Hazard Mitigation Plan
for
Mason County
and
Constituent Local Governments

Update Completed in 2015
Adopted by Mason County
July 14, 2015

WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION
(WMSRDC)

The WMSRDC is a federal and state designated regional planning and development agency serving 120 local governments in Lake, Mason, Muskegon, Newaygo, and Oceana counties.

The mission of WMSRDC is to promote and foster regional development in West Michigan through cooperation amongst local governments.

WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

Project Staff:

Stephen Carlson, Senior Planner
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Prepared by WMSRDC in conjunction with the Mason County Office of Emergency Management and the Mason County Local Emergency Planning Committee

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Mason County
Board of Commissioners
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304 E. Ludington Ave., Ludington, Michigan 49431
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Letter of Transmittal from Chief Elected Official

July 14, 2015

Attached is the Mason County Hazard Mitigation Plan. This plan has been developed in conjunction with involved agencies, the state of Michigan, affected businesses, and interested members of the public. The plan provides the process for evaluation of land use and development in the county from a hazard mitigation perspective, which will protect lives and property in the community.

It is my expectation that all future development decisions in Mason County will <u>consider</u> hazard vulnerability reduction as a standard business practice and that such considerations will be incorporated into land use plans and zoning ordinances, as appropriate. The intent of the hazard mitigation plan is not to limit development, but to ensure that all development avoids the possibility of damage from natural and technological hazards to the extent practicable.

Questions and concerns related to content and use of this plan should be directed to the Coordinator of the Mason County Emergency Management Department at (231) 845-5911.

Sincerely,

Charles Lange, Chairman
Mason County Board of Commissioners

Mason County
Board of Commissioners

Courthouse
304 E. Ludington Ave., Ludington, Michigan 49431
(P) (231) 843-7999 • (F) (231) 843-1972

ADOPTION OF THE HAZARD MITIGATION PLAN

Charles Lange
Chairman

Curtis S. VanderWall
Vice Chairman

Cheryl Kelly
County Clerk

Fabian L. Knizacky
Administrator

Wally Taranko
District 1

Bill Carpenter
District 2

Charles Lange
District 3

Curtis S. VanderWall
District 4

Steven Hull
District 5

Janet S. Andersen
District 6

Thomas M. Posma
District 7

WHEREAS, Mason County, Michigan has experienced repetitive disasters that have damaged commercial, residential and public properties, displaced citizens and businesses, closed streets and bridges dividing the community both physically and emotionally, and presented general public health and safety concerns; and

WHEREAS, the community has prepared a *Hazard Mitigation Plan* that outlines the community's options to reduce overall damage and impact from natural and technological hazards; and

WHEREAS, the *Hazard Mitigation Plan* has been reviewed by community residents, business owners, and federal, state and local agencies, and has been revised to reflect their concerns.

THEREFORE BE IT RESOLVED THAT,

1. The *Hazard Mitigation Plan* is hereby adopted as an official plan of Mason County.

2. The Mason County Local Emergency Planning Commission (LEPC) is hereby established as a permanent community advisory body whose members are subject to the approval of the Mason County Board of Commissioners. The group's duties shall be as designated in the *Hazard Mitigation Plan.*

3. The Mason County Emergency Management Coordinator, or designee, is charged with supervising the implementation of the Plan's recommendations within the funding limitations as provided by Mason County Board of Commissioners or other sources.

4. The Mason County Emergency Management Coordinator shall convene the LEPC quarterly. The LEPC shall monitor implementation of the plan and shall submit a written progress report to Mason County in accordance with the following format:
   a. A review of the original plan.
   b. A review of any disasters or emergencies that occurred during the previous calendar year.
   c. A review of the actions taken, including what was accomplished during the previous year.
   d. A discussion of any implementation problems.
   e. Recommendations for new projects or revised action items. Such recommendations shall be subject to approval by the Mason County Board of Commissioners.

Moved for your approval.

Walter Taranko

I HEREBY CERTIFY this to be a true and correct copy of the record on file with the Mason County Clerk
This Certified Copy Only VALID When SEAL AND RED SIGNATURE Are Affixed.
Cheryl Kelly
7-14-2015
CHERYL KELLY
MASON COUNTY CLERK

HAZARD MITIGATION PLAN

Part A
PURPOSE AND PLANNING PROCESS

Purpose

The Mason County Hazard Mitigation Plan was created to protect the health, safety, and economic interests of residents by reducing the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation. Hazard mitigation is any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. It is an essential element of emergency management along with preparedness, response and recovery.

This plan serves as the foundation for hazard mitigation activities within the county. Implementation of the plan's recommendations will reduce injuries, loss of life, and destruction of property due to natural and technological hazards. The plan provides a path toward continuous, proactive reduction of vulnerability to the most frequent hazards that result in repetitive and often severe social, economic and physical damage. The ideal end-state is total integration of hazard mitigation activities, programs, capabilities and actions into normal, day-to-day governmental functions and management practices.

Some of the mitigation activities recommended in this document are inexpensive to accomplish while others require funding. The Federal Emergency Management Agency's (FEMA's) Pre-Disaster Mitigation (PDM) program and Hazard Mitigation Grant Program (HMGP) can assist with funding for many activities. Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

However, communities must have participated in the development of this plan and adopt it to be eligible to apply. Section 104 of the Disaster Mitigation Act of 2000 (42 USC 5165) states that after November 1, 2003 (later changed to November 1, 2004), local governments applying for pre- and post- disaster mitigation funds must have approved local mitigation plans. Pursuant to these requirements, which are spelled out in 44 CFR (Code of Federal Regulations) Part 201, the Mason County Hazard Mitigation Plan was adopted by the county and fully approved by FEMA in 2006. Eight jurisdictions within Mason County (2 cities, 3 villages and 3 townships) were successful in adopting the county's multi-jurisdictional hazard mitigation plan at the local level.

In addition, mitigation planning regulations state that "a local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding." Thus in 2010, efforts began to perform the mandated five-year update, resulting in this document.

Planning Process

The Mason County Hazard Mitigation Plan examines a wide array of hazards and mitigation activities on a multi-jurisdictional level (county, city, village, and township). Emphasis is placed on hazards, both natural and human-induced, that have had significant impacts on the county in the past. Because this is a multi-jurisdictional plan, the very first action of the planning process was to request a Letter of Participation from each local unit of government within Mason County. All 20 municipalities within the county submitted a letter of participation. Community participation is discussed later in this chapter.

The planning process followed in the update of the Mason County Hazard Mitigation Plan consists of the following steps:

- Public and stakeholder involvement;
- Establishment of an Advisory Team;
- Identification of hazards, risks and vulnerabilities;
- Identification and definition of goals and objectives;
- Identification of alternatives for solving problems;
- Selection of evaluation criteria to prioritize alternatives;
- Selection of potential hazard mitigation actions;
- Preparation of a draft plan;
- Preparation of the final plan;
- Implementation of the plan; and
- Monitoring and periodic revision of the plan.

Planning Approach

The Mason County Hazard Mitigation Plan was developed by the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance of the Mason County Local Emergency Planning Committee (LEPC), the Mason County Hazard Mitigation Advisory Team, and the Mason County Office of Emergency Management.

WMSRDC is a federal and state designated regional planning and development agency serving 120 local governments in Lake, Mason, Muskegon, Newaygo, and Oceana counties. WMSRDC is also the planning agency for the metropolitan transportation planning (MPO) program for Muskegon and Northern Ottawa counties, and is responsible for the management and administration of the homeland security program for the counties of Clare, Ionia, Isabella, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Osceola, and Ottawa.

The LEPC is a thirty-member committee appointed by the county board. It is comprised of representatives from the county government, local government, agriculture, health care, industry, amateur radio, District Health Department #10, public works, United Way, local media, law enforcement, fire services, EMS, Red Cross, U.S. Coast Guard, 911 dispatch, and emergency management. By law, the Michigan Emergency Planning and Community Right-to-Know Commission designates emergency planning districts. Title III of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) requires that the following groups be represented on the LEPC:

- Elected state and local officials;
- Law enforcement;
- Civil defense;
- Fire-fighting;
- First aid and health;
- Local environmental;
- Hospital;
- Transportation personnel;
- Broadcast and print media;
- Community groups; and
- Owners/operators of facilities subject to the reporting requirement of SARA Title III.

Additionally, the Michigan Emergency Planning Commission recommends that representatives from the following sectors also be appointed to the LEPC:

- Organized labor;
- Education; and
- Agriculture.

The Advisory Team was assembled by the Mason County Emergency Management Coordinator to aid the process of reviewing and updating the Mason County Hazard Mitigation Plan. All LEPC members were invited to join the team, which was eventually comprised of fifteen representatives from Mason County Emergency Management, Mason County Administration, Mason County Board of Commissioners, Mason County Sheriff's Department, Mason County Road Commission, Mason County Rural Fire Authority, Life EMS, District #10 Health Department, Mason-Lake Conservation District, Ludington Police Department, Ludington Daily News, Memorial Medical Center, and Riverton Fire Department. This body was established and utilized at the beginning stages of the update process; however, as the Update evolved, the full LEPC emerged as the primary advisory body to the Plan Update.

Appendix E includes the following plan documentation: LEPC appointees (as of September 25, 2013); Advisory Team members; attendance lists from LEPC meetings and other public meetings where hazard mitigation was discussed during the Update Process; resources utilized during the formation of this Plan and Update; and public notices and hazard mitigation articles published in WMSRDC newsletters.

Outreach, Input, and Participation

Mason County Emergency Management and the LEPC provided ongoing guidance and assistance in the plan development. Meetings where the LEPC specifically discussed hazard mitigation are listed in Appendix E. In addition, valuable input was obtained through a survey sent to 111 individuals in March 2012. LEPC members received the survey, as well as representatives of agencies and departments listed below. The survey was also made available to the public on the WMSRDC website during the drafting stage of the planning process.

- County commissioners
- County planning commissioners
- Local planning commissioners
- Local zoning officials
- Village presidents and township supervisors
- Fire chiefs and law enforcement
- Public works directors
- School superintendents
- Ludington Chamber of Commerce
- Mason County Growth Alliance
- Public utilities
- Mason County Administrator
- Mason County Road Commission
- Mason County Drain Commissioner
- Mason County Equalization Director
- Mason County Council on Aging
- Mason County Animal Control
- Mason County Building Department
- District #10 Health Department
- West Michigan Community Mental Health System

- American Red Cross – Lakeshore & West Shore Chapter
- United Way of Mason County
- Department of Human Services, Mason County Office
- Memorial Medical Center
- Oakview Medical Care Facility
- Life EMS
- Mason-Lake Intermediate School District
- Mason-Oceana 911Dispatch
- Mason County MSU Extension Office
- Michigan DNR Fire Supervisor
- Huron-Manistee National Forest Fire Management
- Mason-Lake Conservation District
- Ludington Mass Transit Authority
- Mason County Airport
- United States Coast Guard

The survey, developed with assistance of the Michigan State Police Emergency Management Division, was distributed early in the planning process and served a number of functions. First, the broad distribution of the survey to local, county, and regional agencies, organizations, and stakeholders was intended to raise awareness throughout the community of hazard mitigation planning, as well as to encourage local input and participation. Second, the survey included a list of historical hazard events, as reported in the original Mason County Hazard Mitigation Plan. This offered an opportunity for recipients to not only identify past and potential hazards in their community, but also allowed them to verify the accuracy of the Plan's previous edition. Third, the survey provided a prioritized list of hazards identified in the Mason County Hazard Mitigation Plan, and asked recipients to rank those hazards according to their own priorities. Although feedback obtained from this section was inherently subjective, it was useful for gauging community opinion and was taken into consideration when the hazard rating and rankings were revisited during this Plan Update.

The survey incited responses from a wide range of local and regional entities; including Mason County Office of Emergency Management, Mason County Administration, Mason County Planning Commission, Mason County Road Commission, Mason County Airport, Life EMS, District #10 Health Department, Scottville Fire Department, City of Ludington, Village of Freesoil, townships of Branch, Pere Marquette and Sherman, and local business. Survey feedback was used to help identify hazards, establish goals and objectives, recommend activities and prioritize actions. Although the survey produced a meager 11.7% response rate, it was successful in increasing awareness of hazard mitigation throughout Mason County. Explanations for the low response rate include the survey length, as well as the possibility that some recipients simply agreed with the survey content and chose not to respond. A copy of the survey, cover letter, and summary of responses can be found in Appendix D.

Attempts to obtain input from county stakeholders via email and mail were utilized at other stages of the Planning Process as well. In April 2012, the chief elected official and in some cases the professional manager of each local jurisdiction received a copy of its community profile section for review and comment. In November 2013, these individuals were asked to review the Action Agenda and comment on any hazard mitigation progress that had been made since the plan was approved in 2006. These efforts provided information about hazard mitigation and invited individuals to participate in the Plan Update.

The following chart shows the hazard mitigation participation status of each local jurisdiction in Mason County. Participation is based on whether or not a representative from a jurisdiction (1) attended a hazard mitigation meeting, (2) responded to a request for information, or (3) contributed to the plan in any other was during the planning process.

Mason County Hazard Mitigation Plan Jurisdiction Participation					
Jurisdiction	**Adopted 2006 Mason Co HazMit Plan***	**2006 HazMit Plan Participant**	**2011 Letter to Participate**	**HazMit Plan Update Participant**	**Participant Status**
Mason County	✓	✓	✓	✓	Continuing
Amber Twp			✓		
Branch Twp		✓	✓	✓	Continuing
Custer Village	✓		✓	✓	**New Participant**
Custer Twp			✓		
Eden Twp			✓	✓	**New Participant**
Fountain Village	✓		✓		
Free Soil Village	✓		✓	✓	**New Participant**
Free Soil Twp			✓		
Grant Twp	✓		✓		
Hamlin Twp	✓		✓	✓	**New Participant**
Logan Twp			✓		
Ludington City	✓	✓	✓	✓	Continuing
Meade Twp			✓		
Pere Marquette Twp	✓	✓	✓	✓	Continuing
Riverton Twp			✓	✓	**New Participant**
Scottville City	✓	✓	✓	✓	Continuing
Sheridan Twp			✓		
Sherman Twp		✓	✓	✓	Continuing
Summit Twp		✓	✓	✓	Continuing
Victory Twp			✓		

** Approved by FEMA in 2006*

Neighboring counties were notified of the plan through a communication sent to their Emergency Manager on October 15, 2013. All were asked to identify any concerns of hazards in their county that may impact Mason County, and vice versa. Mason County is bounded by Manistee County to the north; Newaygo and Oceana counties to the south; and Lake County to the east. All were given the option of reviewing drafts of this document.

Public Engagement

The Mason County LEPC hosted a public meeting to discuss hazard mitigation at the beginning of the planning process at its May 15, 2012 meeting. The meeting was noticed in the Ludington Daily News, discussed in the WMSRDC electronic newsletter, and announced in the March 2012 survey mailing. The meeting featured a presentation about the hazard mitigation planning process, and the public was invited to comment upon and discuss the survey that was distributed and made available on the WMSRDC website.

A second public meeting was held during the drafting stage of the planning process. This meeting was hosted by the LEPC at its quarterly meeting on December 16, 2014. The meeting was noticed in the Ludington Daily News; announced on the WMSRDC website and in the WMSRDC e-newsletter; and invitations were mailed and emailed to the LEPC members, chief elected official of each jurisdiction in Mason County, and members of the Mason County Board and Mason County Planning Commission. These communications invited recipients to review the Hazard Analysis and Goals & Objectives sections, which were posted on the WMSRDC website prior to the public meeting. Invitees were offered an opportunity to comment on the drafted sections by attending the public meeting or by submitting comments, in writing to WMSRDC staff prior to the meeting.

The meeting also featured a work session, whereas a proposed set of hazard mitigation action items were reviewed, discussed, and prioritized utilizing interactive polling technology.

Hazard mitigation was featured several times in the WMSRDC's bi-monthly print newsletter. Hazard mitigation was also featured in WMSRDC Updates, an electronic newsletter emailed, at a minimum, bi-monthly (opposite the printed newsletter). Not only were the newsletters distributed to all constituents in Lake, Mason, Muskegon, Newaygo and Oceana counties, but they also reached a majority of the county's neighboring communities. These communications were also presented on the WMSRDC's website. Lastly, the WMSRDC website, www.wmsrdc.org, offered an opportunity for the public to become familiar with hazard mitigation and participate in the plan development. This website provided general information about hazard mitigation; offered access to the latest approved edition of the county's Hazard Mitigation Plan; and provided access to surveys and draft sections for public review.

