



## **Mackinac County Recession Rate Study 2018 Predesignation Report**

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The shoreline of mainland Mackinac County was studied in 2018 to update the recession rates previously determined in 1984 and designated in 1985. The State of Michigan is required to identify changes in the long-term rate of erosion occurring along the shoreline pursuant to R 281.22(22) of the Great Lakes Shorelands Administrative Rules, promulgated pursuant to Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This study identifies shorelines where recession is occurring at an average annual rate of one foot or more per year based on a minimum period of 15 years, R 281.22(2).

### **Site Description**

Mackinac County is in the eastern Upper Peninsula, north of the Mackinac Bridge on Lakes Michigan and Huron. The county has approximately 184 miles of Great Lake mainland shoreline amongst eight townships: Clark, Garfield, Hendricks, Hudson, Marquette, Moran, Newton, and St. Ignace. Discussion with Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD), field staff familiar with the county noted the shoreline east of the Mackinac Bridge was mostly low, typically coastal wetland or cobble beaches, with little to no erosion in the townships of Clark, Marquette, and St. Ignace. For this reason, all efforts were focused on the shoreline west of the Mackinac Bridge, approximately 84 miles where the shoreline structure varies and may be composed of bluffs of sand, coastal wetland, and cobble beaches. The county is sparsely populated, with 11,113 people (2010 census).

### **Methods**

The study area was identified for Mackinac County. Included were all shorelines designated in 1985, areas identified as highly erodible by the United States Army Corps of Engineers (USACE) in 1971, areas identified when viewing the 2012 USACE Oblique imagery, and those areas identified by local government officials.

### **Imagery**

The historic imagery used in the study was from EGLE, WRD, Aerial Imagery Archives. The available leaf-off imagery was reviewed and selected to represent the historic endpoint for the study. Efforts were made to ensure the study period was as long as possible to reflect water level fluctuations and storm events affecting the shoreline. For the shoreline west of Bridge View Park, the historic aerial imagery used for the study was from November 1983, with a scale of 1:6000. The water level was 579.95 feet International Great Lakes Datum (IGLD) 1985. The

imagery used for the area near Bridge View Park was taken in September 1984, when the water level was 580.77 feet (IGLD 1985). Imagery was orthorectified to modern imagery collected in the April 2016, with a 1-foot resolution. This imagery was available through the Michigan Department of Technology, Management and Budget, Center for Shared Solutions, and a United States Geological Survey National Elevation Dataset image with a 10-meter resolution was used to provide elevation information. The error due to orthorectification was approximately 0.6 feet plus or minus 0.02 feet for the 1983 imagery. The error due to orthorectification was approximately 0.5 feet plus or minus 0.4 feet for the 1984 imagery used at Bridge View Park adjacent to the Mackinac Bridge. The 2016 imagery was used as the modern imagery in this study. The water level was 579.95 feet (IGLD 1985).

### Erosion Hazard Line

The erosion hazard line (EHL) as defined in R 281.21(1)(c) means the line along the shoreland that is the landward edge of the zone of active erosion or the line where the 583.7 feet (IGDL 1985) contour on Lake Michigan meets the shoreland, whichever is furthest landward. The zone of active erosion means the area of the shoreland where the disturbance or loss of soil and substrate has occurred with enough frequency to cause unstable slopes or prevent vegetation of the area [R 281.21(1)(r)]. These definitions were effective on May 1, 1992, when the Great Lakes Shorelands administrative rules were amended. Prior to this date the recession rate was calculated by comparing historic and modern blufflines of shoreline on aerial imagery. The shorelines to study were identified through fieldwork as being areas of potential high risk erosion. Bluffline meant “the line which is the edge or crest of the elevated segment of the shoreline above the beach which normally has a precipitous front inclining steeply on the lakeward side.” The term bluffline was deleted from the administrative rules and replaced with the term erosion hazard line.

The 2018 recession rate study compared the EHL on historic aerial photographs to the EHL on modern aerial photographs. The historic EHL was determined by viewing the vegetation lines along the shoreline on the aerial photograph. The modern EHL was determined using the same method with the added information provided by low-level oblique aerial photographs, [2012 USACE Great Lakes Oblique Imagery](#), which shows detailed views of the shoreline from an offshore vantage point. An additional resource was the [Great Lakes Shoreline Geodatabase](#), which gives the approximate location of areas of various bluff heights, among other attributes. Cross-referencing these resources with the modern imagery was helpful in determining the location of the modern EHL. The shoreline was reviewed and the EHL was determined for all previously designated high risk erosion areas (HREAs) and areas of apparent erosion. The EHLs were hand-digitized.

