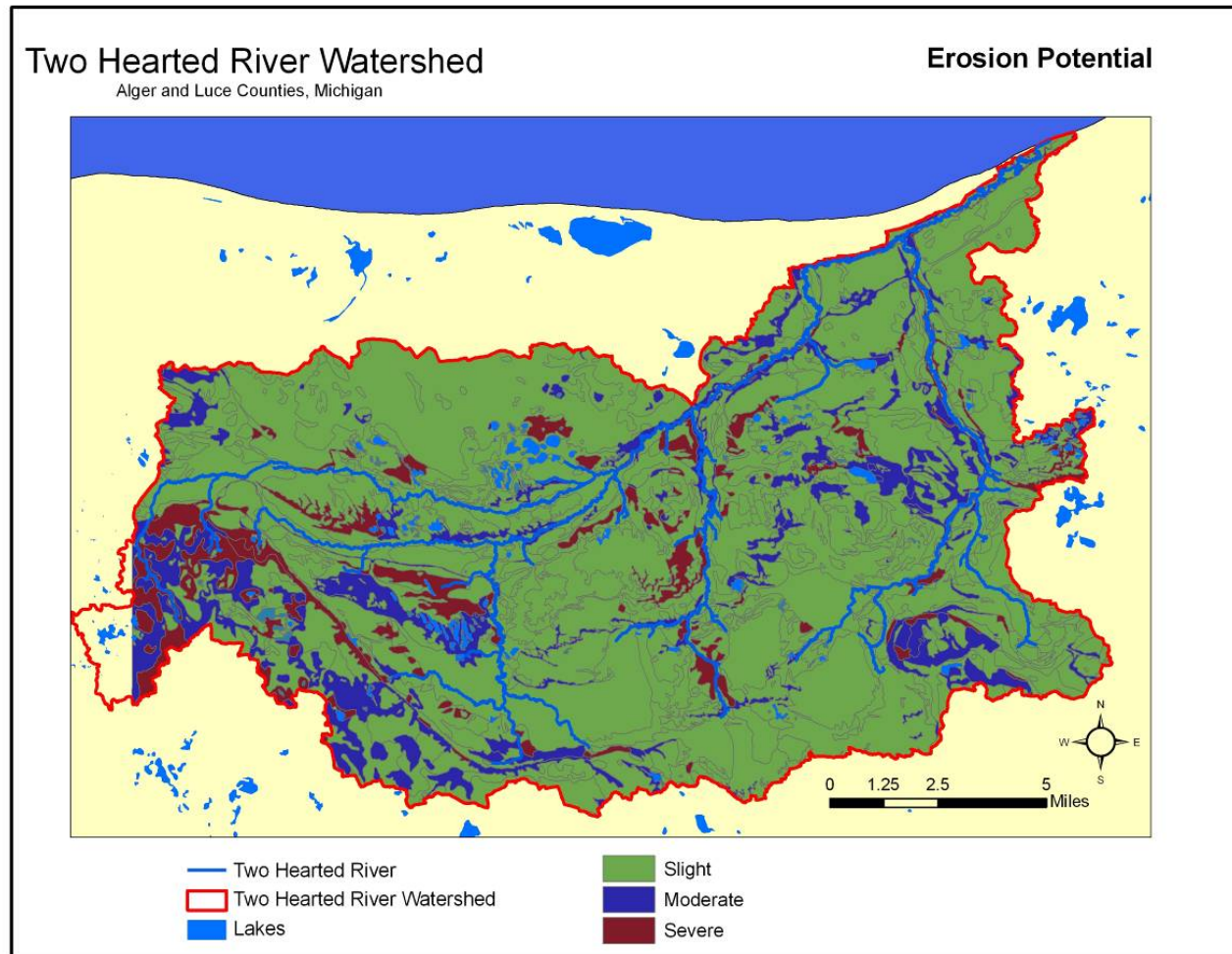


Figure 13- Soil Erosion Potential in the Two Hearted River watershed

Suitability for Timber Harvest

The degree to which the lands are suitable for timber harvesting reflects the characteristics and conditions of the soil that restrict the use of equipment generally utilized in timber management and harvesting (TNC 2007). Based on this information, only 8% of the Two Hearted River watershed is considered *well suited* for timber management, whereas 46% is *moderately suited* and 42% is considered *poorly suited* (Table 8, Figure 14). However, this does not

mean that the lands categorized as *poorly suited* for timber harvesting cannot be harvested; rather, specific precautions for harvest in these areas should be implemented, such as harvesting during frozen conditions or adequate snow cover. These *poorly suited* lands mostly correspond with the extensive wetlands and those lands considered well suited for harvesting largely correspond with upland areas (TNC 2007).

Table 8- *Suitability for Timber Harvest in the Two Hearted River Watershed*

Suitability for Harvesting	Acres	Percent of Watershed
Poorly Suited	55,194	42
Moderately Suited	61,827	47
Well Suited	10,250	8
Not Rated or Open Water	5,207	3
Total	132,478	100

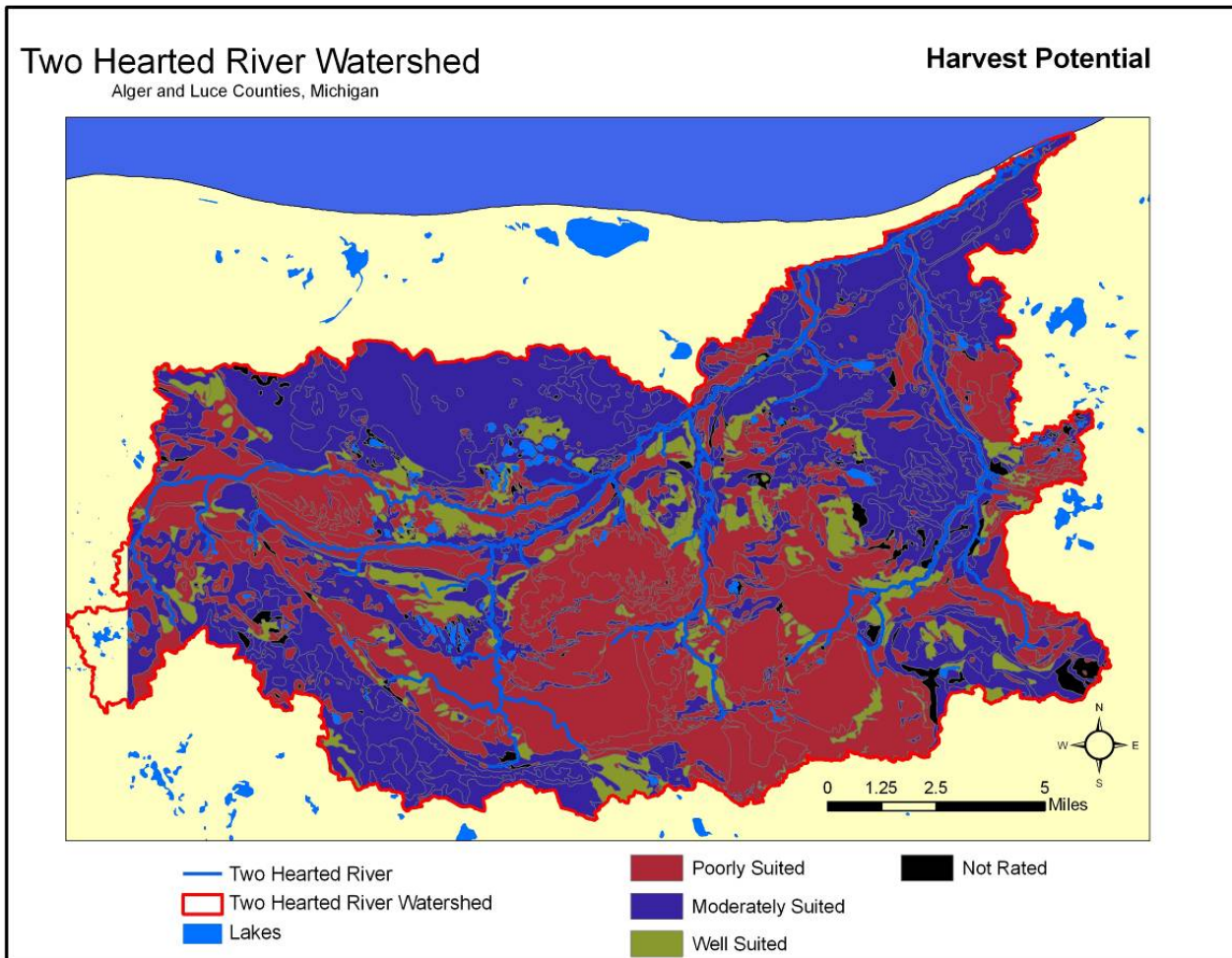


Figure 14- Harvest Potential in the Two Hearted River watershed

Suitability for Buildings and Septic Systems

Similarly, soil characteristics play a role in determining the suitability of a site for building construction and sanitary facilities. Within the Two Hearted River watershed, the majority of the land is considered not well suited for building construction (70% with basement; 53% without basement; or 96% septic) (See Tables 9, 10, and 11 and Figures 15, 16 and 17 respectively). This means that overcoming the limitations, due to soil properties or features at the site, would most likely be too cost prohibitive, both due to initial and potential ongoing maintenance costs. Those areas that are *somewhat limited* for building construction indicate that although the site conditions are unfavorable, these limitations may be overcome through special planning, design and maintenance (TNC 2007).

Table 9- Suitability for Buildings in the Two Hearted River Watershed (with basements)

Suitability for Buildings With Basements	Acres	Percent of Watershed
Very Limited	92,923	70
Somewhat Limited	13,335	10
Not Limited	21,119	16
Not Rated	5,101	4
Total	132,478	100

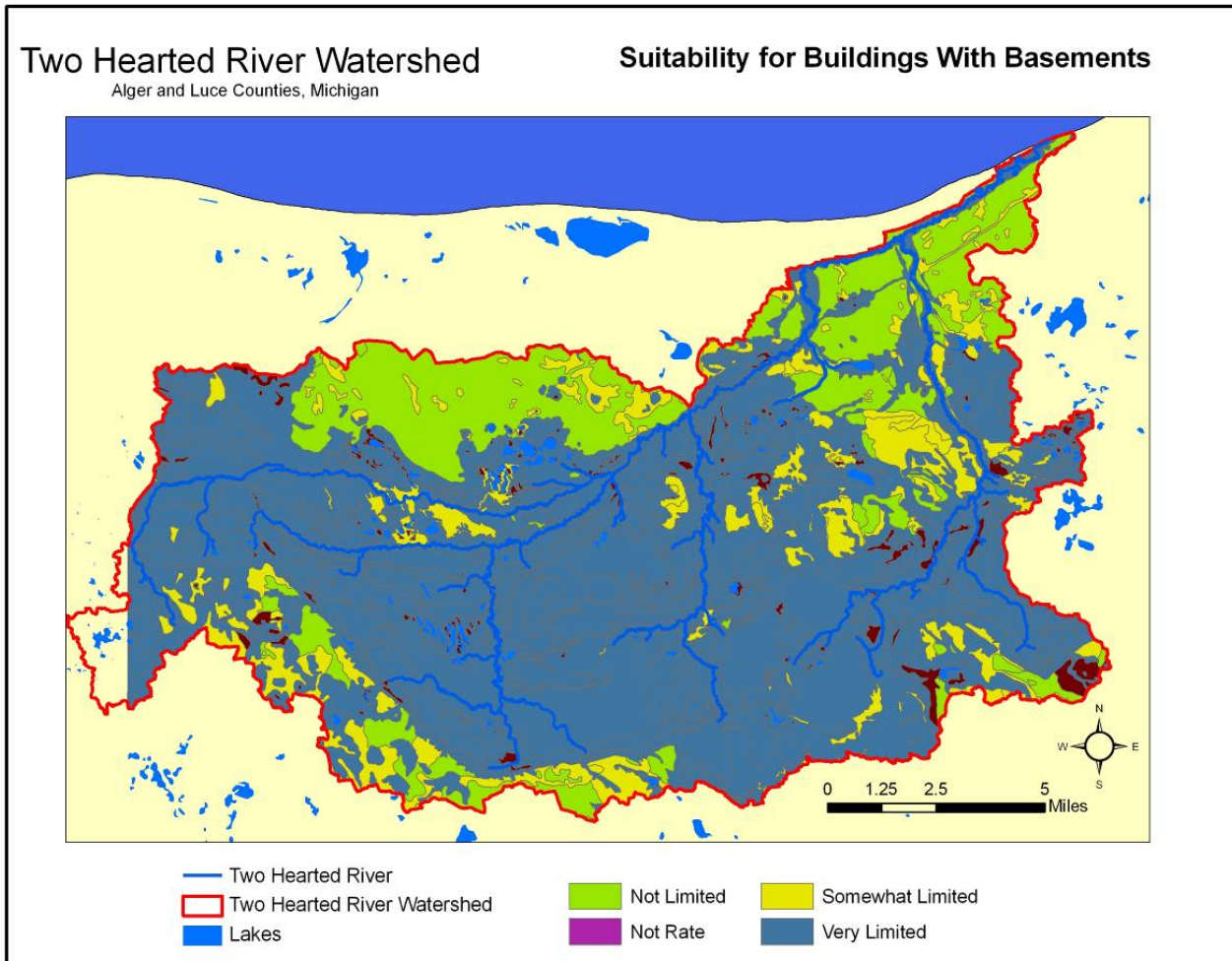


Figure 15- Suitability for Buildings in the Two Hearted River Watershed (with basements)

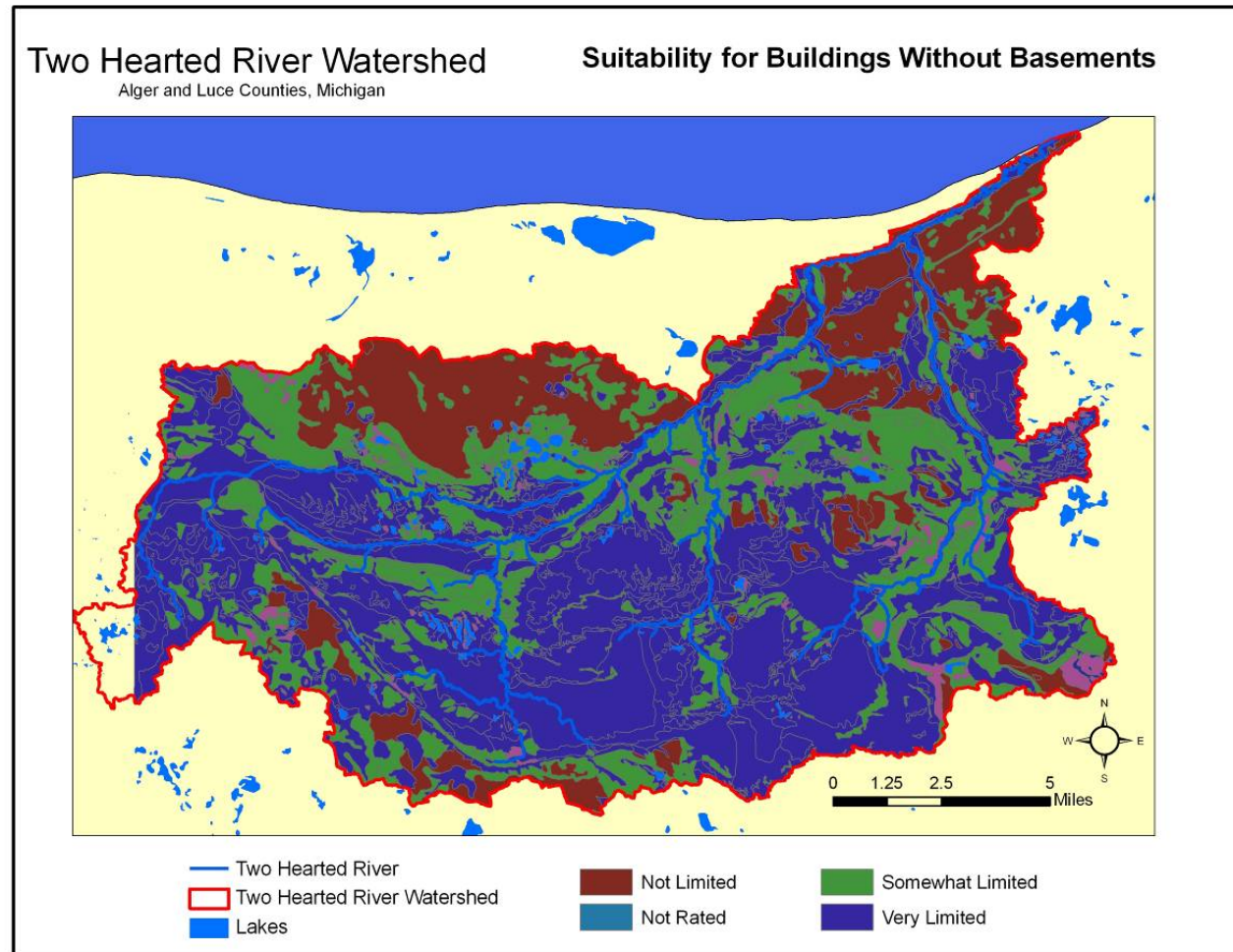


Figure 16- Suitability for Buildings in the Two Hearted River Watershed (without basements)

Table 10- Suitability for Buildings in the Two Hearted River Watershed (without basements)

Suitability for Buildings With Out Basements	Acres	Percent of Watershed
Very Limited	70,325	53
Somewhat Limited	34,844	26
Not Limited	22,208	17
Not Rated	5,101	4
Total	132,478	100

Table 11- Septic System Suitability in the Two Hearted River Watershed

Septic Suitability	Acres	Percent of Watershed
Very Limited	126,967	96
Somewhat Limited	292	<1%
Not Rated	5,219	4
Total	132,478	100

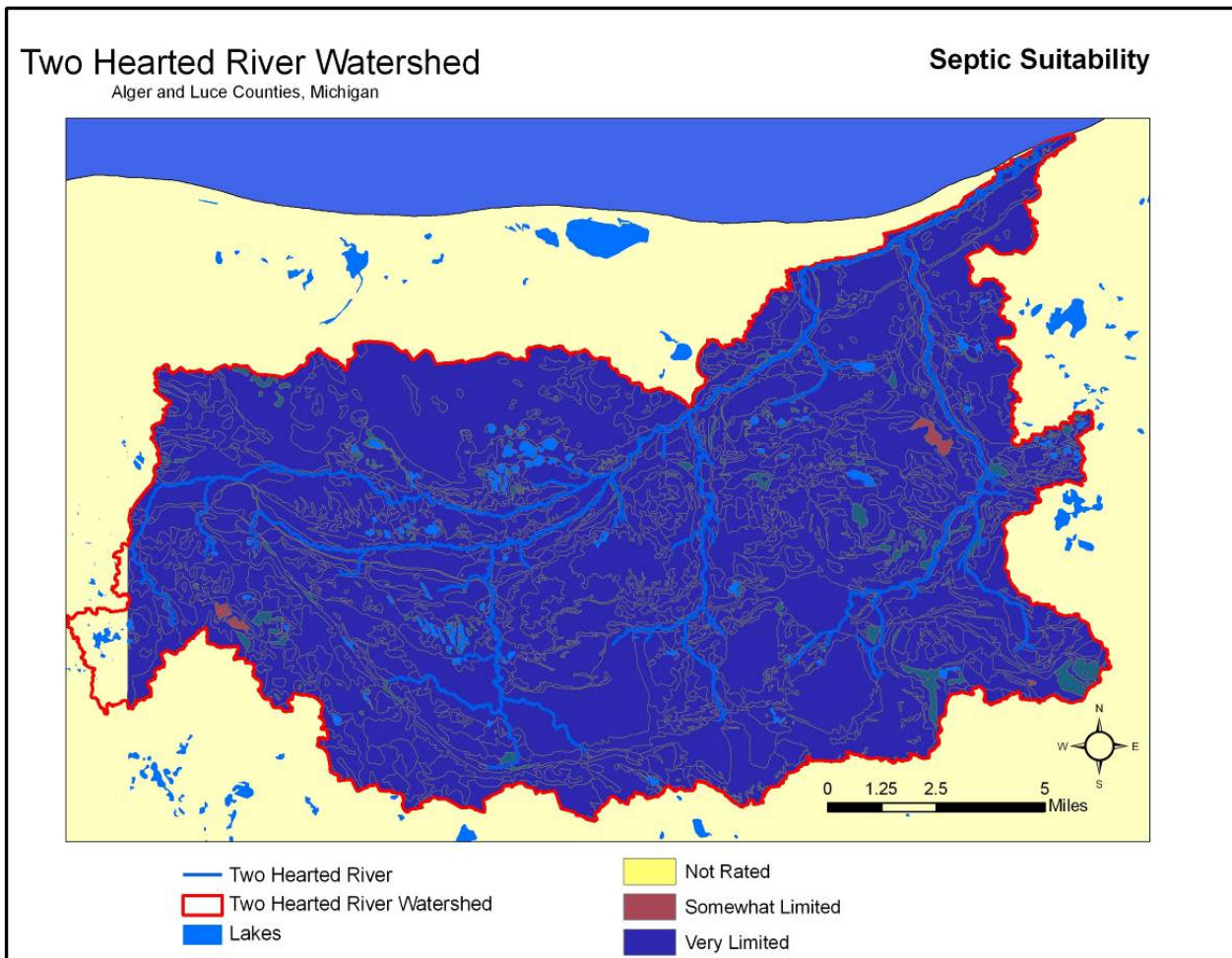


Figure 17- Suitability for Septic Systems in the Two Hearted River Watershed

Soil Characteristics

Based on the most current Luce County soils data, the following characteristics were obtained: soil texture, hydric and non-hydric soils, suitability for structures (without basements), septic system ability, suitability for timber harvesting, and erosion potential.

The majority of the soils within the riparian area are considered to be hydric soils, or soils that were likely formed under saturated

conditions and continue to be maintained under periods of flooding or saturation, hence the extensive wetlands in the landscape. The pockets of non-hydric soils are associated with the coarser textured soils, such as sand and silt loam found along portions of the Main Branch and East Branch, and in areas of the South Branch and North Branch subwatersheds (see Figure 18).

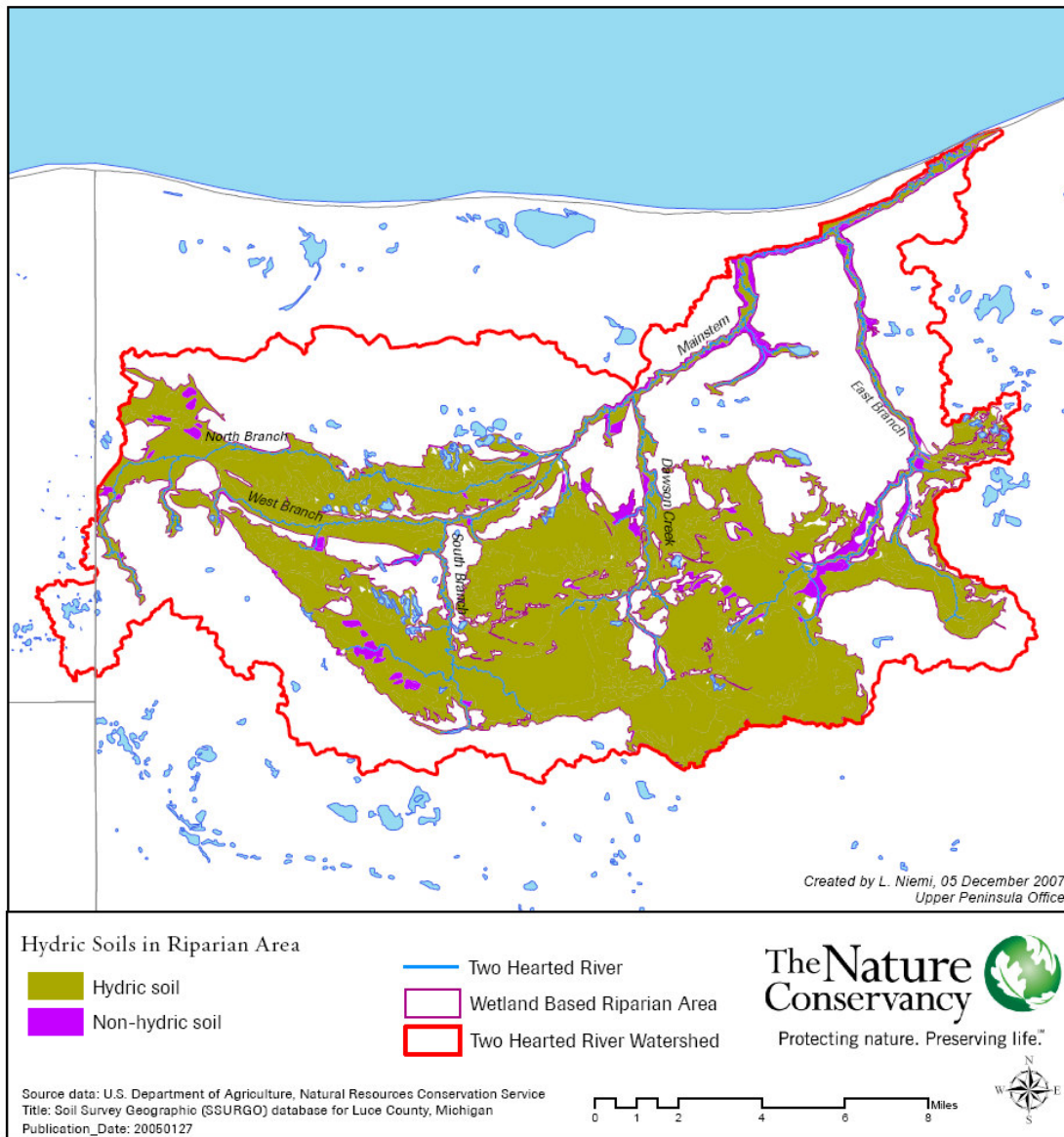


Figure 18- Hydric Soils in Riparian Area

In addition to the pockets of sand and silt loam soils, there are extensive areas within the riparian area of organic soils, such as peat and mucky peat (Figure 19). These soil types support the unique patterned peatland found in the McMahon Lake area in the headwaters of Dawson Creek and East Branch of Two Hearted

River, and the wetland communities between the North and West Branches. These soils are largely moist or saturated year round, except during extreme drought conditions, such as that experienced during the summer of 2007.

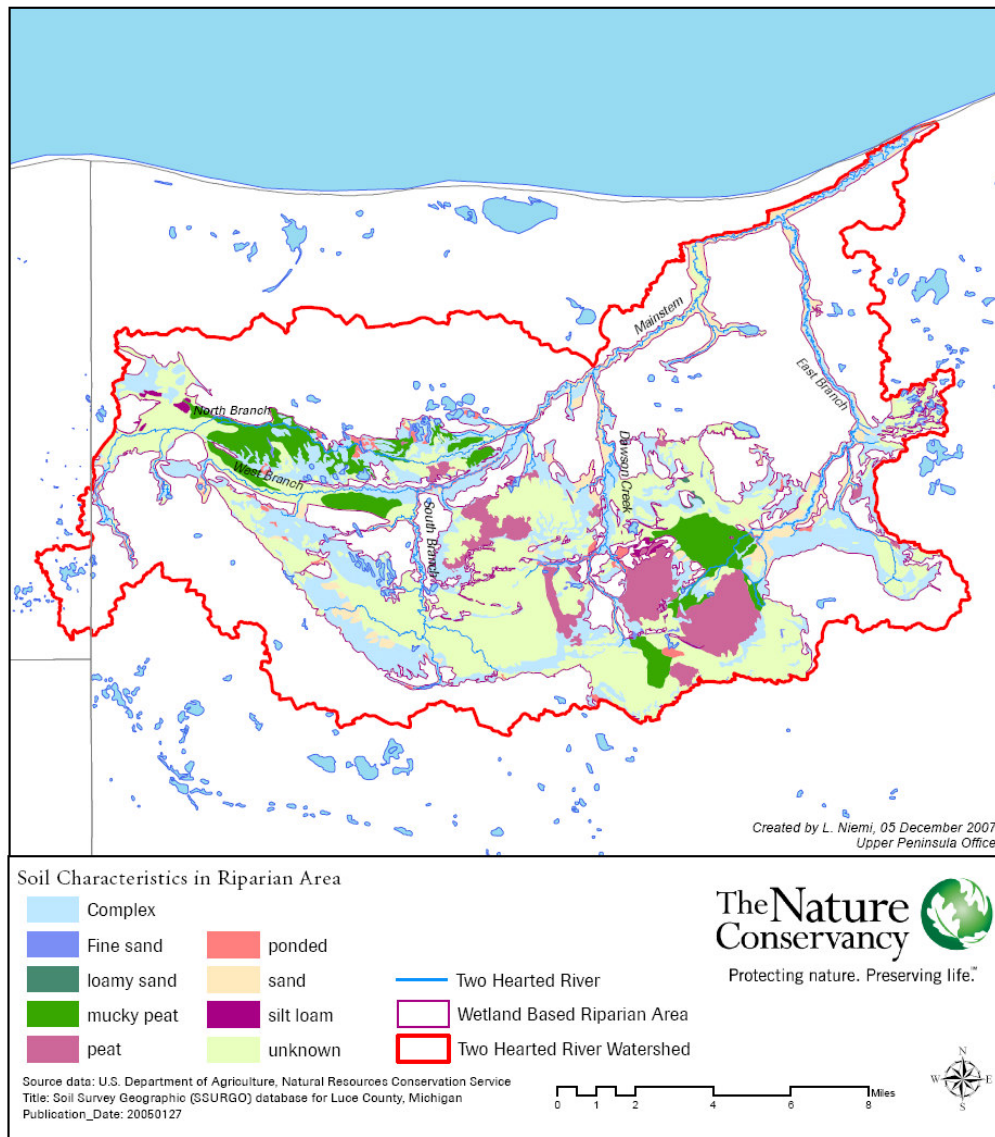


Figure 19- Soil Characteristics in Riparian Area

Soil erosion potential is based on the probability that damage will occur as a result of timber management activities such as site preparation and harvesting where the soil is exposed. This attribute is directly connected with slope and other attributes of the soil type. The ratings, *slight*–*severe*, indicate the degree at which erosion-control measures should be taken in silvicultural activities, with *severe* requiring the most precautions (USDA NRCS, 1997). In the

Two Hearted River riparian area, the majority of the land is characterized as having a *slight* erosion potential rating with only 11% of the riparian area under a *moderate* or *severe* rating (Table 12). The locations with a *severe* erosion potential rating mostly correspond with locations within the riparian area that have greater percent slopes such as in the headwaters of the North Branch and West Branch (Figure 20).

Table 12- Soil erosion potential

Erosion Potential Rating	Acres
Slight	50,176
Moderate	4,318
Severe	2,179
Unknown or open water	1,230

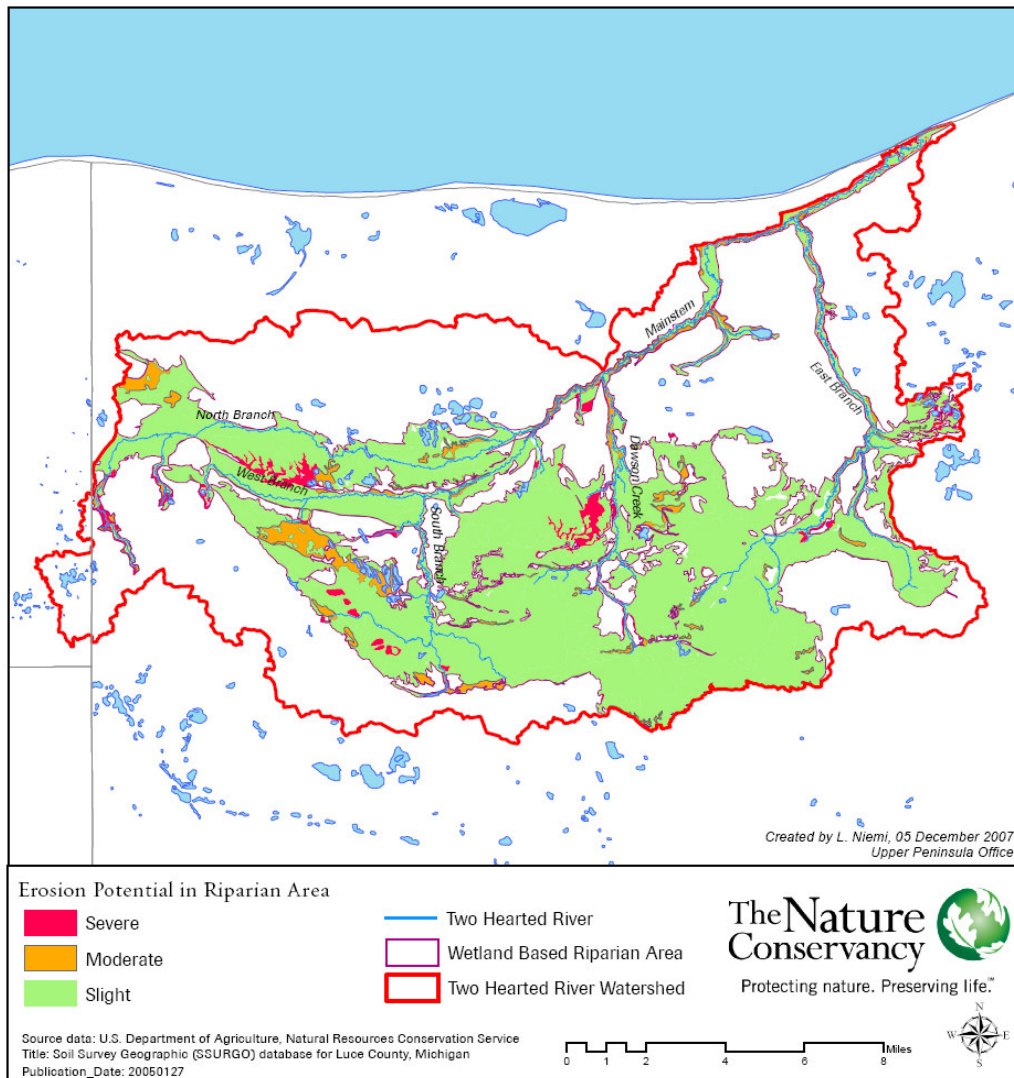


Figure 20- Erosion Potential in Riparian Area

The degree to which the lands are suitable for timber harvesting reflects the characteristics and conditions of the soil that restrict the use of equipment generally utilized in timber management and harvesting. Based on this information, only 5% of the Two Hearted River riparian area is considered *well suited* for timber management, whereas 75% is considered *poorly suited* (Table 13). However, this does not mean that the lands categorized as *poorly*

suitied for timber harvesting cannot be harvested; rather, specific precautions for harvest in these areas should be implemented, such as harvesting during frozen conditions or adequate snow cover. These *poorly suited* lands mostly correspond with the extensive wetlands, and those lands considered well suited for harvesting largely correspond with the pockets of uplands in the riparian area (see Figure 21).