WMSRDC staff discussed hazard mitigation at the "Water, Woods, & Wetlands" regional forum on October 23, 2013 in Muskegon, Michigan. The hazard mitigation session addressed the potential for coordination between hazard mitigation and a variety of environmental initiatives. Examples of successful mitigation projects in Michigan highlighted many common interests, such as culvert improvements, flood control, and stream bank stabilization. Attendees of the forum included representatives from international, regional, and local environmental groups; federal agencies including USGS, USFWS, and NOAA; Michigan agencies MDEQ Office of Great Lakes, MDEQ Coastal Zone Management, MDEQ Non-Point Source, and MDNR; non-profit organizations; and private engineering and consulting firms. The forum also drew attendance from local watershed groups, local government officials, and residents.

Process for Approval and Adoption

At the conclusion of the planning process, Mason County Emergency Management is to submit the Draft Plan prepared by the WMSRDC to the Federal Emergency Management Agency (FEMA) and the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD) to verify that the requirements of a hazard mitigation plan have been met. Subsequent to these approvals, the LEPC (and by extension the Advisory Team) then reviews any comments, approves any necessary adjustments to the Draft Plan, and submits the Final Draft of the Hazard Mitigation Plan Update to the County Board of Commissioners for consideration. Following County Board approval, the plan is then sent to local governments for public hearings and adoption, as desired, to qualify them for pre- and post- disaster hazard mitigation assistance. Documentation of all local adoptions should be returned to the county Emergency Manager for notification to MSP-EMHSD and FEMA.

Part B

COMMUNITY PROFILE DESCRIPTIONS RELATED TO HAZARD RISK

(See Appendix A for additional detail)

1.0 COUNTY PROFILE SUMMARY

1.01 Mason County

Mason County is located in the western part of the Lower Peninsula of Michigan. The county is bordered on the north by Manistee County, on the east by Lake County, on the south by Oceana County, and on the west by Lake Michigan. The county has an area of 326,970 acres, or about 511 squares miles, including federal land in the Manistee National Forest and state land in the Ludington State Park. About 50 percent of the county is forested, 17 percent is used for agriculture, 4 percent is open water and 29 percent is used for transportation facilities, urban development, and other purposes. The County had a U.S. Census population in 2000 of 28,274 persons. Population has grown in recent years to a 2010 population of 28,705 and a projected 2015 population of 28,923 persons. In terms of ethnicity, the 2010 population consisted of 27,225 White, 172 African-American, 289 American Indian, 132 Asian, 0 Pacific Islander, 1,150 Hispanic or Latino, 547 two or more races, and 451 some other race. In 2010, there were 17,293 total housing units with 11,940 occupied and 5,353 vacant. The large number of vacant housing units consisted mostly (4,051 units) of "seasonal, recreational or occasional use" dwellings. Per capita income in 2010 was $21,760 and median household income was $40,039.

1.02 History and Development

Mason County's recorded history dates back to the mid-1600's when French missionaries, including Father Pere Marquette, visited the Ottawa Indians. As the earliest inhabitants of the area, these Native Americans had established an estimated 52 villages. Fur trading was commercially prominent from the 1600's to the 1840's, a period when the population of Native Americans diminished. Father Marquette died on the south side of the mouth of the Pere Marquette River in 1675. (A memorial marking his death stands there.)

Mason County was established in 1855 by legislation that separated it from Ottawa County. Mason County was divided into three townships: Free Soil, Little Sable, and Pere Marquette. When these divisions were made, the Lincoln, Big Sable, and Pere Marquette Rivers were used as boundaries. In 1873, Ludington was named the county seat. The county was named after Steven T. Mason, who was twice elected Governor after Michigan's admission to the Union in 1837.

In the mid-1840's, the first white settlers began to arrive in the area. Burr Caswell, a fur trader, built the first wood-frame house in the area. He later became the first probate judge of the county. After the 1850's, the fur trade was replaced by the lumber industry as the area's economic base. Lumbermen such as James Ludington followed and sawmills, along with the discovery of salt, caused the area's boom in the late 1800's. In 1897, the Pere Marquette Railroad built a fleet of ferries to transport lumber. Agriculture and commerce were established as the population increased. By the early 1900's, the lumber industry became less economically important and was gradually replaced by light manufacturing, a chemical industry, and water-related recreation activities.

1.03 Climate

The major climatic variations in the county are primarily the result of differences in topography and the proximity to Lake Michigan, inland lakes and connecting waterways. Between 1981 and 2010, the average winter (December through February) temperature was 26.4 degrees F at Ludington. The average daily minimum temperature was 37.72 degrees at Ludington. The lowest recorded temperature was -12 degrees at Ludington in February of 1996. The highest recorded temperature was 98 degrees at Ludington.

The total average annual precipitation is 35.6 inches at Ludington. Of the total precipitation, an average of 20.48 inches at Ludington fell in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was over 13 inches on September 10, 1986. Thunderstorms occur on about 32 to 34 days each year. The average annual seasonal snowfall between 1981 and 2010 was 91.02 inches at Ludington. The greatest snow depths at any one time during the period of record were 51 inches at Ludington. The heaviest 1-day snowfall on record was 27.1 inches at Ludington. The greatest monthly snowfall was 66.7 inches at Ludington in January 1977. The greatest seasonal total snowfall was 197.6 inches at Ludington during the 1985-86 season. The least seasonal total snowfall was 26.5 inches at Ludington during the 1931-32 season. The average relative humidity at 1:00 p.m. is about 63 percent. Humidity is higher at night, and the average at about 7:00 a.m. is about 82 percent. The sun shines about 62 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the southwest or south-southwest. Average wind-speed is highest, about 12 miles per hour, in January.

1.04 Agriculture

The agricultural history of Mason County began with Native Americans and early settlers, who raised staple crops and livestock on a small scale for domestic use. With the decline of the lumber industry, farming became increasingly important and attention was given to improving crop and livestock production. George McClatchy, a young Canadian, started the fruit industry in the county in 1864. Alfalfa was first grown in the county in 1900.

According to the 2007 Census of Agriculture, 76,446 acres of land in the county was used as farmland, a four percent decrease from the 2002 Census when 79,621 acres was used as farmland. 73.18% or about 55,943.18 acres was cropland (includes five components: cropland harvested, crop failure, cultivated summer fallow, cropland used only for pasture, and idle cropland), 16.14% or about 12,338.38 acres was woodland, and 10.68% or about 8,164.43 acres was other uses (wetlands, rural residential land, or land generally of low value for agricultural purposes). Of the acreage used for cropland, forage (land used for all hay and haylange, grass silage, and greenchop), corn for grain, vegetables harvested for sale, corn for silage, and soybeans for beans utilized about 37,202 total acres. These are considered the top crops in terms of acres consumed. Milk and dairy products; nursery, greenhouse, floriculture, and sod; vegetables, melons, potatoes, and sweet potatoes; grains, oilseeds, dry beans, and dry peas are an important part of Mason County's agriculture. Fruits, tree nuts, berries, cut Christmas trees and conifer nurseries are also important parts of the agriculture in the county but value of sales of these types of products were not disclosed on the most recent 2007 Census of Agriculture.

The major fruit crops are tart cherries followed by apples and sweet cherries. Peaches, pears, plums, apricots, and nectarines, although of lesser extent, also are significant. Most of the fruit crops are grown in the higher areas, where air drainage is good and frost damage is minimal. Because of its proximity to Lake Michigan, the western part of the county tends to have a longer frost-free period than the inland areas and therefore supports the bulk of the fruit production in the county. Vegetables are grown throughout the county, especially asparagus and snap beans.

1.05 Industry and Transportation

Manufacturing makes up a significant portion of Mason County's economic base, employing about 18.3% of the civilian workforce according to the 2008-2010 American Community Survey. The major industrial activities are chemical manufacturing and hydroelectric power production. The many light industries manufacture a variety of goods, including furniture, tools, metal tool boxes, Styrofoam products, board games, auto parts and trim, concrete and processed agricultural products. The areas of dune sand along Lake Michigan provide raw material for the casting industry. Several sawmills and many active oil wells are scattered throughout the county. Other top industries in terms of number of establishments and paid employees are retail trade; health care and social assistance; accommodation and food service; professional, scientific, and technical; administrative support, waste management and remediation.

Port Ludington serves as a link to other areas in the country and to foreign areas. The port is the point of export for the agricultural and industrial products of the area. One railroad freight line and one commercial airport serve the county. Two major highways, U.S. 31 and U.S. 10, link Mason County with other parts of the State.

1.06 Physiography

Most of the landscape features in the county were formed by the complex action of the Lake Michigan lobe of the Wisconsin glacial ice sheet. This glacial action produced five dominant land features – moraines, till plains, outwash plains, lake plains, and drainage-ways. Winds modified some of the land features and deposited large dunes along most of the coast of Lake Michigan. Winds also modified the interior landscape by reshaping old beach ridges and outwash plains. The movement of shallow water modified the lower areas. The Lake Border morainic system crosses the county from the southwest to the northeast and makes up most of the rolling to steep features in the county. This morainic system is skirted by gently rolling till plains. Areas of nearly level to gently rolling outwash plains dominate the east-central part of the county, along the Pere Marquette River and north of Gun Lake. Nearly level, sandy lake plains are throughout the western half of the county. Many areas are partly covered by rolling dune formations. The many streams of the county have dissected the landscape, making steep ravines. The elevation of Mason County ranges from 580 feet above sea level at the Lake Michigan shoreline to 960 feet above sea level in western Riverton Township. The General Soil Map-Mason County, Michigan is contained in the appendices.

1.07 Lakes and Rivers

Mason County has about 14,500 acres of lakes and ponds, more than 200 miles of rivers, and about 28 miles of Lake Michigan shoreline. The lakes are in scattered areas throughout the county. They range from 5 to 4,990 acres in size. Some lakes are in marshes and exhibit all stages of filling by vegetation. The largest lakes are Hamlin Lake (4,990 acres), Round Lake (571 acres), Bass Lake (524 acres), Gun Lake (219 acres), and Ford Lake (208 acres). Additionally, the Ludington pump-storage reservoir is more than 800 acres. The major rivers are the Pere Marquette River, the Lincoln, and the Big Sable, all of which flow westward to Lake Michigan. The Big Sable River drains the northern part of the county and enters Hamlin Lake before emptying into Lake Michigan. The Lincoln River and its two branches drain the central part of the county into Lincoln Lake. The Pere Marquette River and its south branch drain the southern part of the county into Pere Marquette Lake, through Port Ludington, and finally into Lake Michigan.

Part B Continued

COMMUNITY PROFILE DESCRIPTIONS RELATED TO HAZARD RISK

Cities, Townships and Villages
(See Appendix A for more detail)

2.0 CITY PROFILE SUMMARIES

2.01 City of Ludington

Ludington, the county seat of Mason County, was officially platted in 1867 and organized as a city in 1873. It is named after James Ludington, an investor who purchased much of the timberland region and built a sawmill in the area in the mid 1860's. Located along Lake Michigan's shoreline, Ludington sits within Pere Marquette Township in the southwest quarter of Mason County.

The 2010 population of the city was 8,076, with an estimated summer seasonal population of 9,053. A total of 3,546 persons commute to work daily and 1,396 residents are school-aged. In 2010 there were a total of 4,432 housing units in the city of which 3,549 were occupied and 883 were vacant. 446 of the vacant homes were for seasonal, recreational or occasional use. Critical public or private facilities in the city include City of Ludington Police Department, Mason County Sheriff Department, Ludington Fire Department, a public works yard, a pumping station, Memorial Medical Center, Oakview Medical Care Facility, Tendercare Medical Center, District #10 Health Department and five other city or county government buildings. Important infrastructure includes the Ludington Wastewater Disposal Plant, 12 sanitary lift stations, U.S. Coast Guard Station, S.S. Badger Car-ferry, Pere Marquette Shipping, highway US-10, and Marquette Rail railroad. There are seven schools located in the city including: Ludington High, Ludington Area Catholic Schools, O.J. DeJonge Middle, Lakeview Elementary, Franklin Elementary, Foster Elementary, and Pere Marquette Early Childhood Center. Ludington is home to around 20 major employers with 35 or more employees. Memorial Medical Center is the largest with over 350 employees. Major geographic features include Lake Michigan and the shoreline, coastal sand dunes, Lincoln Lake, Pere Marquette Lake, dense residential, and moderately dense commercial areas.

2.02 City of Scottville

Scottville City is located close to the geographic center of Mason County, at the border between Amber and Custer townships, on the Pere Marquette River, and at the junction of M-31 and US-10. Scottville's recorded history began in 1874 when it was mapped as a station on the Pere Marquette Railroad. It was officially platted in 1882, incorporated as a village in 1889, and became a city in 1907.

The 2010 population of the city was 1,214, with an estimated summer seasonal population of 1,247. A total of 406 persons commuted to work daily and 274 residents are school-aged. In 2010 there were 578 total housing units of which 483 were occupied and 13 were for seasonal, recreational or occasional use. Important or critical facilities in the city include Scottville Police, Scottville Fire Department, one public works yard, and three other city or county government buildings. Important infrastructures include the City of Scottville Wastewater System, Marquette Rail railroad, and highway US-10. The Mason County Central Schools system is the only identified major employer in Scottville City. There are four schools in the city; Mason County Central High, Mason County Central Middle, Scottville Elementary, and Mason County Central Preschool. Major geographic features include the Pere Marquette River and a dense residential area.

3.0 VILLAGE PROFILE SUMMARIES

3.01 Village of Custer

Custer is a village located in Custer Township in central Mason County. In 1876 the community received its name in dedication of General George Armstrong Custer who had been killed in the Battle of Little Big Horn earlier that year. The following year, the community was officially mapped as a stop on the Pere Marquette Railroad. Today, the village is a small agricultural community that is also supported by tourism generated by the Pere Marquette River, which flows through a park one mile to the south.

The 2010 population of the village was 284, with an estimated 289 persons during the summer seasonal period. A total of 106 persons commuted to work daily and 57 village residents were school-aged. In 2010, there were 137 total housing units in the village, of which 110 were occupied and 2 were for seasonal or occasional use. Identified critical public or private facilities in the village include the Custer Fire Department and the village hall. Important infrastructure includes the Wastewater Stabilization Lagoon, highway US-10 and a Marquette Rail railroad. Mason County Eastern Schools and Sanders Meat Packing are the largest identified employers. Major geographic features include the Manistee National Forest and Pere Marquette River nearby.

3.02 Village of Fountain

Fountain is a village in Sherman Township in northeast Mason County. Named after a nearby spring, the village began as a station on the Pere Marquette Railroad in 1882, and was officially organized as a village in 1913. Fountain is now an agricultural community with a strong community spirit reflecting family, small business, and hard work.

The 2010 population of the village was 193, with an estimated 212 persons during the summer seasonal period. A total of 75 persons commuted to work daily, mostly outside the village and 37 residents were school-aged. In 2010, there were 83 total housing units in the village of which 71 were occupied and 12 were for seasonal or occasional use. The Sherman Township Hall and the Fountain Area Fire Department are the only identified critical public or private facilities in the Village. Important infrastructure includes Marquette Rail railroad. Major geographic features include the North Branch of the Lincoln River.

3.03 Village of Free Soil

Free Soil is a village in Free Soil Township in north-central Mason County. Its name was proposed by Charles Freeman and adopted during the first Free Soil Township meeting in 1855. The name "Free Soil", which referenced the anti-slavery party from New York, was later applied to the village when it was officially organized in 1915. The village began as a lumber town and was a regular stop on the Pere Marquette Railroad during the lumber boom. Today the village has a rather successful farming community thanks to fertile soil, which allows for a variety of crop production including apples and orchards.

The 2010 population of the village was 144, with an estimated 164 persons during the summer seasonal period. A total of 71 persons commuted to work daily and 24 residents are school-aged. In 2010, there were 84 total housing units in the village of which 64 were occupied and 9 were for seasonal or occasional use. The Free Soil/Meade Township Fire Department is the only identified critical public or private facility in the Village. Important infrastructure includes a Marquette Rail railroad. Major geographic features include the nearby Manistee National Forest and Big Sable River.