### Fieldwork

The location of the modern EHL was verified by gathering on-the-ground data using a submeter Global Positioning System unit, Trimble Geo7x. All location data were differentially corrected. Data was gathered where there was public access; Bridge View Park, Pte. aux Chenes, US Hwy 2, Brevort River, United States Forest Service (USFS) Lake Michigan Campground, and a restored Michigan Department of Transportation (MDOT), roadside rest near Brevort in Moran Township. The shoreline designated in 1985 and owned by the State of Michigan in Garfield and Newton Townships was not visited due to limited access.

All data were projected to Michigan Georef Meters North American Datum 83.

### Hazard Area Identification

Transects were drawn perpendicular to the shoreline at 150-foot intervals and recession rates calculated along the transect lines. Digital Shoreline Analysis Software was used to determine recession rates. Similar rates were grouped into high risk erosion areas. Average recession rates were calculated within each area. Projected recession distances were determined for each area ([Procedure WRD-SWAS-028](#)). Parcel boundaries and owner data were received from the Mackinac County Equalization Department. The current area and parcel data were compared to the 1984 data to determine designation changes.

Within these hazard areas, placement of new construction requires a permit and must meet setback distances based on projected recession distances when combined with the type of construction and other site specific conditions. The projected recession distance is the calculated rate of recession for the area over a 30-year [for readily moveable structures, as defined in R 281.21(1)(k)] or 60-year [for permanent structures and septic systems, as defined in R 281.21(1)(i)] period as determined by R 281.22(2). The required setback distance is based on the projected recession distances but may be greater in areas of bluffs over 25 feet in height.

Affected parcels were classified under one of the following three categories:

*New:* These parcels were not designated during the previous study as being in an area of high risk erosion; however, the current study found the long-term rate of recession has increased to, or is above, the one foot per year threshold required for HREA designation. The properties are designated and subject to the regulations and permit requirements under Part 323 and the promulgated rules for high risk erosion areas.

*Increasing:* These are parcels where the average rate of recession was documented to be greater than one foot per year during the previous study and are currently designated as being in an HREA. The current study documented an increase in the long-term recession rate.

*Dedesignation:* These are parcels where the average rate of recession was documented to be one foot per year or greater during the previous study; however, the current study found the long-term rate of recession has fallen below the one foot per year threshold required for HREA designation. The HREA designation is therefore removed, also eliminating the permit requirements under Part 323.

### Public Notification

Letters explaining the proposed changes to the high risk erosion areas along the Lake Michigan shoreline of western Mackinac County will be sent to property owners and local governmental agencies as required per R 281.22 (1). A public meeting will be held June 24, 2019, at 10:00 a.m. The meeting will be held at the St. Ignace Office of the St. Ignace/Sault Ste. Marie Ranger District, USDA – Forest Service located at W1900 US 2, St. Ignace, Michigan.

### **Results**

During the current study, 13 percent (11 miles) of the shoreline was identified as needing study because it was either previously designated or showed signs of erosion. Of the shoreline studied, 2.5 percent (0.5 miles) was determined to be in an area of high risk for erosion. Of the currently identified areas of high risk erosion 40 percent (0.2 miles) will be designated for the first time. In 1985, nearly three miles of Mackinac County shoreline was designated as being at

high risk for erosion. Of the originally designated shoreline, 10 percent (0.3 miles) will remain designated. The HREA designation will be removed from approximately 2.4 miles of shoreline. Descriptive statistics for the county and townships are provided in Appendix 1. Preliminary maps dated February 7, 2019, are provided in Appendix 2.

The study will affect a total of 22 parcels. One parcel, managed by the Michigan Department of Natural Resources (DNR), in Garfield Township, will be newly designated. Four parcels in Moran Township will have increased projected recession distances; two parcels are managed by MDOT and two parcels are managed by the federal government. A total of 12 parcels will be dedesignated and will no longer require new structures, or their additions, to be set back a specific distance from the erosion hazard line per Part 323.