Table 13- Suitability for Timber Harvesting

Suitability for Harvesting	Acres	Percent of Riparian Area
Well suited	2,909	5
Moderately suited	10,609	18
Poorly suited	43,154	75
Unknown or open water	1,230	2

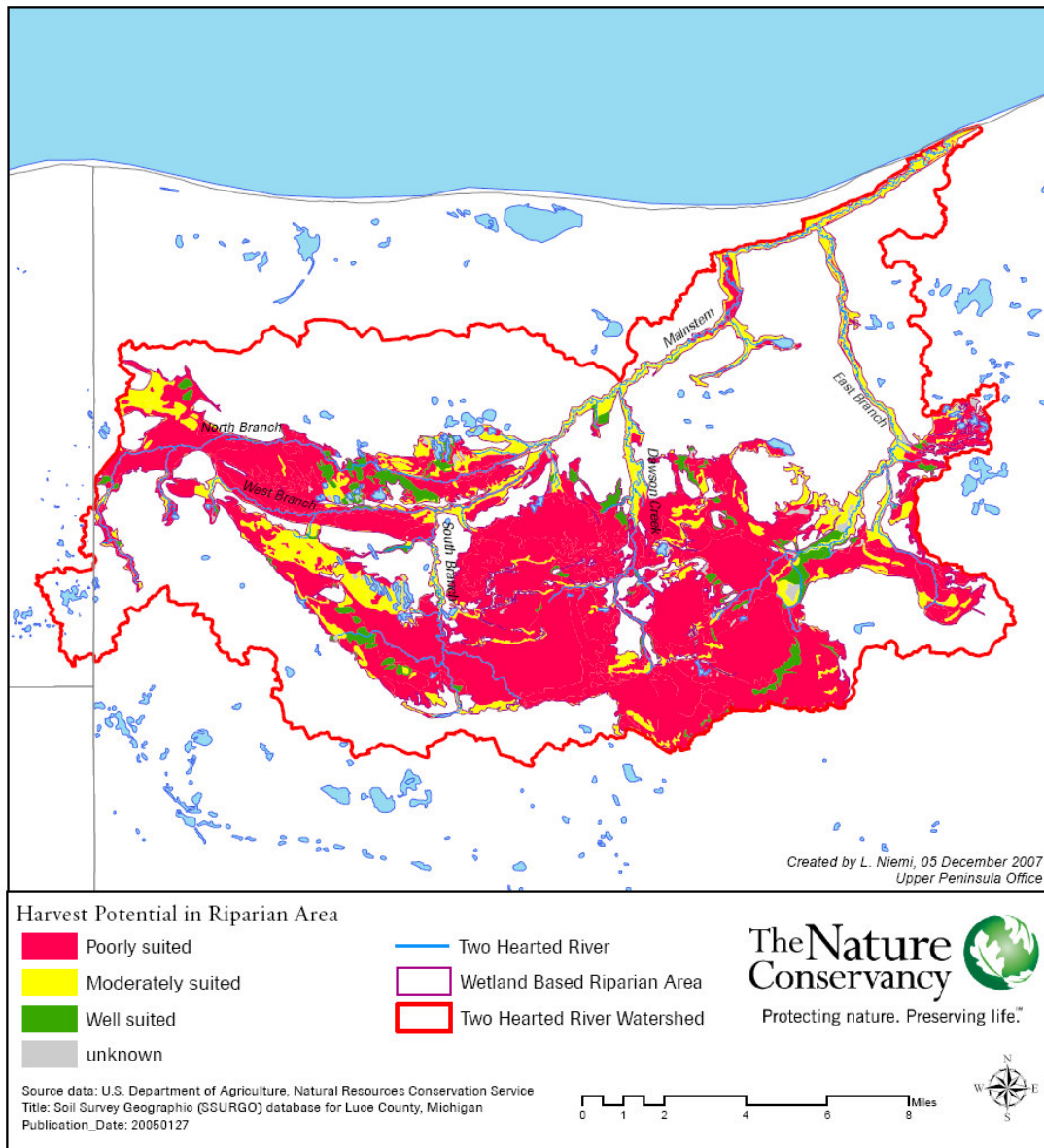


Figure 21- Suitability for Timber Harvesting

Soil characteristics also play a role in determining the suitability of a site for building construction and sanitary facilities. Within the Two Hearted River riparian area, the majority of the land is not considered to be well suited for building construction (without basement) (83%) or for a septic system (98%) (see Tables 14 and 15). This means that overcoming the limitations, due to soil properties or features at the site, would most likely be too cost prohibitive, both due to initial and potential ongoing maintenance costs. Those areas that are *somewhat limited* for building construction indicate that although the site conditions are unfavorable, these

limitations may be overcome through special planning, design and maintenance. Lands in this category are located north of the West Branch and North Branch, in the headwaters of the South Branch and East Branch, and along Dawson Creek, the Main Branch, and Wabash Creek. Less than 1% of the land is considered to have no limitations for buildings and occur in small pockets along Wabash Creek, the Main Branch, and the East Branch (Figure 22). The entire riparian area should be considered to be unsuitable for septic systems (Figure 23).

Table 14- Suitability for Buildings (*without basement)

Suitability for Buildings*	Acres	Percent of Riparian Area
Very limited	43,308	83
Somewhat limited	7,873	14
Not limited	480	<1
Not Rated	11	<1
Unknown or open water	1,230	2

Table 15- Septic Suitability

Septic System Suitability	Acres	Percent of Riparian Area
Very limited	56,661	98
Not Rated	11	<1
Unknown	1,230	2

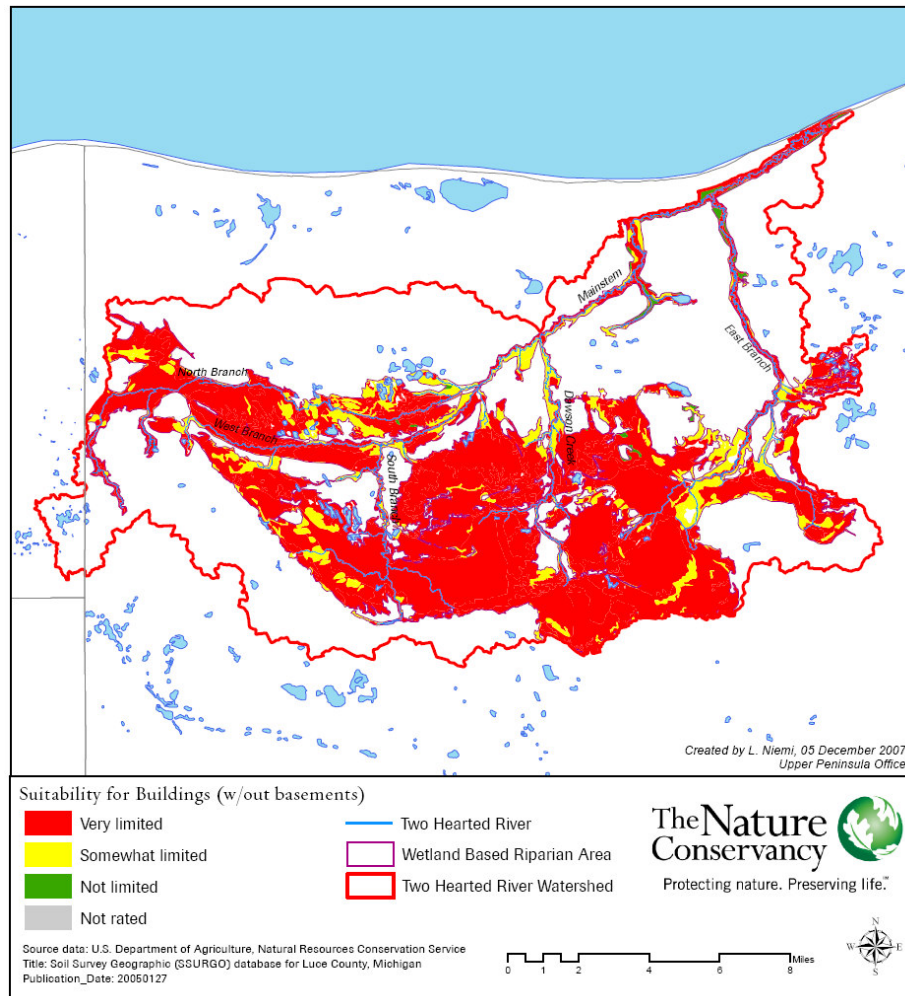


Figure 22- Suitability for Building (without basement)

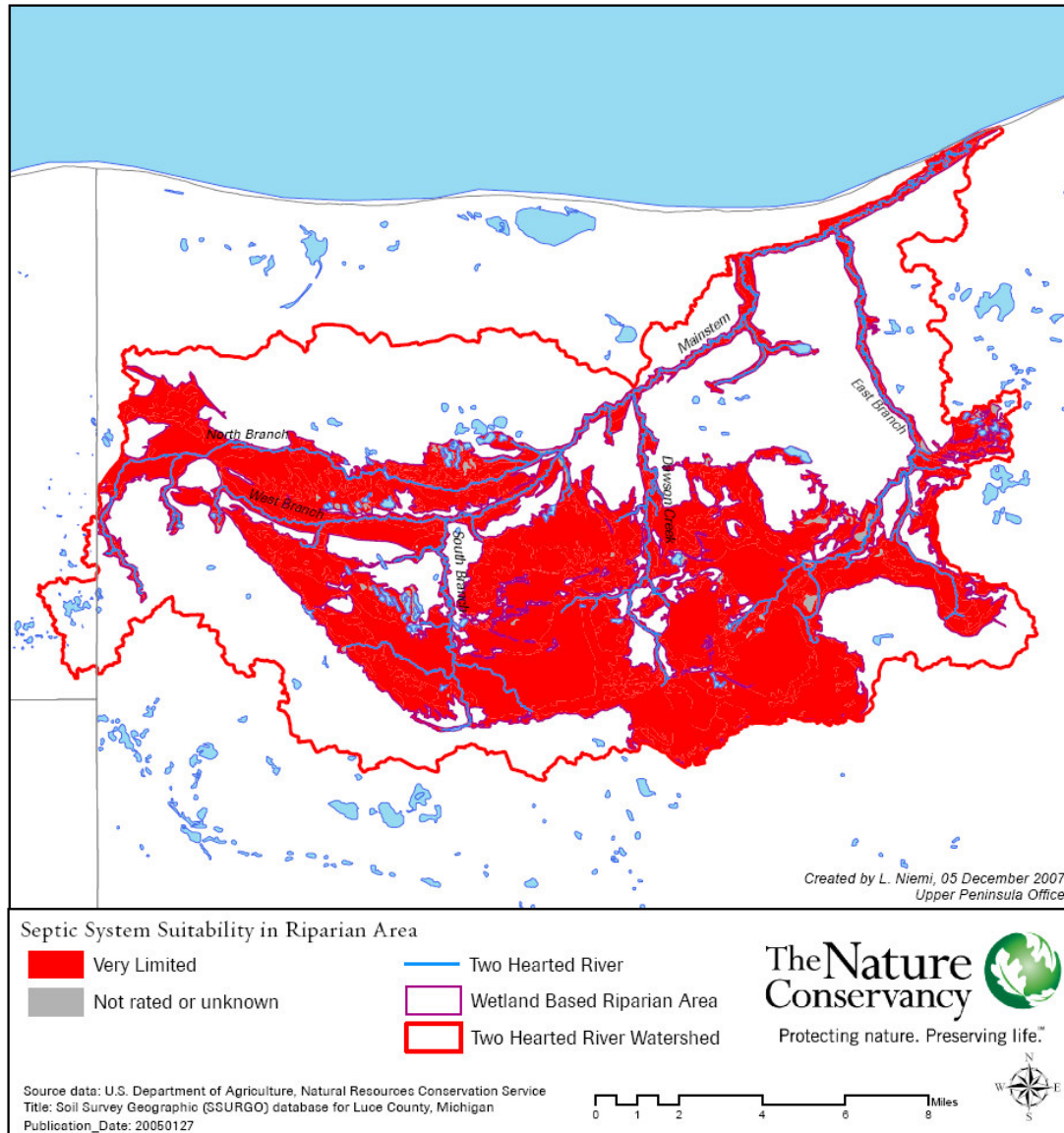


Figure 23- Suitability for Septic System

3.4 Jurisdictions, Roles & Protections

Jurisdictional Roles and Protections

McMillan Township occupies the majority of the Two Hearted River watershed (123,906 acres) with portions of the headwaters located in Columbus Township (6,997 acres) and Burt Township, Alger County (1,575 acres). Zoning in the watershed is regulated by Luce County, one of only 24 of the 83 counties in Michigan that have county-wide zoning ordinances.

Planning, Policy and Regulation

Planning, policy, and regulation are the foundation of watershed protection, because the process sets the minimum standards for development that occurs or is proposed to occur in the vicinity of water resources. It is hoped that recommendations from this watershed plan would be referenced in future comprehensive plans and implemented in ordinances. In many cases, municipal codes also lay the foundation for the types of trees that can be removed from sites as well as what types of plant communities and species that can be replanted. County stormwater ordinances are the primary preventative measure that can be used to standardize for the respective county the requirements that proposed developments must meet. Monitoring and enforcement of implemented municipal codes and county regulations falls in the hands of local municipalities or County agencies. It is up to these enforcing bodies to communicate effectively and discuss often the problems with how ordinance language is interpreted and amendments that may help clarify certain regulations.

Planning/zoning guidance provides another level of watershed and natural resource protection. Most planning and zoning

guidance is in the form of local floodplain or zoning ordinances that regulate onsite land use practices to ensure adequate floodplain, wetland, stream, lake, pond, conservancy soil, and other natural resource protection. Zoning ordinances and overlay districts in particular define what type of development is allowed and where it can be located relative to natural resources. Other examples of planning/zoning forms of resource protection include riparian and wetland buffers, impervious area reduction, open space/greenway dedication, conservation easements and conservation and/or low-density development.

To improve the impact of planning/zoning guidance on water resource protection, there needs to be improved coordination and communication between county and local government. Watershed development regulations should be made very clear to local enforcement officers; local planners and zoning boards should consider revisions to local ordinances that address watershed, subwatershed, and/or site-specific natural resource issues. For example, communities with less impervious development now should revise their zoning ordinances sooner rather than later in order to adequately prevent the types of development that contribute to flooding, degrade wildlife habitat, and reduce water quality.

3.5 Existing Policies and Ordinance Review

In 2002, the Luce County Planning Commission developed a Comprehensive Plan for the County, laying the framework for future land use decisions. The Plan identifies the County's vision "to define the path that will provide an opportunity for controlled growth and progress while maintaining Luce County's unique setting, attitude, community and independent way of life" (Gove Associates, 2002). The goals outlined in the Plan include the

preservation of the area's natural character and forestlands, expansion of services and facilities, improvement of commercial corridors, and the development of a Lake Superior Shoreline Management Plan (TNC 2007).

In 2005, the Luce County Planning Commission began the process of revising the County's zoning ordinances. The proposed ordinances work to begin to implement the Comprehensive Plan and include provisions to expand freshwater resource protection (TNC 2007). Some of these provisions include:

- Identifying wetlands, waterfront setback areas, sand dunes (with >18% slope), lands with steep slopes and other environmentally sensitive areas as "undevelopable land"
- Limiting impervious surfaces, both within the greater watershed and specifically within 500 -700 feet of the waterbody to protect overall watershed health, and lessen the local impacts to the stream channel and aquatic communities
- Maintaining a 50-100 foot vegetated buffer along the lake, stream or wetland with indigenous species
- Setting a minimum river frontage width (330') for all lots; and including all rivers and streams in the "River/stream overlay" in addition to those designated as Natural Rivers

In 2008, the Luce County Planning Commission developed the Lake Superior Coastal Management Plan for Luce County. The intent of this plan is to preserve the natural habitat, resources and beauty of the Lake Superior coastline in Luce County. The plan identifies threats to natural features and provides recommendations to guide future improvement and protection efforts in coastal areas (Luce County Planning 2008). Many of the threats identified and recommendations included in the plan are also applicable to non-coastal areas.

In addition to county-wide zoning and the land/water interface laws in Michigan, other measures that protect the high quality aquatic resources of the Two Hearted River watershed include the Natural River designation and voluntary Best Management Practices (BMPs) regarding forest management (TNC 2007). In 1973, the MDNR developed a Two Hearted River Natural River Plan, which was updated in 2002. The plan identifies the Natural River District as a 400 foot buffer along either side of the designated natural river portions, including the Main Branch, North Branch, South Branch, West Branch, East Branch, and Dawson Creek. This District "establishes a zoning district in which certain types of future development and land use will be regulated so as not to be injurious to the river resource, property values and scenic and recreation values" (MDNR, 2002). The plan regulates activities near or adjacent to the River in order to protect the aquatic resources. The regulations outlined in the plan include:

- A natural vegetation strip 100 feet wide is maintained on each side of the water's edge,
- Commercial timber harvest is permitted beyond 100 feet of water's edge,
- Mining and extractive industries are permitted beyond 300 feet of water's edge, and
- Construction of structures beyond 75 – 100 feet of water's edge, depending on the river bank erodibility.

Other regulations address camping, boat launching, and specifics for development such as septic system placement and minimum lot size. The Natural Rivers Plan does not limit the Luce County Zoning Board from strengthening these regulations through county zoning (TNC 2007).

The MDNR and Michigan EGLE have developed guidelines for forest landowners in order to maintain high quality water on their land. This guide, "Water Quality Management Practices on Forest

Land”, is part of Michigan’s Nonpoint Source Pollution Control Management Plan and includes practices for road construction and maintenance, use of log landings, and forest harvest within the riparian buffers, among others (MDNR 1994). Although these guidelines are voluntary, they are often utilized as mandatory practices for third party forest certification, such as Forest Stewardship Council. The guidelines outline the importance of

buffer strips along rivers and streams with suggested limited activities within these areas in order to minimize soil disturbance and compaction and retain adequate tree cover. Table 16 outlines the minimum width of the buffer strips, based on slope, provided in the manual. The manual is currently being revised and is expected to be released during 2008 (TNC 2007).

Table 16 Buffer strip widths according to slope (TNC 2007)

Slope of Land Above Waterbody or Stream	Minimum Width of Strip (Feet)
0 to 10	100
10 to 20	115
20 to 30	135
30 to 40	155
40 to 50	175
50+	Activity may not be advisable due to erosion potential

Comparison with Existing Regulations

The riparian areas identified in this analysis were compared with existing and proposed regulations pertaining to the Two Hearted River watershed. These include the voluntary riparian buffer widths recommended by Michigan EGLE and MDNR, setbacks developed by the Natural Rivers program, and the proposed Luce County zoning ordinances. In some locations, the riparian area closely mimics the voluntary buffer recommendations and the Natural River District (Figure 24); whereas in other locations, it is significantly more expansive than the existing regulations due to its inclusion of the adjacent wetland systems (Figure 25). If buffers were created along the Two Hearted River utilizing the voluntary

buffer widths laid out in the BMP manual, only 3,900 acres would be within this corridor. This represents approximately 7% of the area encompassed in the riparian area identified through this analysis.

The narrowest portions of the riparian area are at least 300 feet wide, more than 100 feet greater than the minimum recommended buffer width in the BMPs. These occur in portions of the headwaters of the North Branch, the Main Branch (just downstream from the confluence of the North and West Branches), and in the East Branch.

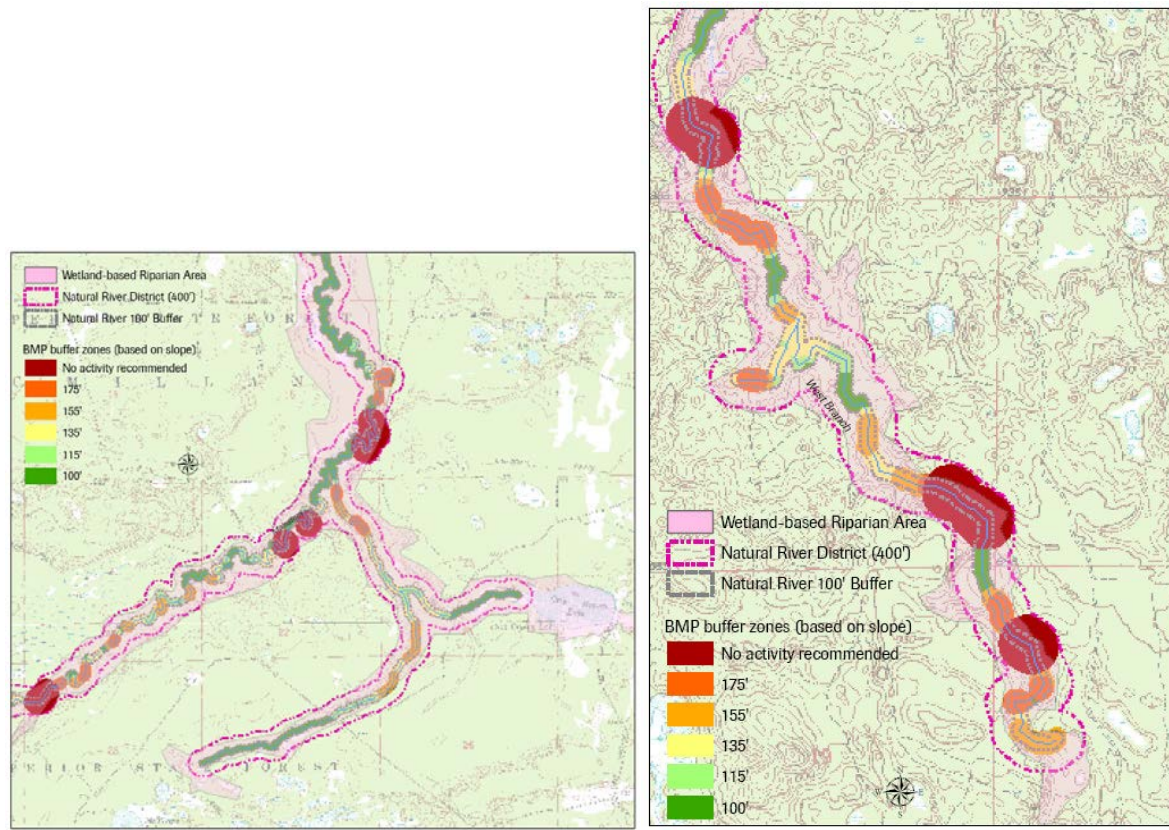


Figure 24- Riparian Area closely mimics existing regulations (left) along portions of the Main Branch and Chris Brown Creek and (right) in the headwaters of the West Branch

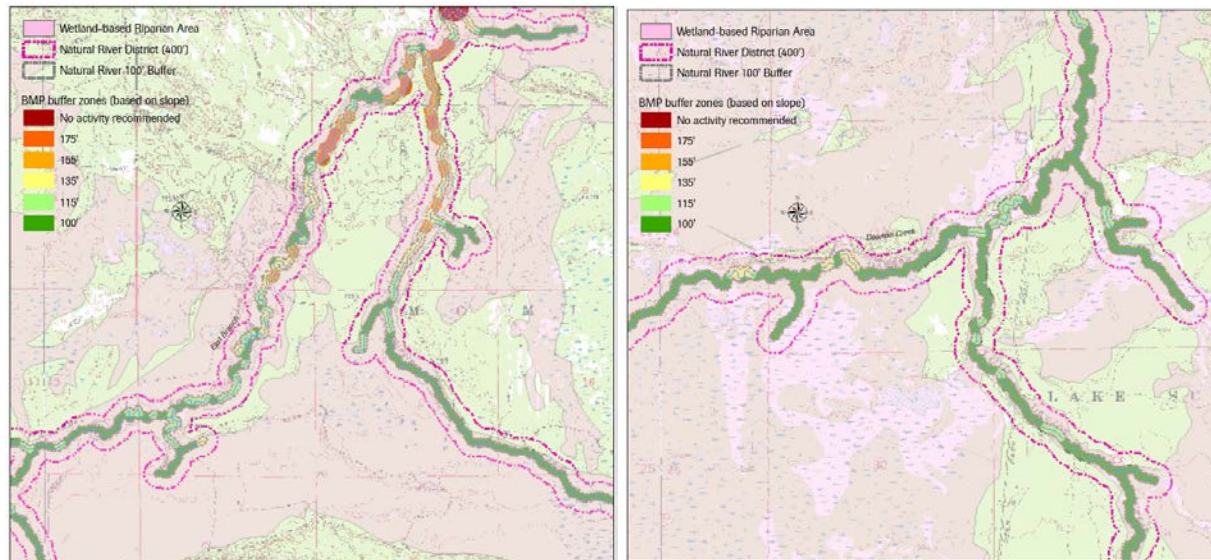


Figure 25- Riparian area extends well beyond the existing regulations on the Two Hearted River in locations dominated by wetlands, such as in the headwaters of the East Branch (left) and headwaters of Dawson Creek (right)

Ordinance Review

The riparian area strongly mimics the Environmentally Sensitive Areas (ESAs) identified in the Draft Luce County Zoning Ordinance of February 2006 (Figure 26). In the draft ordinances,

ESAs are identified as:

- Sand dunes with slopes greater than 18 percent as measured on 2-foot contours
- Beach contiguous to a lake or stream
- Wetlands
- Area which is not accepted by the District Health Department for on-site sewage disposal unless an alternate system of sewage disposal is approved by the District Health Department
- That part of a floodplain where flood waters are expected to have a destructive current
- Waterfront setback areas
- Soil mapping units identified in the Luce County Soil Survey as having slopes 35% or greater (specifically this includes soil mapping units 17F, 18F, 19F, 31F, 46F, 66F, 75F, 90F, 179F and 186F.)

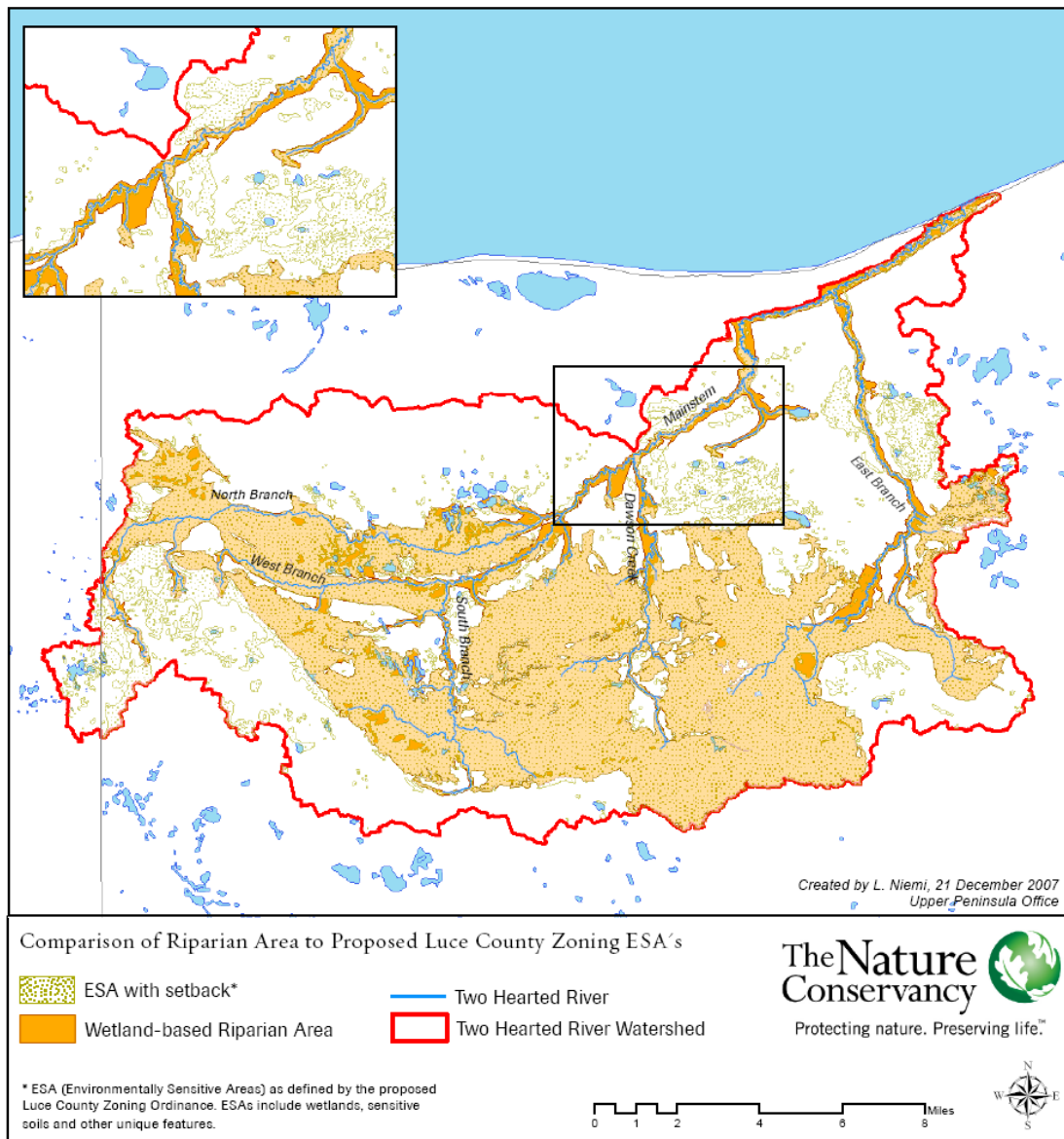


Figure 26- Comparison of Riparian Area with Luce County Proposed Zoning Ordinance's Environmentally Sensitive Areas. Inset provides one example of where the Riparian Area and ESAs differ in the watershed

Both methodologies include similar parameters such as wetlands, areas contiguous to streams, and certain soil parameters. One main difference is that the ESAs cover all lands in the County, not just those that are adjacent to the rivers and streams; therefore, there are areas within the Two Hearted River watershed that have been

3.6 Demographics

Many people are attracted to the Two Hearted River watershed not only for its wilderness-like nature but also for the recreational opportunities that it supports, such as excellent brook trout and steelhead fishing, canoeing, hunting, dog sledding, and many other activities. The Two Hearted River Natural Rivers Plan (MDNR 2002) sums up the potential threat to this pristine water resource by stating, “As the demand for quality recreation increases, the natural beauty and wilderness characteristics of the area could be destroyed by unregulated land use” (TNC 2007).

The following sections summarize the human environment in and around the Two Hearted River watershed including community profile, land uses, transportation routes, the political landscape, and future growth areas.

identified as an ESA but are not included in the riparian area identified in this analysis (see Inset in Figure 26). The ESA and its associated setbacks encompass approximately 62,500 acres, whereas the riparian area encompasses 58,000 acres.

Community Profile

The sparse population and associated lack of development contribute to maintaining the high-water quality of the river and the wilderness character of the watershed. (Luce County has one of the lowest populations in Michigan with an average 7 people per square mile, and a total of 6,229 (2019) and a loss of 6.1% in total population since 2010 (US Census Bureau 2019).

Similarly, the Two Hearted River watershed has remained largely unpopulated with an estimated population of only 396 people during 2000 (U.S. Census Bureau 2000). This is primarily due to physical characteristics of the watershed that limit development as well as landownership, Natural Rivers Program restrictions, and additional restrictions imposed by Luce County. While the total population of the watershed remains low, increasing demands for recreational uses including second home (camp) development have resulted in a 94% increase in population between 1990 and 2000. The majority of this change has occurred around the East Branch, Widgeon Creek, Dawson Creek, and the Main Branch of the Two Hearted River (Table 17, Figure 27).