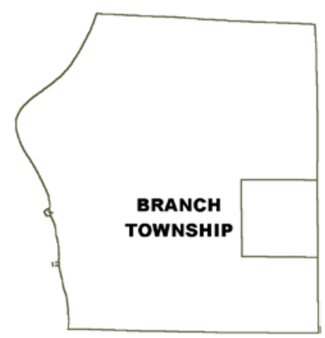
4.0 TOWNSHIP PROFILE SUMMARIES

4.01 Amber Township

Amber Township is located in the southwestern quarter of Mason County between Ludington and Scottville. Thanks in part to this proximity to the county's only cities, Amber is the second most populated township in Mason County. The township's wide ranges of housing opportunities include; low density rural housing, multi-family apartments, and various group and nursing homes. Its borders include Pere Marquette Township to the west, Victory Township to the north, Scottville City and Custer Township to the East, and Riverton Township to the south along the Pere Marquette River.

The 2010 population of the township was 2,535, with an estimated 2,699 persons during the summer seasonal period. A total of 1,038 persons commuted to work daily and 479 residents were school-aged. In 2010, there were 1,210 total housing units in the township of which 1,033 were occupied and 68 were for seasonal or occasional use. Critical public or private facilities include the Amber Township Hall and the Hardman Construction Company. There are three identified major employers in the township employing over 50 people each; Meijer, Home Depot, and Lowe's. Important infrastructure includes natural gas pipelines, a sour gas pipeline, power transmission lines, two lift stations, a Marquette Rail railroad, highways US-10 and US-31, and the Brookside Cemetery Dam. Major geographic features include Hackert Lake, Pere Marquette River and Lincoln River.

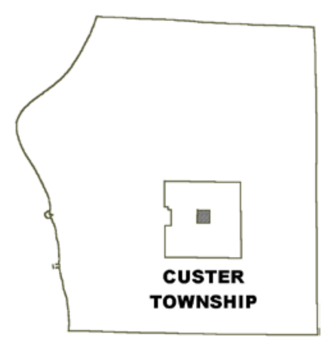
4.02 Branch Township



Branch Township is located in the southeast quarter of Mason County. Its borders include Sheridan Township to the north, Logan Township to the south, Lake County to the east, and Custer Township to the West. The township is home to the unincorporated community of Walhalla, numerous lakes, and dense sections of the Manistee National Forest. Thanks to the many out-door recreational opportunities the township has to offer, a significant portion of the township's housing units are for occasional or recreational use.

The 2010 population of the township was 1,328, with an estimated 2,275 persons during the summer seasonal period. A total of 479 persons commuted to work daily and 270 residents were school-aged. In 2010, there were 1,033 total housing units in the township of which 565 were occupied and 468 were for seasonal or occasional use. Critical public or private facilities include the Branch Township Hall and the Branch Township Fire Department. There are no identified major employers in the township. Important infrastructure includes a natural gas pipeline, Marquette Rail railroad, and highway US-10. Major geographic features include Long Lake, Tallman Lake, and Pere Marquette River.

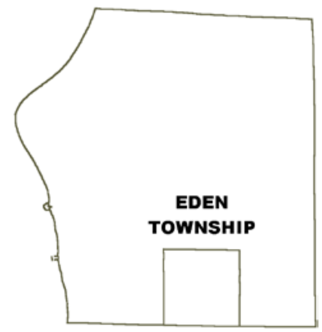
4.03 Custer Township



Custer Township is located in Central Mason County. The township is one of two townships in the county to share seven borders with other municipalities. These borders include Sherman Township to the north, Eden Township to the south, Branch Township to the east, and Scottville City, Riverton Township and Amber Township to the west. The Village of Custer, situated within the township, serves as the center of this rural township. Scattered rural homes, forests and farms coexist to compose this small agricultural community.

The 2010 census of Custer Township includes the Village of Custer. The following township statistics are given with the portions contributed to the township by the village displayed in parenthesis. The township population was 1,254 (284), with an estimated 1,348 (289) persons during the summer seasonal period. A total of 581 (106) persons commuted to work daily, mostly outside the township and 253 (57) were school-aged. In 2010, there were 599 (137) total housing units in the township of which 492 (110) were occupied and 37 (2) were for seasonal or occasional use. There are no critical public or private facilities identified in Custer Township and no identified major employers. Important infrastructure includes a natural gas pipeline, a power transmission line, highways US-31 and US-10, and a Marquette Rail railroad. Major geographic features include a section of the Manistee National Forest, Lincoln River and Pere Marquette River.

4.04 Eden Township



Eden Township is located in southern Mason County. Its borders include Custer Township to the north, Oceana County to the south, Logan Township to the east and Riverton Township to the west. The landscape of the township is scattered with rural houses, agriculture, and parts of the Manistee National Forest.

The 2010 population of the township was 582, with an estimated 957 persons during the summer seasonal period. A total of 285 persons commuted to work daily, mostly outside the township and 111 residents were school-aged. In 2010, there were 391 total housing units in the township of which 228 were occupied and 147 were for seasonal or occasional use. The Eden Township Hall is the only identified critical public or private facility in the township. Important infrastructure includes the Whiskey Creek Dam No. 2 and power transmission lines. There are no identified major employers. Major geographic features include the Pentwater River North Branch, Pleiness Lake, and a section of the Manistee National Forest.

4.05 Free Soil Township

Free Soil Township is located in northern Mason County. It was named after the “Free Soil” anti-slavery party at the first township meeting in 1855. Township borders include Manistee County to the north, Sherman Township to the south, Meade Township to the east, Grant Township to the west, and Free Soil Village. The township’s landscape is scattered with rural houses, agriculture, and parts of the Manistee National Forest.

The 2010 census of Free Soil Township includes the Village of Free Soil. The following township statistics are given with the portions contributed to the township by the village displayed in parenthesis. The township population was 822 (144), with an estimated 1,238 (164) persons during the summer seasonal period. A total of 395 (71) persons commuted to work daily, mostly outside the township, and 140 (24) residents were school-aged. In 2010, there were 566 (84) total housing units in the township of which 345 (64) were occupied and 177 (9) were for seasonal or occasional use. Important or critical public or private facilities in the Township include Camp Sauble (closed in 2005), and the Gun Lake dam. Important infrastructure includes US-31 and a Marquette Rail railroad. Major geographic features include the Manistee National Forest, Gun Lake, and Big Sable River.

4.06 Grant Township

Grant Township is located in the northwest corner of Mason County. Its borders include Manistee County to the north, Free Soil Township to the east, Hamlin and Victory Townships to the south, and Lake Michigan to the west. Grant is the largest township in the county.

The 2010 population of the township was 909, with an estimated 1,243 persons during the summer seasonal period. A total of 309 persons commuted to work daily and 149 residents were school-aged. In 2010, there were 524 total housing units in the township of which 375 were occupied and 138 were for seasonal or occasional use. Critical public or private facilities in Grant Township include the Grant Township Fire and Rescue and the Grant Township Hall. Important infrastructure includes highway US-31, a natural gas pipeline, a sour gas pipeline, and a power transmission line. Major geographic features include the Manistee National Forest, Lake Michigan and shoreline, coastal sand dunes, Hamlin Lake, and Big Sable River.

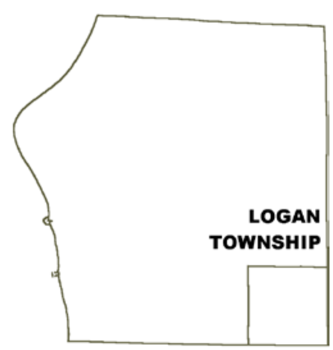
4.07 **Hamlin Township**

Hamlin Township is located on Lake Michigan on the west side of Mason County. It borders Ludington City and Pere Marquette Township to the south, Grant Township to the north, Victory and Amber Townships to the east and Lake Michigan to the west. Hamlin Township experiences the greatest seasonal population increase out of all municipalities in the county, thanks to its proximity to Lake Michigan, Hamlin Lake, the City of Ludington, and Ludington State Park. There are over 20 different resorts and campsites and two golf courses to accommodate and encourage this summertime influx.

The 2010 population of the township was 3,408, with an estimated 5,242 persons during the summer seasonal period. A total of 1,461 persons commuted to work daily and 588 residents were school-aged. In 2010, there were 2,349 total housing units in the township of which 1,440 were occupied and 774 were for seasonal or occasional use. Critical public or private facilities in Hamlin Township include the Hamlin Township Fire Department and the Hamlin Township Hall. Major employers in Hamlin include Bruce Mitchell Refrigeration Heating and Air Conditioning, Hamlin Grocery, Hamlin Sport Center, Omimex Energy, Parklanes Bowling Center, and Vandervest Electric Motor & Fabrication LLC. Important infrastructure includes the Hamlin Lake Dam. Major geographic features include Lake Michigan and shoreline, coastal sand dunes, Hamlin Lake, Lincoln Lake, and Lincoln River. Identified floodplains in the township are located along Lake Michigan, Lincoln Lake, Hamlin Lake, North Bayou, Big Sable River and Lincoln River.

4.08 **Logan Township**

Logan Township is located in the southeastern corner of Mason County. Its borders include Lake County to the east, Oceana County to the south, Eden Township to the west, and Branch Township to the north. Forests dominate the landscape, with some agriculture near Carr Creek and the Lake County border.



The 2010 population of the township was 317, with an estimated 792 persons during the summer seasonal period. A total of 78 persons commuted to work daily, mostly outside the township and 25 residents were school-aged. In 2010, there were 403 total housing units in the township of which 151 were occupied and 232 were for seasonal or occasional use. Identified critical public or private facilities include the Logan Township Hall and the Carr Community Fire Department. There is no identified important infrastructure or any major employers in the township. Major geographic features include the Pere Marquette River and sections of the Manistee National Forest. Identified floodplains in the township are located along the Pere Marquette River and Carr Creek.

4.09 Meade Township

Meade Township is located in an undeveloped and heavily forested area of northeast Mason County. Its borders include Manistee County to the north, Lake County to the east, Sheridan Township to the south, and Free Soil Township to the west. The relatively flat landscape, which is located within the township, borders the Manistee National Forest, has scattered rural housing, some agriculture, and wetlands near rivers in the southeast and northeast corners of the township.

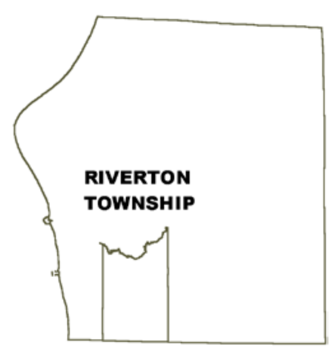
The 2010 population of the township was 181, with an estimated 443 persons during the summer seasonal period. A total of 34 persons commuted to work daily, mostly outside the township and 40 residents are school-aged. In 2010, there were 208 total housing units in the township of which 80 were occupied and 116 were for seasonal or occasional use. The Meade Township Hall is the only identified critical public or private facility. There is no identified important infrastructure or any major employers in the township. Major geographic features include the densely forested Manistee National Forest, Big Sable River, and Little Manistee River.

4.10 Pere Marquette Township

Pere Marquette Township is located in western Mason County. Its borders include Lake Michigan and the City of Ludington to the west, Hamlin Township to the north, Summit Township to the south, and Amber and Riverton townships to the east. Pere Marquette is the most populated township in Mason County even though it is the second smallest township. Its location outside of Ludington, on Lake Michigan, and on the Pere Marquette River, gives the township an ideal environment for urban development and tourism.

The 2010 population of the township was 2,366, with an estimated 3,204 persons during the summer seasonal period. A total of 1,043 persons commuted to work daily and 471 residents are school-aged. In 2010, there were 1,317 total housing units in the township of which 915 were occupied and 335 were for seasonal or occasional use. Critical public or private facilities include the Pere Marquette Township Fire Department and the Pere Marquette Township Hall. There are around ten identified major employers in the township, five of which employ over 150 people. Important infrastructure includes the Ludington Pumped Storage Plant/Dam, Ludington Wastewater Disposal Plant, seven sanitary lift stations, a natural gas pipeline, power transmission lines, Mason County Airport, Ludington Mass Transportation Authority, a Marquette Rail railroad, a county-owned transmission tower, and highways US-10 and US-31. Major geographic features include Lake Michigan and shoreline, coastal sand dunes, Pere Marquette Lake, Lincoln Lake, Pere Marquette River and Lincoln River. Identified floodplains in the township are located along Lake Michigan, Lincoln Lake, Pere Marquette Lake, Lincoln River, and Pere Marquette River.

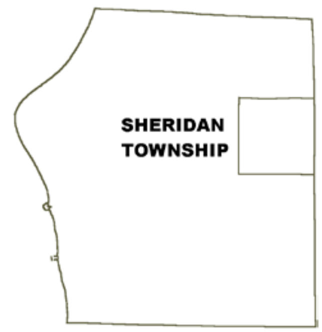
4.11 Riverton Township



The uniquely shaped township of Riverton is located on the south side of Mason County and shares borders with seven different municipalities. These include Amber Township to the north along the Pere Marquette River, Scottville City to the northeast, Custer and Eden townships to the east, Oceana County to the south, and Summit and Pere Marquette townships to the west. Riverton's landscape contains of a mix of scattered forest, agriculture, and rural housing with wetlands along the Pere Marquette River.

The 2010 population of the township was 1,153, with an estimated 1,307 persons during the summer seasonal period. A total of 602 persons commuted to work daily, mostly outside the township and 241 residents are school-aged. In 2010, there were 564 total housing units in the township of which 442 were occupied and 59 were for seasonal or occasional use. Lake Winds Energy Park, operated by Consumers Energy, includes 56 wind-power turbines spread across portions of Riverton and Summit townships. Other critical public or private facilities include the Riverton Township Fire Department and Riverton Township Hall. The two major employers in the township are Mason County Fruit Packers and Indian Summer Co-op. Important infrastructure includes a natural gas pipeline, a sour gas pipeline, and power transmission lines. Major geographic features include forests, the Pere Marquette River and a few small lakes and streams.

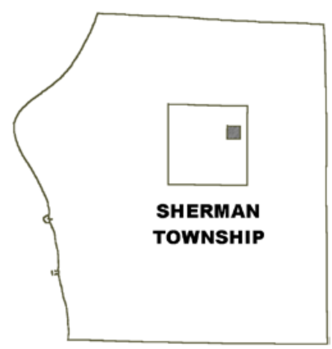
4.12 Sheridan Township



Sheridan Township is a rural locale on the east side of Mason County. It shares borders with Meade Township to the north, Branch Township to the south, Lake County to the east, and Sherman Township to the west. Sheridan's diverse landscape is a mix of scattered agriculture, dense forests, lakes, rivers, and wetlands. A significant amount of resorts and seasonal or occasional use houses have been built around the township's numerous lakes. This may cause the township's population to double at peak times during the summer season.

The 2010 population of the township was 1,072, with an estimated 2,347 persons during the summer seasonal period. A total of 405 persons commuted to work daily, mostly outside the township and 168 residents were school-aged. In 2010, there were 1,062 total housing units in the township of which 462 were occupied and 552 were for seasonal or occasional use. The Sheridan Township Hall is the only critical public or private facility identified, and no major employers have been identified. Important infrastructure includes a Marquette Rail railroad. Major geographic features include the Manistee National Forest, Ford Lake, Round Lake, Lincoln River, Big Sable River, 10 to 12 small lakes and ponds, and 3 to 5 small creeks.

4.13 Sherman Township



Sherman Township is a rural area located north and east of the center of Mason County. It shares borders with Free Soil Township to the north, Custer Township to the south, Sheridan Township to the east, Victory Township to the west, and the Village of Fountain within the township. Sherman's landscape is composed of a mix of scattered agriculture and dense forests.