Historic water levels were obtained from the USACE (2017). The mean long-term water level for Lake Michigan from 1918 to 2017 was 578.81 feet IGLD 1985.

The study period spanned 33 years when comparing EHLs on historic and modern imagery. The study period was 35 years when comparing EHL data collected onsite in 2018 to historic imagery.

#### Moran Township

Bridge View Park, owned by the Mackinac Bridge Authority and located west of the Mackinac Bridge, was studied as the park is popular with travelers and has development potential. There is a visitor's center near the shoreline. Historically, the area was a staging area for the construction of the bridge. The shoreline is armored with broken concrete riprap with exposed rebar. Some shrubs were noted at the water's edge. EHL location data was collected in 2018 and compared to historic imagery. The study indicated the shoreline is receding at a rate of less than one foot per year.

The existing mapped area at Pte. aux Chenes was found to be eroding at a rate of 1.3 feet per year in 1984. This same HREA was studied in 2018 and found to be receding at a rate of less than one foot per year. The property owners notified in 1984 are on the east side of the point and appear to be outside the HREA identified in 1984. The east side of the point was studied in 2018 and found to be receding at a rate of less than one foot per year.

The existing HREA along US Hwy 2 was found to be receding at a rate of 1.3 feet per year in 1984. The current study used EHL data collected onsite in 2018 and determined the HREA is no longer eroding at this rate. The shoreline change is less than an annual average of one foot per year. The shoreline is stabilized with beach grass, *Ammophila breviligulata*.

The existing HREA at the mouth of the Brevort River was receding in 1984 at a rate of 1.3 feet per year. EHL location data was collected in 2018 and compared to historic imagery. The study indicated the shoreline is receding at a rate of less than one foot per year.

The existing HREA at the USFS, Lake Michigan Campground was receding in 1984 at a rate of 1.5 feet per year. EHL location data was collected in 2018 and compared to historic imagery. The study indicated the shoreline is receding at a rate of 1.7 feet per year within the boundaries of the parcel. This is an increase from the previous recession rate study. The new setback from the erosion hazard line for a readily moveable structure is 65 feet and for a permanent structure such as a septic system is 115 feet. The receding shoreline is located south of the

parking area and lakeward of campsites 1 through 14 in the campground along approximately 800 linear feet of shoreline.

The existing HREA at the site of the previous MDOT, Brevort Scenic turnout was receding at a rate of 1.3 feet per year in 1984. A permit for this site, US-2-Escanaba: 15-49-0041-P, was written in 2015 to remove failing guard rails and asphalt due to erosion. The site is a high sand bluff. In 2018, the site was found to have considerable slumping and evidence of piping. Large trees had fallen down the slope and into the lake, see Photo 1. The slope measured approximately 70 percent. The EHL location data collected in 2018 and compared to historic photos noted increased average recession rates of 1.7 and 3.0 feet per year at this site. The erosion hazard line is the top of the bluff for this site. The new setback for a readily moveable structure is 65 feet and for a permanent structure such as a septic system is 115 feet for the shoreline located 900 feet east of the west quarter section line. The new setback for a readily moveable structure is 105 feet and 195 feet respectively on the MDOT, US 2 Right-of-Way C21S.



Photo 1. Old MDOT Brevort Scenic Turnout, Moran Township in Mackinac County, Lake Michigan, looking south. Note slumping, clumps of vegetation sliding down slope, trees falling into the lake.

### Garfield Township

A new HREA north of Fox Point has been identified as receding at an average annual rate of 1.3 feet per year. The setback from the erosion hazard line for a readily moveable structure is 55 feet and for a permanent structure such as a septic system is 95 feet. The HREA is a wooded dune and swale complex. This HREA is in the Lake Superior State Forest managed by the DNR. The area is approximately 2,900 feet from the north parcel line and approximately 750 feet from the south parcel line.

The existing HREA designated near Fox Point crosses into Newton Township. In 1984, the shoreline had a calculated average annual recession rate of 1.3 feet per year and is now receding at a rate of less than one foot per year.

### Newton Township

The existing HREA designated near Fox Point in 1984 had a calculated average annual recession rate of 1.3 feet per year and is now receding at a rate of less than one foot per year. The designation will be removed from the currently designated parcel on state land.