Table 17- Population Change in the Two Hearted River Watershed (1990 to 2000)

Subwatershed	Total Population (1990 Census)	Total Population (2000 Census)	Percent Change
Main and West Branches	39	80	105
South Branch	40	63	57
North Branch	70	95	35
Dawson Creek	19	44	131
East Branch/Widgeon Creek	25	77	208
East Branch	11	37	236
Total	204	396	94

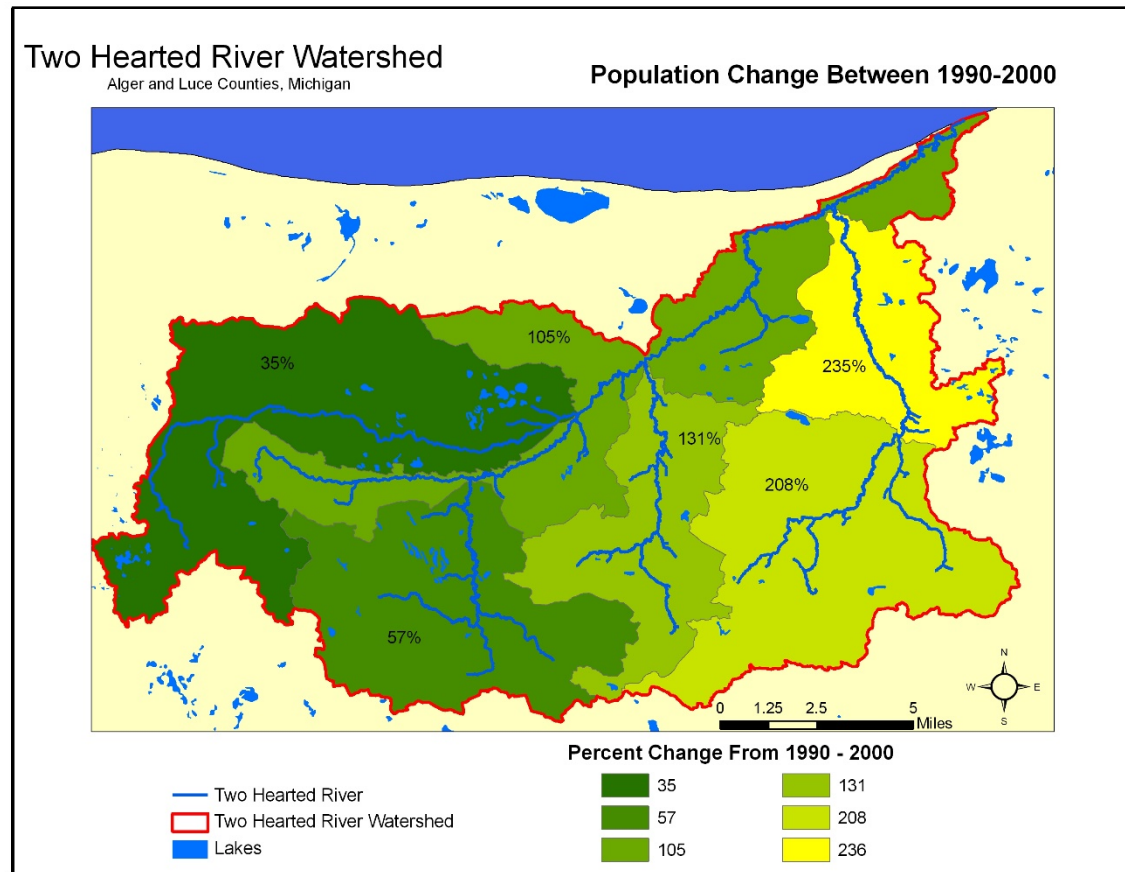


Figure 27- Population Change in the Two Hearted River Watershed (1990 to 2000)

These increases are also reflected in changes in occupied housing units (houses and apartments) between 1990 and 2000 with an estimated 51% increase of in occupied housing units in the

watershed (Table 18, Figure 28). However, in comparison with population changes, changes in housing were more prevalent along the South Branch and Main and West Branches.

Table 18- Housing Changes in the Two Hearted River Watershed (1990 to 2000)

Subwatershed	Total Homes (1990 Census)	Total Homes (2000 Census)	Percent Change
Main and West Branches	62	112	80
South Branch	48	88	83
North Branch	82	126	53
Dawson Creek	35	61	74
East Branch/Widgeon Creek	60	104	73
East Branch	29	52	75
Total	316	477	51

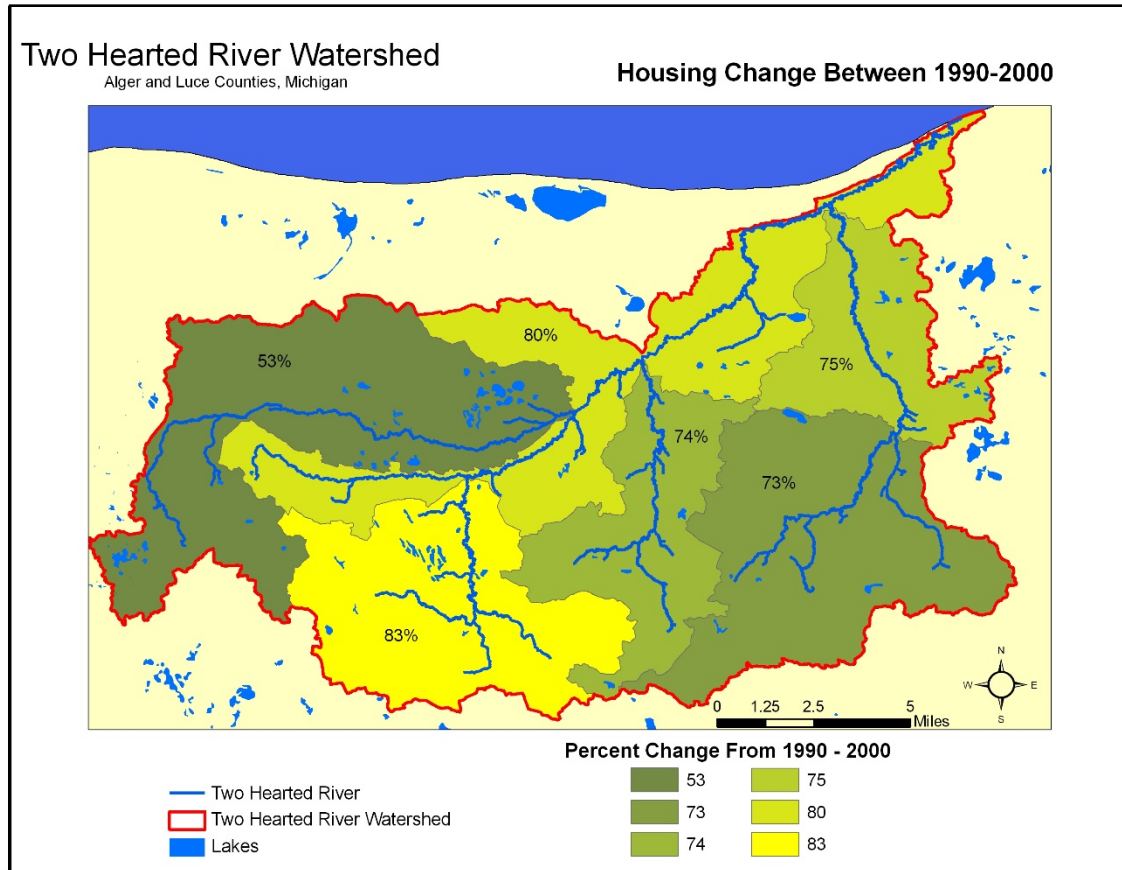


Figure 28- Percent Change in Housing in the Two Hearted River Watershed (1990-2000)

Landownership

The history of the Two Hearted River watershed and surrounding area is closely associated with logging. Logging companies came into the area in the late nineteenth century to cut the virgin white pine. After the pine was removed, fires and hard times caused

many landowners to allow their land to revert to the state for non-payment of taxes (MDNR 2002).

Today, the Michigan Department of Natural Resources (MDNR) remains the largest landowner, owning approximately 50% of the land area in the watershed (Table 19, Figure 29). This land is

managed by the Forest Management Unit under the Lake Superior State Forest.

Another 18% of the watershed is owned and managed by The Nature Conservancy (TNC) as a part of the Northern Great Lakes Forest Project. Other private landowners occupy 15% of the watershed including 4,309 acres owned by private hunting clubs

including the East Branch Sportsman's Club. The remaining 17% is owned by corporate landowners (Timber Product Industry), much of which (19,585 acres) is under a working forest conservation easement. This relatively simple pattern of ownership provides the potential for concerted programs to protect large areas of wetland and forest (TNC 1995).

Table 19- Landownership in the Two Hearted River Watershed

Landowners	Acres	Percent of Watershed
State of Michigan	66,638	50
The Nature Conservancy	23,338	18
Private Landowners	16,280	12
Hunting Clubs	4,309	3
Forest Product Producer (Working Forest Conservation Easement)	19,585	15
Other Forest Product Producer	2,328	2
Total	132,478	100

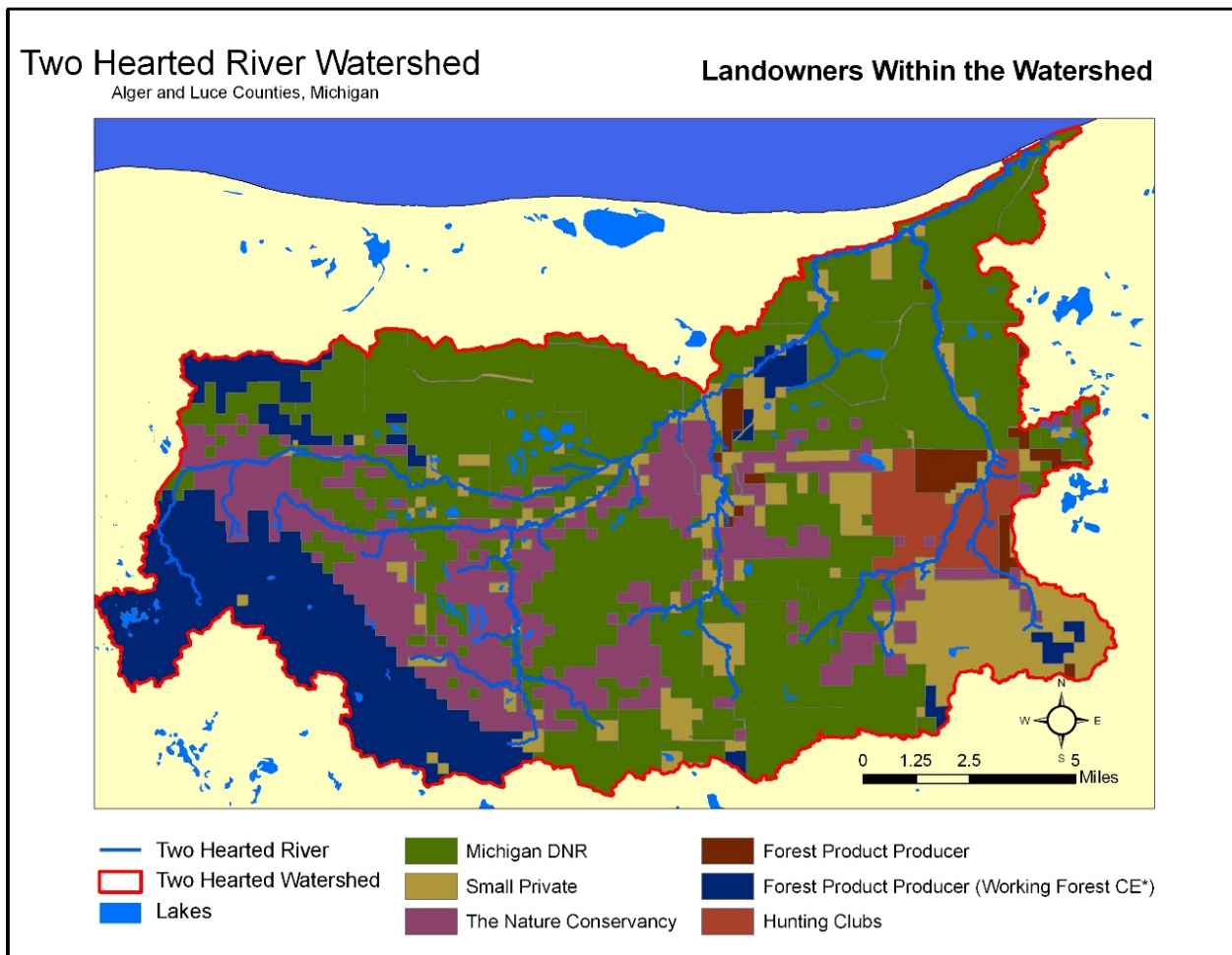


Figure 29- Land ownership in the Two Hearted River Watershed

The land ownership pattern within the riparian area reflects that of the overall watershed with a few exceptions. The State of Michigan and The Nature Conservancy together own approximately 82% of the riparian area, small private landowners own 11% of the riparian area, and the remainder is owned by private hunt clubs and forest product producers (Table 20). There is less land owned by the

forest product producers in the riparian area compared to the overall watershed land ownership statistics. These entities tend to concentrate ownership on the watershed's uplands for forest management; however, their ownership is dominant in the headwaters of both the North Branch and East Branch (Figure 30)

Table 20- Landowners within the Riparian Area

Landowners	Acres	Percent of Riparian Area
State of Michigan	30,962	53
The Nature Conservancy	23,338	29
Private Landowners	6,627	11
Hunting Clubs	2,169	4
Forest Product Producer (Working Forest Conservation Easement)	1,496	<3
Other Forest Product Producer	491	<1

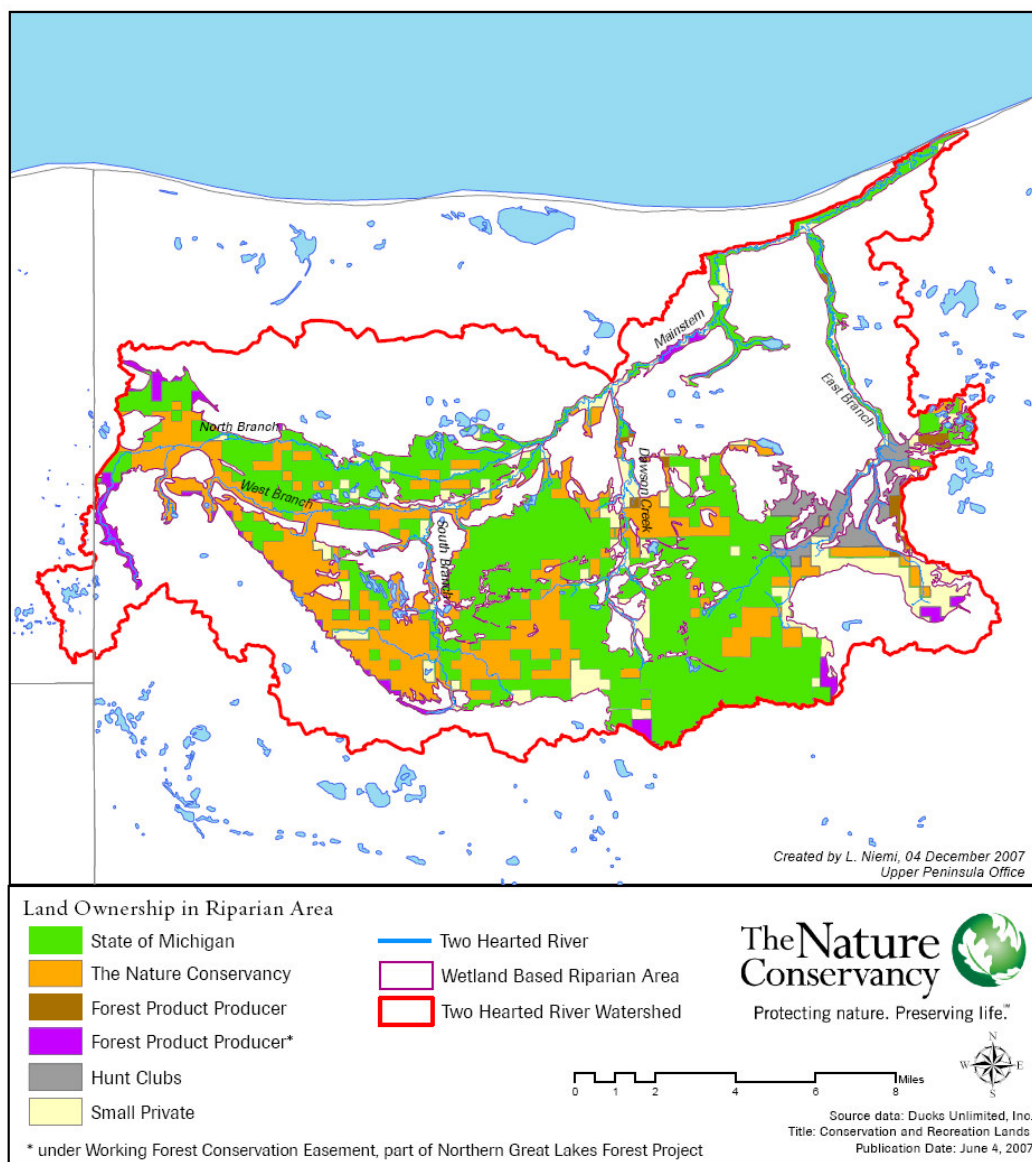


Figure 30- Land Ownership within the Riparian Area

3.7 Transportation Network

Roads

The Two Hearted River watershed is relatively inaccessible by improved road. The main route for access is County Road (CR) 407 which runs north-south through the center of the watershed. A sparse network of unimproved county roads and seasonal “jeep

trails” and logging roads traverse the remainder of the watershed and provide limited access to otherwise remote areas (Figure 31). With the exception of County Road 407, all are dirt roads subject to continuous erosion. Only two bridges cross the Main Branch, High Bridge (CR 407) and Reed and Green Bridge (CR 410), dividing its length roughly into thirds. A footbridge crosses the Main Branch at the forest campground near the mouth.

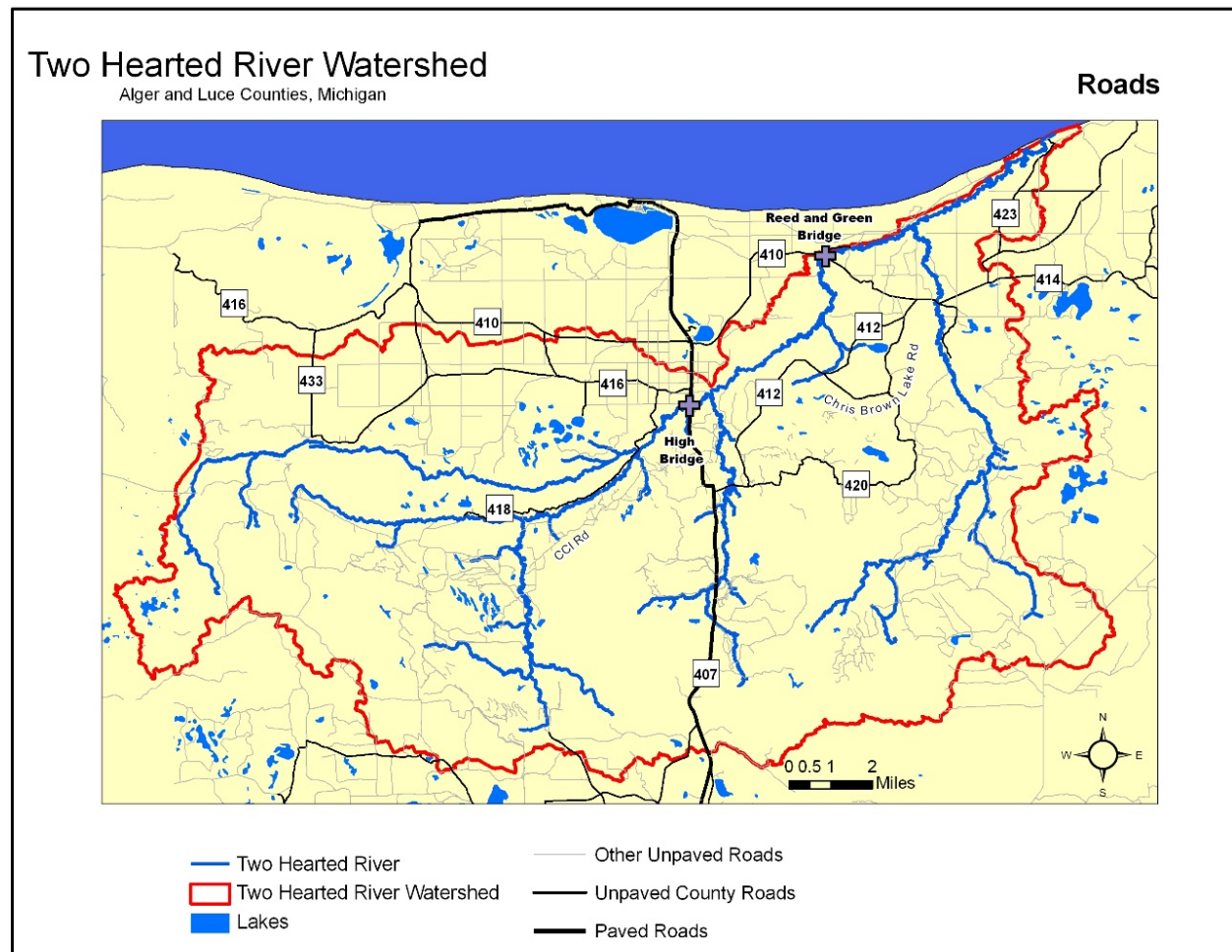


Figure 31- Roads in the Two Hearted River Watershed

Roads can have a significant impact on the landscape because they often destroy and fragment habitat (including wetlands), contribute sediment to streams, block passage for fish, and provide

pathways for other threats including increased recreation or development pressures and invasions of non-native invasive plants.

The majority of the road/stream crossings in the Two Hearted River watershed were inventoried, with TNC field technicians, (and in 2008 with the help of watershed volunteers from the Lake Superior State University Fish and Wildlife Club) to evaluate impacts to water quality and aquatic life (Figure 32). Stream

crossings that were not inventoried included those that were determined to be having little or no impact on the stream (such as High Bridge, Reed and Green Bridge, and the CR 414 crossing of the East Branch), those that appeared on a map but were not actual crossings, and crossings that were too difficult to reach due to road conditions.

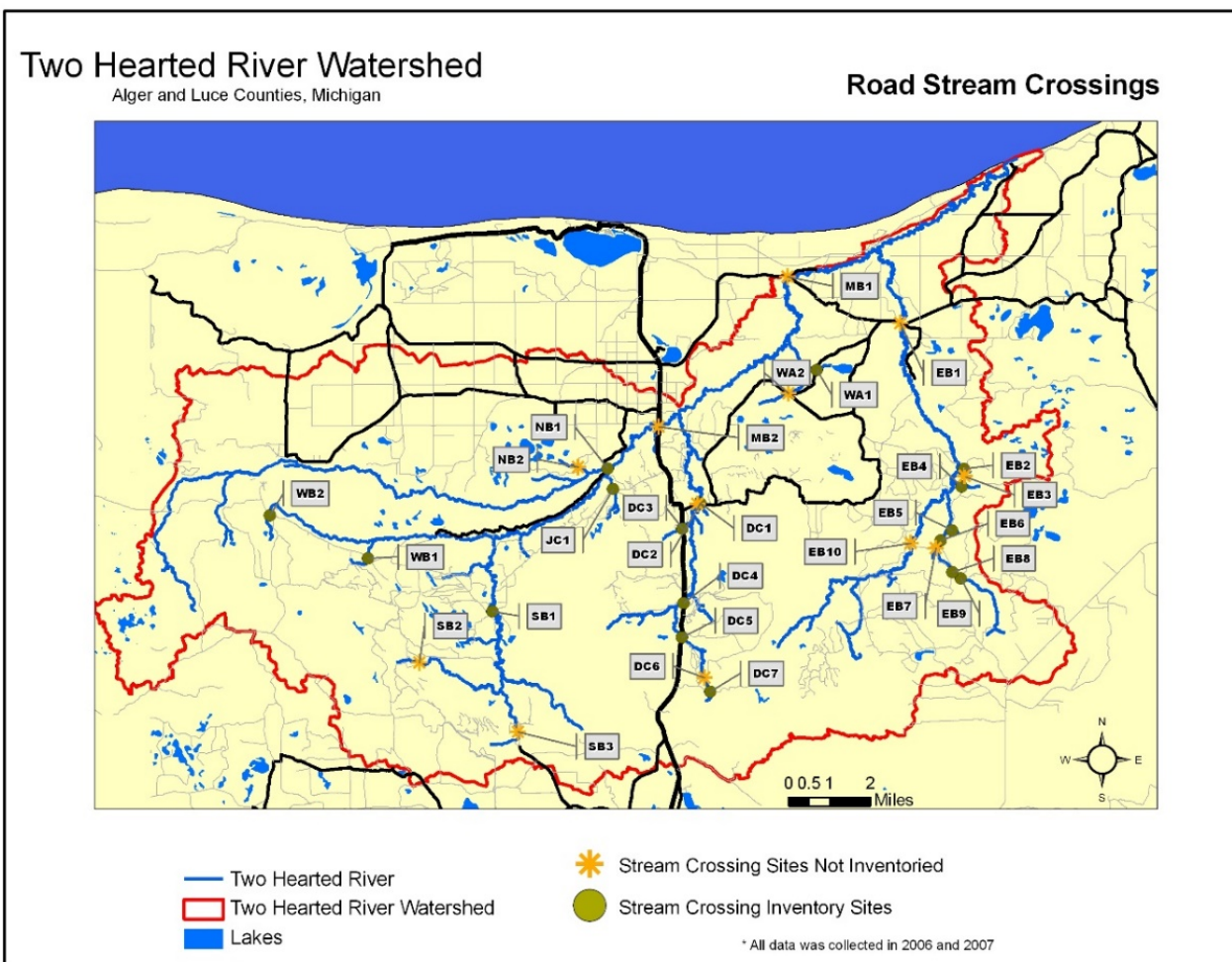


Figure 32- Road/stream crossing inventory sites in the Two Hearted River Watershed

On a watershed-wide scale, the unimproved nature of the roads combined with sandy soils has been a bad combination for erosion at most crossing sites during high water and rain events and

grading operations. The upper East Branch and Dawson Creek are the most impacted by transportation routes due to the number of crossings. In addition, some of the crossings structures are poorly

aligned, undersized, and/or perched, thus impacting stream flow and movement of fish and aquatic organisms. Many of the crossings are situated at the lowest elevation point of the road that they service and function as a focal point to funnel sediment into the river. Some crossings consist of old or improvised materials or have no crossing structure at all, with vehicle traffic driving directly through the stream.

A summary of the road/stream crossings in the Two Hearted River watershed, last inventoried in June 2019, is provided in Table 21. Inventory data sheets and photos are provided in Appendix B. Sediment loading from crossing sites was quantified in a watershed-wide analysis of erosion and pollutant loading using USDA National Agriculture Imagery Program (NAIP) 2005 digital orthophotos and the U.S. Environmental Protection Agency's Spreadsheet Tool for Estimating Pollutant Loads (STEPL 4.1 beta). Discussion and results of this analysis are provided in Chapter Three: Pollutants, Sources, and Causes.

Table 21- Summary of Road/ Stream Crossings in the Two Hearted River Watershed

Site #	Stream Name	Road Name	Location	Crossing type	Crossing Material	Road Surface	Perched	Erosion	Site Description
MB1	Main Branch Two Hearted River	CR 410 (Reed and Green Bridge)	T49N, R10W, Sec 10	Bridge	N/A	Gravel/Native	N/A	No	Restoration work occurred in 2012. In 2019, crossing is stable. Minor erosion from the right approach is washing onto the bridge.
MB2	Main Branch Two Hearted River	CR 407 (High Bridge)	T49N, R10W, Sec 31	Bridge	N/A	Paved	N/A	No	Restoration work occurred in 2013. In 2019, crossing is stable. No erosion.
DC1	Unnamed Tributary to Dawson Creek	CR 414	T48N R10W Sec 5	Bridge	Metal/wood	Gravel/Native	N/A	Yes	Restoration work occurred in 2012. In 2019, the left and right approach have moderate erosion probably due to heavy precipitation.
DC2	Dawson Creek	CR 414	T48N R10W Sec 5	Bridge	Concrete	Gravel/Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: bridge and approach work was completed in 2007.</i>
DC3	Whiskey Creek	CR 407	T48N R10W Sec 8	4' Round Culvert	Metal	Paved	Yes	No	Not inventoried in 2019. <i>Notes from a previous assessment: crossing structure is poorly aligned and perched (<3") during low flow conditions.</i>
DC4	Dawson Creek	CR 407	T48N R10W Sec 20	Bridge	Concrete	Paved	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: bridge abutments appear to restrict flow; however, crossing is stable and channel protection is preventing erosion.</i>
DC5	Little Dawson Creek	CR 407	T48N R10W Sec 29	Multiple Culverts	Concrete	Paved	No	No	Not inventoried in 2019. <i>Notes from a previous assessment: crossing consists of two culverts; one at Little Dawson and one at nearby wetland. Both appear to restrict flow.</i>
DC6	Little Dawson Creek	Unnamed Road off Sleeper Lake Road	T48N R10W Sec 32	N/A	N/A	Native	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: crossing identified on map but not found in the field.</i>
DC7	Little Dawson Creek	Sleeper Lake Road	T48N R10W Sec 32	ATV/foot bridge	Wood	Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: rugged ATV/foot bridge at end of Sleeper Lake Road.</i>
EB1	East Branch Two Hearted River	CR 414	T49N R9W Sec 18	Bridge	N/A	Gravel/Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: crossing is stable.</i>

Site #	Stream Name	Road Name	Location	Crossing type	Crossing Material	Road Surface	Perched	Erosion	Site Description
EB2	Unnamed Tributary to East Branch	Widgeon Trail	T48N R9W Sec 4	2' Round Culvert	Cement	Native	No	No	Not inventoried in 2019. <i>Notes from a previous assessment: culvert is overgrown and plugged and restricts flow and fish passage.</i>
EB3	Unnamed Tributary to East Branch	Widgeon Trail	T48N R9W Sec 4	N/A	N/A	Native	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: intermittent drainage – no stream channel present.</i>
EB4	Unnamed Tributary to East Branch	Widgeon Trail	T48N R9W Sec 5	1.5' Round Culvert	Plastic	Native	Yes	Yes	Not inventoried in 2019. <i>Notes from a previous assessment: culvert is undersized (large wetland/pond upstream), perched on downstream end (>6") and has minor erosion from road embankments.</i>
EB5	Unnamed Tributary to Widgeon Creek	Widgeon Trail	T48N R9W Sec 8	Bridge	Metal with Open Wood Decking	Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: crossing is stable.</i>
EB6	Widgeon Creek	Widgeon Trail	T48N R9W Sec 8	Bridge	Metal with Open Wood Decking	Native	N/A	Yes	Not inventoried in 2019. <i>Notes from a previous assessment: moderate erosion of bridge side slopes, cement blocks and rock used for stabilization washes away during high water events (Larry Frost, EBSC President personal communication).</i>
EB7	Unnamed Tributary to Widgeon Creek	Widgeon Trail	T48N R9W Sec 17	N/A	N/A	Native	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: crossing identified on map but not found in the field.</i>
EB8	Widgeon Creek	South Widgeon Trail	T48N R9W Sec 17	No Structure	N/A Former Crossing	Native	N/A	Yes	Not inventoried in 2019. <i>Notes from a previous assessment: crossing is stable. Replaced by EBSC in 2010.</i>
EB9	Widgeon Creek	Unnamed Road	T48N R9W Sec 17	Bridge	Metal with Open Wood Decking	Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: site is stable, not inventoried due to deep water and adjacent wetlands.</i>
EB10	East Branch Two Hearted River	Widgeon Trail	T48N R9W Sec 7	Bridge	Metal with Open Wood Decking	Native	N/A	Yes	Restoration work in 2012. In 2019, it is noted that the bridge abutments are too close together, constricting the stream channel, and creating an eddy where the stairs are. This is causing the stairs to pop out of the streambank, moderate erosion,

Site #	Stream Name	Road Name	Location	Crossing type	Crossing Material	Road Surface	Perched	Erosion	Site Description
									and sediment loading on the area planted downstream. Site engineering, structural replacements, and stabilization is needed.
JC1	Johns Creek	CCI Road	T48N R11W Sec 1	Rectangular culvert	Concrete	Gravel	No	No	Crossing is stable. No erosion.
NB1	North Branch Two Hearted River	CR 418	T48N R11W Sec 1	Bridge	Metal with Open Wood Decking	Gravel/Native	N/A	Yes	Bridge side rails and supports are rusted. The left and right approaches have gullies and runoff paths from precipitation. The wetted width is about 10 ft wider than the bridge. Overall, the bridge is in poor condition and moderate erosion is occurring at the site.
NB2	North Branch Two Hearted River	Unnamed Road/Trail	T48N R11W Sec 2	N/A	N/A	N/A	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: crossing identified on map but not found in the field due to limited access.</i>
SB1	South Branch Two Hearted River	CCI Road	T48N R11W Sec 21	One 4' and Three 6' Round Culverts	Metal	Native	No	Yes	Not inventoried in 2019. <i>Notes from a previous assessment: site restoration work in 2011-2012.</i>
SB2	Dairy Creek (South Branch)	Unnamed Road	T48N R11W Sec 30	N/A	N/A	N/A	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: restoration and portable bridge installation in 2014.</i>
SB3	South Branch Two Hearted River	Unnamed Road	T47N R11W Sec 3	N/A	N/A	N/A	N/A	N/A	Not inventoried in 2019. <i>Notes from a previous assessment: replaced culvert and stabilized bank in 2011.</i>
WA1	Chris Brown Creek (Wabash Creek)	CR 414	T49N R10W Sec 23	5.8' Round Culvert	Metal	Gravel/Native	No	Yes	Moderate erosion at the crossing caused by runoff from the road at the inlet and outlet sides of the culvert. Sediment from road grading is reaching stream.
WA2	Wabash Creek	CR 414	T49N R10W Sec 27	Bridge	Metal	Gravel/Native	N/A	Yes	Moderate erosion at low point in road and the edge of the road is knocked out for drainage. Erosion is reaching the stream.
WB1	Unnamed Tributary to West Branch	Jeep Trail off	T48N12W Sec 13 (NW)	Ford	None	Native	N/A	No	Not inventoried in 2019. <i>Notes from a previous assessment: Site work 10/7/2011, Portable bridge completed 10/8/2013.</i>

Site #	Stream Name	Road Name	Location	Crossing type	Crossing Material	Road Surface	Perched	Erosion	Site Description
		Dillingham Lake Road							
WB2	West Branch Two Hearted River	Jeep Trail off Dillingham Lake Road	T48N R12W Sec 9	Portable bridge	Metal/wood	Native	N/A	No	Crossing is stable. No erosion.
WB3	West Branch Two Hearted River	Unknown	T48N12W	Elliptical Culvert	Metal	Gravel	No	No	Crossing is stable. No erosion.
WB4	West Branch Two Hearted River	Unknown	T48N12W	Round Culvert	Metal	Sand	No	No	Crossing is stable. No erosion.
WB5	West Branch Two Hearted River	Burma Road	T48N12W	Round Culvert	Metal	Gravel	No	No	Crossing is stable. No erosion.