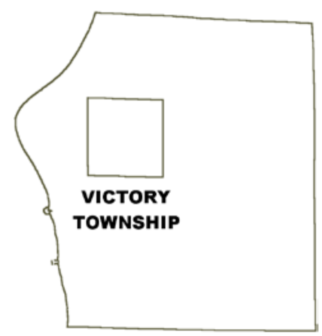
The 2010 census of Sherman Township includes the Village of Fountain. Please note the following township statistics are given with the portions contributed to the township by the village displayed in parenthesis. The 2010 population of the township was 1,186 (193), with an estimated 1,347 (212) persons during the summer seasonal period. A total of 460 (75) persons commuted to work daily, mostly outside the township and 244 (37) residents are school-aged. In 2010, there were 548 (83) total housing units in the township of which 457 (71) were occupied and 62 (7) were for seasonal or occasional use. The Sherman Township Hall is the only identified critical public or private facility and is located in the Village of Fountain. McCormick Sawmills, LLC is the township's largest employer. Important infrastructure includes highway US-31, Marquette Rail railroad, and four bridges. Major geographic features include the Manistee National Forest, the Lincoln River, and numerous scattered small lakes and streams.

4.14 Summit Township

Summit Township is located in the southwest corner of Mason County and is bordered by Pere Marquette Township to the north, Oceana County to the south, Riverton Township to the east and Lake Michigan to the west. Its undeveloped nature and location on Lake Michigan offer numerous outdoor recreational activities, campgrounds, and resorts for visitors to enjoy.

The 2010 population of the township was 924, with an estimated 1,896 persons during the summer seasonal period. A total of 398 persons commuted to work daily, mostly outside the township and 144 residents were school-aged. In 2010, there were 866 total housing units in the township of which 399 were occupied and 419 were for seasonal or occasional use. Lake Winds Energy Park, operated by Consumers Energy, includes 56 wind-power turbines spread across portions of Riverton and Summit townships. Other critical public or private facilities include the Bass Lake Dam and the Ludington Pumped Storage Plant, which happens to be the township's largest employer. Important infrastructure includes the Ludington Pumped Storage Plant Dam, power transmission lines and US-31. Major geographic features include Bass Lake, Lake Michigan and its shoreline, coastal sand dunes, and the Ludington Pumped Storage Plant Reservoir. Identified floodplains in Summit Township are located along Lake Michigan, Bass Lake, Hopkins Lake, Kibby Creek, and Quinn Creek.

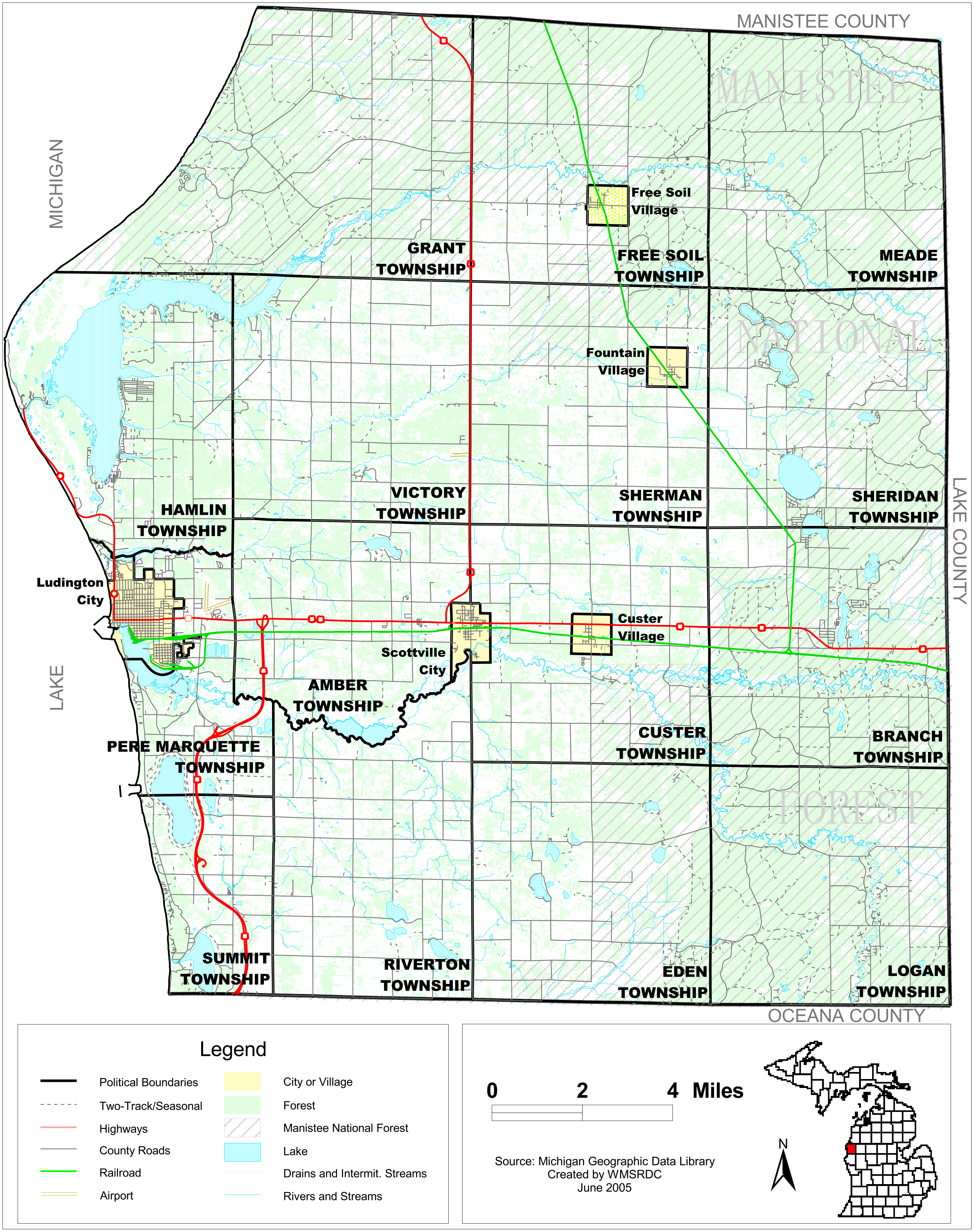
4.15 Victory Township



Victory Township was established in the fall of 1867. Located in the northwest quarter of Mason County, Victory is bounded by Grant Township to the north, Amber Township to the south, Sherman Township to the east, and Hamlin Township to the west.

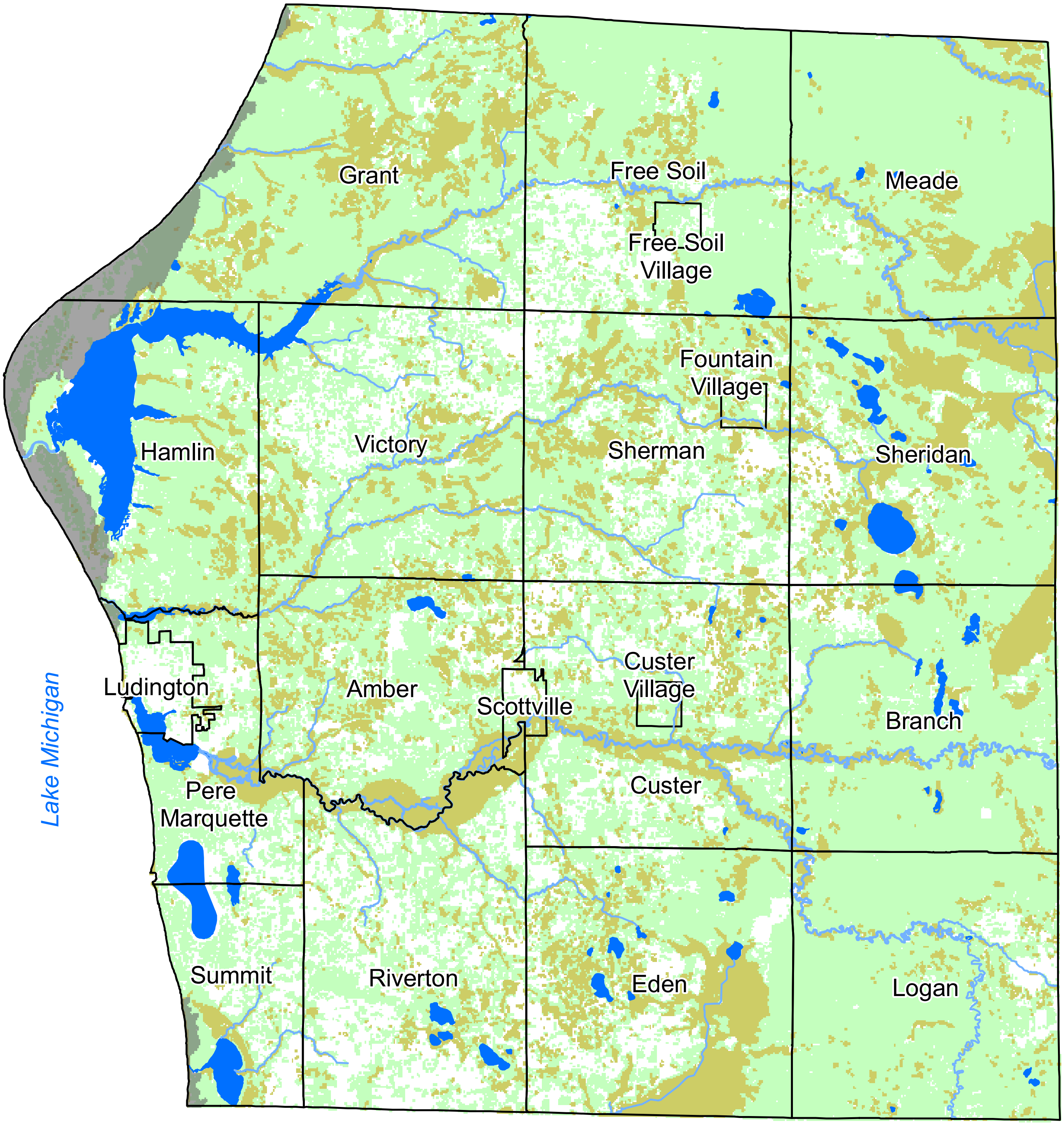
The 2010 population of the township was 1,383, with an estimated 1,576 persons during the summer seasonal period. A total of 638 persons commuted to work daily, mostly outside the township and 323 residents were school-aged. In 2010, there were 643 total housing units in the township of which 524 were occupied and 73 were for seasonal or occasional use. The Victory Township Hall is the only identified critical public or private facility in the township. Important infrastructure includes the West Shore Community College Dam, a natural gas pipeline, a sour gas pipeline, power transmission lines, highway US-31, and a sanitary lift station. There are also two schools, Victory Elementary and West Shore Community College, which happens to be the township's largest employer. Major geographic features include the Lincoln River, Hamlin Lake, and moderately dense forests.

MASON COUNTY
Base Map



Source: Michigan Geographic Data Library
Created by WMSRDC
June 2005

MASON COUNTY
Natural Features

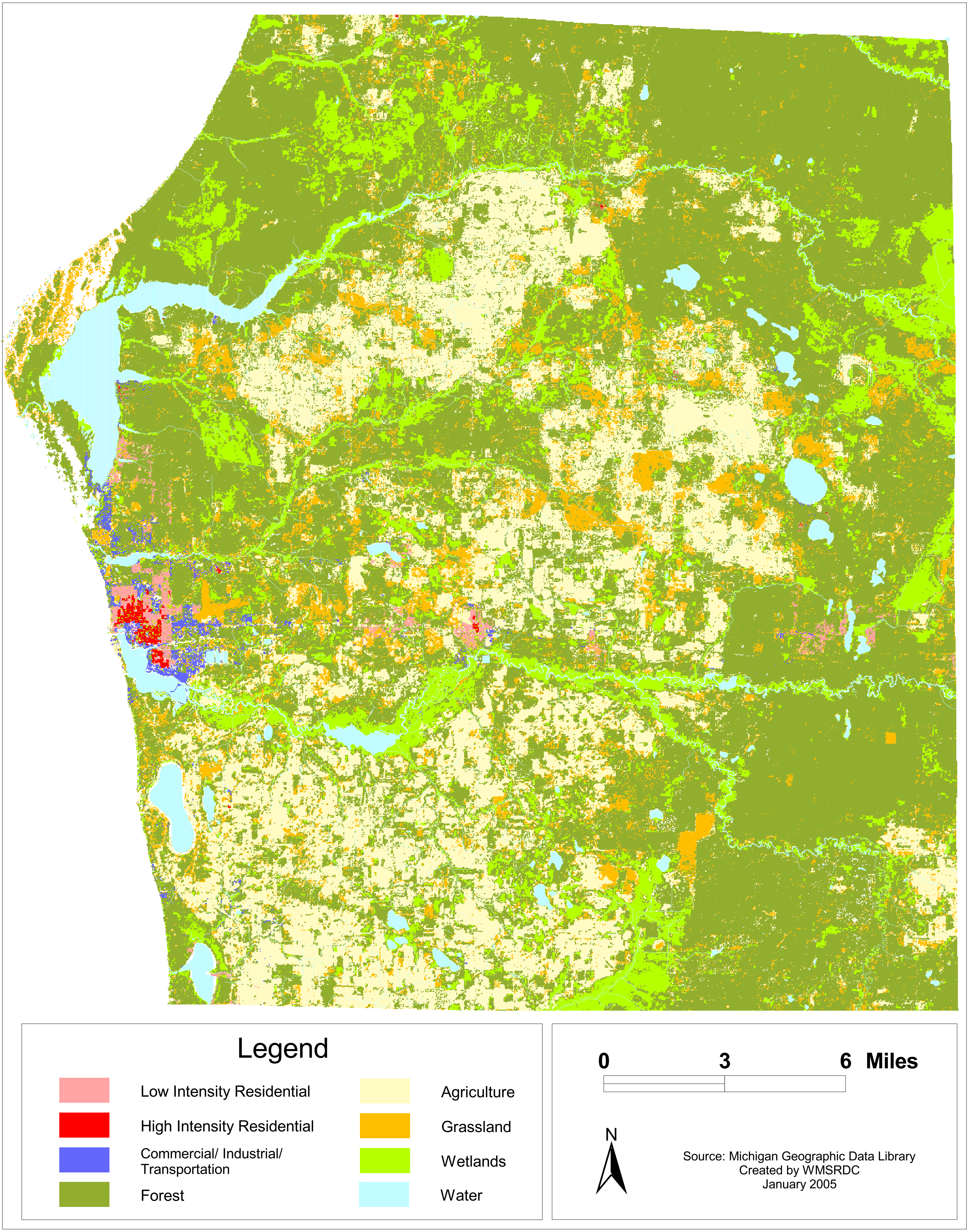


Forest
Water Feature
Critical Dunes
Wetlands

WMSRDC
WEST MICHIGAN SHORELINE
REGIONAL DEVELOPMENT COMMISSION

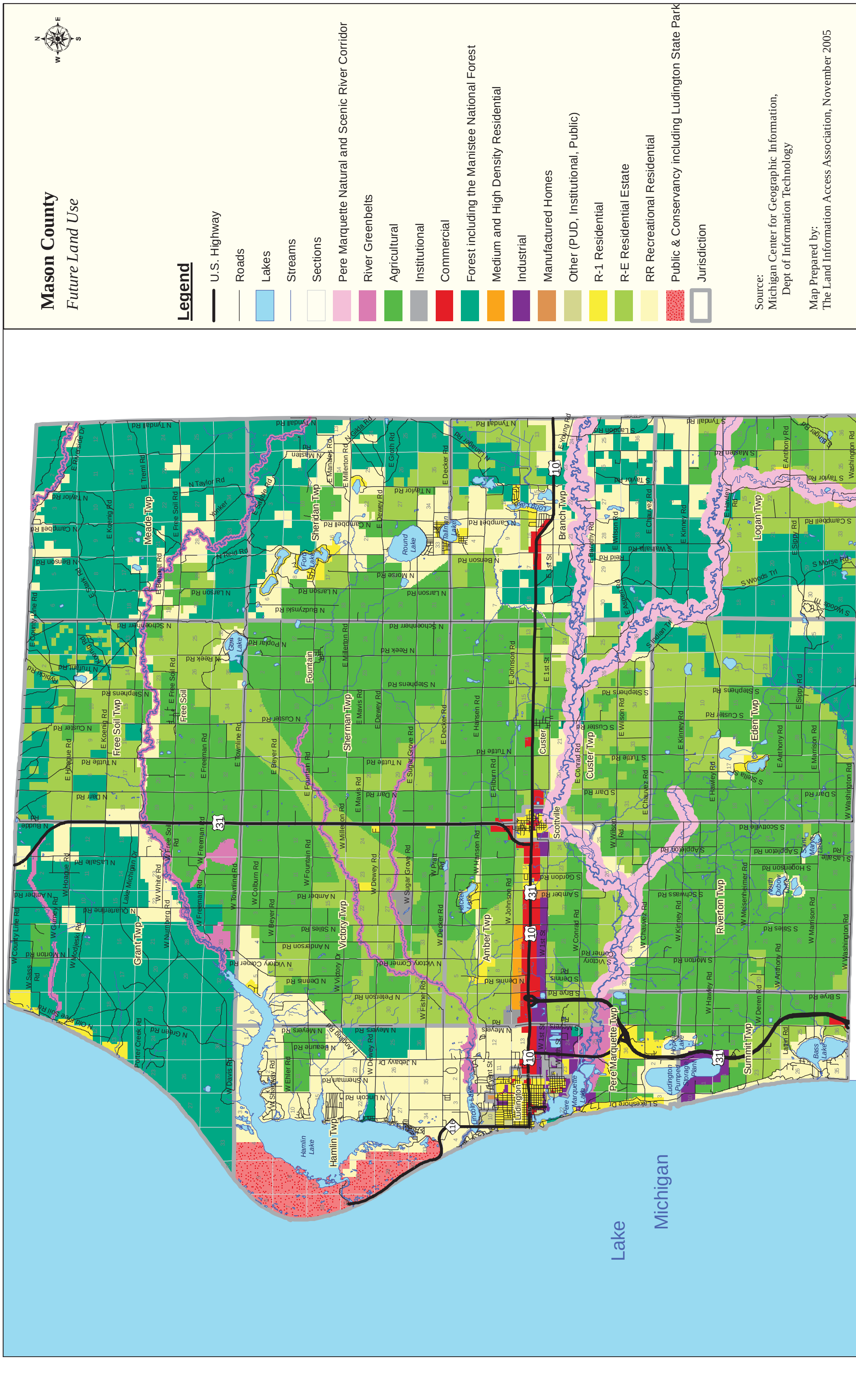
Sources: MDNR, MCGI, NWI
Created June 13th, 2013