## **Summary**

A recession rate study, meeting the technical requirements of Rule 281.22(2), was conducted of the Lake Michigan shoreline west of St. Ignace in Mackinac County. The high risk erosion area designations have changed on 22 shoreline parcels. With the higher water levels of Lake Michigan, the wave action will continue to erode the shoreline. Short-term periods of significant erosion can be masked by the long-term average erosion rate. Because there is still a risk to structures from erosion, the property owner is cautioned to locate new structures and additions t back from the edge of the bluff. When determining where to locate new projects they may want to consider using the previous study's projected recession distances. All structures should be built according to local building code and zoning ordinances. Future recession studies of the Mackinac County shoreline may change the locations of the high risk erosion areas identified on the Lake Michigan shoreline as a result of this study.

## **References**

United States Army Corps of Engineers. 2017. Coordinated Monthly Mean Lakewide Average Water Levels, 1918-2017.

[www.lre.usace.army.mil/Missions/Great-Lakes-Information/Great-Lakes-Water-Levels](http://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Great-Lakes-Water-Levels).

United States Census Bureau. 2010. <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

WRD-SWAS-028. 2016. Department of Environmental Quality, Water Resources Division, Surface Water Assessment Section, Policy and Procedure Part 323 – Determining Recession Rates of Great Lakes Shorelines.

Appendix 1. Mackinac County descriptive statistics (all mileage is approximate).

Table 1. Countywide.

<b>Year of Designation</b>	<b>1985</b>	<b>2019</b>
Miles of shoreline in County (mainland) = 184 Miles of shoreline east of St. Ignace = 100 Miles of shoreline west of St. Ignace = 84		
Miles of shoreline studied	unknown	11
Miles of shoreline designated	2.9	0.5
Miles of shoreline newly designated	2.9	0.2
Miles of shoreline that will remain designated	NA	0.3
Miles of shoreline with designation removed	NA	2.4
# of HREAs*	5	4
# of parcels designated	17	5
# of parcels newly designated	17	1
# of parcels remain designated	NA	4
# of parcels with designation removed	NA	17
Highest rate of recession (ft/yr) and PRDs** (ft)	1.5; 60/105	3.0;105/195
Lowest rate of recession (ft/yr) and PRDs (ft)	1.3; 40/80	1.3;55/95

The difference between the number of parcels designated in 1985 and the number of parcels with the designation removed in 2019 is attributed to parcel boundary changes made since 1985.

\*HREA is High Risk Erosion Area per Part 323. Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

\*\*PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 2a. Moran Township descriptive statistics (all mileage is approximate).

<b>Year of Designation</b>	<b>1985</b>	<b>2019</b>
Miles of shoreline in Township = 26.4		
Miles of shoreline studied	unknown	9.5
Historic photo year	1953	1983
Modern photo year	1983	2016 and 2018
Number of years between historic and modern imagery	30	33 and 35
Miles of shoreline designated	2.5	0.5
Miles of shoreline newly designated	2.5	0
Miles of shoreline that will remain designated	NA	0.5
Miles of shoreline with designation removed	NA	2.0
# of HREAs*	5	3
# of parcels designated	12	4
# of parcels newly designated	12	0
# of parcels remain designated	NA	4
# of parcels with designation removed	NA	15
Highest rate of recession (ft/yr) and PRDs (ft)	1.5; 60/105	3.0; 105/195
Lowest rate of recession (ft/yr) and PRDs** (ft)	1.3; 40/80	1.7; 65/115

Table 2b. Moran Township average annual recession rates and projected recession distances.

<b>Study Site Name</b>	<b>1985 Rate (ft/yr)</b>	<b>1985 30yrPRD (ft)</b>	<b>1985 60yrPRD (ft)</b>	<b>2019 Rate (ft/yr)</b>	<b>2019 30yrPRD (ft)</b>	<b>2019 60yrPRD (ft)</b>	<b>2019 HREA</b>	<b>2019 Update Code</b>
Pte. aux Chenes	1.3	40	80	<1	NA	NA	NA	Dedesignated
US 2 Roadside	1.3	40	80	<1	NA	NA	NA	Dedesignated
Brevort River	1.3	50	90	<1	NA	NA	NA	Dedesignated
USFS Lake Michigan Campground	1.5	60	105	1.7	65	115	A1	Increased
MDOT Brevort Scenic Turnout	1.3	40	80	1.7 3.0	65 105	115 195	B1 B2	Increased Increased

\*HREA is High Risk Erosion Area per Part 323. Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

\*\*PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 3a. Garfield Township descriptive statistics (all mileage is approximate).