Trails

Luce County offers miles of well-groomed and scenic snowmobile and Off Road Vehicle (ORV) trails along with sections of the North County National Scenic Trail, a premier footpath that stretches for about 4,600 miles linking communities, forests, and prairies across seven northern states.

Approximately 135 miles of snowmobile trails exist in Luce County with over 53 miles located within the Two Hearted River watershed. Similarly, ORV operation is permitted on designated trails, routes and areas, and state forest roads unless they are posted closed (MDNR 2008). The Two Heart and Pine Ridge ORV trails, located in McMillan Township, provide over 37 miles

of trails within the watershed (Figure 33). These trails are designed for ORVs less than 50" in width, off road motorcycles, and All Terrain Vehicles (ATVs). Off Road Vehicle operation is not permitted off roads or trails or on private land without written permission.

The Grand Marais Chapter of the North Country Trail Association has responsibility for approximately 150 miles of trail which runs from the mouth of the Two-Hearted River, west to Grand Marais and then to Munising and ending at the Rock River Canyon. Sections of this trail, while not located within the boundary of the watershed, offer beautiful forest and cliff walks with tremendous views of Lake Superior (<http://www.northcountrytrail.org/gmc/index.htm>).

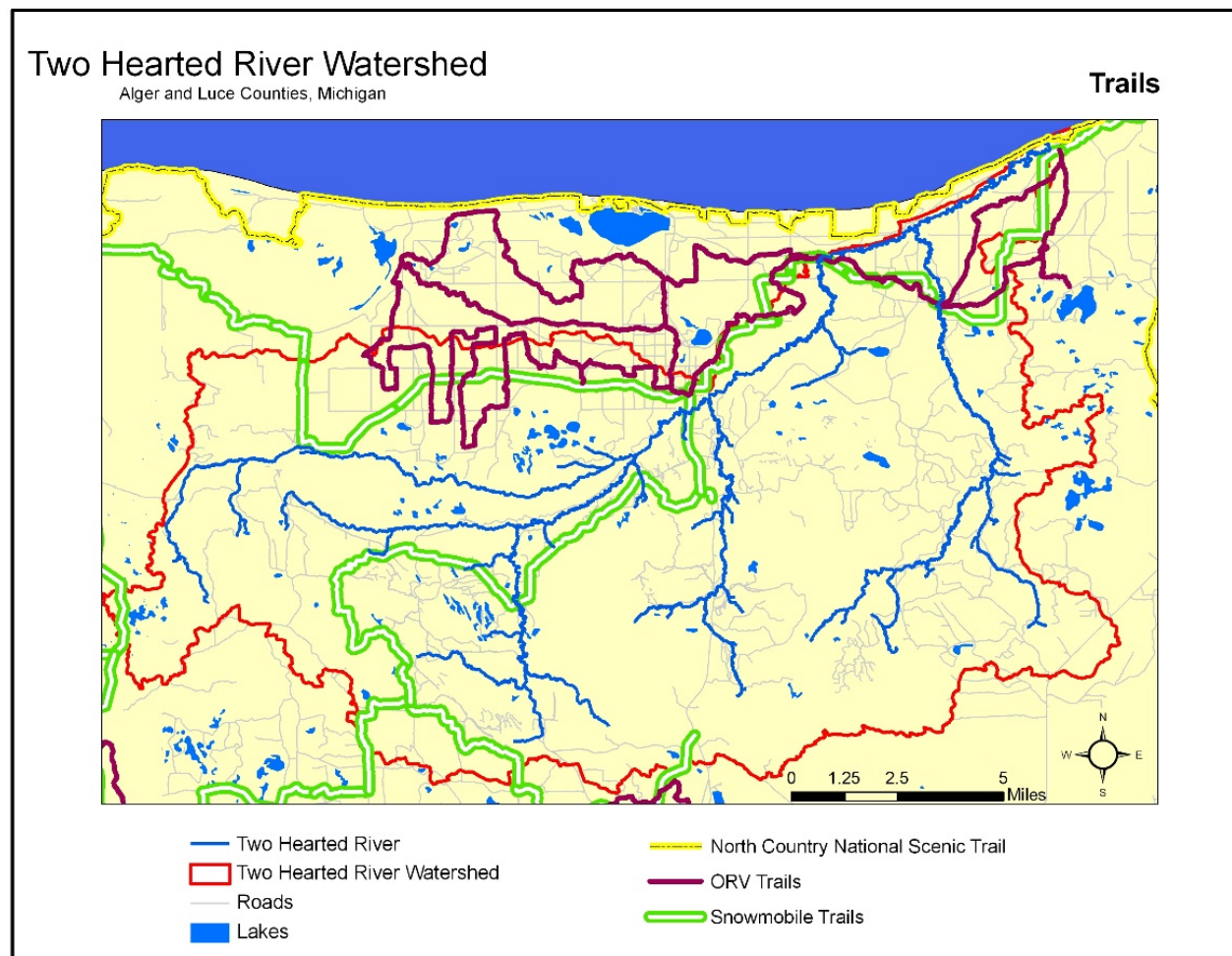


Figure 33 Designated Trails in and around the Two Hearted River Watershed

In September of 2006, the Luce County Board of Commissioners opened all Luce County roads to ORV traffic. With the county

roads open, ORV riders now have the means to reach every fire lane, two-track and logging road in the county. Many two-tracks

lead to or across private property which has led to an increase in trespass issues involving ORVs. This also affords them access to lakes, streams, rivers, marshes, Lake Superior beaches and many areas that were previously inaccessible. While most ORV users are responsible in their riding habits, the availability of new routes has resulted in escalating environmental damage. The website www.lucecountyorvdamage.com provides information on the damage that has resulted from ORV use in northern Luce County, including details of a recent lawsuit in which a private landowner was awarded \$22,071 for damages to wetlands on his property.

Illegal ORV use not only hurts the environment but harms the reputation of responsible users and threatens the future of legal ORV use in Michigan. The issue has prompted many law-abiding ORV riders to take action before the majority loses privileges as a result of the law-abusing few. Organizations such as “Tread Lightly”, a national nonprofit organization of ORV users, seek to protect recreational access through education and stewardship initiatives.

Similarly, the Michigan Department of Natural Resources Draft Off-Road Vehicle (ORV) Management Plan (MDNR 2008) provides recommendations to fulfill the public’s desire for more riding opportunities while ensuring safety of riders and protection of the environment. Some of the recommendations include in the plan:

- More emphasis on education and public awareness campaigns
- Mandatory ORV youth education/certification programs with emphasis on the importance of legally operating ORVs
- More patrols and tougher enforcement in areas with heavy damage caused by ORVs and high ORV use
- A toll-free line to report illegal ORV use similar to the Report All Poaching (RAP) line

- An ORV license with a readily identifiable number to aid law enforcement officials
- Partnerships between conservation officers and local law enforcement agencies to crack down on ORV enforcement
- Increased penalties for illegal ORV use
- More effective management plans for restoring environmentally damaged sites

3.8 Existing & Future Land Use/Land Cover

Land Use

The land uses within the Two Hearted River watershed have remained relatively unchanged since the early 1800’s. This is likely due to the remoteness of the area and limitations based on soils and topography (TNC 2007).

Land use maps based on the Michigan EGLE Geographic Information Systems (GIS) data for 1800 and 1978 are shown in Figures 34 and 35, respectively. Percent land use within each of the subwatersheds is also detailed in Table 22.

Land use circa 1800 is from a statewide database based on original surveyors’ tree data and descriptions of the vegetation and land between 1816 and 1856. Michigan was systematically surveyed during that time by the General Land Office, which had been established by the federal government in 1785. The detailed notes taken by the land surveyors have proven to be a useful source of information on Michigan’s landscape as it appeared prior to widespread European settlement. The database creators recognize that there are errors in the database due to interpretation and data input (Fongers 2007).

The 1978 land use files represent a compilation of data from county and regional planning commissions or their subcontractors.

This data set is intended for general planning purposes. It is not intended for site specific use. Data editing, manipulation, and evaluation was completed by the Michigan State University Center

for Remote Sensing and GIS and by the MDNR. Files have been checked by MDNR against original MDNR digital files for errant land cover classification codes (Fongers 2007).

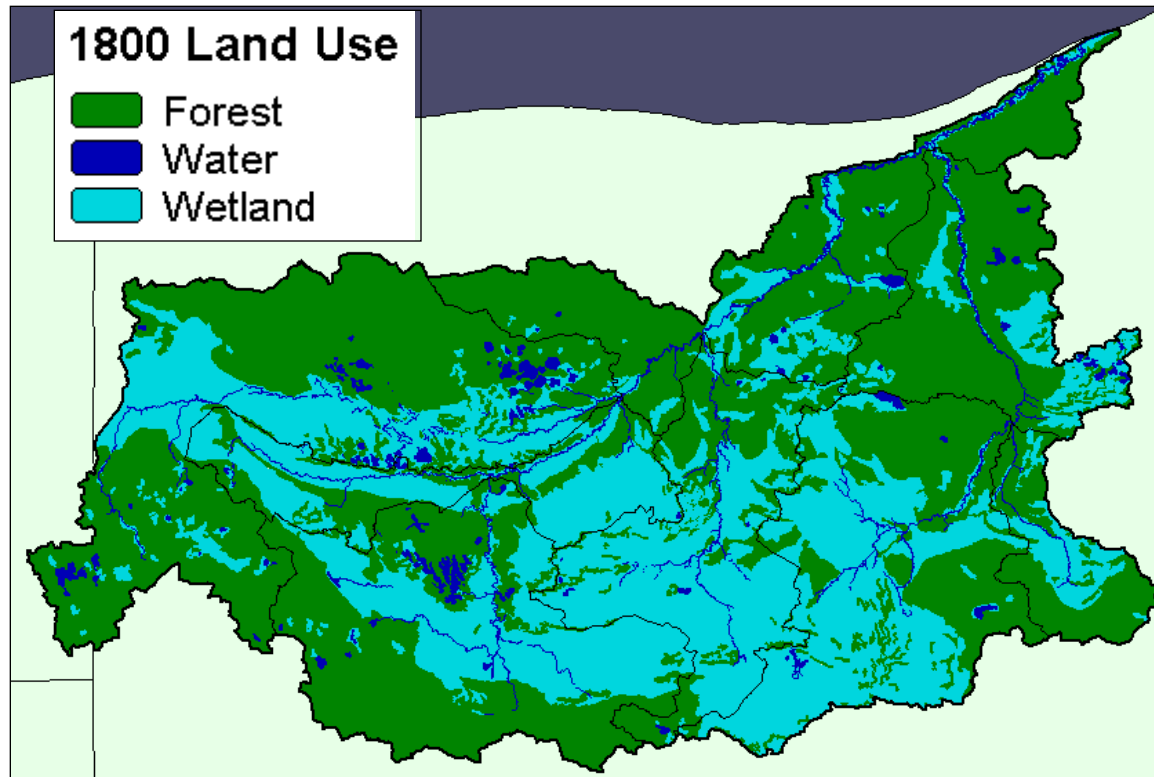


Figure 34- Land Use in the Two Hearted River Watershed circa 1800 (Fongers 2007)

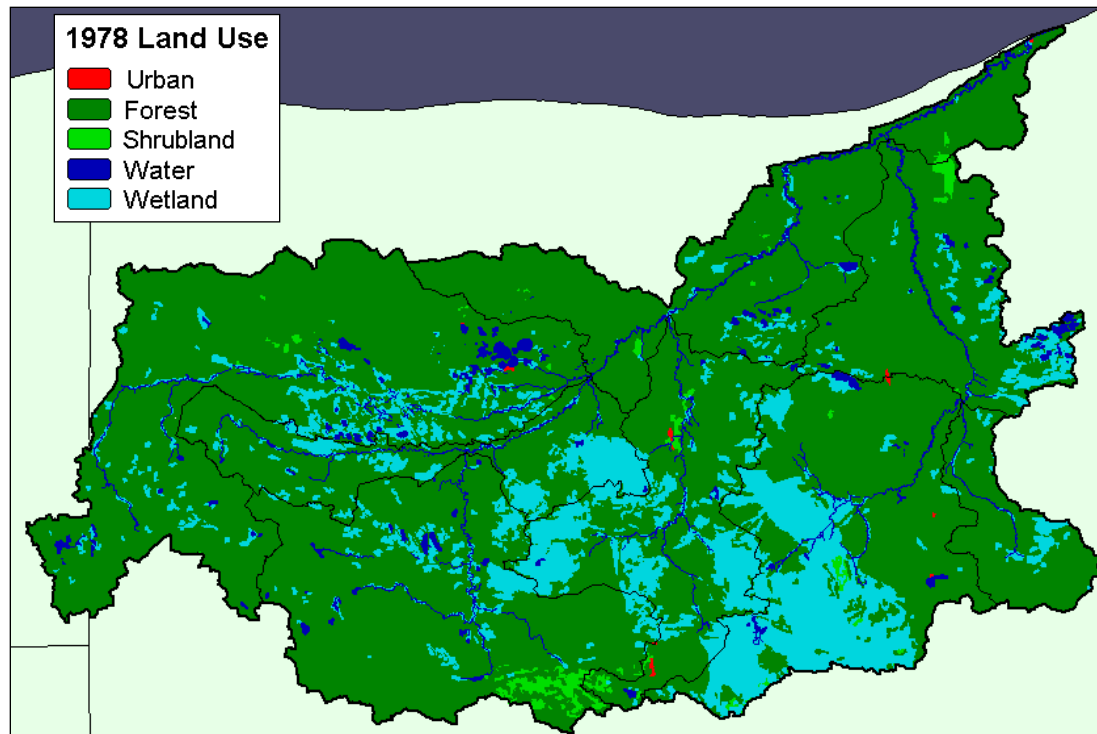


Figure 35- Land Use in the Two Hearted River Watershed circa 1978 (Fongers 2007)

Table 22- Land Use Types in the Two Hearted River Watershed (Land use percentages that round to 0 are not listed) (Fongers 2007)

Description	Scenario	Percent Land Cover (%)			
		Shrubland	Forest	Water	Wetland
Dawson Creek	1800		32		68
	1978	1	68		30
East Branch, lower	1800		79	1	20
	1978	2	89	2	7
East Branch, upper	1800		42	1	57
	1978	1	59	1	40

North Branch	1800		69	2	29
	1978		90	2	8
South Branch	1800		56	2	42
	1978	3	89	1	7
Two Hearted, lower	1800		84	1	16
	1978	1	95	1	3
Two Hearted, upper	1800		31		69
	1978		76		24
Widgeon Creek	1800		68		32
	1978		93		7
Entire Watershed	1800		59	1	41
	1978	1	83	1	17

Comparison of 1800 and 1978 land use data indicates changes in land use types. Minor changes (<1%) to more urban land use types can be seen in Figure 35. These changes are located primarily on private lands and along heavily traveled routes and correspond roughly to increases in population density and occupied housing units (Figures 27 and 28).

Changes in upland (forest) and wetland land use types (Figure 36) can likely be attributed to classification of forested wetlands as a Forest land use type in the 1978 data layer. National Fish and Wildlife Service National Wetlands Inventory data (USFWS 1980) indicate a variety of wetland types occupying approximately 43% of the watershed including 31,709 acres of forested wetlands (see Table 30 and Figure 50). These data suggest relatively no change in wetland and upland land use types.

Two Hearted River - Land Use Comparison

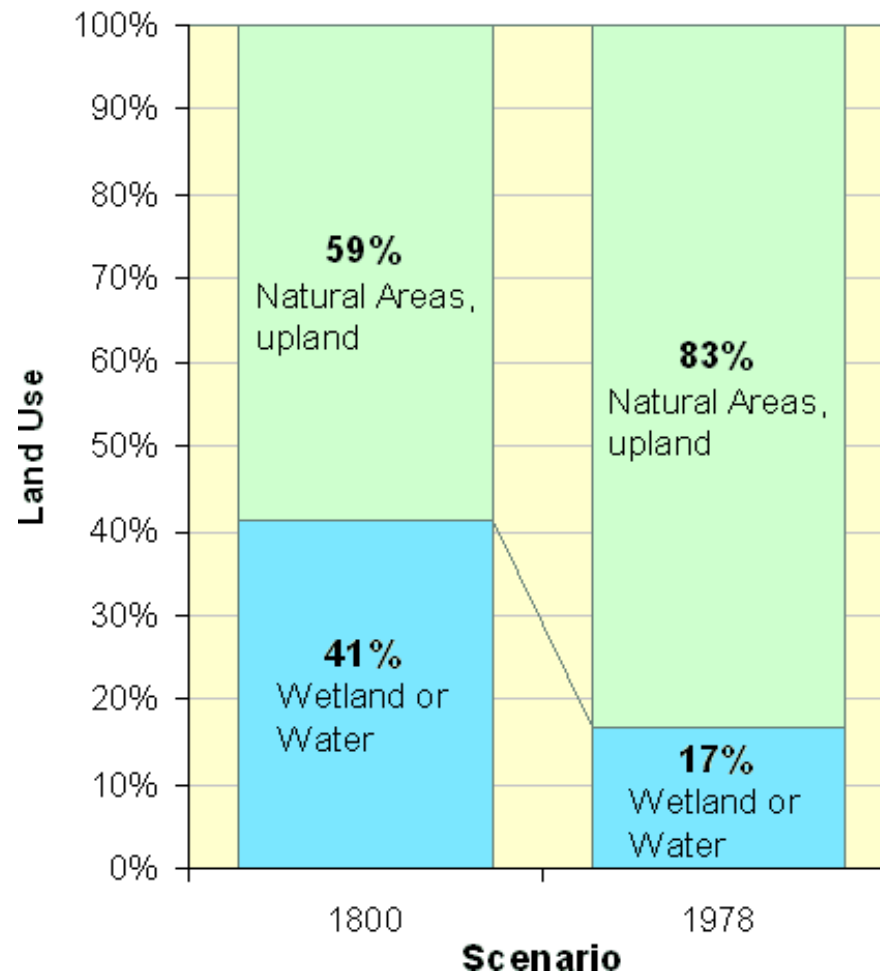


Figure 36- Changes in Upland and Wetland Land Use Types (1800 – 1978) in the Two Hearted River Watershed (Fongers 2007)

Future Land Use/Land Cover Predictions

Given the rate of change observed in the watershed between 1990 and 2019, population growth in the watershed is low, and that is not likely to drastically change. However, despite observed increases in growth and development, human settlement remains largely limited by large tract land holdings with few private parcels, unimproved roads, and natural features including the extensive wetland complexes. Landowners such as the State of Michigan and The Nature Conservancy, who combined own almost 70% of the land in the watershed, offer an additional level of protection per current long-term land use plans. An additional 15% of the land in the watershed held by corporate forest products producers under working forest conservation easement allows for continued economic and environmental sustainability of these lands along with accessibility to the public.

Private land holdings along the upper East Branch and Dawson Creek offer the greatest potential for future growth and

3.9 Sensitive Areas

The main land use activity within the Two Hearted River watershed is forest management conducted by the State of Michigan, large forest product producers such as The Forestland Group, LLC and Plum Creek Timber, The Nature Conservancy, private hunt clubs, and other small private landowners. While a large portion of the watershed is undeveloped, there is further potential for residential development, especially along the rivers, tributaries, and lakes. Therefore, the goal of this analysis was to identify the riparian areas sensitive to development and/or forest management activities.

development. These lands have become increasingly attractive as demands for recreational opportunities increase and real estate values continue to rise including the high value of water front property. While this type of development appears to pose the greatest threat to water quality, Natural Rivers Program regulations and proper planning by Luce County including the proposed Luce County zoning ordinances and Lake Superior Coastal Management Plan for Luce County provide provisions for protection of water quality and the natural character of the watershed.

Future improvements to the road infrastructure leading from the population centers of Newberry and Grand Marais will increase the public's access to the Two Hearted watershed. These improvements will also likely result in increased development and recreation pressures. However, Luce County continues to prepare for this type of growth through proper planning and coordination with watershed stakeholders and the public.

In this analysis, sensitive areas are defined as locations within the riparian area that, given their multiple attributes, create a unique area that if disturbed may affect the water quality of the Two Hearted River or its riparian area. A GIS analysis was conducted to identify these potentially sensitive areas, and was followed by limited field visits to monitor the accuracy of the data input. Characteristics such as physical distance from river, slope, soil erosion potential, presence of unique natural features, presence of wetlands, and other soil attributes related to building/development conditions were utilized to identify these sensitive areas. Each portion of the riparian area was assigned a score for each of these characteristics, and then the sum of all of these scores provided its overall rank. The ranking information may be analyzed in two ways, by breaking it out into categories (e.g. High, Medium,

and Low) or by looking at the numerical ranks as a gradient of sensitivity to these activities. For illustration purposes, the entire riparian area was separated into five categories (using the equal interval classification) related to its sensitivity to development and to forest management activities. These categories (from *High* to *Low*) illustrate the varying degrees of sensitivity of the specific area.

Field monitoring was conducted to verify the accuracy of the input data for the GIS analysis, to gauge the general characteristics and condition of the riparian area within the Two Hearted River watershed, and to provide field verification of those sites identified as sensitive to develop and/or forestry through the analysis. In total, 30 sites were visited during the field seasons of 2006 and

2007. Overall, the input data for the GIS analysis was fairly representative of the on-the-ground characteristics. General topography was compared with the County Digital Elevation Models and land cover was compared with the IFMAP data. The vegetation composition identified through the field visits reflected the general land cover of the riparian area with the majority of the sites being characterized as forested wetlands or lowland coniferous forests. There were sites characterized as scrub-shrub wetlands, patterned fens, White pine- red maple/blueberry-wild sarsaparilla habitat type, White pine-red maple/blueberry habitat type, and Sugar maple-Hemlock-American beech/Spinulose shield fern habitat type (see Figures 37 and 38).



Figure 37- Wetland Complex at Site #15 in Riparian Area



Figure 38- Steep slope with large hemlock, white pine and sugar maple, at site #14

Sensitivity to Development

The riparian area was analyzed for its sensitivity to development utilizing the following parameters: nearness to river or stream, presence of wetlands, percent slope, ownership, soil suitability for septic, soil suitability for building construction (without basement), soil erosion potential, and presence of unique natural features.

Based on the classification utilized, equal interval, the majority of the riparian area within the watershed is considered to have a *moderate to low – moderate* sensitivity to development (Table 23). The

areas with the highest sensitivity to development include the Swamp Lakes area, due to the presence of a unique natural community, and other specific locations along the West Branch, Main Branch and Dawson Creek (Figure 39). These latter areas all have a percent slope exceeding 30%; are under private ownership; have an erosion potential of *moderate to severe*; and most are within 100 feet of the river. The areas ranked *moderate- high*, which make up about 7% of the riparian area, are all located on soils considered *very limited* for septic suitability; most are located on soils with an erosion potential of *moderate – severe*; and the majority have a percent slope greater than 20%.

Table 23- Percent of Riparian Area by Sensitivity Categories

Rank Category	Sum Rank	Acres	Percent of Riparian Area
Low	1 to 5	902	2
Low-moderate	6 to 9	20,408	35
Moderate	10 to 14	32,532	56
Moderate-high	15 to 18	4,012	7
High	19 to 22	60	<1

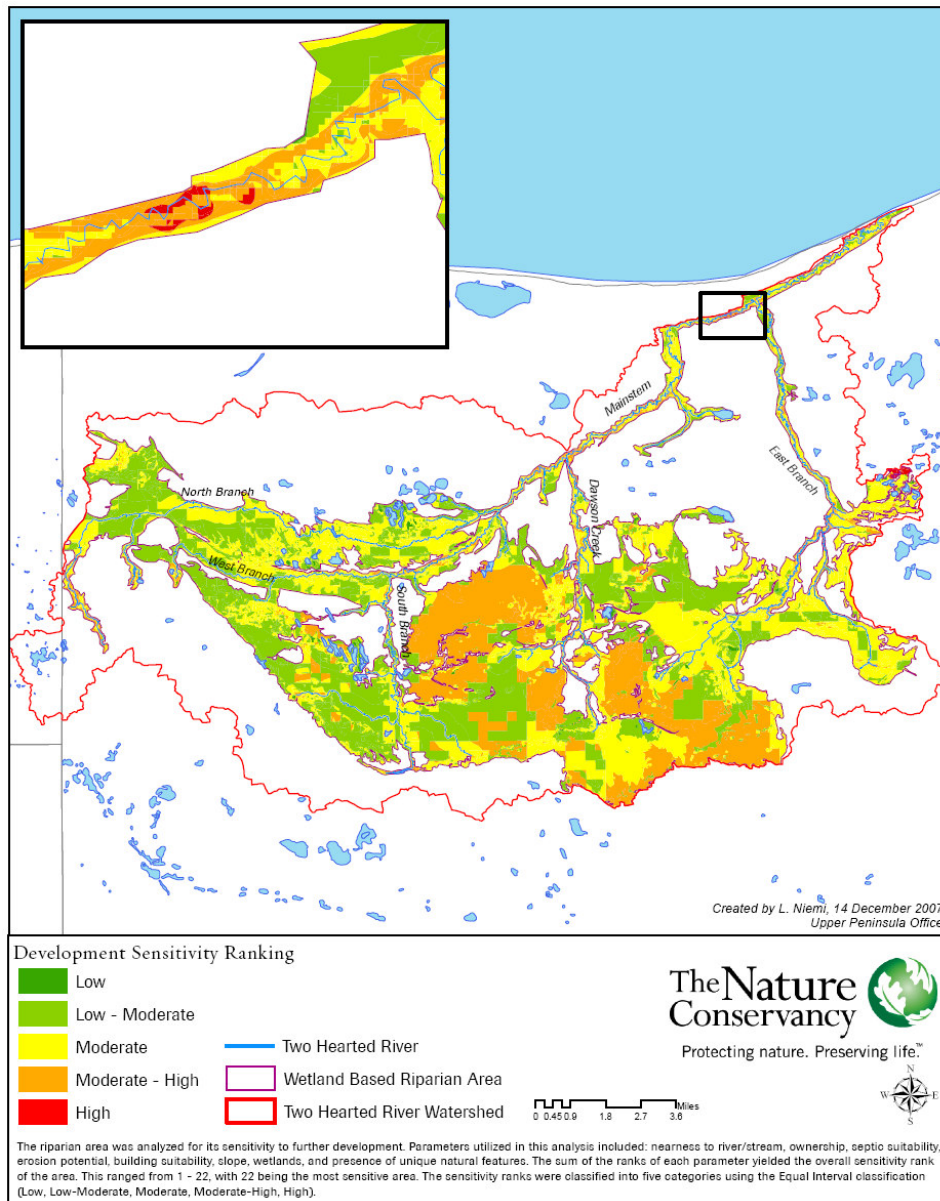


Figure 39- Development Sensitivity Ranking categories across the Two Hearted River watershed riparian area with an illustration of a location with High rating along the Main Branch (inset)

There was not a strong correlation of this category to the property ownership or its nearness to the river. Approximately 2% of the riparian area ranked *low* in its sensitivity to development. In general, most of these locations were located at least 500 meters from the river or stream; are under public or a form of conservation ownership (ie. The Nature Conservancy); do not have limitations based on the soils (e.g. *slight* erosion potential and *not limited* for septic suitability); and have a percent slope of less than 10%. Some of these locations do overlap with unique natural features in the watershed and others are coincidental with lakes, such as the Two Hearted Lakes complex.

The sensitivity to development in the riparian area by subwatershed has a similar pattern to the watershed-wide perspective (Table 24). Most of the riparian areas have a similar

percentage of areas ranked *low* and *high*. The riparian area within the North and South Branches have a higher percentage of area within the *low-moderate* ranking, while the riparian area within the West and East Branches, the Main Branch, and Dawson Creek all have a greater percentage of land with a *moderate* ranking. The riparian area within the Main Branch, Dawson Creek, and the South Branch subwatersheds has a higher percentage ranked *moderate-high*. In the Main Branch, this is likely due to the topography and erosion potential of the sandy soils, while in the South Branch and Dawson Creek subwatersheds, this is likely reflecting the extensive hydric soils limited for septic and construction suitability. The field monitoring reflected the GIS analysis. The majority of the sites visited, 21 out of 30, represented the attributes of an area that would be sensitive to development.

Table 24- Sensitivity to Develop Ranking for Subwatersheds

Subwatershed	Percent within Ranking Categories per Subwatershed				
	Low	Low-Moderate	Moderate	Moderate-High	High
North Branch	39	46	49	1	0
West Branch	1	35	61	3	4
South Branch	29	52	34	11	0
Dawson Creek	1	27	58	14	<1
East Branch	0	26	68	5	<1
Main Branch	2	20	61	18	<1
Watershed-wide	2	35	56	7	<1

Sensitivity to Forest Management

Through a similar process, the riparian area was analyzed for its sensitivity to forest management activities. The following parameters were utilized: nearness to river or stream, presence of wetlands, percent slope, soil erosion potential, and presence of unique natural features. The parameters based on the soil data

include considerations such as seasonal limitations for equipment use. Based on the classification utilized, equal interval, the majority of the riparian area within the watershed is considered to have a *moderate* to *low* – *moderate* sensitivity to forest management (Table 25). In comparison with the sensitivity to development, there is a greater percentage of land considered to have a *low* and *moderate* – *high* sensitivity to forest management.

Table 25- Percent of Riparian Area in 5 Forestry Sensitivity Categories

Rank Category	Sum Rank	Acres	Percent of Riparian Area
Low	1 to 4	11,102	19
Low-moderate	5 to 7	20,524	35
Moderate	8 to 11	16,336	28
Moderate-high	12 to 14	9,883	17
High	15 to 17	57	<1

The area with the highest sensitivity to forest management is the Swamp Lakes area, due to the presence of a globally rare natural community (see Figures 40 and 41). It represents less than one percent of the riparian area land base. As with potential development, this area is very sensitive to forest management and would be greatly impacted by such activity. Approximately 17% of the riparian area is considered to have a *moderate* – *high* sensitivity to forest management activities. About one third of these areas include one or more unique natural features; the majority have a percent slope greater than 30% with an erosion potential rating of

severe; and some are located within 100 feet of the river, while others are more than 500 meters from the river or stream. These lands are found within forested wetlands, but also on the uplands. Lands considered to have a *low* sensitivity to forest management (19% of the riparian area) are located mostly in the uplands; the majority have a slight slope of 0 to 10% with *slight* erosion potential rating; and the majority are located more than 100 feet from the river or stream. Some of these areas do support unique natural features and others have a *severe* erosion potential rating; however, these latter areas are located more than 500 meters from the river.