MASON COUNTY
1992 Land Cover Map



Future Land Use

2013 Mason CountyMaster Plan Update



NOTE: Grant, Hamlin, and Pere Marquette Townships, plus the cities of Ludington and Scottville, and villages of Free Soil, and Fountain maintain their own comprehensive plans and zoning ordinances. It is NOT the intent of this Plan to directly or indirectly propose changes to those local plans or zoning maps. If there is a difference on this map from a local map classification that does not exactly match the closest legend category on this map, please let the County Planning Commission know before this map is adopted. Also, the Planning Commission will be actively studying the location of all zones around waterfront property, and all lands zoned commercial or industrial with the possibility of creating new zones to better address a variety of issues surrounding use of those parcels. See description in Chapters 3 and 4.

Part C
IDENTIFICATION OF COMMUNITY HAZARDS

(See Appendix B for the Hazard Identification Profile for each local governmental unit in the county)

Although FEMA requires that only natural hazards be addressed in the Hazard Mitigation Plan (44CFR Part 201), the Michigan Department of State Police (MSP) recommends that plans also look at technological and human-related hazards. MSP believes that it is important to discuss **all** known hazards that **could** impact the area, even those that pose no known threat, and to document the analyses on all hazards. Such documentation assures that risks from all hazards were considered and none were overlooked in the hazard analysis.

For hazards that are not considered significant, it is recommended that statements be included to explain why they are not. For example, a nuclear plant located over 50 miles away may not pose a threat to the area. Thus, if Mason County is located over 100 miles away from a nuclear power plant, it is sufficient analysis to state the fact. Further analysis is not required.

The Michigan Hazard Mitigation Plan, 2011 edition (MHMP), produced by the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD), considers a wide range of potential hazards in the state. The table below reveals the classification of those hazards as presented in the statewide plan.

NATURAL HAZARDS	TECHNOLOGICAL HAZARDS	HUMAN-RELATED HAZARDS
Weather Hazards: ▪ Thunderstorms, including Hail & Lightning ▪ Severe Winter Weather, including Ice, Sleet, & Snow ▪ Severe Winds ▪ Tornadoes ▪ Extreme Temperatures ▪ Fog Hydrological Hazards: ▪ Riverine/Urban Flooding ▪ Great Lakes Shoreline Hazards ▪ Dam Failures ▪ Drought Ecological Hazards: ▪ Wildfire ▪ Invasive Species Geological Hazards: ▪ Earthquakes ▪ Subsidence ▪ Celestial Impact	Industrial Hazards: ▪ Structural Fires ▪ Scrap Tire Fires ▪ HAZMAT – Fixed Site ▪ HAZMAT – Transportation ▪ Nuclear Power Plant Emergencies ▪ Petroleum & Natural Gas Pipeline Accidents ▪ Oil & Natural Gas Well Accidents Infrastructure Problems: ▪ Infrastructure Failures ▪ Energy Emergencies ▪ Transportation Accidents, including Air, Rail, Highway & Marine	▪ Catastrophic Incidents (National Emergencies) ▪ Civil Disturbances ▪ Nuclear Attack ▪ Public Health Emergencies ▪ Terrorism and Similar Criminal Activities

The list above represents a significant expansion and reorganization of potential hazards contained within the MHMP. The hazards addressed in this plan have therefore been expanded and reorganized to remain consistent with the MHMP. Hazard descriptions within this chapter draw heavily upon the wealth of information and data contained within the MHMP. The MHMP can be consulted for information additional to that which is included in this document, especially with regard to hazard analyses conducted at the state-level, as opposed to the county and local levels.

Analysis of each individual natural, technological, and human-related hazard is included in the remainder of this chapter. The analyses are organized alphabetically, and draw heavily on historical records, especially those of the National Climatic Data Center (NCDC), a division of the National Oceanic and Atmospheric Administration (NOAA). NCDC receives information from the National Weather Service (NWS) and maintains records of tornadoes from 1950, of thunderstorm winds and hail since 1955 and of all storms (including lightning) since 1993. Storm Data are categorized by County or by NWS Forecast Zone. Smaller (areal coverage) events are collected by County for Tornado, Thunderstorm Winds, Flash Floods and Hail events. Larger scale events are collected by NWS Forecast Zone for Heat, Cold, Drought, Flood, Tropical, and Winter Weather events. Mason County is situated in the Southwest Lower Michigan Forecast Area of the NWS, headquartered in Grand Rapids, MI.

A few words of caution: Severe weather observations are strongly population-dependent. The likelihood of a report being made is proportional to population density. Therefore it is likely that many severe weather events in less-populated areas have gone unreported to the NCDC Storm Events Database. This may understate the actual frequency of a particular hazard in a particular area. On the other hand, the observations that are made will tend to come from areas of human development which may be more likely to benefit from hazard mitigation actions.

Preceding the individual analyses is a summary of notable natural hazard events in the county, including Declarations of Major Disasters and Emergencies by the President, as well as Declarations of Disasters by the Governor. A major disaster is defined as “any natural catastrophe (including any hurricane, tornado, storm, high water, wind driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), regardless of cause, any fire, flood, or explosion, in any part of the U.S. which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.” An emergency is defined as “any occasion or instance for which, in the determination of the President, federal assistance is needed to supplement state and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the U.S.”

Significant Updates

While the general format of this chapter has remained the same, a number of significant updates have been made. Five new hazards have been introduced to the plan, increasing the total number of hazards addressed within to 31. These additional hazards include Celestial Impacts, Fog, Invasive Species, Energy Emergencies, and Catastrophic Incidents.

Further, a number of hazards have been renamed or reorganized. For example, “Flooding: Shoreline” is now considered “Great Lakes Shoreline Hazards” and “Snow/Ice/Storms” is now “Winter Weather.” “Land Subsidence” is now simply “Subsidence,” and has been classified under Natural Hazards, rather than Technological Hazards. Lastly, “Weapons of Mass Destruction/Terrorism Incidents” has been revised to “Terrorism and Similar Criminal Activities.”

Where appropriate, other updates within this chapter include: revisions to hazard descriptions; inclusion of recent hazard events, or additional events identified by research; and adjustments to “Frequency of Occurrence.”

Historically Significant Natural Hazard Events

Drought:

- Droughts lasting eight or more months (12): 1895-96, 1899-1900, 1901-02, 1909-11, 1925-26, 1930-31, 1956-57, 1962-63, 1971-72, 1976-77, and 2002-03.

Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide.
- Summer 1988: 39 days in Michigan with temperatures over 90 degrees Fahrenheit.
- March 2012: Record warmth. Early growing season led to $209.8m crop losses in Michigan.

Floods (riverine, urban):

- September 1986: Flooding. Declarations of disaster by Governor and major disaster by President.
- May-June, 2004: Flooding. $1m property damage, $200k crop damage across Mason County.
- June 9, 2004: Flooding. Declaration of state of emergency by County for Riverton, Summit, Pere Marquette and Amber Townships. $20k property damage.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.

Great Lakes Shoreline:

- 1986: Record high water level on Lake Michigan.
- 2013: Record low water level on Lake Michigan.

Severe Winds & Thunderstorm Hazards (winds, tornadoes, hail, lightning):

- April 12, 1972: Tornado (F2). 8 injuries, $2.5m property damage, Eden Township.
- September 16, 1997: Thunderstorm winds. Property damage of $25k Ludington and $10k in Fountain.
- May 31, 1998: Thunderstorm winds. Declaration of major disaster by President. Over $1m in public and private damage.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan, $50k property damage in Mason County.
- October 4, 2006: Thunderstorm Winds. $80k property damage, $20k crop damage, Mason County.
- May 3, 2012: 1.75" hail. $25k property damage in Scottville.
- August 2, 2012: Thunderstorm winds. $100k property damage in Hamlin Township.

Severe Winter Weather (ice, sleet, snow storms):

- January 26-27, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President and statewide disaster by Governor. $18.7m public damage, $4.3m private damage across Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across Michigan.
- April 3-5, 2003: Ice storm. $200k property damage in Mason County, $4.9m property damage throughout West Michigan.
- December 5-7, 2010: Lake effect snow. 18-24 inches in western Mason County.

Wildfires:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.

1.0 NATURAL HAZARDS

1.01 CELESTIAL IMPACT

An impact or threatened impact from a meteorite, asteroid, comet, satellite, space vehicle, space debris, solar storm, or similar phenomena that may cause physical damages or other disruptions.

Summary: Historically, celestial impact has not received consideration as a potential hazard in Mason County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

The most likely effect of celestial impacts in Mason County appears to be "space weather" generated by the sun. This is considered relevant to Mason County primarily for its potential to disrupt complex modern communication systems (i.e. satellites, television, radio, GPS, power supply networks), as well as the extensive human and technological infrastructure that rely upon those communication and utility networks. Physical collision of an object on the Earth's surface, although potentially devastating or even catastrophic, is considered to be significantly less likely.

Hazard Description: The celestial impact hazard primarily concerns the effects of large forces (from objects or energy) upon the Earth or its atmosphere. Most such forces are extraterrestrial in origin—meteors (which burn up in the atmosphere) or meteorites (which impact physically upon the ground) that were originally asteroids or comets from elsewhere in the solar system. Even in cases where no meteorite actually strikes the ground, the explosive energies from the meteor's impact upon the many layers of atmosphere can create an intense heat and blast area, along with very strong winds, and can release more energy than even the largest nuclear bombs. Massive or fast moving bodies that impact upon either the ground, the oceans, or the atmosphere can cause widespread destruction and disruption of both human and natural systems, including secondary hazards such as earthquakes, volcanoes, tsunamis, and severe winds.

Although it has been estimated that a major impact from a physical body upon the Earth occurs approximately once per century, recent discoveries (and the fact that human activities continue to expand across the Earth's surface) have increased concern over this hazard. Celestial objects are more likely to strike a body of water rather than land because, according to the United States Geological Survey (USGS), approximately 70% of the Earth's surface is water. This should not underscore the potential effects an ocean strike can have upon land, such as widely damaging tsunamis and seismic activity.

Much more common than physical collisions is the flare-up of energy and charged particles that are emitted and ejected by the Sun towards the Earth. Solar flares and storms (also known as "space weather") are highly relevant for their potential impacts and possible disruption of these complex modern communication systems—satellites, television, radio, GPS, power supply networks, and the extensive human and technological infrastructure that relies upon those communication and utility networks. The space weather hazard is far more likely to cause disruptive effects, economic impacts, and risks to human life in the near term. The effects of space weather have already had strong impacts upon Michigan within the normal historical timeframe typical for this type of plan.

The following discussion of asteroids, comets, and space weather is provided primarily to be "on the safe side" so that readers and emergency managers can be well-informed in the event that a very serious incident does occur, or threatens to occur.

<u>Asteroids</u>: Most asteroids are located in the main asteroid belt and have well-defined orbits there between 200 and 310 million miles from the Sun, but thousands of asteroids also exist in other

parts of the solar system. There are groups of "Trojan" asteroids that share an orbit with Jupiter, for example, located 60 degrees both ahead of and behind that planet itself while going around the Sun. Asteroids that have paths which cross over Earth's orbit are classified as Near-Earth Objects (NEOs), and are called Apollo asteroids. Two other types of NEOs are Amor asteroids, which approach the Earth's orbit from positions outside of it, and Aten asteroids, which approach the Earth's orbit from the direction of the Sun. As of January 2009, there were 6,021 NEOs identified, of which 1,026 were classified as posing the possibility of threat (having the potential to come within 466,000 miles of the Earth's orbit). The typical asteroid would impact upon the Earth at an angle of 45 degrees and a speed of 10 miles per second.

Comets: More than 99% of all meteorites come from asteroids, but some comet impacts have also been confirmed (9 are known, constituting less than 0.03% of all meteorites). The main difference between comets and asteroids is that comets tend to have elliptical orbits that carry them out beyond the "nebular frost line" (located in the main asteroid belt, about 250 million miles from the Sun) and thus their composition includes a substantial amount of icy and frozen matter. Comets usually lose about 0.1% of this matter each time they pass by the sun, due to the effects of warming and the pressure of solar radiation, and this matter trails behind them in their long "tails," which include charged particles (with associated magnetic fields) and can stretch across many tens of millions of miles of space. Where such tails cross the Earth's orbit, this matter (typically small and harmless to us) generates sometimes spectacular "meteor showers" as it periodically burns up in the Earth's atmosphere at regular times during the year. After a certain number of orbits, however, the comet simply breaks apart. Even if less dense than the average asteroid, a comet's heavy nucleus can be sizeable (from several hundred meters to over 40km in diameter), and a comet impact upon the Earth would typically occur at a speed of 31 miles per second—about three times as fast as the average asteroid, with a proportionally larger momentum of destructive energy if the amount of mass is the same. (It is worth noting here that the maximum impact upon the Earth for any object orbiting the Sun would be no more than 44.5 miles per second.)

Comets are classifiable by their orbital period, with long period comets taking more than 200 years to travel around the Sun, and short period comets taking less than that. The short period comets are further subdivided into Halley-type comets with orbital periods between 30 and 200 years, and Jupiter-type comets with orbital periods of less than 30 years. Long period comets originate in the farthest reaches of the Solar System (the Oort Cloud) and approach the Sun and Earth from any direction, while short period comets originate from the "Kuiper Belt" that exists beyond Neptune and is approximately in the same plane as all of the major planets.

A physical impact by a celestial object that is either sufficiently massive or fast-moving can cause effects comparable to any number of other hazards described in this plan. For example, it could compare to a nuclear blast in terms of the amount of energy released in the form of pressure (shock) waves and thermal effects (heat/fire). Additionally, major earthquake activity would be felt in areas that normally wouldn't have had to worry about such effects. An impact into any major water body (including the Great Lakes) can cause tsunamis and significant shoreline flooding, and severe winds could also result in extensive physical damages many miles (or hundreds of miles) from the main impact site. Depending upon the mass and velocity of the meteorite, the effects on the public may range from barely noticeable to complete destruction in a given area.