<b>Year of Designation</b>	<b>1985</b>	<b>2019</b>
Miles of shoreline in Township = 17.7		
Miles of shoreline studied	unknown	1.0
Historic photo year	1953	1983
Modern photo year	1983	2016
Number of years between historic and modern imagery	30	33
Miles of shoreline designated	0.1	0.2
Miles of shoreline newly designated	0.1	0.2
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	0.2
# of HREAs*	1	1
# of parcels designated	1	1
# of parcels newly designated	2	1
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	1
Highest rate of recession (ft/yr) and PRDs** (ft)	1.5; 60/105	1.3; 55/95
Lowest rate of recession (ft/yr) and PRDs (ft)	NA	NA

Table 3b. Garfield Township average annual recession rates and projected recession distances.

<b>Study Site Name</b>	<b>1985 Rate (ft/yr)</b>	<b>1985 30yrPRD (ft)</b>	<b>1985 60yrPRD (ft)</b>	<b>2019 Rate (ft/yr)</b>	<b>2019 30yrPRD (ft)</b>	<b>2019 60yrPRD (ft)</b>	<b>2019 HREA</b>	<b>2019 Update Code</b>
North of Fox Point	NA	NA	NA	1.3	55	95	A1	New
Fox Point	1.5	60	105	<1	NA	NA	NA	Dedesignated

\*HREA is High Risk Erosion Area per Part 323. Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

\*\*PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Table 4a. Newton Township descriptive statistics (all mileage is approximate).

<b>Year of Designation</b>	<b>1985</b>	<b>2019</b>
Miles of shoreline in Township = 15.9		
Miles of shoreline studied	unknown	0.5
Historic photo year	1953	1983
Modern photo year	1983	2016
Number of years between historic and modern imagery	30	33
Miles of shoreline designated	0.3	0
Miles of shoreline newly designated	0.3	0
Miles of shoreline that will remain designated	NA	0
Miles of shoreline with designation removed	NA	0.3
# of HREAs*	1	0
# of parcels designated	1	0
# of parcels newly designated	1	0
# of parcels remain designated	NA	0
# of parcels with designation removed	NA	1
Highest rate of recession (ft/yr) and PRDs** (ft)	1.5; 60/105	NA
Lowest rate of recession (ft/yr) and PRDs (ft)	NA	NA

Table 4b. Newton Township average annual recession rates and projected recession distances

<b>Study Site Name</b>	<b>1985 Rate (ft/yr)</b>	<b>1985 30yrPRD (ft)</b>	<b>1985 60yrPRD (ft)</b>	<b>2019 Rate (ft/yr)</b>	<b>2019 30yrPRD (ft)</b>	<b>2019 60yrPRD (ft)</b>	<b>2019 HREA</b>	<b>2019 Update Code</b>
Fox Point	1.5	60	105	<1	NA	NA	NA	Dedesignated

\*HREA is High Risk Erosion Area per Part 323. Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

\*\*PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.

Appendix 2. Maps.

Index of maps.

<b>Map Name</b>	<b>Study Site Name</b>	<b>Municipality</b>	<b>Township Range Section</b>
US 2 Roadside and Pte. aux Chenes	Pte. aux Chenes, US 2 Roadside	Moran Township	T41N R5W Sections 22, 27
Brevort River	Brevort River	Moran Township	T41N R5W Sections 9,16
USFS Lake Michigan Campground	USFS Lake Michigan Campground	Moran Township	T41N R5W Sections 5, 6 T42N R5W Section 31
Old MDOT Brevort Scenic Turnout	Old MDOT Brevort Scenic Turnout	Moran Township	T42N R6W Section 25
North of Fox Point	North of Fox Point, Fox Point	Garfield and Newton Townships	T42N R11W Sections 19, 24, 25

\*HREA is High Risk Erosion Area per Part 323. Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

\*\*PRD is the Projected Recession Distance (feet) at 30 years and 60 years, respectively, as referred to in Rule 281.22 of the Great Lakes Shorelands Administrative Rules.