Figure 40- Swamp Lakes area, site #24

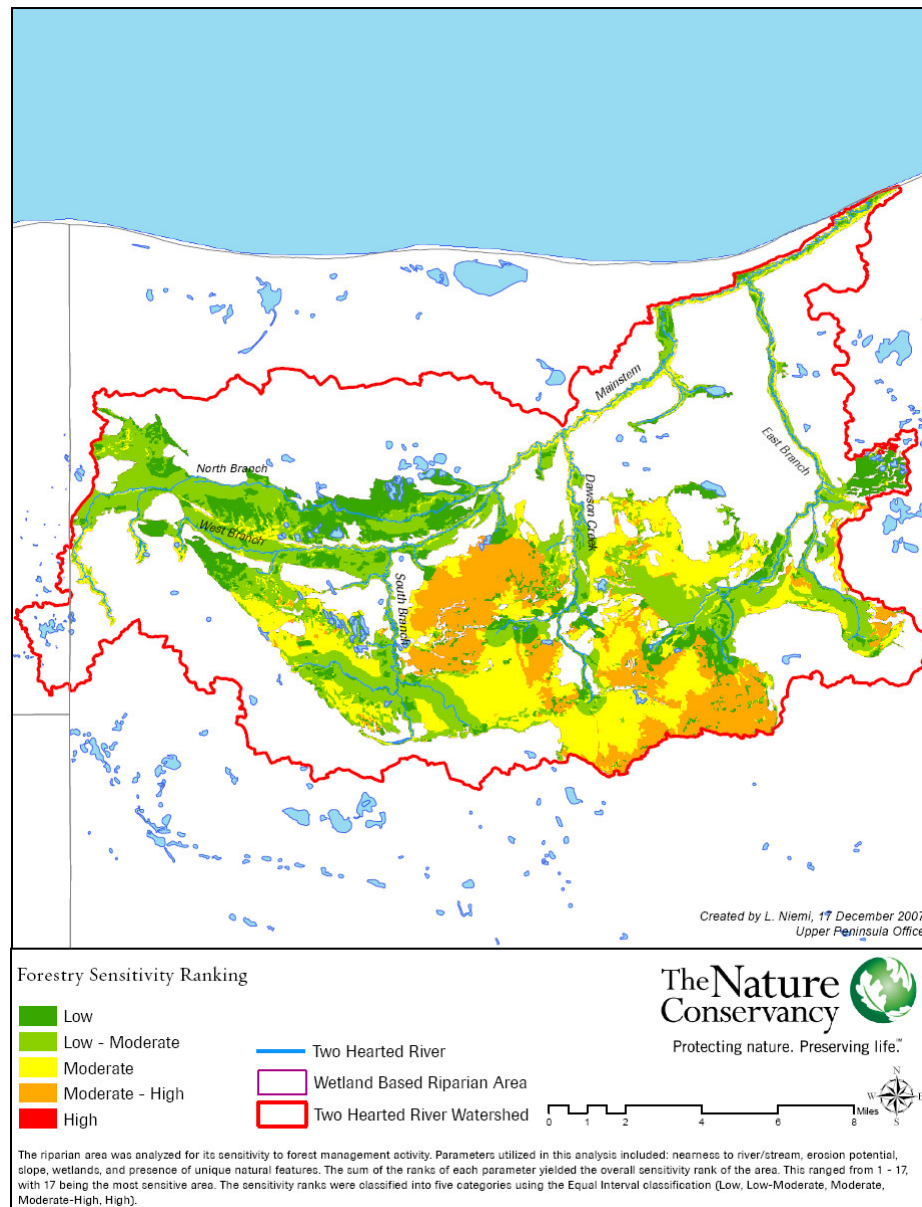


Figure 41- Forest Management Sensitivity Ranking categories across the Two Hearted River watershed riparian area

The sensitivity to forest management in the riparian area by subwatershed illustrates some similarities and deviations from the watershed-wide pattern (Table 26). The only subwatershed with areas considered to be *high* sensitivity is the East Branch, where Swamp Lakes is located. The Main Branch and the North Branch subwatersheds have less than 1% of their land base within the *moderate – high* category, greatly below the watershed-wide average of 17%. This deviation is most likely due to minimal amount of

wetlands and hydric soils in the riparian areas of these two subwatersheds.

Overall, the riparian areas within the North and West Branches are less sensitive to forest management than the other subwatersheds. They both have a less percentage of land within the *moderate* sensitivity rating with higher percentages of land rated *low – moderate* and *low*.

Table 26- Ranking of Sensitivity to Forestry by Subwatersheds

Subwatershed	Percent within Ranking Categories per Subwatershed				
	Low	Low-Moderate	Moderate	Moderate-High	High
North Branch	39	46	49	1	0
West Branch	1	35	61	3	4
South Branch	29	52	34	11	0
Dawson Creek	1	27	58	14	<1
East Branch	0	26	68	5	<1
Main Branch	2	20	61	18	<1
Watershed-wide	2	35	56	7	<1

The field monitoring reflected the GIS analysis conducted for areas sensitive to forest management activities. The majority of the sites visited, 24 out of 30, represented the attributes of an area that would be sensitive to forest management either due to the slope or soil characteristics. From the field work, it became clear that there is a great deal more wetlands on the landscape than what is represented in the GIS data. Most of these are less than one acre in size but still contribute to overall water quality and hydrologic connectivity within the riparian area. This stresses the need for on-

the-ground field reconnaissance to identify these in order to ensure that they are protected if and when timber harvesting occurs.

Management Recommendations

In assessing the areas identified through this analysis, there are a few items that need to be addressed. First, some of the GIS data utilized is at a coarse scale and may not accurately represent the on-the-ground characteristics at the exact locations. The purpose of the analysis is to provide a tool in landscape level planning, not necessarily in planning at the site specific scale. Therefore, a field

reconnaissance is necessary to make decisions and recommendations at a particular site. Second, in the GIS analysis, the areas within 100 feet of the river or stream were not automatically rated as having a

High sensitivity even though this corridor is regulated under Michigan's Natural Rivers Program and is a mandatory vegetative buffer. Activities regarding timber harvesting and development are greatly restricted in this 100-foot buffer through the Natural Rivers Program, and these regulations should be adhered to in all instances.

Development

There are a few locations in the riparian area where the sensitivity to development ranked *High*. In these locations, further development should not be allowed unless a field reconnaissance illustrates a less vulnerable landscape from what the GIS analysis portrayed. The Swamp Lakes area is ranked *high* due to the presence of a globally rare natural community; therefore special precautions should be taken if and when further development is considered near this complex. The other sites that ranked *High*, were found to have severe slopes, high potential for erosion, and are located near the river; therefore, development is not suitable on or near these sites. The areas ranked *moderate-high* are all located on soils considered *very limited* for septic suitability, and most are located on soils with an erosion potential of *moderate – severe*. In general, it is recommended that these areas remain undeveloped. Similarly to above, these areas should be assessed at a site specific level to determine the potential impact of development.

Overall, further development in the Two Hearted River riparian area should be limited to ensure the protection of the river's water quality and unique habitat. The majority of the riparian area is considered unsuitable for building (see Figure 22) and also is considered to be *very limited* for septic suitability (see Figure 23). In

general, further development should be guided and concentrated in those areas of uplands following the existing regulations and the proposed Luce County Zoning Ordinances. In addition, further measures should be utilized to ensure long-term protection of the aquatic system, including the utilization of conservation easements. In those areas adjacent to the river, stream, and/or a unique natural community owned by private entities, the purchase or donation of conservation easements should be considered. The terms of the conservation easement should be tailored to ensure the protection of the water resources at the site level, and they should be held by a qualified organization or agency dedicated to the long-term monitoring of these easements.

Forest Management

Similar to sensitivity to development, only a small percentage of the Two Hearted River riparian area is considered to have a *High* sensitivity to forest management. The Swamp Lakes complex is the only area that falls within this category, due to the presence of a globally rare natural community. Forest management within or near these complexes should be extremely limited, and conservation easements should be utilized to protect these resources for the long-term.

About 17% of the riparian area is considered to be in the *moderate – high* rating of sensitivity to forest management. The majority of these lands are considered to have a severe slope (>30%) with an erosion potential of *severe*. In general, forest management should be limited in these areas to enhance slope stability and prevent erosion. Further analysis of other factors that drove these areas into this category must be considered to develop additional recommendations. For example, about one-third of these areas include one or more unique natural features. Additional information on those natural features and the potential impacts of forest management should be considered prior to harvesting. In

other areas, such as those located on hydric soils, forest management should be limited to the winter season with frozen conditions. This would minimize impacts to the soil and water resources of the riparian area.

Overall, the majority of the Two Hearted River riparian area is considered to be poorly suited for timber harvesting due to equipment limitations based on the soil characteristics (see Figure 21). This does not imply that all forest management should be restricted, rather that seasonal and/or conditional limitations for this activity are recommended. In general, forest management should be guided by existing regulations, the proposed Luce County Zoning Ordinances, and additional measures to ensure protection of the aquatic resources and unique habitat. Additional

3.10 Significant Natural Resources

The variety of wetland communities and the complexity of the peat-land forest ecosystem found within the Two Hearted River watershed are incomparable within the Great Lakes region. This landscape remains un-fragmented and relatively undeveloped. The high diversity of natural communities and broad expanse supports a great number of species including wide-ranging mammals such as black bear, fisher, pine marten and moose (TNC 1995).

The Michigan Natural Features Inventory has identified a number of significant natural features in the watershed including a listing

measures include conservation easements that recognize and limit forest management in areas that would negatively impact the aquatic resources and/or unique natural features, and better defined riparian management zones. The latter should be identified based on slope and soil characteristics and should exceed 100 feet from the waterbody. Activities that cause soil compaction should not be allowed within these areas, and native long-lived, larger trees should be promoted. The hydrology of the Two Hearted River watershed is complex due to the wetland-peatland complexes, and the groundwater flow is not well documented. To learn more about this function and the hydrology of the watershed, it is also recommended that demonstration areas are created to illustrate sustainable forestry practices in relation to the enhancement of water quality.

of all known occurrences of threatened (T), endangered and special concern species (SC) and high-quality natural communities that are either significant at a global or statewide scale (Table 27). This list is based on known and verified sightings of threatened, endangered, and special concern species and represents the most complete data set available. It should not be considered a comprehensive listing of every potential species found within a watershed. Because of the inherent difficulties in surveying for threatened, endangered, and special concern species and inconsistent of inventory effort across the State species may be present in a watershed and not appear on this list (MNFI 2007).

Table 27- Natural Features found within the Two Hearted River Watershed

Common Name	Scientific Name	Protection Status	Global Rank	State Rank
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T	G4	S4
Common Loon	<i>Gavia immer</i>	T	G5	S3S4
Merlin	<i>Falco columbarius</i>	T	G5	S1S2
Osprey	<i>Pandion haliaetus</i>	T	G5	S4
Yellow Rail	<i>Coturnicops noveboracensis</i>	T	G4	S1S2
English Sundew	<i>Drosera anglica</i>	SC	G5	S3
Northern Prostate Clubmoss	<i>Lycopodiella margueriteae</i>	SC	G2	S2
Panicled Screw-stem	<i>Bartonia paniculata</i>	T	G5	S2
Wiegand's Sedge	<i>Carex wiegandii</i>	T	G3	S2
Fir Clubmoss	<i>Hyperzia selago</i>	SC	G5	S3
Alga Pondweed	<i>Potamogeton confervoides</i>	SC	G4	S3
American Dune Wild-rye	<i>Elymus mollis</i>	SC	G5	S3
Black Crowberry	<i>Empetrum nigrum</i>	T	G5	S2
Moor Rush	<i>Juncus stygius</i>	T	G5	S1S2
American Shore-grass	<i>Littorella uniflora</i>	SC	G5	S2S3
Lake Huron Tansy	<i>Tanacetum huronense</i>	T	G4	S3
Lake Huron Locust	<i>Trimerotropis huroniana</i>	T	G2G3	S2S3
Dry Northern Forest			G3?	S3
Intermittent wetland			G2	S3
Patterned Fen			GU	S2
Muskeg, Bog			G4	S3
Dry-mesic northern forest			G4	S3
Mesic northern forest			G4	S3
Rich conifer swamp			G4	S3
Hardwood-conifer swamp			G4	S3

G2	Imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure: common; widespread.
GU	Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
G?	Incomplete data

S1	Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
S2	Imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
S3	Vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	Uncommon but not rare; some cause for long-term concern due to declines or other factors.

Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) in the Two Hearted River watershed are defined as the portions of the watershed that are most sensitive to environmental degradation and those areas having the most impact or potential to impact water quality and designated and desired watershed uses. They include areas that may contribute the greatest amount of pollutants to the watershed, either now or in the future, and where preservation and restoration efforts will have the most profound results.

Environmentally sensitive areas were analyzed to identify potential critical habitat and areas sensitive to environmental degradation; to assess natural community condition; and to provide a basis for

management decisions. This was accomplished through a comprehensive study of the functional riparian area of the Two Hearted River and its tributaries and comparison with ESAs identified in the revised Luce County zoning ordinances (Figure 26).

Unique Natural Features

In addition to the general land cover types; there are a number of natural features found within the riparian area. According to the MNFI, these include six species listed as state threatened (protection status = T), two plant species of special concern (protection status = SC), and a host of natural communities that are either significant at a global or statewide scale (see Table 28).

Table 28- Natural Features Found within Riparian Area

Common Name	Scientific Name	Protection Status	Global Rank*	State Rank*
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T	G4	S4
Common Loon	<i>Gavia immer</i>	T	G5	S3S4
Merlin	<i>Falco columbarius</i>	T	G5	S1S2
Yellow Rail	<i>Coturnicops noveboracensis</i>	T	G4	S1S2
Alga Pondweed	<i>Potamogeton confervoides</i>	SC	G4	S3
English Sundew	<i>Drosera anglica</i>	SC	G5	S3
Panicled Screw-stem	<i>Bartonia paniculata</i>	T	G5	S2
Wiegand's Sedge	<i>Carex wiegandii</i>	T	G3	S2
Dry Northern Forest			G3?	S3
Intermittent wetland			G2	S3
Patterned Fen			GU	S2
Muskeg, Bog			G4	S3
Dry-mesic northern forest			G4	S3
Mesic northern forest			G4	S3
Rich conifer swamp			G4	S3
Hardwood-conifer swamp			G4	S3

3.11 Watershed Drainage System

Hydrology

The Two Hearted River watershed includes 7 sub-watersheds and over 118 miles of river (Figure 42). There are 2 dams on the river system (from the MI-wide GIS dam data) but they do not act as impediments to the system. Lakes are widely distributed throughout the watershed and constitute features of scenic interest and recreational value (MDNR 2002).

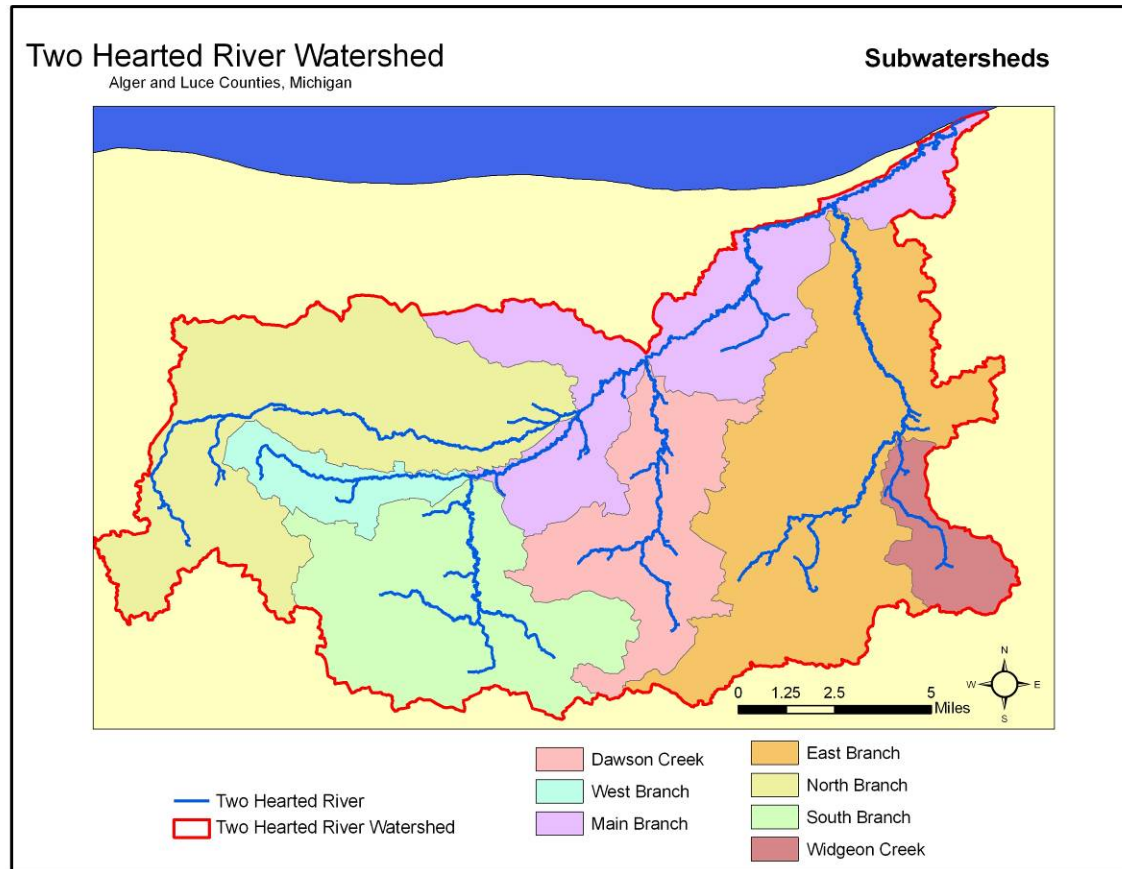


Figure 42- Subwatersheds and Main Tributaries of the Two Hearted River Watershed

The Two-Hearted River is a cold water trout fishery and was designated as a Michigan Natural River (Part 305, P.A. 451) in December of 1973. It has also been designated as an Outstanding

State Resource Water (OSRW) (TNC 2007). A general description of the main tributaries to the Two Hearted River including headwater location and average length is provided in Table 29.

Table 29- Description of the main tributaries of the Two Hearted River

Name	Headwater Location	Average Length (miles)
Main Branch	T48N, R11W, Sec.9 (confluence with South Branch)	28.9
Wabash Creek	T49N, R10W, Sec. 27	2.6
West Branch	T48N, R12W, Sec. 9/10 (West Branch Lakes)	7.9
John's Creek	T48N, R11W, Sec. 12	1.4
East Branch	T48N, R10W, Sec. 27	22.8
Widgeon Creek	T48N, R9W, Sec. 28	5.0
Dawson Creek	T48N, R11W, Sec. 25	10.0
Little Dawson Creek	T48N, R10W, Sec. 32	3.3
South Branch	T48N, R11W, Sec. 33 (Whorl Lake) and T47N, R11W, Sec. 4 (Whorl Pond)	8.8
Jack Creek	T48N, R12W, Sec. 25 (Jack Lake)	3.7
Camp One Creek	T47N, R11W, Sec. 2	3.0
North Branch	T48N, R12W, Sec. 20	19.2
Potters Creek	T48N, R12W, Sec. 9 (Potters Lake)	2.2
Total		118.8

In addition to providing excellent brook trout and steelhead fishing, the Two Hearted River and its tributaries also support

larval populations of the undesirable Great Lakes invader the sea lamprey. Sea lampreys are parasitic fish that feed on desirable fish

such as trout and salmon and if left uncontrolled, have a devastating impact on the sport, commercial and tribal fisheries of the Great Lakes.

The Great Lakes Fishery Commission oversees a Sea Lamprey Management Program for all five Great Lakes and contracts with the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada to implement an integrated program of sea lamprey

control. The U.S. Fish and Wildlife Service Marquette Biological Station oversee larval sea lamprey assessments and control (with the lampricide TFM) in the Two Hearted River watershed on a 3-5 year cycle. The distribution of larval sea lampreys in the Two Hearted River and its tributaries during 2004 is shown in Figure 43. This distribution is scheduled for re-evaluation and treatment during 2008 (Marquette Biological Station, personal communication).

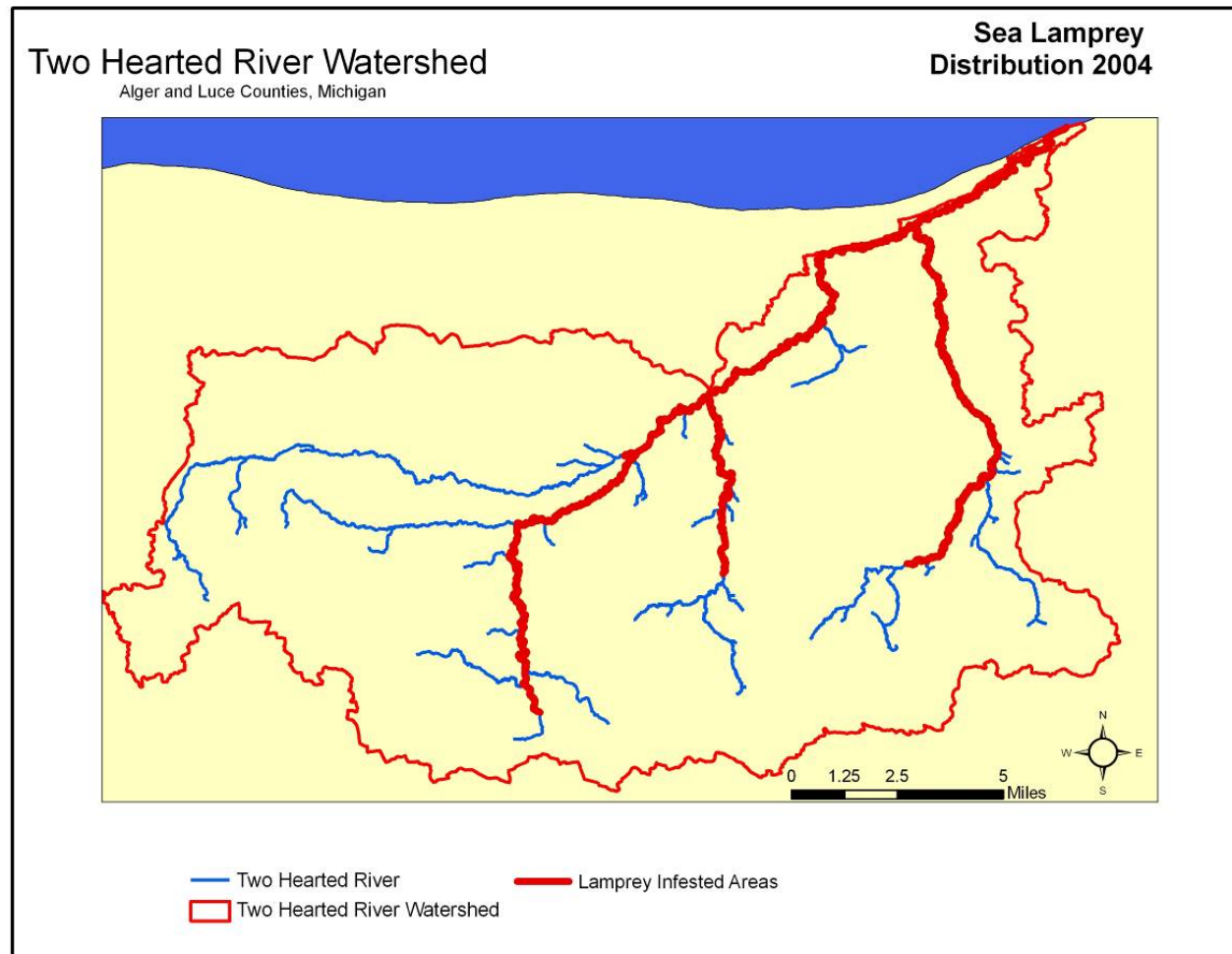


Figure 43- Sea Lamprey Distributions in Tributaries of the Two Hearted River Watershed (2004)

Stream Order

Stream order provides a comparison of the size and potential power of streams. It is a numbering sequence which starts when two first order, or headwater, streams join, forming a second order stream, and so on. Two second order streams converging form a third order. Streams of lower order joining a higher order stream do not change the order of the higher, as shown in Figure 44. The Two Hearted River results are shown in Figure 45. The stream orders shown are not absolute. If larger scale maps are used or actual channels are found through field reconnaissance, the stream orders designated in Figure 45 may increase, because smaller channels are likely to be included (Fongers 2007).

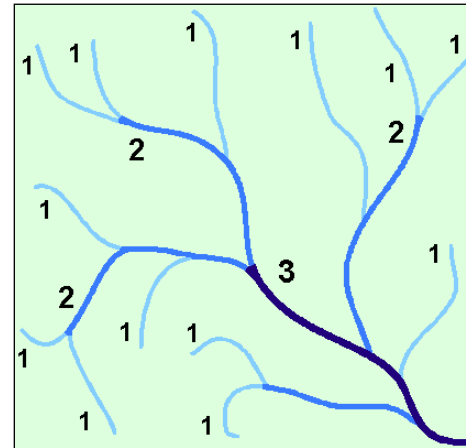


Figure 44- Stream Ordering Procedure
(Fongers 2007)

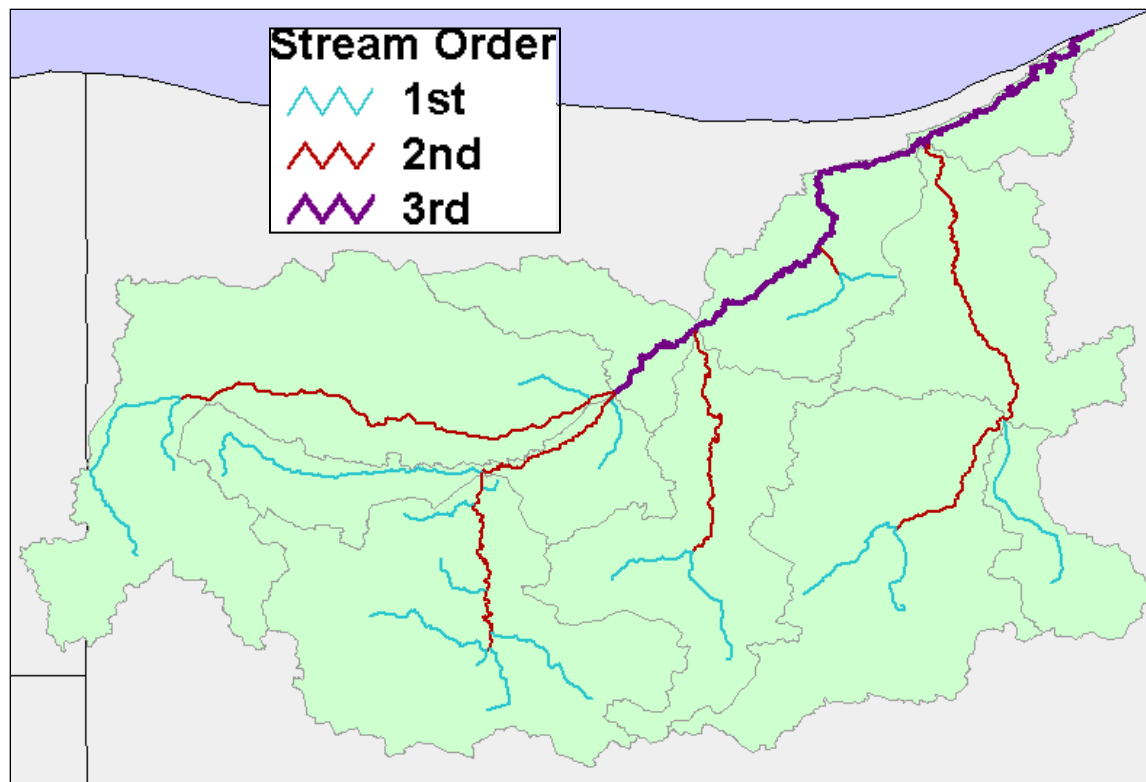


Figure 45- Two Hearted River Watershed Stream Orders (Fongers 2007)

Peak Flows

A USGS stream gage (04044813) is located at the mouth of the Two Hearted River near Lake Superior (Figure 46). The

contributing drainage area for this gage is 200 square miles. This gage has provided peak flow data from 1973-2013 (now discontinued) (Figure 47).

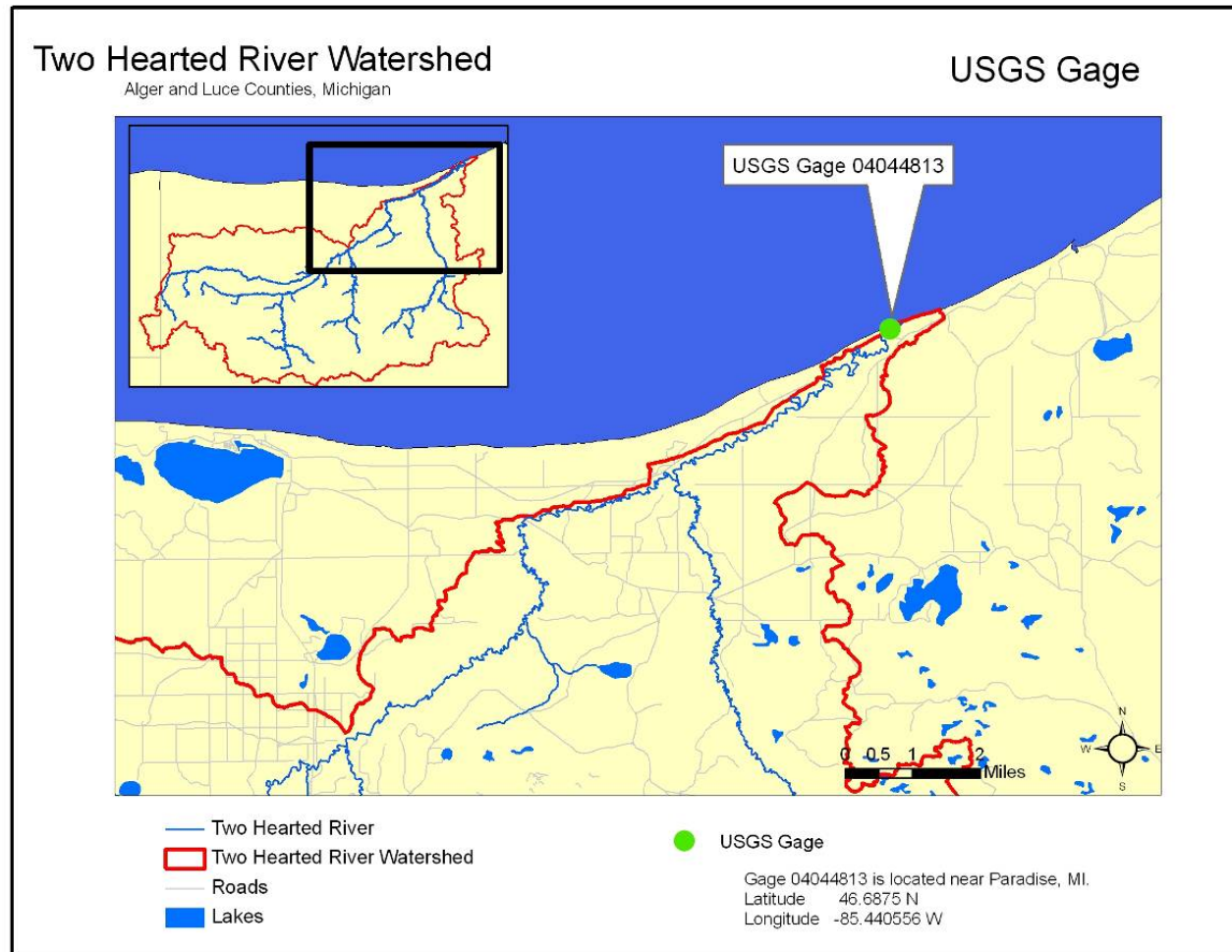


Figure 46- Location of USGS Stream Gage (04044813) in the Two Hearted River Watershed

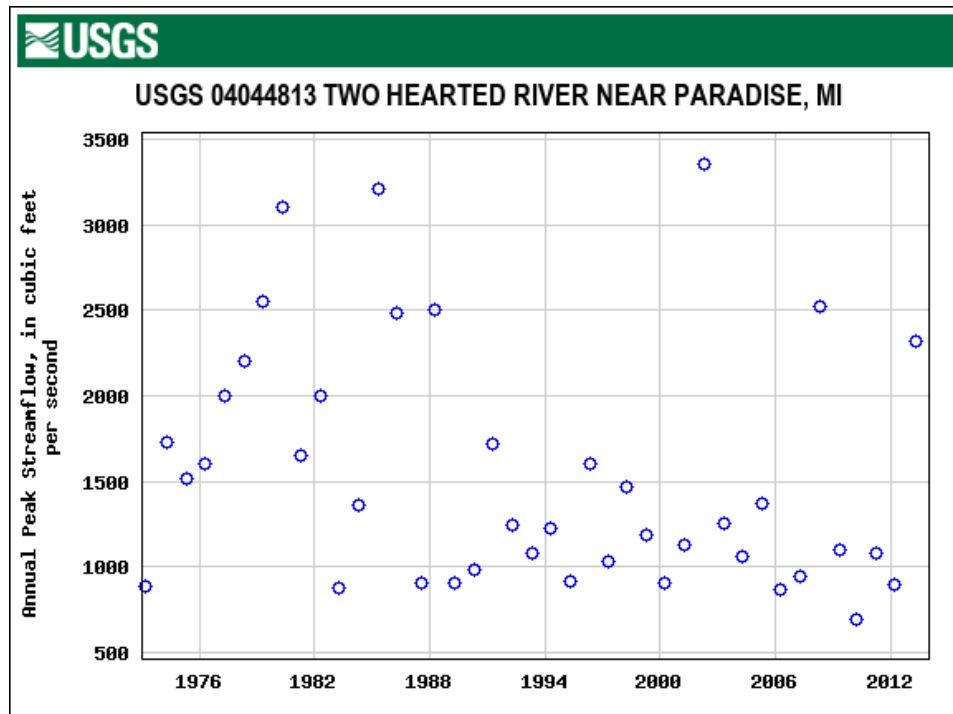


Figure 47- Peak Flow data from USGS gage 04044813 (USGS 2020)

Date	Gage height (ft)	Discharge (ft/sec ³)
4/25/1977	2.9	1270
5/16/1978	3.68	1550
5/2/1979	2.36	738
4/6/1981	5.83	1400
4/27/1982	5.84	1980
12/1/1982	5.25	310
4/26/1983	4.75	456
4/16/1984	5.28	1200
4/22/1985	7.45	2710
4/14/1986	6.17	989
4/7/1988	3.1	1380
4/11/1988	2.73	1420
6/29/1988	5.97	129
3/30/1989	6.93	356
4/24/1989	8.78	773
4/23/1990	8.77	781
4/5/1991	7.39	488
4/10/1991	11.53	1490
4/21/1992	9.55	942
4/22/1993		564
5/6/1993	9.96	1010
4/15/1994	7.74	582
4/29/1994	9.47	971
4/21/1995	8.8	813
4/25/1996	11.96	1560
4/30/1997	9.31	904
4/1/1998	10.94	1310
4/8/1999	10.3	1180

3/10/2000	8.69	783
4/11/2001	7.95	608
4/17/2002	14.19	3040
4/15/2003	8.4	667
4/22/2004	9.45	994
4/4/2005	8.31	766
4/5/2006	8.59	770
4/2/2007	9.02	856
4/18/2008	13.33	2270
4/30/2009	8.66	807
4/13/2011	9.56	1010
3/21/2012	8.8	890

Figure 48 USGS Peak Flow Dates for gage 04044813

A hydrologic study of the Two Hearted River watershed was conducted by the Michigan Department of Environment, Great Lakes and Energy (EGLE) Hydrologic Studies Unit (HSU) in support of the Two Hearted River Nonpoint Source watershed planning project (EGLE Tracking Number 2005-0149). This analysis was conducted to 1) better understand the watershed's hydrologic characteristics, 3) provide a basis for storm water management to protect stream morphology, and 3) help determine the watershed management plans critical areas (Fongers 2007).