If advance notice of an approaching meteor, asteroid, or comet is available, then widespread alerts may be distributed, similar to when the explosive breakup of the Space Shuttle Columbia in 2003 prompted warnings and alerts across the southwestern U.S. due to the possible effects of falling debris. In this case, debris needed special handling for both investigation purposes and out of concern of exposure to hazardous substances. The threat of a celestial impact could be much more dangerous and far-reaching. One clear example of the potential damage was seen in the impact of the comet Shoemaker-Levy 9 on the planet Jupiter, in 1994, which resulted in blasts that were estimated as the equivalent of ten million megatons of explosives. In comparison, the 1979 Mount St. Helens eruption was roughly 5 megatons, and the 1885 Krakatoa eruption in Indonesia was about 100 megatons. Following the Shoemaker-Levy comet impact, Congress authorized new research to analyze this type of celestial impact hazard.

Space Weather: The Sun does not "burn" in the sense that we usually experience that common heat-generating process on Earth, but rather emits huge amounts of energy from the continuous processes of nuclear fusion that take place in the Sun's core. The gravitational pressures of the Sun's enormous mass, pulling toward itself, are thus generally offset by outward pressures from the fusion processes that take place at its core. Enormous amounts of energy are radiated from the Sun, including the spectrum of electromagnetic waves up through gamma wave frequencies. These include infrared (heat) radiation, ultraviolet, all colors of visible light, x-rays, microwaves, and radio waves. The intensity of these forms of radiation varies, and gamma waves are normally only emitted during solar flare events (to be explained shortly). It should also be understood that in the midst of all these solar interactions of matter and energy are powerful magnetic forces, which also affect the distribution of heat energy in and around the Sun and sometimes cause cooler areas, called sunspots, to form for a while, readily visible even with crude forms of observational equipment. (Although an observer should never look directly at the Sun, a pinprick of solar light projected onto a surface provides one basic means of seeing a Solar image). The relatively low temperatures of sunspot areas, however, are coupled with a rise in energy above the Sun's surface. Solar prominences are arches of plasma that soar above the Sun's surface, in a pattern that is itself shaped by the powerful magnetic fields present. In some cases, these magnetic fields have become too twisted to maintain such forces within these ordinary patterns, and a solar flare is generated, which releases a huge amount of energy from the Sun. Normally, a solar wind exists in the form of milder pressures exerted by emitted photons, ions, and other particles that flow outward from the Sun until they are eventually halted (beyond the orbit of Neptune, at an area called the heliopause) by the pressure of interstellar gases. Within the realm of the Sun's planets, however, the solar wind is an ongoing feature of the space environment, constantly sending energy and charged particles outward.

Space weather is a term that denotes the impacts of the Sun's activity upon the bodies within this sphere inside the heliopause, including our own Earth. As with the weather on Earth, there are some clear patterns that are exhibited by space weather. More turbulent space weather is produced during times when more sunspots are present (called a solar maximum), and space weather is calm during times when sunspots are rare and small (or not even seen to be present at all, called a solar minimum). A sunspot cycle exists, in which sunspot activity regularly shifts between a minimum and maximum level. As with our Earthly seasons, however, it cannot be known in advance exactly how turbulent or calm things will be at a given moment during the sunspot cycle—only that calmer periods regularly give way to more turbulent periods. As to the regularity of the sunspot cycle itself, although it has been found that the average amount of time between a solar minimum and a solar maximum is about 11 years, the actual length varies quite a bit within each cycle. The interval is sometimes as long as 15 years and sometimes as short as 7 years. In addition, it has been observed that long periods can occur with little or no sunspot activity. The "Maunder minimum," which occurred between the years 1645 and 1715, is the primary example of such long-term variation from the normal cycle, but it is not yet known what caused it, or when it might recur. The Earth's atmosphere serves as a shield for us against many types of particles and radiation zipping across space, and Earth also has a magnetosphere that similarly provides protection against most of the charged particles traveling through space. There are some weak spots in the Earth's magnetic field, however, that exist near its two magnetic poles and allow many ions to penetrate, where they collide with atoms in the Earth's upper atmosphere and glow to produce the beautiful auroras in the skies of the arctic regions of the north and south. In addition, the Earth is surrounded by "belts" of charged particles (called Van Allen belts) which are hazardous to spacecraft and astronauts. These are known and predictable conditions of calm space weather, however, and the actual hazard is the turbulence that is generated by large solar flares, causing problems with radio communications, damage to satellites, and even disruptions in power delivery networks on the Earth. As of early 2011, sunspot cycle number 24 proceeded from a solar minimum that was reached in December 2008, and was projected to transition to a solar maximum by the middle of 2013.

Another type of solar disturbance is a coronal mass ejection (CME), in which built-up pressures cause the sudden release of gases and magnetic fields at tremendous speeds, with impacts that reach far across interplanetary space. Like solar flares, CME events are a source of geomagnetic storms on Earth (usually 1 to 4 days after the solar event), and occur more frequently during periods with more sunspots. An additional effect of space weather involves increased exposure to ionizing radiation, especially to those in aircraft at high altitudes and along polar flight paths. Extra costs in fuel and delays are imposed upon airlines during periods of harmful space weather.

Space weather may result in the disruption of transportation and communication systems, and in some cases may result in fatal transportation accidents, economic losses, and widespread power supply interruptions. A catastrophic physical impact event would require extensive use of mutual aid and state/federal disaster and emergency assistance, with the likelihood that all normal response resources would be disabled within the area of impact, and would need to be replaced by resources from adjacent local areas, or even from beyond the state. In addition, an extremely large impact, even if not in Michigan, could cause a National Emergency situation to arise, which Michigan may have to help to respond to and recover from (please refer to the chapter on National Emergencies).

Historically Significant and Related Events: The Michigan Hazard Mitigation Plan includes an extensive list of historical celestial impacts and solar weather events. A variety of these are included below as examples of potential effects of this hazard.

March 19, 1996 – International

A celestial "close call" involved asteroid 1996 JA1 (large enough to cause catastrophic damage), which came within 280,000 miles—nearly as close as the Moon.

Feb 1, 2003 – National

The Space Shuttle Columbia broke apart violently when returning from a mission, causing a widespread alert about the potential for falling debris across the southwestern United States. More than 2,000 debris impact sites were eventually reported, but fortunately these were predominantly in sparsely populated areas. NASA issued warnings that the shuttle debris could contain hazardous materials and that it should remain untouched (and instead reported to authorities upon discovery).

March 26, 2003 – "Park Forest event" in Suburban Chicago, Illinois

Hundreds of meteorites fell across residential areas in the suburbs of Chicago. This event was highly unusual, having been described as "the most densely populated region to be hit by a meteorite shower in modern times." Coincidentally, the area of impact was in the midst of numerous highly-trained experts associated with the University of Chicago and other scientific institutions. The original meteoroid was calculated to have been between 1 and 7 thousand kilograms (possibly more) before it broke apart in the atmosphere. About 30 kilograms of meteorite fragments were recovered, with the largest weighing 5.26kg. Numerous holes were punched through windows, roofs, and ceilings in homes, and also a fire station. One roof hole was caused by a meteorite that weighed only 545 grams. There were about 18 documented fragments of about that size or larger across a couple of square miles of neighborhoods.

December 2005 – International

A geomagnetic storm caused the disruption of satellite-to-ground communications and GPS (Global Positioning System) navigational signals. Although this disruption only lasted about 10 minutes, it threatened the safety of commercial air flights and marine traffic during that time.

September 20, 2007 – Southern Peru

After a loud explosion was heard, residents of an isolated village found a large crater measuring 41 feet in diameter near Lake Titicaca and filled with water. A 1.5 magnitude earthquake was detected in the area.

The unusual aspect of this incident is that many villagers subsequently reported symptoms such as headaches and nausea. It has been proposed that the impact of a meteorite, along with the heat that was generated, caused the release of toxic fumes from the ground.

Frequency of Occurrence: It is likely that the next major celestial physical impact will occur somewhere in the world other than Michigan, and that Michigan's role as part of the United States would at most involve the provision of support to the impacted areas. If a major impact happens to occur in North America, state-level mutual aid may result, and possibly even the intake of evacuees, as had taken place during the Katrina and Rita hurricane disasters of 2005.

The space weather hazard, by contrast, is likely to cause one or more serious infrastructure failures in the near future, due to the extent of our reliance on complicated electronic and satellite systems that are vulnerable to disruption. In addition to power failures and phone communication breakdowns, it is also quite possible for the disruption of radio and navigational systems to cause risks for air and marine traffic. Even if cautious transportation providers are diligent about maintaining safety during such events, considerable economic impacts and delays can result from the electronic breakdowns caused by solar geomagnetic storm events.

1.02 DROUGHT

A water shortage caused by a deficiency of rainfall, generally lasting for an extended period of time.

Summary: Mason County is located adjacent to the world's fifth largest body of fresh water, yet is still vulnerable to drought. Droughts experienced in Michigan can cause significant economic losses and increase the likelihood of brush and forest fires. The gradual and unpredictable onset and recession of a drought, combined with the relative impacts it may have from location to location, complicate mitigation efforts for this hazard.

Hazard Description: Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Drought is a normal part of the climate of Michigan and of virtually every climate around the world – including areas with high and low average rainfall. In low rainfall areas, drought differs from normal arid conditions in that the extent of aridity exceeds even that which is unusual for the climate. The severity of a drought depends not only on its location, duration, and geographical extent, but also on the area's water supply needs for human activities and vegetation. This local variation of drought standards makes the hazard difficult to define a drought and assess when and where one is likely to occur.

Drought differs from other natural hazards in several ways. First, droughts lack an exact beginning and ending, as effects may accumulate slowly and linger long after the event is generally considered over. Second, the lack of a clear-cut definition of drought can make it difficult to confirm whether one actually exists, and/or its degree of severity. Third, drought impacts are often less obvious than other natural hazards, and are typically spread over a larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have a drought contingency plan in place. This lack of preparation can hinder support for drought mitigation capabilities that would otherwise effectively increase awareness and reduce drought impacts.

Some of the potential drought impacts on communities and regions include: 1) water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation; 2) a decrease in quantity and quality of agricultural crops; 3) decline of water quality in lakes, streams and other natural bodies of water; 4) malnourishment of wildlife and livestock; 5) increase in wildfires and wildfire-related losses to timber, homes, and other property; 6) decline in tourism in areas dependent on water-related activities; 7) decline in land values due to physical damage from the drought conditions and/or decreased economic or functional use of the property; 8) reduced tax revenue due to income losses in agriculture, retail, tourism and other economic sectors; 9) increases in insect infestations, plant disease, and wind erosion; and 10) possible loss of human life due to food shortages, extreme heat, fire, and other health-related problems such as diminished sewage flows and increased pollutant concentrations in surface water.

Although it is difficult to determine when a drought is actually occurring, once a drought is recognized it can be classified within four categories: meteorological, hydrologic, agricultural, and socioeconomic. A *meteorological* drought is based on the degree of dryness, or the departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual periods. These droughts are generally short-lived. A *hydrologic* drought involves the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels. Human activity, such as land use or dam construction, may exacerbate naturally occurring drought conditions. Onset and recovery of hydrologic droughts typically lag behind the other types of drought. An *agricultural* drought concerns soil moisture deficiencies relative to the water demands of plant life, usually crops. A *socioeconomic* drought is when the effective demand for water exceeds the supply, as a result of weather-related shortfalls.

The U.S. Drought Monitor uses four classifications of severity, from the least intense category (D1) to the most intense (D4), with an additional category (D0) used to designate a “drought watch” area in which long-term impacts such as low reservoir levels are probably present. The Drought Monitor summary map is available online, identifying general drought area and labeling their intensity. While not the only way to characterize droughts, the U.S. Drought Monitor is a standardized and convenient representation of drought conditions which is widely referenced in various reports and assessments. The Drought Monitor is available at the website http://droughtmonitor.unl.edu/.

Another useful index for monitoring drought conditions is the Palmer Drought Severity Index, which was developed in the 1960’s. The U.S. Drought Monitor and the Palmer Index are compared in the following table along with other drought indices.

Drought Classification Categories

Category	Description	Possible Impacts	Palmer Drought Index	CPC Soil Moisture Model, USGS Weekly Streamflow, Objective Short & Long-term Drought Indicator Blends (percentiles)	Standardized Precipitation Index (SPI)
D0	Abnormally Dry	Going into drought: short-term dryness that slows planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9	21-30	-0.5 to -0.7
D1	Moderate Drought	Some damage to crops, pastures, streams, reservoirs, or wells low; some water shortages developing or imminent; voluntary water-use restrictions requested.	-2.0 to -2.9	11-20	-0.8 to -1.2
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed.	-3.0 to -3.9	6-10	-1.3 to -1.5
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions.	-4.0 to -4.9	3-5	-1.6 to -1.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies.	-5.0 or less	0-2	-2.0 or less

Source: Michigan Hazard Mitigation Plan, 2011

Historically Significant and Related Events: To aid the tracking and analysis of drought conditions in the state, the Michigan Hazard Mitigation Plan 2011 edition divided the state into ten climate divisions and analyzed historical data from the National Climatic Data Center (NCDC) dating back to 1895. Mason County is grouped with Lake, Muskegon, Newaygo, and Oceana counties in west-central Lower Michigan. The statewide plan lists the following 12 drought events recorded within this division lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months). The most extreme of these droughts was in January 1931, when the Palmer Drought Severity Index hit a record low of -7.20.

In addition, the Michigan plan identified the percentages of years and months exhibiting a degree of drought in Mason County's climate division. The minimum qualification for drought in this analysis is a Palmer Index of -2.0, which is considered a moderate drought on the U.S. Drought Monitor (category D1).

Percentage of Drought Months and Years, 1895 to 2010
Lake, Mason, Muskegon, Newaygo, and Oceana Counties

	No Drought	Palmer ≤ -2.0	Palmer ≤ -3.0	Palmer ≤ -4.0	Palmer ≤ -5.0	Palmer ≤ -6.0	Palmer ≤ -7.0
Drought Years	43%	57%	29%	12%	2%	2%	1%
Drought Months	77.9%	22.1%	8.2%	2.5%	0.7%	0.4%	0.1%

Source: Michigan Hazard Mitigation Plan, 2011

The Ludington Daily News provided a great deal of information on the drought of 1891, and ensuing fires, in its March 18, 2003 edition. A quote from the Manistee Times-Sentinel described the effect of the drought on river log drives ("The Muskegon River is so low that logs are being glided o'er its bosom with great difficulty.") and reported that Michigan's lumber production for the year was estimated to be 300 million feet less than the output for 1890.

In August 2012, the United States Department of Agriculture (USDA) issued a Secretarial Designation for all 83 counties in the State of Michigan as primary natural disaster areas for drought and excessive heat conditions which began in March 2012. The counties designated by USDA as natural disaster or contiguous disaster areas means that qualified farm operators are eligible for low interest emergency (EM) loans from USDA's Farm Service Agency (FSA), provided eligibility requirements are met.

Frequency of Occurrence: A review of historic drought events reveals that Mason County is certain to occasionally experience drought. Mild droughts are common, while severe droughts are less frequent and generally of shorter duration. A severe drought in Mason County may significantly lower the water table and pose multiple threats as described in the preceding Hazard Description. Low water levels could possibly hinder water-based recreation and tourism, negatively affect agriculture, increase risk of wildfire, and affect the drinking groundwater supply.

According to NCDC records, Mason County has experienced drought conditions of eight months or greater 12 times in the 116-year period from 1895 to 2010. Of those events, 11 occurred over three separate spans of 21 years or less: 1895-1911 (4 events, 16 years), 1925-1931 (2 events, 6 years), and 1956-1977 (5 events, 21 years). The outlying event occurred in 2002-2003. Overall, historical trends suggest there is an approximate 10 percent chance of experiencing lengthy drought conditions in any given year.

Drought conditions of shorter duration are more common than lengthy events, as 57 percent of the years from 1895 to 2010 attained a Palmer Index rating of at least -2.0. This statistic however, may overstate the prevalence and effects of drought in Mason County because it fails to address their duration and severity. A more precise indication of drought frequency is revealed in the percentage of months experiencing drought from 1895 to 2010, which is 22.1 percent.