Based on peak flow dates for the USGS gage and weather data (Figure 48), this analysis indicated that the Two Hearted River watershed is a snowmelt-driven system. A snowmelt-driven system is usually much less flashy than a storm-driven system, because the snow pack supplies a steadier rate of flow. However, a rain-on-snow event, where rain and snowmelt simultaneously contribute to runoff, can produce dramatic flow increases. The runoff from the rain and snowmelt also likely occur with saturated or frozen soil conditions, when the ground can absorb or store less water, resulting in more overland flow to surface waters than would occur otherwise (Fongers 2007).

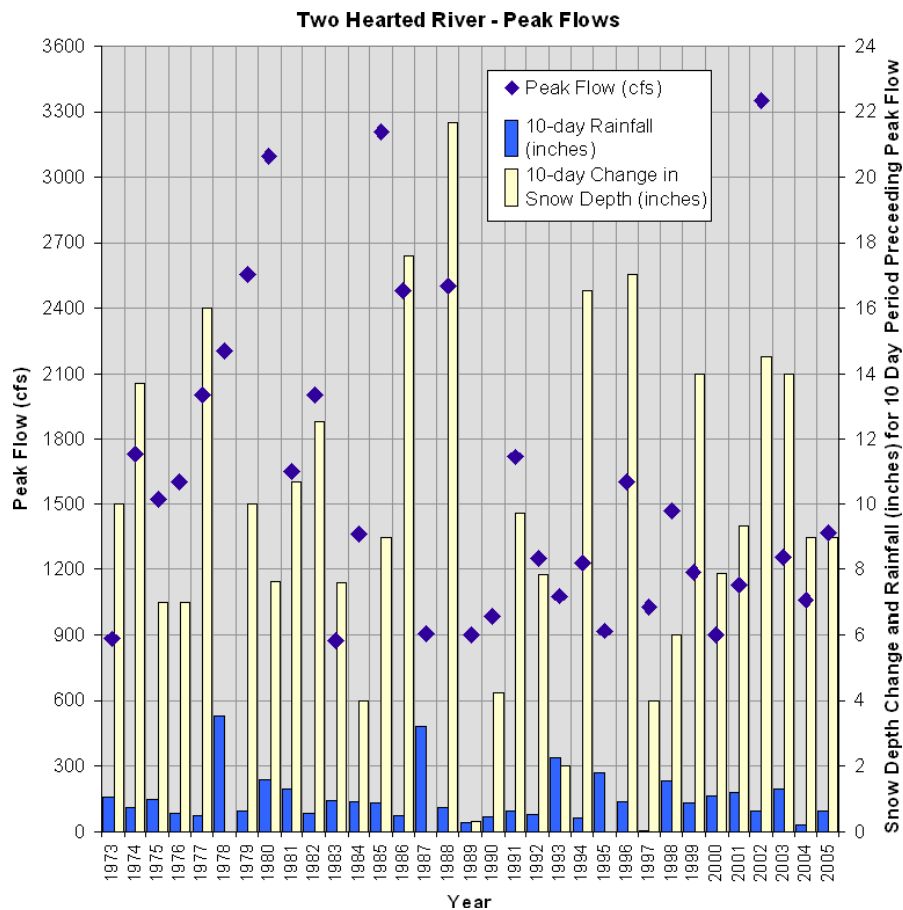


Figure 49 Peak Flows from Two Hearted River USGS Gage 04044813 near Paradise, 10-day Snow Depth Changes and Rainfall averaged from National Weather Stations at Grand Marias, Newberry, and Tabquamenon Falls (Fongers 2007).

Sediment Transport Capacity

A stream's ability to move sediment, both size and quantity, is directly related to the stream's slope and flow. Steeper reaches generally move larger material, such as stones and pebbles and the flatter reaches tend to accumulate sediment. A typical river profile is steeper in the headwaters and flatter toward the mouth. The Two

Hearted River's profile is somewhat different, with a steeper section in the middle (Figure 50). The MDNR Natural River Plan (2002) describes this river reach as a series of shallow sandstone ledges with intermittent deep pockets. The steeper reach is likely a reflection of the underlying geology and not an indicator of morphologic instability (Fongers 2007).

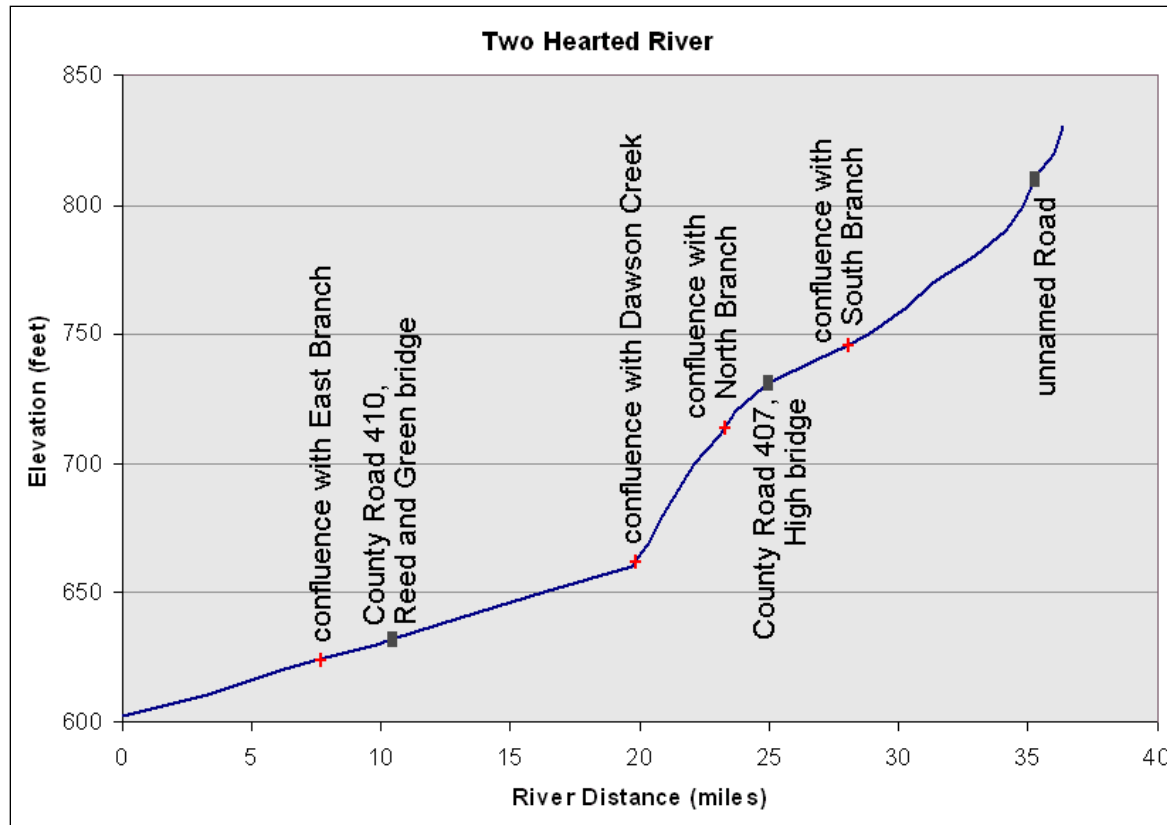


Figure 50- Two Hearted River Profile from Fongers (2007).

Tributary Streams

Two Hearted River Riparian Analysis

The Two Hearted River Riparian Analysis was conducted in partnership with The Nature Conservancy in Michigan to identify the functional riparian area of the Two Hearted River system and to assess its sensitivity to further development and forest

management activities. The following sections are from the *Two Hearted River Riparian Analysis* (TNC 2007).

The Two Hearted River Riparian Analysis goes beyond the fixed buffer width concept (largely focused on the floodplain), which may not capture all of the diversity and ecosystem function that the riparian area represents. The objectives of the project were to:

- Identify potential critical habitat and areas sensitive to environmental degradation and to assess natural community condition by conducting a Geographic Information System (GIS) analysis on the Two Hearted River riparian area
- Verify the GIS analysis through field work conducted on representative and accessible lands
- Develop management recommendations for critical areas within the riparian corridor

Riparian Area Condition

Riparian areas have been defined in various ways ranging from a static area extending a fixed distance from a river to a more dynamic and variable width area defined by the ecosystem functions it performs in that particular system. For the purpose of this analysis, a definition closer to the latter example was adopted. As outlined by Ilhardt, Verry, and Palik (2000), “Riparian areas are the three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at a variable width.”

The riparian areas are extremely important since they play many different roles both at a local scale (i.e. neighboring aquatic and terrestrial ecosystems) and at a watershed scale. From the aquatic ecosystem perspective, the riparian area provides energy and nutrient inputs to the system while filtering sediments and absorbing nutrients and water from the uplands. These services help buffer aquatic organisms and maintain key aquatic ecosystem

In this analysis, sensitive areas were defined as locations within the riparian area that, given their multiple attributes, create a unique area that if disturbed may affect the water quality of the Two Hearted River or its riparian area. A GIS analysis was conducted to identify these potentially sensitive areas, and was followed by limited field visits to monitor the accuracy of the data input. Characteristics such as physical distance from river, slope, erosion potential, presence of unique natural features, presence of wetlands, and other soil attributes related to building/development conditions were utilized to identify these sensitive areas.

functions such as temperature regulation, energy flow, and hydrologic flow (Flaspohler et al. 2002). The riparian areas also provide the vital connection from the aquatic habitat to the upland habitats. At the watershed scale, riparian areas contain distinct species pools altogether (Sabo, 2005) and support habitat for diverse vegetation and increased species richness due to the diversity of the fluvial landforms (ie. floodplain, terrace, slope, etc.) (Goebel et al. 2003).

Riparian Area Analysis Summary

Based on the above discussion, it became clear that in order to truly provide added protection to the Two Hearted River System, its functional riparian areas needed to be identified. This goes beyond the fixed buffer width concept (largely focused on the floodplain), which may not capture all of the diversity and ecosystem function that the riparian areas represent.

The initial step was the identification of the riparian areas. This was done by utilizing the concepts of the riparian area as a functional and dynamic component of both the aquatic and terrestrial systems (Ilhardt, Verry, and Palik 2000). Areas within the riparian area potentially sensitive to development and forestry were determined

by using a rating system based on the areas' attributes such as slope, soil characteristics, land ownership, and significant natural communities. The riparian areas were categorized (e.g. high, medium, or low) based on the probability that degradation would occur as a result of development or forestry in these areas. Data was collected from 30 sites in or near the riparian area to confirm the riparian area extent and attributes. Management recommendations were developed based on the areas' attributes.

Defining Riparian Areas

The general process of identifying the riparian areas included a GIS analysis and limited field sampling. The GIS analysis incorporated soils, topography, and adjacent and/or nearby waterbodies (i.e. wetlands and lakes) to determine the extent of the riparian area along the Two Hearted River Main Branch and major tributaries. Initially, two riparian areas were identified: one with a defined maximum extent of 500 m from the river (500 m Based Riparian Area) and one without a defined maximum extent (Wetland Based Riparian Area) (Figure 51). Both methods yielded identical results for the riparian area along the Main Branch, the majority of the

East Branch, downstream portions of Dawson Creek, the South Branch, and headwaters of the North Branch. The 500 m Based Riparian Area recognized the wetlands adjacent to the river, but did not include the full extent of these wetlands. The Wetland Based Riparian Area (WBRA) included the full extent of the wetlands adjacent to or near the river. Due to the nature of the watershed, a wetland-dominated system, the WBRA was utilized as the basis for the GIS analysis.

In conducting any GIS analysis, the result is only as accurate as the original input data. The most evident data limitation encountered was the coarse scale topographic information utilized to decipher the various fluvial landforms, terrace, slope and floodplain. The watershed is largely characterized by slight topographic relief with microtopography playing a key role in determining specific habitats, especially in the peatland wetlands; therefore, coarse scale data is definitely a limiting factor. Field sampling was conducted at thirty sites within the identified riparian areas across the watershed to further assess the accuracy of the GIS analysis.

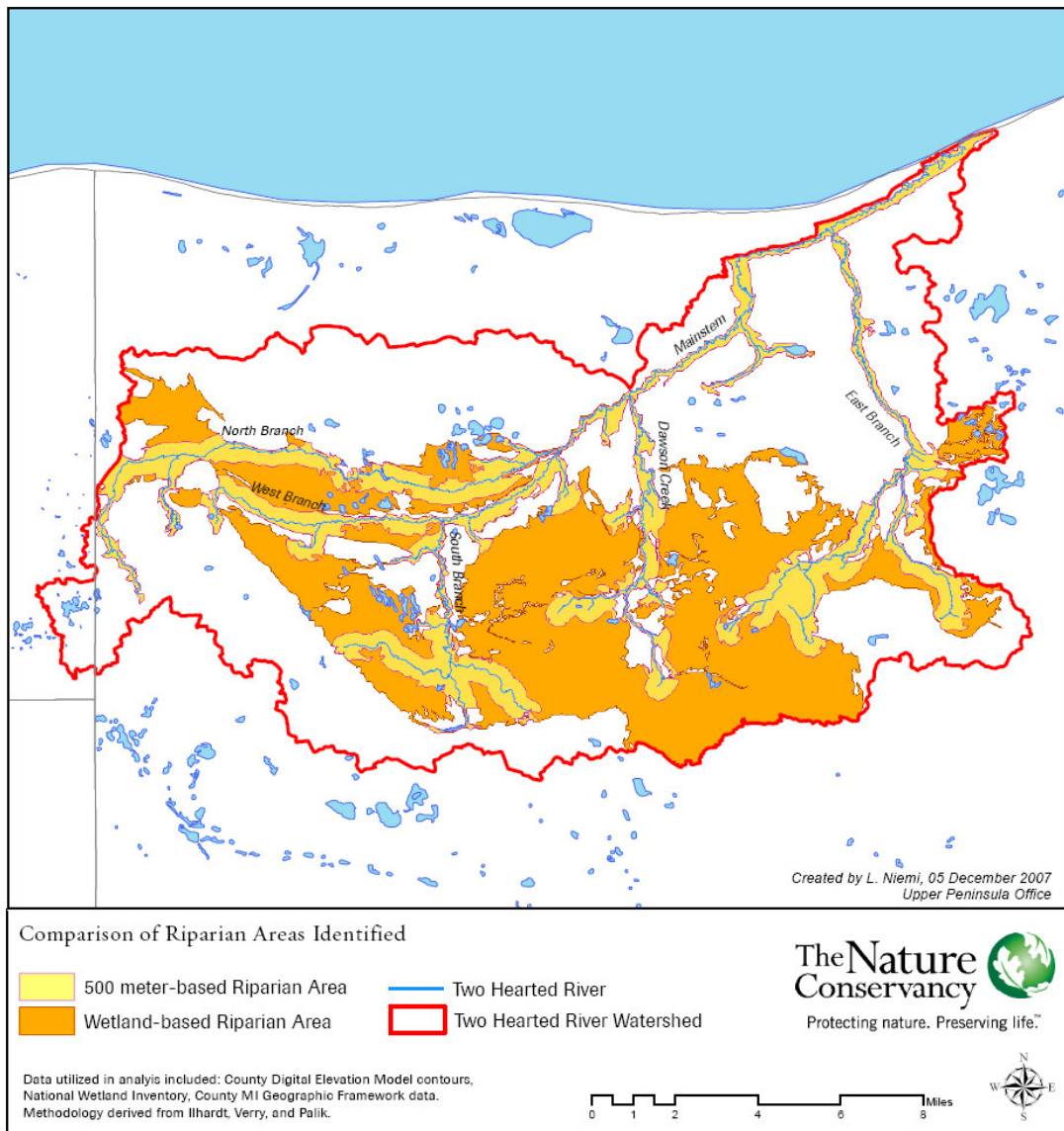


Figure 51- Comparison of Riparian Areas Identified for the Two Hearted River Watershed

Wetlands

Wetlands

Freshwater wetlands provide cool water sources to streams, shade, flood storage, wildlife habitat, and water quality protection. The U.S. Fish and Wildlife Service National Wetland Inventory indicate

five (5) wetland types within the Two Hearted River watershed (USFWS 1980). These wetlands cover over 56,500 acres or 43% the total watershed land area (Table 30). The most prevalent wetland type is forested, covering 31,709 acres. Scrub shrub wetlands make up over 21,024 acres and emergent wetlands comprise over 1,624 acres of the watershed (Figure 52).

Table 30- Wetland Types in the Two Hearted River watershed

Type of Wetland	Acres
Beach	10
Emergent	1,624
Forested	31,709
Open Water/Unknown Bottom	2,214
Scrub-Shrub	21,024
Total	56,581

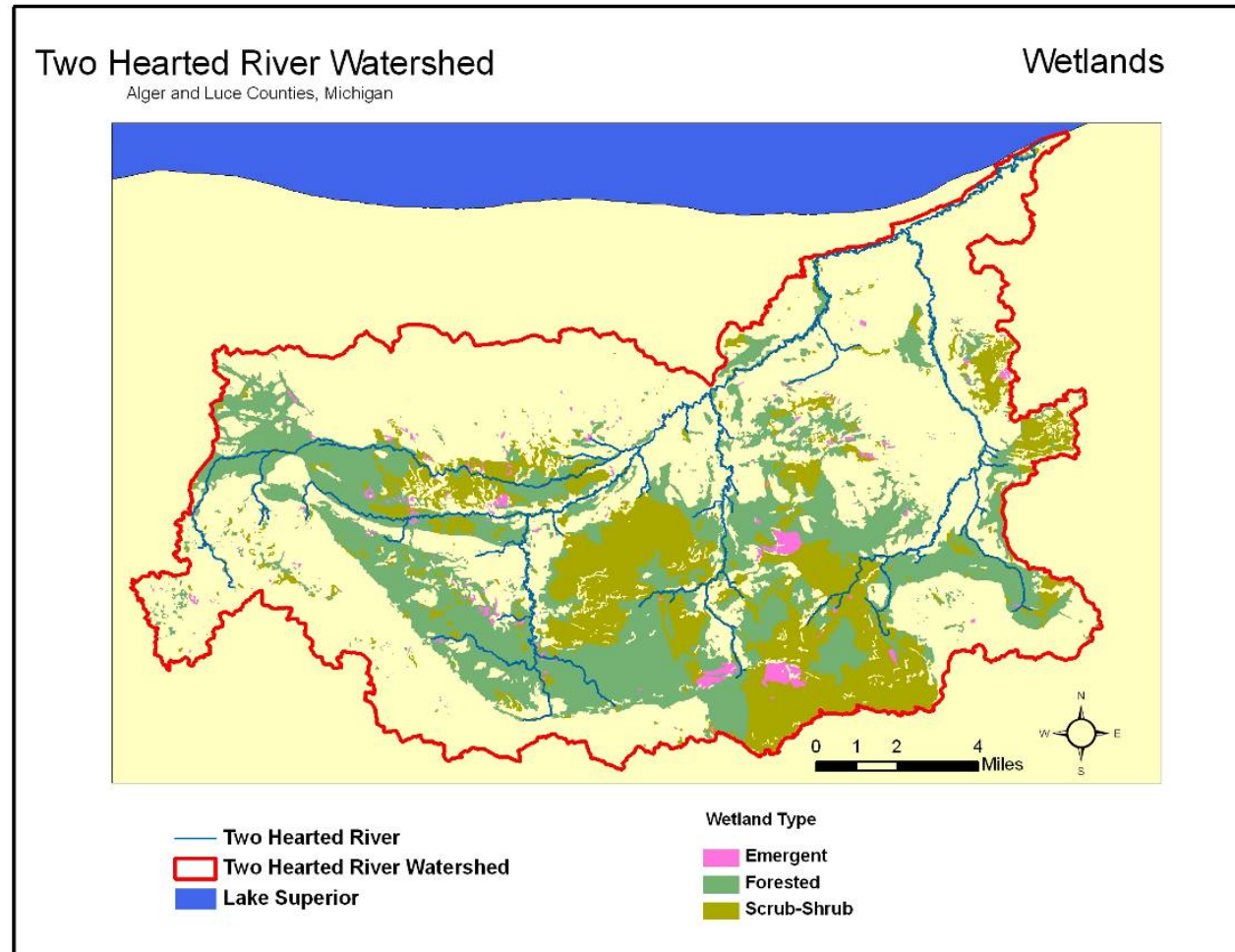


Figure 52- General Wetland Types in the Two Hearted River Watershed

3.12 Groundwater Aquifers & Recharge, Contamination Potential, & Water Supply

Groundwater Aquifers and Recharge

Groundwater is the primary source of drinking water within in the Two Hearted River watershed. Groundwater and surface water are closely linked, and any contamination of one has the potential to significantly impact the other. It also supplies much of the water in the mainstream and tributaries of the Two Hearted River. This helps keep water temperatures relatively cold, even in the summer.

The groundwater recharge potential in the Two Hearted River watershed ranges from 13-16 inches/year (based on a scale of 1-22 inches/year. Those areas with the greatest recharge potential (15/16 inches/year) are at the mouth of the Two Hearted River, along portions of the Main Branch (just downstream from the

confluence with Wabash Creek) and the East Branch, and in the headwaters of the North Branch. The areas with the least groundwater recharge potential are located along the middle of the North Branch, West Branch, portions of the South Branch, and the headwaters of Dawson Creek (Figure 53).

Groundwater Recharge in the riparian area

The groundwater recharge potential in the riparian area is estimated to be 13 – 16 inches/year. Those areas with the greatest recharge potential (15-16 inches/year) are at the mouth of the Two Hearted River, along portions of the Main Branch (just downstream from Wabash Creek confluence) and the East Branch, and in the very headwaters of the North Branch. The areas with the least groundwater recharge potential are located along the middle of the North Branch, West Branch, and the downstream portions of the South Branch (Figure 54).

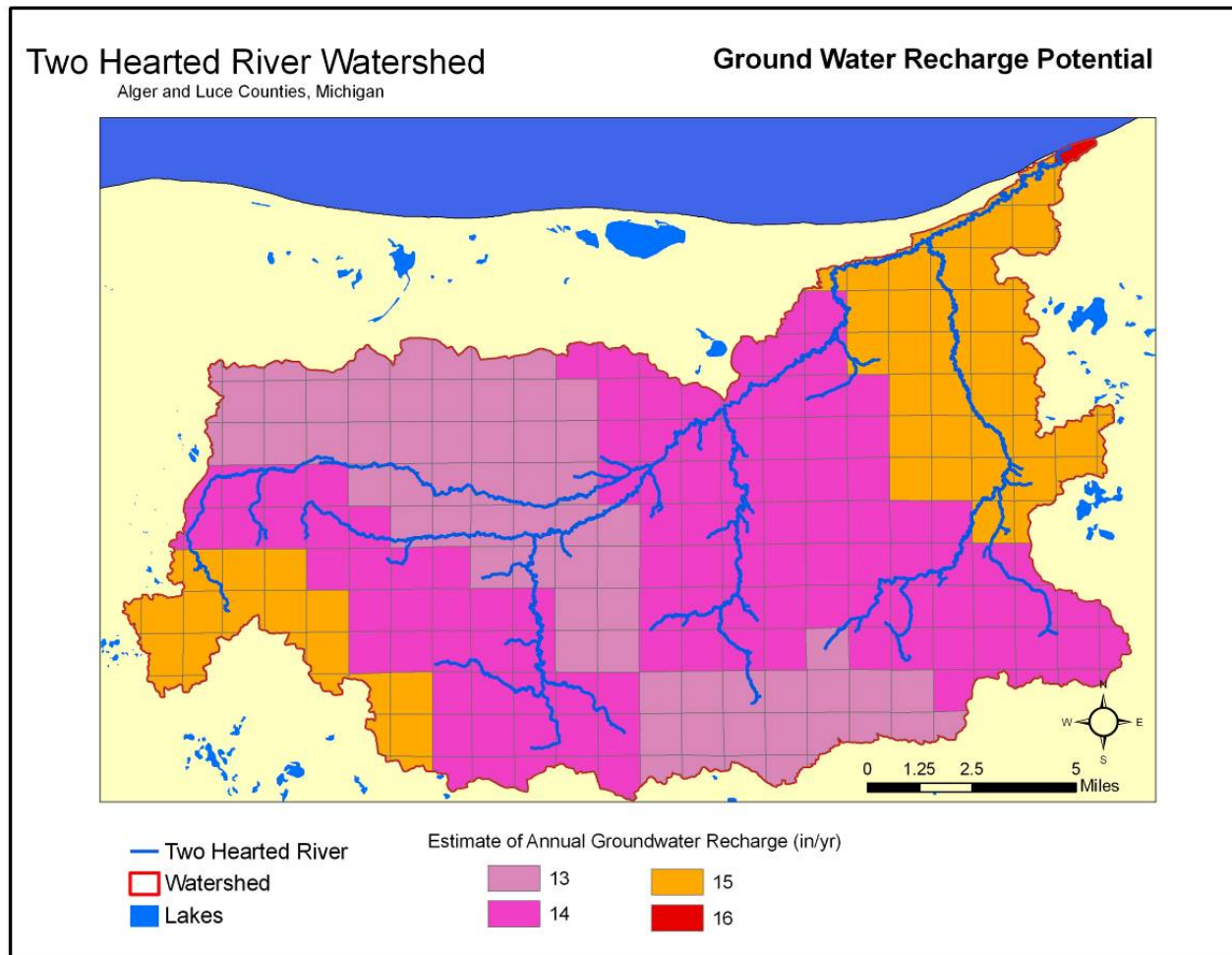


Figure 53- Groundwater recharge potential in the Two Hearted River Watershed

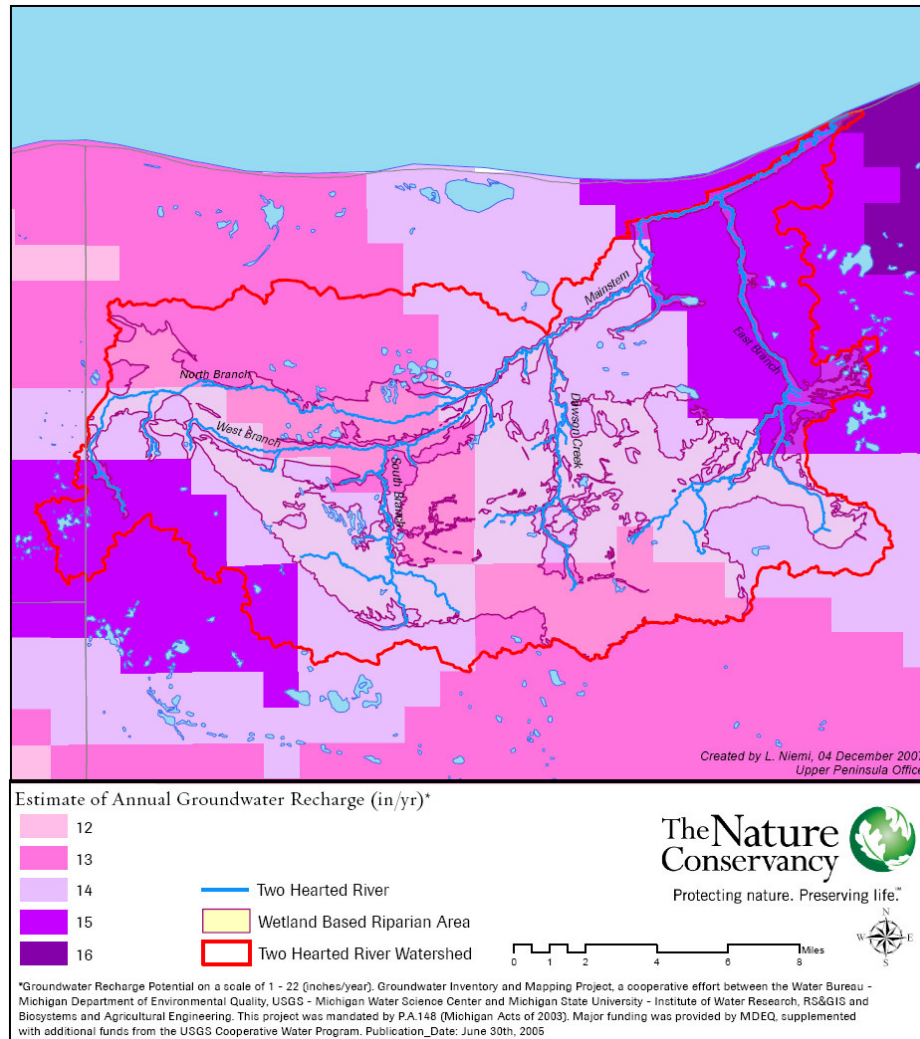


Figure 54- Groundwater Recharge in Riparian Area

4.0 WATER QUALITY ASSESSMENT AND POLLUTANT LOADING ANALYSIS

4.1 Point and Nonpoint Source Water Quality Pollutants

Water quality can be adversely affected by both point and nonpoint source pollutants. Point sources are identified as any discharge that comes from a pipe or permitted outfall, such as municipal and industrial discharges. Any future municipal and industrial discharges within Two Hearted River watershed would be regulated by Michigan's National Pollution Discharge Elimination System (NPDES) program and Industrial Pretreatment Program (IPP).

Michigan NPDES permit program

The Federal Water Pollution Control Act of 1948 established the first legislation aimed at addressing water pollution. Section 402 of the federal Clean Water Act established the National Pollutant Discharge Elimination System in 1972. This program regulates point source discharges of pollutants into United States waters

and sets specific limits on discharges from point sources, establishes monitoring and reporting requirements, and establishes exceptions. The permitting program is designed to prevent storm water runoff from washing harmful pollutants into local surface waters such as streams, rivers, lakes or coastal

waters. It also allows for the USEPA to authorize states to assume many of the permitting, administrative, and enforcement responsibilities of the program (USEPA, 2012). In Michigan, the authority to administer the Federal Water Pollution Control Act was delegated to the Michigan Department of Environment, Great Lakes, and Energy (EGLE). While the permitting process has evolved over time the Act has four main tenants:

1. *The discharge of pollutants to navigable waters is not a right.*
 2. *A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged.*
 3. *Wastewater must be treated with the best treatment technology economically achievable - regardless of the condition of the receiving water.*
 4. *Effluent limits must be based on treatment technology performance, but more stringent limits may be imposed if the technology-based limits do not prevent violations of water quality standards in the receiving water.*
- EGLE, 2019

A National Pollutant Discharge Elimination System (NPDES) permit is required of anyone discharging waste or wastewater into surface waters in Michigan. Indirect discharges (those who discharge to a municipal treatment facility via a sanitary sewer) do not need an NPDES permit but may require a permit from the municipality under the Industrial Pretreatment Program (IPP). Goals of the Industrial Pretreatment Program include maintaining and restoring watershed quality, encouraging pollution prevention, prevention of poisonous gases forming in sanitary sewer systems, increased beneficial uses of sewage sludge,

and helped communities to meet wastewater discharge standards (EGLE, 2019).

NPDES Permit Sites

There are currently no permitted NPDES sites within the Two Hearted River watershed as of October 2020. However, as population growth continues, NPDES permits may be applied for in the future with new construction or industrial development.

Nonpoint Source Pollutants

Nonpoint source pollutants are pollutants that enter a waterway from a source other than a pipe or permitted outfall. Historically these pollutants are the most difficult to control because tracking them back to their source is difficult. Nonpoint source pollutants can include, but are not limited to, illicit discharges into waterways, excess nutrients (such as nitrogen and phosphorus), oils and chemicals washed off of roadways (such as chlorides from deicing agents), and/or excess sediment (from construction sites or streambank destabilization). Most nonpoint source pollutants are monitored via physical-chemical water quality testing.

4.2 Water Quality Report, Designated Use, & Impairments

The Federal Clean Water Act requires Michigan and all other states to submit to the United States Environmental Protection Agency (USEPA) a biannual report of the quality of the state's surface and groundwater resources and an updated Section 303 (d) list. The *Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report* was compiled by the Michigan Department of Environment, Great Lakes and Energy (EGLE) and is the most recent of these reports to be finalized. This report must also describe how Michigan assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a stream or lake as defined in the State of Michigan's Part 4 Rules of the Water Resources Protection Act (Act 451, Part 31). When a waterbody is determined through biological and/or physical-chemical sampling to be impaired, EGLE must list potential causes and sources for impairment in the 303 (d) impaired waters list (EGLE 2020).

Michigan's Water Quality Standards require that all designated uses of surface waters be protected, and those designated uses include: agriculture, navigation, industrial water supply, public water supply at the point of water intake, warmwater or cold water fish, other indigenous aquatic life and wildlife, fish consumption, partial body contact recreation, and total body contact recreation from May 1 to October 31 (EGLE 2020). Each designated use is associated with particular water quality criteria and set the standards a waterbody must meet in order to protect the intended use.

The first step in establishing goals for this watershed planning project was to evaluate the current condition of water quality in the watershed. The primary criterion for water quality is whether the waterbody meets designated uses.

Designated uses are recognized uses of water established by state and federal water quality programs. In Michigan, all surface waters of the state are protected by water quality standards for specific designated uses (Table 32). These standards and designated uses are designed to 1) protect the public's health and welfare, 2) to enhance and maintain the quality of water and 3) to protect the state's natural resources.

Table 31- Designated Uses

In Michigan, all surface waters of the state are designated for and shall be protected for all of the following uses:	
1.	Agriculture
2.	Industrial water supply
3.	Public water supply and the point of intake
4.	Navigation
5.	Warmwater fishery (or coldwater fishery)
6.	Other indigenous aquatic life and wildlife
7.	Partial body contact recreation
8.	Total body contact recreation between May 1 and October 31

Citation: R323.1100 of Part 4, Part 31 of the Natural Resources and Environmental Protection Act, 1994 P.A. 452, as amended

According to EGLE's Water Quality and Pollution Control in Michigan 2020 Sections 303(d), 305(b), and 314 Integrated Report (EGLE, 2020), all of the streams and rivers in the Two Hearted River watershed are fully supporting for the use designations they were assessed for including other indigenous aquatic life and wildlife, and the cold water fishery. All other uses for all streams were not assessed. South Branch Two Hearted River, North Branch Two Hearted River, Pratt Lake, Mainstem Two Hearted River, Dawson Creek, Windgeon Creek, East Branch Two Hearted River and West Branch Two Hearted River are fully supporting of the other indigenous aquatic and wildlife use designation. Bullhead Lake, Deer Lake, Dillingham Lake, Pratt Lake, Sid Lake and the West Branch Two Hearted River are fully supporting of the cold water fishery use designation. Pretty Lake (HUC 040202010302) is not supporting for fish consumption due to mercury found in fish tissue. A Total Maximum Daily Load Assessment completion date has not been established in the report. Use designations for all waterbodies in the Two Hearted River watershed are summarized in Table 33 (EGLE 2020).

Table 32- Michigan EGLE Integrated Report Listings for the Two Hearted River Watershed (EGLE 2020)

Stream Reach/Waterbody	Designated Use								
	Total Body Contact Recreation	Partial Body Contact Recreation	Navigation	Industrial Water Supply	Agriculture	Warm Water Fishery	Other Indigenous Aquatic Life and Wildlife	Cold Water Fishery	Fish Consumption
040202010301-01 South Branch Two Hearted River	X	X	X	X	X	X	FS	X	X
040202010302-01 North Branch Two Hearted River	X	X	X	X	X	X	FS	X	X
040202010302-06 Pratt Lake	X	X	X	X	X	X	FS	FS	X
040202010306-02 Mainstem Two Hearted River from confluence of North Branch Two Hearted River and West Branch Two Hearted River to mouth	X	X	X	X	X	X	FS	X	X
040202010303-01 Dawson Creek and Little Dawson Creek	X	X	X	X	X	X	FS	X	X
040202010304-01 Windgeon Creek-East Branch Two Hearted River	X	X	X	X	X	X	FS	X	X
040202010305-01 East Branch Two Hearted River	X	X	X	X	X	X	FS	X	X
040202010306-01 West Branch Two Hearted River	X	X	X	X	X	X	FS	FS	X
040202010302-03 Bullhead Lake, 040202010302-04 Deer Lake, 040202010302-05 Dillingham Lake, and 040202010302-07 Sid Lake	X	X	X	X	X	X	X	FS	X
040202010302-02 Pretty Lake	X	X	X	X	X	X	X	X	NS

X = Not Assessed, FS = Fully Supporting, NS = Not Supporting

Based on the bodies of water and stream reaches assessed and the designated uses they were assessed for, the only waterbody in the Two Hearted River watershed listed as not attaining a designated use is Pretty Lake. Pretty Lake is not currently supporting the designated use for fish consumption. The cause of this listing is mercury in fish tissue. No other designated uses are known to be impaired on a watershed wide scale. While the source of elevated mercury levels in Pretty Lake is unknown, it may be a result of atmospheric deposition or natural attenuation of mineral deposits or a combination of sources. Air pollutants can reach water bodies as direct deposition (falling directly into the water) or as indirect deposition (falling onto the land and washing into a waterbody). The impacts of atmospheric deposition of pollutants such as

mercury on land and surface waters are well documented. There is some evidence atmospheric pollutants can affect groundwater (USEPA 2006).

The combined pressures from recreation, development and forest management activities can dramatically affect water quality and aquatic habitat conditions resulting in threats to designated uses. Threatened water bodies are defined as those that currently meet water quality standards but may not in the future. In the Two Hearted River watershed, three designated uses are currently threatened on a watershed-wide scale. They include the cold water fishery, other indigenous aquatic life and wildlife, and public water supply (Table 33).

Table 33- Threatened Designated Uses in the Two Hearted River Watershed.

Designated Uses	Status
Coldwater Fishery	Threatened
Other Indigenous Aquatic Life and Wildlife	Threatened
Public Water Supply (groundwater)	Threatened

One source of threat to the cold water fishery and other aquatic life is increasing public recreation pressures such as fishing, canoeing and camping which have aggravated stream bank erosion and sedimentation at many sites. Off Road Vehicles (ORV's), or four-wheelers, pose one of the most serious threats by accessing remote and sensitive areas prone to erosion or by simply driving through tributary streams. Sand and sediment harm fish and other aquatic life by covering the natural stream substrate they rely upon. Excessive inputs of sediment also fill in stream channels, making them shallower and wider and more susceptible to changes in hydrologic flow and increases in water temperature.

The cold water fishery and aquatic life are also threatened by continued timber harvest. Corporate and private non-industrial logging operations pose both historic and modern challenges to maintaining water quality. Old logging roads continue to cause erosion and sedimentation problems especially at stream crossings. New logging access roads, if not properly designed, create similar problems as well as accelerating habitat fragmentation and development pressures.

Increasing trends in second home or camp development are a growing concern in the watershed with much of the new building occurring on waterfront or riparian property. This type of development, if not sited properly, can result in erosion, nutrient

loading (septic systems) or other water quality impacts threatening the cold water fishery, other aquatic life and the public water supply.

Pollutants, Sources, and Causes

There are known and potential pollutants in the Two Hearted River watershed that have the potential to adversely affect water quality and threaten designated uses (Table 34). The sources and causes of these pollutants were ascertained through literature review, water quality monitoring data, road/stream crossing inventory data, field observations, land use and erosion analysis, and personal contact with watershed residents and experts.

Table 34- Threatened Designated Uses in the Two Hearted River Watershed including Pollutants, Sources, and Causes.

Threatened Designated Use	Pollutants	Sources	Causes
Coldwater fishery Other indigenous aquatic life and wildlife	Sediment (k, p)	Road stream crossings (k)	Poor design/construction/maintenance (k) Lack of erosion controls (k) Steep approaches (k) Culverts not aligned to stream bed (k) Undersized or perched culverts (k) Lack of crossing structure (k) Road grading operations (k)
		Forest management practices (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Equipment problems due to steep topography (p) Numerous crossings of small streams and drainages routes (p)
		Recreational activities (p)	Off Road Vehicle crossings of wetlands and streams (p) Aggravated stream bank erosion from unauthorized or unimproved access points (p)
		Development (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Construction of secondary access roads (k)
Coldwater fishery Other indigenous aquatic life and wildlife	Nutrients (p)	Septic systems (p)	Unsuitable sites/soils (p) Poorly designed or maintained systems (p)
		Residential fertilizer use (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p)
Public water supply			

Threatened Designated Use	Pollutants	Sources	Causes
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply	Toxins (herbicides, pesticides, oils, gas, grease, salts/chloride, etc.) (p) and heavy metals (p)	Forest Management Practices (p)	Improper application of herbicides and/or pesticides (amount, timing, frequency, location, method, chemical content) (p) Hazardous waste spills from heavy equipment (p)
		Recreational/residential uses (p)	Improper application of herbicides and/or pesticides (amount, timing, frequency, location, method, chemical content) (p) Illegal dumping (p) Burn barrel use (p) Oil/gas spills from ORVs, snowmobiles, or other equipment (p)

Desired Uses

In addition to designated uses, the Two Hearted River Watershed Advisory Council identified a number of locally determined desired uses for the watershed. Desired uses are factors important to the watershed stakeholders. They reflect the way stakeholders

want to use the watershed and their desire to maintain it for future generations. A summary of the desired uses identified by stakeholders of the Two Hearted River watershed and threats to those uses are included in Table 35.

Table 35- Desired Uses and Existing Threats in the Two Hearted River Watershed

Desired Use	Threat	Comment
Coldwater fishery	Erosion and sedimentation from unimproved roads and illegal crossings (fords), canoe put-in sites and campgrounds	Human influences have resulted in sedimentation to the Main Branch Two Hearted River and its tributaries; potential impacts include changes water quality, stream characteristics, and loss of spawning habitat and macroinvertebrate communities (food sources)
Non-motorized Boating	Unimproved put-in sites; forest pathogens	Lack of established put-in sites creates erosion and sedimentation issues; forest pathogens that affect riparian areas result in additional input of coarse woody structure (High Bridge downstream to mouth); potential impacts include loss of riparian cover, changes in stream characteristics and loss of recreational opportunities
Hunting, Trapping	Inappropriate use of State, Commercial Forest Act and other private lands; forest pathogens and invasive species	Potential impacts due to illegal uses and forest pathogens include loss or modification of habitat and loss of recreational opportunities
Forestry	Forest pathogens (example: Beech bark disease) and invasive species	Beech bark disease advancing at a rate of ~6 miles per year; very few trees are resistant – affects production; Forestland Group, LLC planting Northern red oak in place; loss of trees provides pathways for invasive species
Wildlife Observation (bird watching, etc.)	Incompatible recreational uses (ORVs); lack of designated areas and marketing; forest pathogens and invasive species	Need established viewing areas, signage and marketing; potential impacts include loss or modification of habitat due to damage, forest pathogens and invasive species and loss of recreational opportunities

Desired Use	Threat	Comment
Lake Superior shoreline at mouth of Two Hearted River – unique habitat and dynamic processes	Incompatible recreation use (ORV, snowmobile)	Need for additional signage, public information, education and enforcement; potential impacts include loss or modification of unique habitats due to damage
Vacation Cottages (also called camps)	Inappropriate vegetative buffers, location of structures in 100-year floodplain	Enforcement of setbacks and vegetative buffers needed to prevent loss of riparian cover, changes in stream characteristics and habitat; example of potential violation near confluence of Widgeon Creek and East Branch
Trail Riding (Snowmobile, ORV)	Inappropriate use on State, Commercial Forest Act and other private lands, illegal stream crossings	Need for additional signage, public information, education and enforcement; potential impacts include loss or modification of unique habitat and sensitive areas (wetlands, beaches, etc.) and loss of recreational opportunities
Dog Mushing	No designated trails; incompatible with existing trail uses (snowmobiles, ORVs)	Need for established trails, signage and marketing; ten (10) or more established kennels in area; at least 3 races annually from Rainbow Lodge
Hiking, cross-country skiing, snow shoeing	Few designated trails; incompatible with existing trail uses (snowmobiles, ORVs)	Need more established trails, signage and marketing; linkage to North County Trail, etc.

4.3 Physical, Chemical, and Biological Water Quality Monitoring

Water Chemistry Monitoring

All streams within the Two Hearted River watershed fully support the designated uses they were assessed for according to the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Specific surface water chemistry data for the Two Hearted River watershed is not available.

Biological Monitoring

In September 2014, EGLE staff conducted biological surveys of the Two Hearted and Tahquamenon River Watersheds as part of the Surface Water Assessment Section's (SWAS) five-year rotating basin monitoring design. Macroinvertebrate and habitat surveys were completed at nine sites (six status, three trend) following the SWAS Procedure 51 (Michigan Department of Environment, Great Lakes, and Energy [EGLE], 1990). Within the Two Hearted River Watershed, four sites were sampled in 2014 following SWAS

Procedure 51. The results of the analysis concluded that the West Branch Two Hearted River habitat was characterized as Good or Excellent, but pool substrate and sediment deposition were characterized as Marginal. The macroinvertebrate community in the West Branch was Excellent overall with 5% *Ephemeroptera* and 30% *Tricoptera* (Turek 2015). The Mainstem Two Hearted River habitat was characterized as Good with individual parameters ranging from Marginal to Excellent. The macroinvertebrate community was scored as Acceptable overall with 14% *Ephemeroptera* and 32% *Tricoptera* (Turek 2015).

Back in 2008, the Superior Watershed Partnership and watershed volunteers conducted stream monitoring at six (6) sites throughout the Two Hearted River watershed. The Michigan Clean Water Corps (MiCorps) Volunteer Stream Monitoring Procedures (Latimore 2006) were utilized for data collection. The MiCorps program was created through an executive order by Governor Jennifer M. Granholm to assist the Michigan Department of Environment, Great Lakes, and Energy (EGLE) in collecting and sharing water quality data for use in water resources management and protection programs and provides standardized assessment

and data recording procedures that can be easily used by trained volunteers. The MiCorps program also provides a web-based data exchange platform with online access to enter and view volunteer monitoring data through a searchable database.

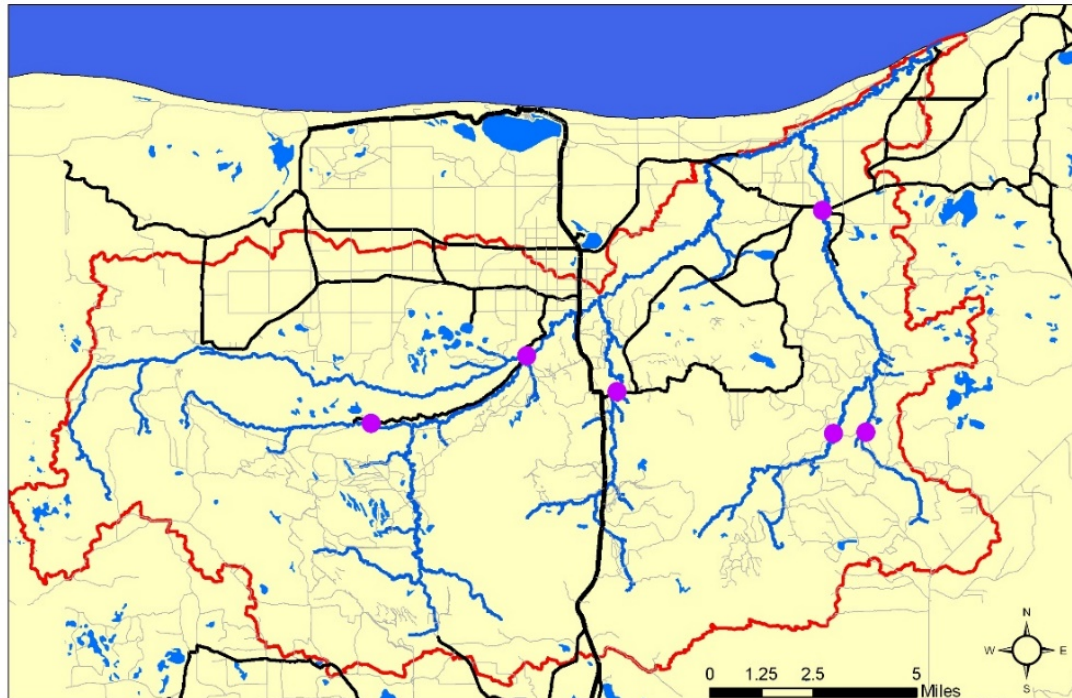
Specific objectives included collecting baseline data, characterizing stream ecosystems, identifying water quality problems, determining water quality trends, and informing and involving the public. The sampling procedures included assessments of stream habitat characteristics and the macroinvertebrate community. The stream habitat assessment is a visual assessment of stream conditions and watershed characteristics. The macroinvertebrate sampling procedure is used in conjunction with the stream habitat assessment to provide a measure of stream health.

Assessments were conducted at six (6) sites distributed throughout the watershed (Figure 55). Four (4) of these sites were established previously by the Michigan Department of Environment, Great Lakes, and Energy (EGLE 2004). The assessments covered approximately 300 feet of stream at most sites. A description of each site is provided in Table 36.

Two Hearted River Watershed

Alger and Luce Counties, Michigan

Stream Monitoring Sites



- Two Hearted River
- Two Hearted River Watershed
- Lakes

● Stream Monitoring Sites

* All data was collected in 2006 and 2007

Figure 55- Location of Stream Monitoring Sites in the Two Hearted River Watershed

Table 36- Stream monitoring sites in the Two Hearted River Watershed

Site Number	Waterbody	Location	Latitude	Longitude	Stream Quality Score	EGLE Site
1	East Branch	CR 412 (T49N R9W Sec. 18)	46.64175	-85.47870	27.3	Yes
2	East Branch	East Branch Sportsman's Club Bridge (T49N R9W Sec. 7)	46.56407	-85.47432	35.3	Yes
3	Widgeon Creek	East Branch Sportsman's Club Widgeon Trail Bridge (T49N R9W Sec. 8)	46.56491	-85.45863	14.1	Yes
4	Dawson Creek	Pine Stump Junction (T48N R10W Sec. 5)	46.57893	-85.58411	32.3	Yes
5	North Branch	CR 418 (T48N R11W Sec. 1)	46.591	-85.63	34.3	No
6	West Branch	CR 418 – Jeep Trail (T48N R11W Sec. 8)	46.568	-85.709	32.8	No

The procedure utilized consists of evaluation of physical and biological parameters including stream substrate composition, channel morphology, physical appearance, instream cover, riparian vegetation, adjacent land uses and the macroinvertebrate community. The biological integrity of each monitoring site is based on the results of the macroinvertebrate community evaluation, which provides a qualitative rating of stream quality (excellent, good, fair, or poor). Stream quality ratings are based on scores for the number of sensitive, somewhat sensitive, and pollution tolerant taxa present. Scores are assigned to each group (sensitive, somewhat sensitive, tolerant) based on the number of rare (1-10) and common (11 or more) organisms present. The total

stream quality score for each site is a sum of the scores for each group. A total stream quality score less than 19 indicates water quality is poor, 19 to 33 is fair, 34 to 48 is good, and a score greater than 48 indicates excellent water quality.

Data from the spring 2008 monitoring event indicates stream quality is good at most sites (Figure 56). Table 37 includes macroinvertebrates present at the six sites during the monitoring event. Appendix A provides complete monitoring data collected during 2008 including photographic documentation of site characteristics.



Figure 56- Stream Quality Ratings at Six Sites in the Two Hearted River Watershed

Table 37- Macroinvertebrates Collected from Six sites in the Two Hearted River Watershed

Taxa	Site Number					
	1	2	3	4	5	6
Group 1: Sensitive						
Caddisfly larvae (Trichoptera)	X	X	X	X	X	X
Hellgrammites (Megaloptera)				X	X	X
Mayfly nymphs (Ephemeroptera)	X	X	X	X	X	X
Gilled snails (Gastropoda)						
Stonefly nymphs (Plecoptera)	X	X		X	X	X
Water penny (Coleoptera)	X					
Water snipe fly (Diptera)	X	X			X	
Group 2: Somewhat Sensitive						
Alderfly larvae (Megaloptera)						
Beetle adults (Coleoptera)		X		X		X
Beetle larvae (coleoptera)				X		
Black fly larvae (Diptera)						
Clams (Pelecypoda)						
Crayfish (Decapoda)						
Crane fly larvae (Diptera)		X		X		
Damselfly nymphs (Odonata)		X			X	
Dragonfly nymphs (Odonata)	X		X		X	X
Net-spinning caddisfly larvae (Hydropsychidae; Trichoptera)	X	X		X	X	X
Scuds (Amphipoda)						X
Sowbugs (isopoda)						
Group 3: Tolerant						
Aquatic worms (Oligochaeta)						
Leeches (Hirudinea)						
Midge larvae (Diptera)						
Pouch snails (Gastropoda)		X	X			
True bugs (Hemiptera)		X				
Other true flies (Diptera)						

4.4 Pollutant Loading Analysis

Pollutant Loading

Similar to many watersheds of the Upper Peninsula of Michigan, sediment is the greatest pollutant of concern in the Two Hearted River watershed. Due to the number and extent of stream bank erosion sites, sediment was quantified in a watershed-wide analysis of erosion and pollution loading. Watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery were also analyzed based on various land uses and management practices.

The U.S. Environmental Protection Agency's Spreadsheet Tool for Estimating Pollutant Loads (STEPL) was used to calculate erosion and pollution loads in the Two Hearted River and its tributaries. Annual sediment loading was calculated using STEPL and the Universal Soil Loss Equation (USLE). More STEPL information can be found at <http://it.tetrattech-ffx.com/stepl/>.

Erosion was characterized in two ways:

1. Soil loss for the watershed as a whole (not including streambank erosion)

2. Impaired streambank erosion points (both natural and manmade)

Watershed-wide Soil Loss

The USLE uses several parameters to calculate the soil loss in tons per acre per year, such as rainfall runoff, soil erodibility, topography, cover and management practices. Data for these parameters came from the U.S. Environmental Protection Agency STEPL website (<http://it.tetrattech-ffx.com/stepl/>), which contains the data for the Two Hearted River watershed.

Based on the information available, the estimated sheet and rill soil loss for the Two Hearted River watershed was calculated to be 0.0034 tons per acre per year or 448.06 tons per year watershed-wide. These results were compared to croplands such as in St. Joseph County in the Lower Peninsula of Michigan, which is primarily agricultural and often exceeds 10 tons per acre per year (<http://www.glc.org/basin/pubs/annual/pdf/AR-2002.pdf>). It is likely that the low amount of soil loss in the Two Hearted River watershed is largely due to lack of agricultural croplands, the large number of forests and wetlands, and how the land is managed by landholders such as the MDNR, The Nature Conservancy, and corporate forest products producers.

Impaired Streambank Erosion Points

A stable stream is one that maintains a stable morphology, constant pattern (sinuosity), slope, and cross-section and neither aggrades or degrades over time. Stream stability is not the absence of erosion; some sediment movement and streambank erosion are natural. Possible causes of erosion are (Fongers 2007):

- Natural river dynamics
- Sparse vegetative cover due to too much animal or human traffic
- Concentrated runoff adjacent to the streambank (i.e. gullies, seepage)
- In-stream flow obstructions, i.e. log jams, failed bridge supports
- An infrequent event, such as an ice jam or low probability flood

- Unusually large or frequent wave action
- A significant change in the hydrologic characteristics (typically land use) of the watershed
- A change in the stream form impacting adjacent portions of the stream (i.e. dredging, channelization)

An inventory and assessment of streambank erosion conditions at Two Hearted River watershed road-stream crossing sites was conducted by The Nature Conservancy field technicians in 2019. At each site, erosion was measured and quantified in the field. Stream margins, ditches, and approaches were assessed for pollutant loading to the stream. The EPA Spreadsheet Tool for Estimating Pollutant Loads (STEPL) was used to calculate pollutant load estimates by site and by watershed.

Potential Pollution Load

STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. Using STEPL and watershed-wide

land use data, a watershed wide pollution load was calculated for Nitrogen (N), Phosphorus (P), Biological Oxygen Demand (BOD) and sediment based on current land use data (Table 38). Specific estimated load reductions by location are provided in Table 42.

Table 38- Nitrogen, Phosphorus, Biological Oxygen Demand and Sediment loads based on land uses within the Two Hearted River Watershed

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	10842.48	1670.55	41324.61	249.70
Cropland	0	0	0	0
Pastureland	0	0	0	0
Forest	6064.22	3024.18	15126.07	21.56
Feedlots	0	0	0	0
Water	564.70	217.41	1129.40	176.47
Septic	126.84	49.68	517.93	0
Gully	0	0	0	0
Streambank	0.45	0.17	0.90	0.33
Groundwater	0	0	0	0
Total	17598.69	4961.99	58098.91	448.06

STEPL does not take into account the large number of wetlands located within the Two Hearted River Watershed. The wetlands in the watershed are primarily sphagnum-based which can greatly increase nitrogen levels within the system. As such, nitrogen, phosphorus and BOD should be tested in the field for comparison with model estimates.

Priority Pollutant Ranking

The watershed pollutants were ranked and prioritized based on how they most affect or have the potential to affect water quality and the watershed's threatened designated uses (Table 39). Overall, sediment is the highest priority pollutant with known sources occurring from most land uses within the watershed. Without

Table 39- Priority ranking of pollutants in the Two Hearted River Watershed

Pollutant	Priority Ranking
Sediment	1
Nutrients	2
Heavy metals, toxins	3

Impacts from nutrients (septic, residential fertilizer, etc.) pose a significant threat to three designated and many desired watershed uses. The majority of the land within the Two Hearted River watershed is considered not well suited for septic (96% or 126,967 acres). This means that overcoming the limitations, due to soil properties or features at the site, would most likely be cost prohibitive, both due to initial and potential ongoing maintenance costs. It also means that there is a high probability that groundwater contamination could occur as a result of systems that are not properly installed or maintained (TNC 2007).

The potential for impacts from heavy metals, nutrients, and toxins also pose threats to water quality and designated uses in the Two

Hearted River watershed. Future water quality monitoring efforts should include periodic sampling for these pollutants. While each pollutant has a different effect on water quality and threatened designated uses, all are important and should be priorities for periodic monitoring.

Priority Source Ranking

Pollutants were also ranked by their sources in order to prioritize implementation of corrective actions (Table 40). Also, because pollutants are often interconnected with each other, implementing corrective actions at one source can often result in reductions of pollutants from other sources.

Table 40- Priority Ranking of Sources of Pollutants in the Two Hearted River Watershed

Pollutant	Sources	Priority Ranking
Sediment	Recreational activities (k)	1
	Road/stream crossings (k)	2
	Forest management practices (k)	3
	Development (k)	4
Nutrients	Septic systems (p)	1
	Residential fertilizer use (p)	2
	Forest management practices (p)	3
Heavy Metals (Mercury and others)	Forest management practices (p)	1
	Residential uses (p)	2
	Atmospheric deposition (p)	3
Toxins (herbicides, pesticides, oils, gas, grease, salts/ chloride, etc.)	Atmospheric deposition (p)	1
	Recreational uses (p)	2

k=known, p=potential

5.0 CAUSES/SOURCES OF IMPAIRMENT & REDUCTION TARGETS

5.1 Causes & Sources of Impairment

There are a number of pollutants in the Two Hearted River watershed that adversely affect designated and desired uses or have the potential to (Table 41). The sources and causes of these pollutants were ascertained through scientific research reports, water quality monitoring data, road/stream crossing inventory data, field observations, land use analysis, and personal contact with watershed residents and experts (Table 42). As discussed in previous sections of this plan, sediment is the greatest pollutant of concern in the Two Hearted River watershed. Sand and sediment harm fish and other aquatic life by covering the natural stream substrate they rely upon. Excessive inputs of sediment also fill in stream channels, making them shallower and wider and more susceptible to changes in hydrologic flow and increases in water temperature. Unstable road/stream crossings are a significant source for tons of loose sediment which ultimately reaches surface waters of the Two Hearted River and its tributaries each year. Much of this sediment is deposited in the low gradient reaches of the lower river where it degrades critical habitat for coaster brook trout. While other sources such as forest management practices and recreational activities such as

ORV-use contribute additional sediment to surface waters, these sources were not quantified due to the absence of data collection efforts and historical records. Other contributing factors include any kind of excavation, earth moving, drainage, crossing, tunneling, or other activity in which soil is disturbed and transported to nearby streams.

Heavy metals, nutrients, and toxins (herbicides, pesticides, oils, gas, grease, salts/chloride, etc.) often enter water bodies unnoticed via runoff, making them difficult to locate and quantify. The potential exists for these pollutants to contaminate both surface water and groundwater sources in the Two Hearted River watershed due to current and anticipated future land uses. These pollutants have the potential to impact terrestrial and aquatic ecosystems as well as public health if the concentrations are high enough. Heavy metals, nutrients and toxins often attach to soil particles, thus linking them to sediment pollution. Mercury levels exceeding standards for fish tissue were detected in Pretty Lake. Mercury contamination is a widespread problem in waterbodies across the Upper Peninsula of Michigan and should be monitored during future stream evaluations. Methods to determine the presence and extent of mercury and the other potential pollutants listed above were not employed during this project.

Table 41 Known and Potential Pollutants, Sources, and Causes in the Two Hearted River Watershed

Threatened Designated Uses	Pollutants	Sources	Causes
Coldwater fishery Other indigenous aquatic life and wildlife	Sediment (k, p)	Road stream crossings (k)	Poor design/construction/maintenance (k) Lack of erosion controls (k) Steep approaches (k) Culverts not aligned to stream bed (k) Undersized culverts (k) Lack of crossing structure (k) Road grading operations (k)
		Forest management practices (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Equipment problems due to steep topography (p) Numerous crossings of small streams and drainage routes (p)
		Recreational activities (p)	Off Road Vehicle crossings of wetlands and streams (p)
		Development (p)	Removal of riparian vegetation (lack of riparian buffers) (p) Clearing by landowners (p) Construction of secondary access roads (p)
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Heavy metals (mercury and others) (p)	Forest management practices (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p) Hazardous waste spills from heavy equipment (p)
		Residential uses (p)	Leaching of metals from landfills/waste dumps (p)
		Atmospheric deposition (p)	Nearby coal fired power plants (p) Other industries (p) Forest fires (p) Use of burn barrels (p)
		Septic systems (p)	Poorly designed/maintained systems (p) Unsuitable sites/soils (p)

Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Nutrients (p)	Residential fertilizer use (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p)
		Forest management practices (p)	Improper application (amount, timing, frequency, location, method, chemical content) (p) Hazardous waste spills from heavy equipment (p)
		Septic systems (p)	Poorly designed/maintained systems (p) Unsuitable sites/soils (p)
Coldwater fishery Other indigenous aquatic life and wildlife Public water supply (groundwater)	Toxins (herbicides, pesticides, oils, gas, grease, salts/chloride, etc.) (p)	Atmospheric deposition (p)	Use of burn barrels (p) Burning scrap tires (p) Industries (p)
		Recreational uses (p)	Off Road Vehicle crossings of wetlands and streams (p)

5.2 Critical Areas, Management Measures & Estimated Impairment Reductions

Critical areas in the Two Hearted River watershed are defined as the portions of the watershed that are most sensitive to environmental degradation and those areas having the most impact or potential to impact water quality and designated and desired uses. They include areas that may contribute the greatest amount of pollutants to the watershed, either now or in the future, and where preservation and restoration efforts will have the most profound results. Critical areas were identified through a detailed analysis concerning protection potential, current and future land uses, pollutant loading, and anticipated load reductions from particular Best Management Practices. The goal of this analysis was to target specific strategies to those areas most in need of protection or restoration. It should be noted that these critical areas are by no means the only areas in need of protection and restoration efforts; they are simply those with the highest priority. Without implementation of the strategies outlined under the Goals and Objectives section of this management plan, the future negative impacts in critical areas of the Two Hearted River watershed will be significant and the mitigation very costly.

Since 2006, many restoration projects have already been implemented and the Two Hearted River watershed continues to be monitored regularly. As a result, the need for management actions has been greatly reduced. However, the need for long-term monitoring continues, which will ensure the integrity and maintenance to existing BMPs.