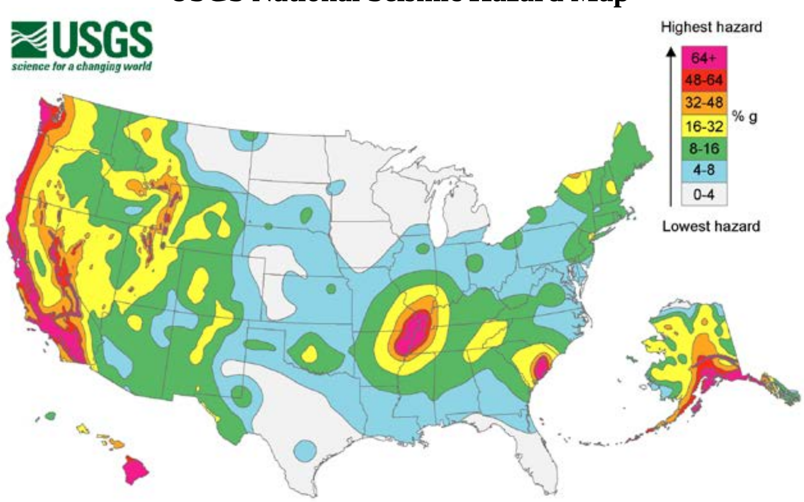
1.03 EARTHQUAKE

A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface.

Summary: The earthquake hazard is low for Mason County. The United States Geological Survey predicts a 2% probability of an earthquake occurring in the next 50 years of a magnitude capable of a peak acceleration of 4% g (gravity). This might cause damage and possible collapse of buildings constructed before 1940.

Hazard Description: Earthquakes range in intensity from slight tremors to great shocks. They may last from a few seconds to several minutes, or come as a series of tremor over a period of several days. Earthquakes, whose energy is released through a series of seismic waves, usually occur without warning. In some instances, advanced warnings of unusual geologic events may be issued. However, it is not yet possible to forecast or predict where an earthquake will occur. Earthquakes tend to strike repeatedly along faults, which are formed where tectonic forces in the earth's crust cause the movement of rock bodies against each other. Risk maps have been produced, such as the map shown below, which show areas earthquakes are more likely to occur. Earthquake monitoring is conducted by the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and universities throughout the country.

USGS National Seismic Hazard Map

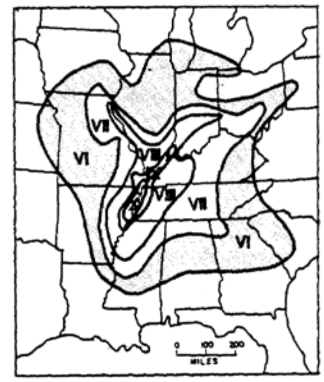


Source: http://earthquake.usgs.gov/hazards/products/

Actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris. Disruption of communications systems, electric power lines, and gas, sewer and water mains can be expected. Water supplies can become contaminated by seepage around water mains. Damage to roadways and other transportation systems may create food and other resource shortages if transportation is interrupted. In addition, earthquakes may trigger other emergency situations such as fires and hazardous material spills, thereby compounding the difficulties of an emergency situation.

Historically Significant and Related Events: Research for this document found no records of earthquake damage in Mason County. The nearest significant tremors have historically been no closer than the lower third of the state. On August 9, 1947 a 4.6 magnitude earthquake shook southern Michigan. According to the USGS, it is the largest earthquake to occur in Michigan. More recently, a magnitude 5.8 earthquake in central Virginia on August 23, 2011 was felt well into the Midwestern states. At least weak shaking was widely reported across the southern half of Lower Michigan.

New Madrid Seismic Zone



Regional map of maximum intensities that would result from a magnitude Ms=7.6, maximum intensity earthquake *anywhere* along the New Madrid Seismic Zone.

The New Madrid Seismic Zone is the most likely source of seismic activity to affect the area. It is located in the vicinity of the Mississippi River in Missouri, Tennessee, and Arkansas, poses a minimal threat to Mason County. Notable historic earthquakes emanating from this area occurred in 1811, 1812 and 1895, with intensities ranging from to 6.6 about 8.0 on the Richter Scale. These earthquakes sent vibrations across the eastern United States, including southern Lower Michigan.

Frequency of Occurrence: According to U.S. Geological Survey maps, Mason County lies north of the area of impact that would be expected to result from a maximum intensity earthquake anywhere along the New Madrid Seismic Zone. Earthquakes are not considered a significant hazard in Mason County.

1.04 EXTREME TEMPERATURES

Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions.

Summary: Mason County enjoys a relatively stable and comfortable climate year-round, thanks to the moderating influence of nearby Lake Michigan. Even so, significant temperature extremes are realized every year. From 1981 to 2010, the City of Ludington annually averaged 5 days with a high temperature of 90 degrees or more and 3.7 days with a low temperature of 0 degrees or less.

High humidity in summer and high winds in winter exacerbate the effects of temperature extremes and increase the risk of harm on human health and property, while prolonged periods of extreme temperatures can pose life-threatening problems for residents. Public education about extreme temperature hazards, early notification of impending extremes, and the availability of cooling and warming shelters are all beneficial actions in mitigating the impacts of these hazards upon people. Although quite different from each other in terms of conditions and impacts, the two hazards share a commonality in that they both pose particular problems for the most vulnerable segments of society: the elderly, children, impoverished persons, and persons in poor health. Extreme temperatures can also negatively impact livestock, crops, wildlife, and infrastructure.

Hazard Description: Temperature extremes are broken down into two categories: extreme heat and extreme cold. Both extremes can last for weeks, affect large expanses, and occur without any advance warning and in the middle of a seemingly normal weather pattern. Additionally, both extreme heat and extreme cold can cause loss of life to vulnerable populations, sporadic damage to infrastructure, and disruptions to schools and businesses. About 900 annual deaths nationwide have been attributed to extreme temperatures (mostly from extreme cold, which claims about 700 deaths). Each type of extreme temperature is addressed separately in the following discussion.

<u>Extreme heat</u> occurs primarily in the summer months of June, July, and August and is marked by temperatures over 90 degrees Fahrenheit. When these conditions persist over a prolonged period of

time, it is known as a heat wave. Heat can be lethal by taxing the human body beyond its abilities to maintain homeostasis. Conditions characterized by a combination of very high temperature and high humidity can result in several dangerous and potentially life-threatening health conditions including heat cramps, heat exhaustion, and heatstroke.

- *Heat cramps* are muscular pains that are caused by an imbalance of fluids in the body because of dehydration from heavy sweating. These cramps usually involve the legs or abdominal muscles.
- *Heat exhaustion* is often the result of exercise or heavy work in a hot place. Physical exertion causes a person to lose fluids through heavy sweating. Blood flow to the skin increases, causing blood flow to vital organs to decrease, leading to a mild form of shock. Symptoms include dizziness, weakness, and fatigue. Heat exhaustion can usually be treated by drinking fluids and staying in a cool place until the body temperature and fluids return to normal.
- *Heatstroke* is a life threatening condition that results when a person's temperature control system, which produces sweating to cool the body, stops working. When this happens, the body's temperature can rise so high that brain damage and death may be possible.

In general, fatigue sets in (80 to 90 degrees), followed by heat exhaustion (90 to 105 degrees), then sunstroke or heatstroke (106 to 130 degrees). Urban areas are especially prone to high heat, with impervious surfaces reflecting sunlight, air pollutants trapping heat, and lessened air circulation in densely developed areas. Individuals in urban and rural areas who are young, elderly, impoverished, in poor health, or isolated are at additional risk to extreme heat due to poor access to air conditioning or having physical limitations.

The "Heat Index" table indicates an estimation of how warm temperatures might actually feel to the human body when combined with a given humidity. It should be noted that conditions for each individual will vary with the duration and type of weather, activity, exposure, personal health, extent of acclamation, and the type of clothing worn. Also, actual indoor conditions may vary, trapping heat and/or humidity in some locations and making them potentially more dangerous.

Heat Index

Relative Humidity	Actual Temperature (degrees Fahrenheit) 90	92	94	96	98	100	102	104	106	108
40%	91	94	97	101	105	109	114	119	129	130
45%	92	96	100	104	109	114	119	124	130	137
50%	95	99	103	108	113	118	124	131	137	144
55%	97	101	106	112	117	124	130	137	145	
60%	100	105	110	116	123	129	137	145		
65%	103	108	114	121	128	136	144			
70%	106	112	119	126	134	143				
75%	109	116	124	132	141					
80%	113	121	129	138						
85%	117	126	135	145						
90%	122	131	141							
95%	127	137								

Source: Michigan Hazard Mitigation Plan, 2011

Prolonged extreme heat can also have an economic impact on society, through (1) lost work, (2) increased electricity usage, leading to brown-outs or black-outs, (3) drought, (4) increased stress on farm crops, streams and lakes, (5) increased stress on farm animals, pets, and wildlife, and (6) increased stress on infrastructure and on commercial and residential buildings. The table to the right reveals heat statistics recorded in Ludington between 1981 and 2010.

Extreme Heat in Ludington
1981-2010

	May	June	July	Aug.	Sept.	Annual
Avg. number of days with 90° F or greater	<1	1.5	1.8	1.4	.23	5
Annual chance at least 1 day of 90° F or greater	3.3%	43.3%	40%	36.7%	10%	63.3%

Source: Michigan State Climatologist's Office

Extreme cold is primarily associated with the wintery months of November through April and categorized by temperatures plunging near or below 0 degrees Fahrenheit. Periods of extreme cold are risky for those in both urban and rural areas. Frostbite and hypothermia are common in rural areas where people are trapped outdoors and do not adjust properly to the temperatures. Even indoors, hypothermia is a concern for individuals living in inadequately heated dwellings. Loss of life can occur with either of these situations. Damage to buildings and infrastructure can also occur in bitter cold conditions, resulting in expensive repairs and days of business and school shutdowns. Strong winds accompanying the cold temperatures work to intensify their effects. Like extreme heat, exposure to extreme cold can create significant health problems. Most cold-related deaths are not the direct result of freezing, but rather the result of pre-existing illness and diseases that are exacerbated by the extreme temperatures. These illnesses may include stroke, heart disease, and/or pneumonia. Health conditions directly resulting from exposure to extreme cold include:

- *Frostbite* is the freezing or partial freezing of some part of the body, usually occurring in the extremities such as toes, fingers, ears, or nose. Frostbite rarely results in death, but does damage the tissue that has been frozen, and in extreme cases may require amputation. A loss of feeling and a white or pale appearance in body parts are symptoms of frostbite.
- *Hypothermia* is a condition brought on when the body's temperature drops significantly due to exposure to cold. Hypothermia becomes serious when the body's internal temperature goes below 95 degrees Fahrenheit. When the body falls below 90 degrees, normal shivering reactions stop and emergency treatment is necessary. Symptoms of hypothermia include uncontrollable shivering (when body temperature is above 90 degrees), slowed speech, memory lapses, frequent stumbling, drowsiness, and exhaustion. If left untreated or treated improperly, hypothermia can lead to death. Unlike frostbite, hypothermia can occur in a person who is exposed to only moderately cold temperatures (even when indoors)—typically over a prolonged period of time. Infants, the elderly, and persons with conditions that do not allow their bodies to heat normally are most susceptible to this form of hypothermia.

Wind chill temperatures reflect the effects of winds and cold, based on the rate of heat loss from exposed skin. Wind chill does not affect inanimate objects such as car radiators or exposed water pipes because they do not cool below the actual air temperature. As extreme cold and winds cool the skin, frostbite can occur as the body tissue begins to freeze. Hypothermia occurs when a person cools to an abnormally low body temperature (below 95 degrees). Similar to extreme heat, individuals who are young, elderly, impoverished, in poor health, or isolated in a rural location are at additional risk to extreme cold due to poor access to heating or having physical limitations.

The "Wind Chill" table indicates an estimation of how cold temperatures might actually feel to the human body when combined with a given wind speed. Actual conditions for each individual will vary with the duration and type of weather, activity, exposure, personal health, extent of acclamation, and the type of clothing worn.

Wind Chill

Wind Speed (mph)	Actual Temperature (degrees Fahrenheit)									
	40	30	20	10	0	-10	-20	-30	-40	-50
5	36	25	13	1	-11	-22	-34	-46	-57	-69
10	34	21	9	-4	-16	-28	-41	-53	-66	-78
15	32	19	6	-7	-19	-32	-45	-58	-71	-83
20	30	17	4	-9	-22	-35	-48	-61	-74	-88
25	29	16	3	-11	-24	-37	-51	-64	-78	-91
30	28	15	1	-12	-26	-39	-53	-67	-80	-94
35	28	14	0	-14	-27	-41	-55	-69	-82	-96
40	27	13	-1	-15	-29	-43	-57	-71	-84	-98
45	26	12	-2	-16	-30	-44	-58	-72	-86	-100
50	26	12	-3	-17	-31	-45	-60	-74	-88	-102
55	25	11	-3	-18	-32	-46	-61	-75	-89	-104
60	25	10	-4	-19	-33	-48	-62	-76	-91	-105

Source: Michigan Hazard Mitigation Plan, 2011

The economic impacts of extreme cold include (1) lost work, (2) increased use of utilities, (3) increased stress to farm animals, pets and wildlife, (4) damage to infrastructure, particularly roadways and water systems, and (5) disrupted transportation. Unusually cold temperatures during the growing season, even if not normally defined as "extreme" under other circumstances, can harm or destroy agricultural crops, drastically reducing crop yields and thus causing economic hardship for farmers and farming communities. Severe, extended below-freezing temperature situations are defined as when the air temperature or wind factor temperature stays below 20 degrees Fahrenheit for 12 hours or more. These conditions pose the greatest risk when partnered with another hazard such as severe winter weather, transportation accidents, and infrastructure failure. The table to the right reveals cold temperature statistics recorded in Ludington between 1981 and 2010.

Extreme Cold in Ludington
1981-2010

	Dec.	Jan.	Feb.	Mar.	Annual
Avg. number of days with 0° F or less	0.5	1.6	1.2	0.37	3.7
Annual chance at least 1 day of 0° F or less	26%	60%	53%	23%	87%

Source: Michigan State Climatologist's Office

Historically Significant and Related Events: While Mason County is certainly susceptible to prolonged periods of hot, humid weather in the summer and extreme cold during the winter, their impacts are somewhat mitigated due to the county's proximity to Lake Michigan. This geographic relation leads to moderated temperature extremes throughout the year. The all-time record high temperature in Ludington is 99 degrees (August 1988), while the all-time low temperature is -22 degrees (February 1979). From 1981 through 2010, there was an annual average of 5 days with temperatures 90 degrees or above, and 3 to 4 days per year with temperatures 0 degrees or below. Although there were more hot days per year on average than cold days, the cold days were actually more common from year to year. Over one-third of the years in that span did not reach 90 degrees at all, while only 13 percent of those years failed to achieve a minimum temperature at or below 0 degrees.

The record cold of January 13-20, 1994 warranted a Presidential Declaration of Major Disaster (Underground Freeze) for counties primarily in the Upper Peninsula. Although Mason was not included in the declaration, it was mentioned in an NCDC compilation of 32 counties in Michigan suffering a combined $5 million in property damages and frozen water and sewer lines from the event.

The Michigan Hazard Mitigation Plan also lists a number of significant heat waves affecting Michigan. For example, extreme heat during the summer of 1936 caused 570 deaths statewide. In the summer of 1988, the central and eastern regions of the U.S. experienced drought and heat wave conditions that caused an estimated 5,000 to 10,000 deaths (depending on one's definition of "heat-related" death). In that year, a Michigan state record was set for consecutive days of 90 degrees or more, 39 days. The previous record of 36 days was set during the "Dust Bowl" era in 1934. Undoubtedly these events had some degree of impact on Mason County; however specific accounts were not identified.

While not extreme in terms of annual temperatures, anomalous temperatures were realized across the Great Lakes region, including Mason County, for a significant duration in March 2012. The following is summary of the event taken from the "March 2012 Climate Summary for Southwest Lower Michigan" by the National Weather Service in Grand Rapids, MI. Mason County resides within the forecast area of this NWS Forecast Office.

"March 2012 was a historically warm March, setting records at the primary climate sites. Average temperatures ranged from 45 degrees to over 50 degrees, which is 13 to 16 degrees above normal across Southwest Lower Michigan and most of the Great Lakes region. Grand Rapids, Lansing and Muskegon all set or equaled the all-time March high temperature records

on the 20th. This happened again on the 21st. The new record highs for March are 87 degrees in Grand Rapids, 86 degrees in Lansing and 82 degrees in Muskegon. Temperatures were most extreme from the 11th through the 25th. There were only about ten days during the month with values near or just below normal."