The first goal addressed through the tasks and action plans outlined in this watershed planning process is to protect and improve the quality of water in order to support all designated

and desired uses. As mentioned, erosion BMPs have previously been implemented at 27 sites throughout the watershed, and only minor repairs and stabilization efforts are needed.

Implementation of streambank stabilization and crossing BMPs will reduce the loading of sediment, nitrogen, phosphorus, and biological oxygen demand (BOD5). Critical areas with aquatic impacts to be addressed include road/stream crossings and adjacent streambank erosion sites located within the Wabash Creek, Dawson Creek, the North Branch, and the East Branch subwatersheds. In total, the annual sedimentation load reduction estimates for the Two Hearted River and tributaries is 6.26 tons/year at five locations. Implementing BMPs at the identified sites will address designated uses of the cold water fishery, indigenous aquatic life and wildlife, and the public water supply.

The second goal addressed through this planning process is closely tied to the first; it is to protect the integrity of aquatic and terrestrial ecosystems. Where fisherman access to the streambank and/or climate-influenced heavy precipitation, flooding and destabilized sediment creates man-made erosion issues, more attention is needed to stabilize the stream margins and install or replace structures. The use of erosion BMPs will reduce sediment loading impacts and allow the aquatic ecosystem to maintain its integrity. In locations where restoration to the riparian area is needed due to the presence of man-made erosion, restoration with diverse terrestrial plant species will be applied. Critical areas where BMPs should be implemented to address these issues are located in within the Wabash Creek, Dawson Creek, the North Branch, and the East Branch subwatersheds.

The third goal addressed through this watershed planning process is to increase stewardship practices of corporate and private landowners, recreational users and the public. Critical areas to focus the implementation of this goal are within the East Branch

where population growth increased by 236% in the 2000 census. Other subwatersheds that may have opportunities to increase landowner stewardship include the North Branch, Main Branch and West Branch where housing units are concentrated and where population growth was indicated in the 2000 census. The promotion of environmentally sound and economically feasible land use management practices can be done through existing landowner incentive programs.

The fourth goal addressed through the planning process is to increase nature-based tourism opportunities that protect natural features and preserve the natural character of the watershed. Regional recreation planning should address the importance of protecting environmentally-sensitive areas throughout the watershed. Map of critical areas provided in Figure 57.

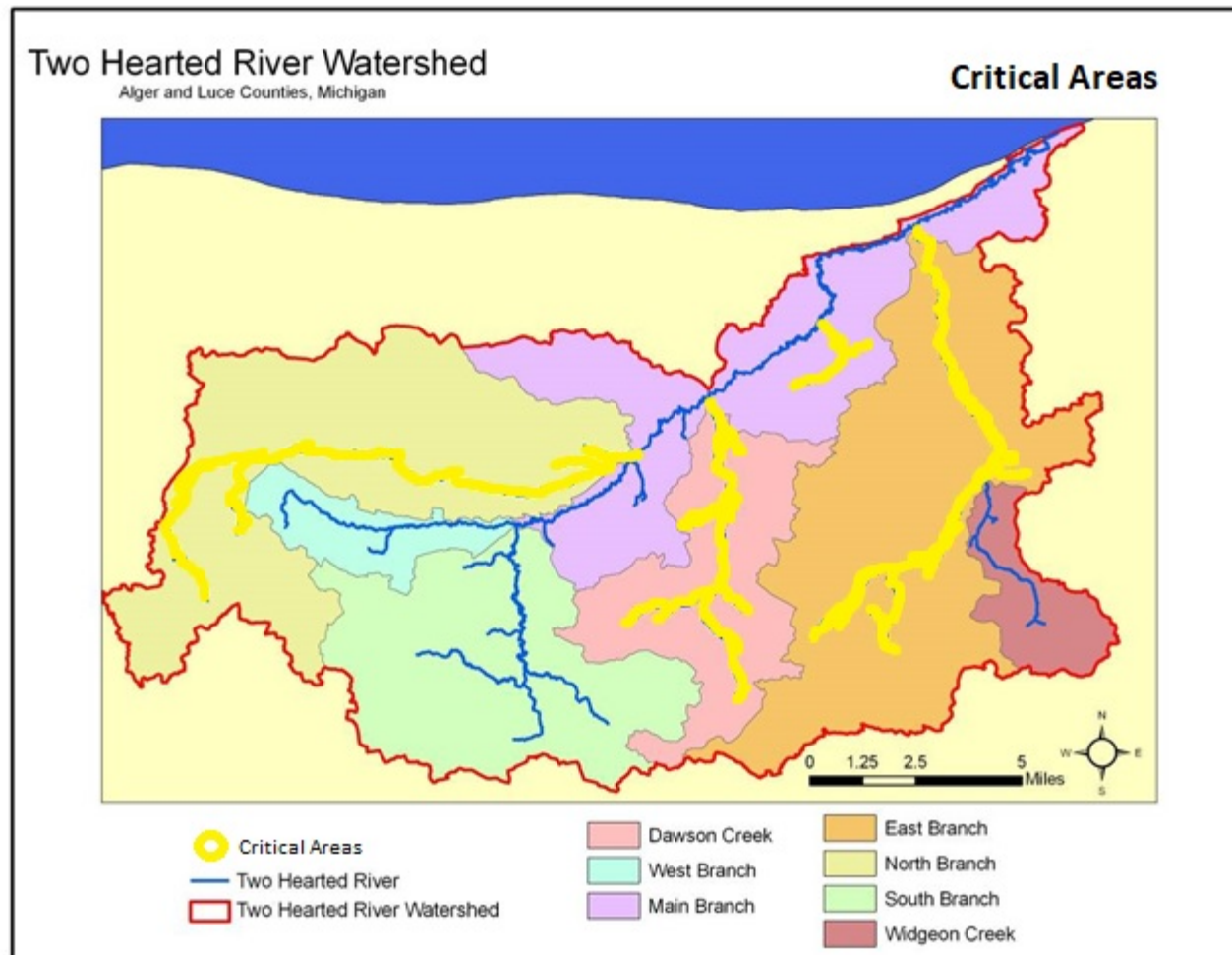


Figure 57 Two Hearted River watershed critical areas

5.3 Water Quality Impairment Reduction Targets

In a summer 2019 assessment of streambank erosion at road-stream crossing sites by The Nature Conservancy, six eroding locations were identified with a range of moderate to severe erosion. Six of the sites that were visited were in good condition and had no erosion or crossing issues at all. One location with severe erosion on the West Branch at WB2 was restored in the

fall of 2019. The portable bridge is now being used at that location. A total of 378.4 feet of erosion remains unrestored (Table 42). This streambank erosion inventory was estimated by measuring and quantifying eroding streambanks in the field, and the annual sediment loads were calculated using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL).

Table 42 2019 Two Hearted River Watershed Erosion Inventory Sites (not restored)

Priority Rank	Sub Watershed	Site Num	Length (ft)	Height (ft)	Lateral Recession	Rate (ft/yr)	BMP Efficiency (0-1)	Soil Textural Class	Soil Dry Weight (ton/ft ³)	Nutrient Correction Factor	Annual Load (ton)	STEPL Estimated Load Reduction (tons/yr)
1	Wabash Creek	WA1	31.4	24.5	Moderate	0.13	0.95	Sands, Loamy sands	0.055	0.85	2.08	1.98
2	Dawson Creek	DC1	90	6	Moderate	0.13	0.95	Sands, Loamy sands	0.055	0.85	2.0	1.9
3	North Branch	NB1	230	2	Moderate	0.13	0.95	Sands, Loamy sands	0.055	0.85	1.65	1.56
4	East Branch	EB10	15	4	Moderate	0.13	0.95	Sands, Loamy sands	0.055	0.85	0.43	0.41
5	Wabash Creek	WA2	12	5	Moderate	0.13	0.95	Sands, Loamy sands	0.055	0.85	0.43	0.41
Total			378.4	41.5							6.59	6.26

Pollution Load Reduction Estimates

In addition to sediment, STEPL also computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based

on various land uses and management practices. Using STEPL and watershed-wide land use data, a watershed wide pollution load was calculated for Nitrogen (N), Phosphorus (P), Biological Oxygen Demand (BOD) and sediment based on current land use data (Table 43).

Table 43 Pollutant Load Reduction Estimates for the Erosion Inventory Sites (not restored)

	N Load (no BMP)	N Load (with BMP)	N Reduction	%N Reduction	P Load (no BMP)	P Load (with BMP)	P Reduction	%P Reduction
Two Hearted Total	lb/year	lb/year	lb/year	%	lb/year	lb/year	lb/year	%
	17607.2	17598.7	8.5	0.05	4965.3	4962.0	3.3	0.1
	BOD (no BMP)	BOD (with BMP)	BOD Reduction	%BOD Reduction	Sediment Load (no BMP)	Sediment Load (with BMP)	Sediment Reduction	%Sediment Reduction
Two Hearted Total	lb/year	lb/year	lb/year	%	t/year	t/year	t/year	%
	58115.9	58098.9	17.0	0.03	454.3	448.1	6.3	1.4

6.0 MANAGEMENT MEASURES ACTION PLAN

Earlier sections of this plan summarized the watershed's characteristics and identified causes and sources of watershed impairment. This section includes an "Action Plan" developed to provide stakeholders with recommended "Management Measures" (Best Management Practices) to specifically address plan goals at general and site-specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures*: general remedial, preventive, and policy watershed-wide Management Measures that can be applied across the watershed by various stakeholders.
- *Site-Specific Measures*: actual locations where Management Measure projects can be implemented to improve surface and groundwater quality.

The recommended programmatic and site-specific Management Measures provide a solid foundation for protecting and improving watershed conditions but should be updated as projects are completed or other opportunities arise. Key

implementation stakeholders are encouraged to organize partnerships and develop various funding arrangements to help delegate and implement the recommended actions. The key stakeholders in the watershed are listed in connection to each individual project and task.

6.1 Programmatic Management Measures Action Plan Management Strategies

The goals and objectives of this watershed management plan will be implemented through a suite of management strategies or tasks. These tasks were developed based on the prioritization of watershed pollutants, sources, and causes, and critical areas of the watershed. A ten-year timeline was used as the schedule for implementation. Tasks that should be done in the short term were given a completion timeline of 3 years. Tasks that should be undertaken annually were given a timeline of "ongoing". Estimated costs for implementation tasks do not include staff oversight or administrative costs. A summary of implementation tasks and milestones is provided in Table 45.

Task 1: Promote voluntary arrangements and regulatory incentives for corporate and private landowners

Work with Luce County to promote voluntary arrangements and regulatory incentives to preserve and protect water quality, sensitive or biologically important areas and high-quality natural communities. Topics include:

- Use existing governmental planning toolkits and overlay ordinances to protect and preserve watershed characteristics
- Avoid development that encroaches on sensitive or biologically important areas
- Preserve high quality natural communities (conservation easements, etc.)
- Protect critical riparian areas (avoid development, maintain appropriate riparian buffers and setbacks)
- Properly manage working lands (forest lands) and roads
- Install and maintain properly designed septic systems
- Minimize the number of access roads needed for land use practices such as timber harvest, private development, and recreation
- Avoid stream and wetland crossings when constructing new roads
- Encourage voluntary landowner assistance programs for conservation practices
- Encourage the use of conservation easements

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Goal 3: Increase stewardship practices

Designated Uses Addressed:

Coldwater fishery, other aquatic life, public water supply

Desired Uses Addressed:

All

Estimated Cost: \$30,000

Timeline: 5 years

Priority: High

Milestones:

- Work with partners to develop and distribute information and education on voluntary landowner arrangements (Year 1)
- Work with Luce County to develop and adopt incentive programs (Years 1-3)
- Work with landowners to improve land use management practices (Years 2-5)

Measurements:

- Number of landowners participating
- Number of volunteer/incentive programs adopted
- Number of acres protected
- Number of improved land use management practices

Potential Partners: Luce County Planning and Development, McMillan Township, Columbus Township, Burt Township (Alger County), The Nature Conservancy in Michigan, Superior Watershed Partnership, and Luce West Mackinac Conservation District.

Task 2: Promote increased awareness of water quality/watershed issues

Adapt the *Lake Superior: Urban and Rural Watershed Restoration Project* process, developed by the Model Forest Policy Program (MFPP) and Superior Watershed Partnership (SWP), to disseminate a social survey. The process was originally used to collect and compare data from urban and rural watersheds near Marquette, MI. The social survey creation and dissemination methods can be applied to the Two Hearted River watershed for the purpose of 1.) Identifying the watershed and conservation priorities and concerns of landowners, 2.) Informing policy development, and 3.) Improving land use planning and actions by local units of government and landowners. In addition, the survey results help to assess the social indicators of the region, which are helpful when developing plans to educate and promote watershed-based awareness. With the survey results, watershed planners will be able to create information/education materials and programs to disseminate information to public and private sector partners, corporate and private landowners, recreational users, and the public. Sustainable land use practices including forest management and development

- Low-impact recreational opportunities
- Protecting water quality, aquatic habitat, and environmentally sensitive areas
- Preventing non-point source pollution (sediment, nutrients, heavy metals, nutrients, etc.)
- Invasive species identification and control methods

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Goal 3: Increase stewardship practices

Goal 4: Increase nature-based tourism opportunities

Designated Uses Addressed:

Coldwater fishery, other aquatic life, public water supply

Desired Uses Addressed:

All

Estimated Cost: \$5,500/year

Timeline: Ongoing

Priority: High

Milestones:

- Create contact lists of focus groups and target audiences (Year 1)
- Develop survey language and dissemination plan (Year 1)
- Conduct survey of recipients (Year 2)
- Tabulate and analyze responses. Compare data to urban watersheds such as the Lower Dead River watershed (Year 2-3)
- Develop and distribute a minimum of two I/E materials (articles, newsletters, brochures, etc.) per year to target audiences (Years 1-10)

Measurements:

- Number of people surveyed with increased knowledge of watershed issues, etc.
- Number of survey responses
- Number of information/education materials developed and distributed per year
- Number of recipients per year (number of target audiences and individuals)

- Number of requests for more detailed information and/or technical assistance
- Number of people surveyed with changes in behavior
- Number of people attending work days and events

Potential Partners: Trout Unlimited, Luce County Planning and Development, Chippewa, Luce, Mackinac Conservation District, Superior Watershed Partnership, The Nature Conservancy in Michigan, Model Forest Policy Program (MFPP).

Task 3: Update and continue to maintain project website

Maintain and continue to promote the project website and web map which serves as a centralized clearing house for all data, restoration activities, and knowledge gained from the project. The working web-map managed by The Nature Conservancy is entitled *Two Hearted River Watershed Conservation Data Viewer 4.0* and it houses detailed watershed information including data, studies, reports, photos, historical datasets, projects implemented, and any other available data. The web map houses detailed information related to land use and land management including conservation easements, forest harvest locations, and working forest reserves. The web map is located at maps.tnc.org/web_maps.html. The web map may be useful for planning and zoning and incorporating new and improved nature-based tourism and recreation opportunities in the watershed. Existing trails and future trail construction could be incorporated.

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Goal 3: Increase stewardship practices

Goal 4: Increase nature-based tourism opportunities

Designated Uses Addressed:

Coldwater fishery, other aquatic life, public water supply

Desired Uses Addressed:

All

Estimated Cost: \$1,500/year

Timeline: ongoing

Priority: Medium

Milestones:

- Update all existing information (Year 1)
- Update website (post new information, data, reports (Years 1-10))
- Evaluate website use/effectiveness (Years 2, 5 and 10)

Measurements:

- Number of website hits
- Number of contacts made and/or requests for information
- Public response related to usefulness

Potential Partners: The Nature Conservancy of Michigan, Superior Watershed Partnership, Luce West Mackinac Conservation District, and Luce County Planning and Development.

Task 4: Increase nature-based tourism opportunities and improve stewardship practices of recreational users and the public

Work with partners to improve trail systems and promote low-impact recreational uses and responsible high-impact recreational uses (ORVs, etc). Topics include:

- Evaluate current recreational uses and develop a watershed-wide recreation plan
- Enhance existing trails systems or develop new trails for low-impact recreation (hiking, biking, dog sledding, wildlife viewing, skiing, etc.)
- Promote nature-based tourism opportunities through existing regional initiatives (Great Waters, Scenic Byways, recreational clubs, etc.)
- Promote responsible high-impact uses

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Goal 3: Increase stewardship practices

Goal 4: Increase nature-based tourism opportunities

Designated Uses Addressed:

Coldwater fishery, other aquatic life, public water supply

Desired Uses Addressed:

All

Estimated Cost: \$5,000/year

Timeline: ongoing

Priority: High

Milestones:

- Evaluate existing recreational uses and opportunities for trail enhancement/development (Year 1)
- Develop watershed-wide recreation plan (Year 2)
- Identify target audiences and opportunities to link to regional initiatives (Years 1-2)
- Promote (market) existing, enhanced or new opportunities (Years 2-10)
- Evaluate effectiveness of marketing and implementation efforts (Years 4, 6 and 10)

Measurements:

- Watershed-wide recreation plan with recommendations for implementation
- Number of projects implemented
- Number of partners participating
- Number of contacts made
- Effectiveness of marketing efforts

Potential Partners: The Superior Watershed Partnership, Luce West Mackinac Conservation District, Luce County Planning and Development, The Nature Conservancy in Michigan, Trout Unlimited, Michigan Department of Natural Resources, Chippewa, Luce, Mackinaw Conservation District, Northern Initiatives and the Eastern Upper Peninsula Nature Tourism Alliance.

Task 5: Establish volunteer programs to monitor water quality and aquatic habitat conditions and track invasive species infestations and spread

Work with partners to establish volunteer programs to monitor trends in water quality and aquatic habitat conditions and invasive species infestations:

- Conduct volunteer training (stream monitoring and invasive species identification and control methods)
- Conduct annual (spring and fall) water quality monitoring at previously established sites using Michigan Department of Environment, Great Lakes, and Energy (EGLE) protocol or other acceptable methods (habitat and macroinvertebrate communities)
- Track invasive species infestations and control efforts (mapping)
- Host volunteer invasive plant work days
- Share data and results with volunteers, stakeholders, and local, state, and federal agencies other interested parties

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Goal 3: Increase stewardship practices

Designated Uses Addressed:

Coldwater fishery, other aquatic life

Desired Uses Addressed:

All

Estimated Cost: \$7,000/year

Timeline: ongoing

Priority: Medium

Milestones:

- Conduct annual volunteer stream monitoring training sessions (Years 1-10 or as needed as new volunteers participate)
- Conduct periodic education sessions on invasive species identification and work days for volunteers and landowners (Years 1-10 or as needed as new volunteers participate)
- Conduct annual spring and fall water quality monitoring at previously established sites (Years 1-10)
- Map invasive species infestations and treatment/control areas (Years 1-10)

Measurements:

- Number of volunteers participating
- Annual water quality monitoring data and long-term trends analysis
- Number of invasive species infestations identified and mapped
- Number of invasive species controlled (acres)

Potential Partners: The Superior Watershed Partnership, Luce West Mackinac Conservation District, The Nature Conservancy in Michigan, Trout Unlimited, Michigan Department of Natural Resources, the Upper Peninsula Invasives Council, and corporate and private landowners.

6.2 Site Specific Management Measures Action Plan

Task 6: Reduce sediment from manmade erosion sites including road/stream crossings, fords and recreational access points

- Use bioengineering techniques and native plants to maintain the natural character of the watershed and comply with Natural Rivers Program requirements
- Stabilize road approaches, side slopes and embankments
- Install fisherman's access stairs and platforms and/or make restorations to existing structures where appropriate
- Plant native vegetation on disturbed or bare soil areas
- Create diversion outlets and spillways to direct road runoff away from surface waters
- Replace undersized, perched, mis-aligned, and plugged culverts with appropriately-sized and designed crossing structures, specifically at DC3, DC5, EB2, and EB4.
- On the East Branch Two Hearted, site EB6 requires stream stabilization/ erosion BMPs.
- On the North Branch Two Hearted, the bridge at site NB1 is in poor condition and needs to be replaced. Moderate erosion is occurring at the site.
- On the East Branch Two Hearted, site EB10 requires additional restoration BMPs to address ongoing sediment loading. The bridge abutments are too close together, constricting the stream channel, and creating an eddy where the stairs are. This is causing the stairs to pop out of the streambank, moderate erosion, and sediment loading on the area planted downstream. Site engineering, structural replacements, and stabilization is needed.

Goals Accomplished:

Goal 1: Protect and improve the quality of water

Goal 2: Protect the integrity of aquatic and terrestrial ecosystems

Designated Uses Addressed:

Coldwater fishery, other aquatic life

Desired Uses Addressed:

All

Estimated Cost:

Sub Watershed	Site Number	Estimated Cost	Brief Description of Work Needed	STEPL Estimated Load Reduction (tons/yr)
Wabash Creek	WA1	\$5,000	Erosion BMPs	1.98
Dawson Creek	DC1	\$5,000	Erosion BMPs	1.9
Whiskey Creek	DC3	\$25,000	Replace culvert	TBD
Little Dawson Creek	DC5	\$25,000	Replace culvert	TBD
North Branch	NB1	\$85,000	Bridge replacement, erosion BMPs	1.56
Unnamed tributary to E. Branch	EB2	\$25,000	Replace culvert	TBD
Unnamed tributary to E. Branch	EB4	\$25,000	Replace culvert	TBD
Widgeon Creek	EB6	\$25,000	Erosion BMPs	TBD
East Branch	EB10	\$45,000	Site engineering, structural replacement, erosion BMPs	0.41
Wabash Creek	WA2	\$2,500	Erosion BMPs	0.41
Total		\$267,500		6.26

Timeline: 10 years**Priority:** High**Milestones:**

- Implement improvements at 1-2 sites/year (Years 1-10) Conduct pre and post BMP field evaluations (site condition evaluation and stream monitoring) (Years 1-10)
- Achieve 10% reduction in sediment load (Year 5)
- Achieve 25% reduction in sediment load (Year 10)
- Achieve water quality ratings of good or excellent at all monitoring sites (Year 10)
- Continue to monitor road-stream crossings in the watershed to ensure their integrity, locate culverts that have not been

surveyed, work on access issues, and expand survey to include private roads (Years 1-10)

Measurements:

- Number of sites improved
- Number of partners participating
- Quantity of sediment reduced – pre and post BMP field data (overall reduction goal of 314 tons by Year 10)
- Improved water quality ratings (annual stream monitoring)

Potential Partners: Superior Watershed Partnership, Chippewa, Luce, Mackinac Conservation District, Luce County Road Commission, The Nature Conservancy in Michigan, Forestland Group LLC, Plumb Creek, Michigan Department of Natural Resources, East Branch Sportsman's Club, and other private land owners.

7.0 INFORMATION & EDUCATION PLAN

As a part of the *Lake Superior: Urban and Rural Watershed Restoration Project*, the Model Forest Policy Program (MFPP) assisted SWP with development of a social survey for watersheds near Marquette, MI. The survey data was collected from the Salmon Trout River watershed as well as the Lower Dead River watershed in the City and Township of Marquette, MI for urban and rural comparison. This survey instrument will be adapted to the Two Hearted River watershed. The survey is useful for 1.) Identifying the watershed and conservation priorities and concerns of landowners, 2.) Informing policy development, and 3.) Improving land use planning and actions by local units of government and landowners. In addition, the survey results help to assess the social indicators of the region, which are helpful when developing plans to educate and promote watershed-based awareness.

The survey categories and their relative significance are based on the Great Lakes Regional Water Program - Social Indicators Data Management and Analysis (SIDMA); the survey was developed using “The Social Indicator Planning & Evaluation System (SIPES) for Nonpoint Source: A Handbook for Watershed

Projects Management” (“Handbook”) as a guide. The required guidelines allow for minimal modification of survey questions. Examples of survey forms used on other watersheds can be viewed at <https://superiorwatersheds.org/social-surveys>. The survey will be sent to all deliverable addresses within the Two Hearted River watershed.

8.0 PLAN IMPLEMENTATION

8.1 Plan Implementation Roles and Coordination/Responsibilities

The strategies for protection, restoration, and public involvement outlined under the goals and objectives of this watershed management plan will be implemented through a suite of recommendations or tasks. These tasks were developed based on the prioritization of watershed pollutants, sources, and causes,

and critical areas of the watershed. A ten-year timeline was used as the schedule for implementation. Tasks that should be done in the short term were given a completion timeline of 3 years. Tasks that should be undertaken annually were given a timeline of "ongoing". Estimated costs for implementation tasks do not include staff oversight or administrative costs. A summary of implementation tasks and milestones is provided.

8.2 Implementation Schedule

Table 43 Implementation Tasks and Milestones

Implementation	Timeline (years)									
Task/Milestone	1	2	3	4	5	6	7	8	9	10
1. Promote voluntary arrangements and regulatory incentives for corporate and private landowners	X	X	X	X	X	X				
Work with partners to develop and distribute information and education on voluntary landowner arrangements (Year 1)	X									
Work with Luce County to develop and adopt incentive programs (Years 1-3)	X	X	X							
Work with landowners to improve land use management practices (Years 2-5)		X	X	X	X	X				
2. Promote increased awareness of water quality/watershed issues	X	X	X	X	X	X	X	X	X	X
Create contact lists of focus groups and target audiences (Year 1)	X									
Develop survey language and dissemination plan (Year 1)	X									
Conduct survey of recipients (Year 2)		X								
Tabulate and analyze responses. Compare data to urban watersheds such as the Lower Dead River watershed (Year 2-3)		X	X							
Develop and distribute a minimum of two I/E materials (articles, newsletters, brochures, etc.) per year to target audiences (Years 1-10)	X	X	X	X	X	X	X	X	X	X

3. Update and continue to maintain project website	X	X	X	X	X	X	X	X	X	X
Develop project website and post all existing information (Year 1)	X									
Update website (post new information, data, reports (Years 1-10)	X	X	X	X	X	X	X	X	X	X
Evaluate website use/effectiveness (Years 2, 5 and 10)		X			X					X
4. Increase nature-based tourism opportunities and improve stewardship practices of recreational users and the public	X	X	X	X	X	X	X	X	X	X
Evaluate existing recreational uses and opportunities for trail enhancement/development (Year 1)	X									
Develop watershed-wide recreation plan (Year 2)		X								
Identify target audiences and opportunities to link to regional initiatives (Years 1-2)	X	X								
Promote (market) existing, enhanced or new opportunities (Years 2-10)		X	X	X	X	X	X	X	X	X
Evaluate effectiveness of marketing and implementation efforts (Years 4, 6 and 10)				X		X				X
5. Establish volunteer programs to monitor water quality and aquatic habitat conditions and track invasive species infestations and spread	X	X	X	X	X	X	X	X	X	X
Conduct annual volunteer stream monitoring training sessions (Years 1-10 or as needed as new volunteers participate)	X	X	X	X	X	X	X	X	X	X
Conduct periodic education sessions on invasive species identification and work days for volunteers and landowners (Years 1-10 or as needed as new volunteers participate)	X	X	X	X	X	X	X	X	X	X
Conduct annual spring and fall water quality monitoring at previously established sites (Years 1-10)	X	X	X	X	X	X	X	X	X	X
Map invasive species infestations and treatment/control areas (Years 1-10)	X	X	X	X	X	X	X	X	X	X
Conduct annual volunteer stream monitoring training sessions (Years 1-10 or as needed as new volunteers participate)	X	X	X	X	X	X	X	X	X	X
Conduct periodic education sessions on invasive species identification and work days for volunteers and landowners (Years 1-10 or as needed as new volunteers participate)	X	X	X	X	X	X	X	X	X	X
6. Reduce sediment from manmade erosion sites including road/stream crossings, fords and recreational access points	X	X	X	X	X	X	X	X	X	X
Implement improvements at 1-2 sites/year (Years 1-10)	X	X	X	X	X	X	X	X	X	X

Conduct pre- and post-BMP field evaluations (site condition evaluation and stream monitoring) (Years 1-10)	X	X	X	X	X	X	X	X	X	X
Achieve 10% reduction in sediment load (Year 5)					X					
Achieve 25% reduction in sediment load (Year 10)					X					
Achieve water quality ratings of good or excellent at all monitoring sites (Year 10)										X
Continue to monitor road-stream crossings in the watershed to ensure their integrity, locate culverts that have not been surveyed, work on access issues, and expand survey to include private roads (Years 1-10)	X	X	X	X	X	X	X	X	X	X

8.3 Funding Sources

Potential Funding Sources

Increased communication between stakeholders and other local, state, and federal entities will provide a means to find more effective solutions, eliminate program duplication, and maximize human, financial, and institutional resources. However, these resources alone will not be sufficient to implement all the goals and objectives of this watershed management plan.

The following are some of the possible funding sources (grant, loan, and cost share programs) available to stakeholder agencies and non-governmental organizations for implementation of this plan. This list is not exhaustive and many other funding sources exist, especially on the local level. Information on these funding sources can be found on the internet or by contacting the agency or nonprofit.

- Michigan Department of Environment, Great Lakes, and Energy (EGLE) (multiple programs)
- Federal Clean Water Act, Section 319(h)
- U.S. Environmental Protection Agency Targeted Watersheds Implementation
- U.S. Environmental Protection Agency Environmental Education Grants
- U.S. Environmental Protection Agency Five Star Restoration Program
- U.S. Fish and Wildlife Service (multiple programs)
- Michigan Department of Natural Resources Forest Land Enhancement Program
- Great Lakes Commission Great Lakes Basin Program for Soil Erosion and Sediment Control
- Great Lakes Commission MiCorps Volunteer Stream Monitoring Program
- People and Land – Kellogg Foundation
- Private Foundations
- Fundraisers
- Donations

9.0 MEASURING PLAN PROGRESS & SUCCESS

Water Quality Monitoring Plan & Evaluation Criteria

Continual evaluation provides information regarding the success of ongoing efforts to improve watershed characteristics. It allows for an assessment of the effectiveness and appropriateness of the original goals and objectives of this plan as tasks are implemented and conditions change over time. Evaluation also provides a feedback mechanism for periodically assessing the effectiveness of management practices and allows stakeholders to identify areas where program improvements are possible.

The measurements identified in relation to the goals and objectives of this plan provide helpful tools for local stakeholders to assess the effectiveness of their implementation projects or educational/outreach efforts. These measures however, are by no means exhaustive. Many other evaluation measures exist and local stakeholders must ensure evaluation programs and protocols meet local needs.

Evaluation programs typically include two types of measures: quantitative and qualitative. Quantitative attributes are those which it is possible to measure. Qualitative measures try to shed light on changes in attitudes, perceptions and knowledge levels. Examples of the two approaches as they related to the goals and objectives of the Two Hearted River Watershed Management Plan are provided below.

Quantitative Measures

- Biological monitoring of surface waters (e.g. macroinvertebrate communities)
- Chemical monitoring of surface waters (e.g. temperature, dissolved oxygen)
- Stream flow monitoring (e.g. volume, velocity)
- Sediment monitoring (e.g. deposition, quantity)
- Number of buffer ordinances adopted by townships
- Number of acres protected (conservation easements)
- Educational workshop attendance levels
- Number of storm water Best Management Practices implemented
- Number of restoration projects completed

Qualitative Measures

- Workshop evaluation surveys
- Public opinion surveys (e.g. increased awareness of impacts of nonpoint source pollutants on aquatic habitats, etc.)
- Increased cooperation and networking between stakeholders and other entities
- Level of enthusiasm expressed about revising zoning ordinances and master plans
- Public confidence that groundwater is safe

Whether using quantitative or qualitative measures, measuring the effectiveness of the Two Hearted River Watershed Management Plan will be two-tiered. First, individual agencies and communities will monitor certain projects and programs on the agency and community levels. Secondly, there will be a need to monitor progress and effectiveness on a regional watershed level in order to assess the health of the Two Hearted River and its tributaries as a result of administrative, environmental, and social effects of collective community and agency actions. This responsibility will most likely fall to the Two Hearted River Watershed Advisory Council.

Previously established water quality and road/stream crossing monitoring programs provide valuable information and offer a fairly objective and verifiable way to evaluate water quality trends, water quality differences related to land use, or to relate improvements in water quality to specific implementation objectives over time. Ideally, this data would be consistently incorporated into a data management system for sharing with other interested stakeholders and policy makers but at the present time is not. It is also critical to continue these programs in a consistent manner that ensures the data are reliable and useful to stakeholders throughout the watershed.

Although a common and valuable approach, water quality and road/stream crossing monitoring may not be sufficient for evaluation of all implementation efforts. Both natural and man-made factors affect water quality and limit the ability to attribute improvements to any specific Best Management Practice or educational tool. A combination of quantitative and qualitative measures should be an integral part of any evaluation program to provide a more comprehensive picture of the success of implementation.

In general, implementation activities should be reviewed and compared to results with interim milestones to ensure smooth implementation and to measure progress toward meeting goals. A sense of what messages, delivery mechanisms, and Best Management Practices are working and not working and why is dependent on conscientious evaluation and reporting by all stakeholders responsible for implementation of the watershed management plan. As the objectives outlined in this plan are implemented in subsequent years, an assessment based on trends as compared to previously established baseline data will be possible. Such an assessment is needed if the plan is to remain flexible, relevant, and effective for those who use it.

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