"The daily temperatures were well above normal nearly continuously from the 6th through the 28th. From the 14th through the 23rd temperatures were more than 20 degrees above normal every day. That is the all-time record for any month for days in a row with temperatures 20 degrees or more above normal. There have only been 2 years on record with more than 10 days at 20 degrees above normal, 1894 and 1990, both of those years had 11 days for the entire year."

The March warmth was a major contributing factor to the spring of 2012 becoming the most extreme season of any kind in U.S. history to date. This historically significant event triggered an early growing season across much of the U.S. In Michigan, this put sensitive crops and agriculture at a significant risk of exposure to freezing temperatures following the warm spell. Crop loss was estimated to be $209.8 million in Michigan, while the total estimated economic impact of the crop loss was $502.9 million.

Frequency of Occurrence: Extreme or anomalous temperatures are inevitable in Mason County and are possible any given day of the year. Long stretches of these conditions are certainly less likely than short duration events. Fortunately, these extreme events can be forecast well ahead of time.

Temperature observations taken in Ludington from 1981 to 2010 give an indication of the possible future frequencies of extreme heat and cold. The temperature Ludington reached a high temperature of 90 degrees or more at least once per year in 63.3% of the years, with an overall average of 5 days per year. A minimum temperature of 0 degrees or less was observed at least once per year in 87% of the years, with an overall average of 3.7 days per year.

1.05 FLOODING: RIVERINE/URBAN

The overflowing of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice.

Summary: Annual flood losses amount to several billion dollars per year nationwide, along with over 140 fatalities on average. In Michigan, as well as across the nation, the leading cause for disaster declarations by the Governor or the President is flooding.

Mason County has a number of rivers and streams whose flows occasionally exceed their banks, and there are some developed areas that are at risk of flooding. Eleven communities in the county participate in the National Flood Insurance Program (NFIP), and one repetitive loss property has been identified. In addition, Mason County has watercourses that are prized for their natural scenery, historic value, and outstanding recreational attributes such as paddling and fishing. Major flooding and flash flooding may damage theses systems, endanger individuals, and negatively impact the local economy.

Hazard Description: Flooding of lands adjacent to the normal course of a stream, river, drain, lake, or reservoir has been a natural occurrence throughout recorded history. If these floodplain areas were left in their natural state, floods would not cause significant damage. In addition, developments near waterways increase the potential for serious flooding by increasing runoff rates and decreasing opportunities for natural infiltration. Impervious surfaces such as streets, parking lots and rooftops, and man-made channels and pipes, increase rainfall runoff that would otherwise soak into the ground, or take several days to reach a river or stream via a natural drainage basin (also known as a watershed). Developments within a floodplain are not only at a risk for significant damage, but they may also impede the carrying capacity of the drainage area, increasing flood levels and putting additional development at risk.

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. Long-term collateral dangers include the outbreak of disease, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fire, release of hazardous materials, dam failure, and environmental damage to natural ecosystems.

Most riverine flooding occurs in the early spring as the result of excessive rainfall and/ or the combination of rainfall and snowmelt. Ice jams (in winter and early spring), log jams, and any other type of debris jam can also lead to flooding. These blockages can cause flash flooding if the jam suddenly gives way. Severe thunderstorms are another common cause flooding, and are most likely during the spring, summer, or fall. These instances are normally localized events and have more impact on watercourses with smaller drainage areas.

It is widely known that controlling floodplain development is the key to reducing flood-related damages. Although there are state and local programs to regulate new development and substantial improvements in flood-prone areas, the opportunity to mitigate flood hazards ultimately rests with local governments since they control the regulation or direction of land development. Proper land use management and strict enforcement of building codes can make communities safer from flood hazards and help reduce the high cost of flood losses.

The Federal Emergency Management Agency's National Flood Insurance Program (NFIP) is designed to identify and map floodplains, to provide flood insurance to flood-prone locations, and also to encourage flood protection activities. Through the NFIP Community Rating System (CRS), communities involved in the program are awarded points based on the various flood protection activities they are engaged in. These points are then applied to a rating system used to grant insurance premium reductions based on the number of points attained by each community. There are no communities in Mason County currently participating in the CRS.

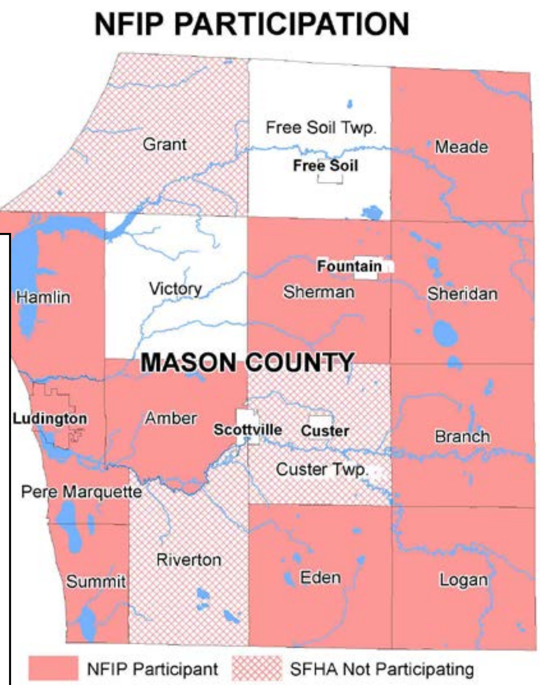
One goal of the NFIP is to reduce the number of "repetitive loss properties." This is any property receiving two or more flood insurance claim payments for at least $1,000 within any 10-year period since 1978. Repetitive loss properties are a high priority because they account for approximately 33% of the total NFIP claim payments. Mason County has only one repetitive loss property. It is a single-family home, located in Meade Township, and had been damaged by two floods within the past 10 years, averaging several thousand dollars per event

NFIP Insurance Policies
- As of November 30, 2014 -

Community	Total Premium	Policies (#)	Policy Coverage	Since 1978 *# of Claims*	Since 1978 *Claims Paid*
Amber Twp	$1,819	1	$189,000	-	-
Hamlin Twp	$17,035	26	$6,077,200	-	-
Logan Twp	$1,023	1	$100,00	-	-
Ludington City	$25,200	7	$3,509,500	-	-
Meade Twp	$165	1	$13,900	2	$11,735
Pere Marquette Twp	$21,066	15	$3,688,100	2	$937
Sherman Twp	$490	1	$45,000	-	-
Summit Twp	$4,312	4	$871,400	3	$16,221
Mason Co. Total	**$71,110**	**56**	**$14,494,100**	**7**	**$28,893**

Source: *Federal Emergency Management Agency, November 30, 2014.*
http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

There are eleven (11) jurisdictions in Mason County participating in the NFIP: City of Ludington, and the townships of Amber, Branch, Eden, Hamlin, Logan, Meade, Pere Marquette, Sheridan, Sherman, and Summit. Flood Insurance Rate Maps (FIRM) have been produced for all of these communities except for Meade, Sheridan, and Sherman townships. In addition, the townships of Custer, Grant, and Riverton have special flood hazard areas identified (SFHA), but they do not participate at this time. The map below shows all NFIP-participant communities and SFHA communities.



NFIP participation as of January 2015

NFIP Participating Communities

City of Ludington
Amber Township
Branch Township
Eden Township
Hamlin Township
Logan Township
Meade Township
Pere Marquette Township
Sheridan Township
Sherman Township
Summit Township

Flooding may not always be attributable to the overflowing of a natural water feature. Rather it may result from a combination of excessive rainfall and/or snowmelt, saturated or frozen ground, and inadequate drainage. Flooding may also occur from a combined sewer system if it becomes overloaded by an excessive amount of water in a short time span, such as during a heavy thunderstorm. These additional sources of flooding typically result in flooded basements and ponding of water over roads or other low-lying areas because surface water of any kind will always gravitate to the lowest elevation. Flooding in such locations may lead to significant property damage, infrastructure failure, crop loss, and/or public health and safety concerns, even if it occurs outside a floodplain. In rural areas of Mason County, sources of flooding other than rivers and streams are mitigated somewhat by natural vegetation. Even so, roads, bridges, and culverts in Mason County are susceptible to erosion and failure from flash flooding produced by torrential rainfall.

Flooding is a hazard whose risks are routinely underestimated by the public, who may be inclined to attempt to walk or drive through shallow waters, or to allow their children and pets to play in the water as if it were part of a beach or swimming pool. Public education is vital so that there is widespread knowledge of the contaminants and germs that floodwaters may contain, and a greater awareness of the risks that floodwaters pose to drivers and pedestrians. Drivers need to know that roads and bridges are often weakened and degraded by flood impacts, and that the road they assume is still there under shallow waters may no longer be intact. Less than a foot of flowing water can cause travelers to end up in a ditch or sinkhole where it may be impossible to escape a submerged vehicle under the pressure exerted by flowing water. Pedestrians should be informed that floodwaters tend to conceal open manholes and dangerous debris, such as rusty nails and metal, or live electrical wires.

Flooding is generally part of a natural cycle that has many important and beneficial functions for the environment. Flooding raises the water table in wetlands, maintains biodiversity, and replenishes soil nutrients. Additionally, high water tables allow fish and vegetation to recolonize and may also help to control some invasive species. Flooding, however, becomes a problem in the built environment. Impervious surfaces cause increased runoff, which may carry pollutants into natural water resources. Increased runoff also promotes erosion, which can lead to road washouts and increased sediment in surface water features. Finally, drainage systems and city sewers can become overwhelmed, causing raw sewage to enter basements, spread onto roadways, and infiltrate groundwater supplies. Residential septic systems can also be flooded, which may cause a release of household waste and chemicals into the environment.

The potential effects of flooding on recreational and ecological values of water features must also be considered. In Mason County, the Pere Marquette River is a designated National Wild and Scenic River and a Michigan Natural River. The Little Manistee River is another high-quality watercourse whose consistent supply of unusually high quality water allows opportunities for fly fishing and canoeing. Increased erosion and sedimentation near water bodies in the county may harm the ecology of water features, destroying habitat for fish and wildlife. A sudden inundation of rainfall runoff, especially when enhanced by impervious surfaces, may also pose serious dangers to persons recreating in and near waterways.

Historically Significant and Related Events: Mason County has had two Declarations of Major Disaster by the President due to flooding: September 1986 and June 2008.

In all, the NCDC lists ten flood or flash flood events from 1996 through 2013. NCDC records are not available for the 1986 flood; however it is known that the event caused the Sauble River to flood in Meade Township and caused a bridge to fail and be replaced with a culvert. This was the worst flood in recent history for many communities across Lower Michigan.

In May-June 2004, Mason County was not included with the state or federal declarations of disaster for flooding in 23 affected counties. However, this was considered the biggest and longest duration flooding event in the region since 1986, and was blamed for one million dollars in property damage and two hundred thousand in crop damage in Mason County according to the NCDC. On June 9, 2004, a local emergency was declared for Riverton, Summit, Pere Marquette, and Amber townships after over 8" of rain in three hours. The event resulted in $20,000 in property damage, 31 roads closed, and put a strain on the county's supply of marker barrels. In addition, one Chauvez Road at Swan Creek washed out in Riverton Township. According to the Ludington Daily News, a "minivan plunged into a 40-foot gap opened when a section of road, weakened by heavy rains, gave way." The driver "narrowly escaped after being swept almost 75 feet downstream." Apparently "the torrential rains were too much for the small culvert which runs beneath Chauvez Road."

The June 2008 flooding disaster was characterized by damaging flash floods from excessive rains that dropped up to eleven inches of rain over six to eight hours in the hardest hit areas. According to the NCDC report, the Michigan Department of Transportation shut down U.S. 31 from Manistee to Scottville when the road washed out. There were four washouts on M-116 near Ludington State Park, one of which was eight feet deep. The Department of Natural Resources evacuated and closed Ludington State Park due to flooding and concerns about the Hamlin Lake Dam. Mason County officials shut down 47 roads due to flooding and washouts. Damage to public infrastructure (mostly road and bridge washouts) was estimated to have reached close to $3 million, and damage to crops totaled $500,000 for this event. Mason County was included in the federal Major Disaster Declaration for severe storms, tornadoes, and flooding which was declared on July 14, 2008.

Mason County experienced significant floods each year between 2012 and 2014. In 2012, an estimated 5 to 7 inches of heavy rain fell across parts of the County on May 3, resulting in several roads that were either flooded or washed out. This episode caused an estimated $75,000 in property damage. In early to mid-April 2013, rainfall led to significant flooding in the surrounding region, but only minimal damage in Mason County. The flood resulted in a presidential disaster declaration for many areas in Michigan, but did not include Mason County. In April 2014, another flood impacted the area causing the Governor to issue a disaster declaration for eight counties in western Lower Peninsula. Damages sustained in Mason County as a result of this event were not yet available at the time this description was written.

Frequency of Occurrence: Minor flooding is likely to naturally occur every year in Mason County. Flood insurance rate maps have identified floodplains in the City of Ludington and the townships of Amber, Branch, Eden, Hamlin, Logan, Pere Marquette, and Summit. (Meade, Sheridan and Sherman townships participate in the NFIP, but have not been mapped). By definition, these areas have at least a 1% chance per year of flooding. Refer to the Hazard/Risk Profile maps in Appendix B for approximate delineations of floodplain areas in the county. In addition, the severity and frequency of flooding are likely to increase when Lake Michigan is at or near record levels, as it was in 1986. The levels of the Great Lakes are cyclic, but impossible to predict at this point.

In 30 years from 1985 through 2014 Mason County averaged a major flood about once every 10 years. Three such events (1986, 2004, and 2008) have been noted during that period. Two of those events occurred in the most recent 10-year period.

1.06 FOG

Condensed water vapor in cloud-like masses close to the ground and limiting visibility.

Summary: Historically, fog has not been considered as a significant hazard in Mason County. However, this hazard is addressed by the Michigan Hazard Mitigation Plan, and is therefore discussed in this plan.

The NCDC does include fog and freezing fog events in its Storm Events Database; however documentation for these events is not as extensive and standardized as it is for other natural hazards, such as thunderstorms and winter weather.

Hazard Description: Fog forms near the ground when water vapor condenses into tiny liquid water droplets that remain suspended in the air. Many different processes can lead to the formation of fog, but the main factor is saturated air. Two ways that air can become saturated are by cooling it to its dew point temperature or by evaporating moisture into it to increase its water vapor content. Fog is often hazardous when visibility is reduced to 1/4 mile or less. The interaction between humans and fog can be a dangerous situation, sometimes resulting in disastrous consequences. The National Weather Service issues dense fog advisories when fog reduces visibility to 1/8 mile or less over a widespread area. For marine environments, dense fog advisories are issued for widespread or localized fog reducing visibilities to regionally or locally defined limitations not to exceed 1 nautical mile. Freezing fog (a hazard for which the National Weather Service issues special statements) can cause harm by causing slickness on roadways and thus leading to serious transportation accidents.

In considering severe and high-impact meteorological events, attention can easily become focused on the more dramatic storms. Tornadoes and hurricanes for example, are readily recognized by the general public and the meteorological community alike for their devastating consequences. Fog, on the other hand, does not lend itself as readily to this categorization. Yet, in terms of cost and casualties, fog has consistently impacted society. In particular, the transportation sector is vulnerable to fog, with sometimes deadly consequences. Fog has played a contributing role in several multi-vehicle accidents over the past several years. While statistics suggest that highway accidents and fatalities have generally decreased in recent history, that trend is not evident with respect to accidents and fatalities caused by fog.

Fog may be widespread or localized, and can be very dangerous because it reduces visibility. Although some forms of transport can penetrate fog using radar, road vehicles have to travel slowly and use more lights. Localized fog is especially dangerous, as drivers can be caught by surprise. Fog is particularly hazardous at airports, where some attempts have been made to develop methods to aid fog dispersal, such as using heating or spraying salt particles. These methods have seen some success at temperatures below freezing.

The primary risks from fog involve the dangers of traveling under conditions of limited visibility. Although some modes of transportation such as aircraft are well-regulated, other modes, including simple pedestrian travel, may involve risks that have not been properly accounted for by those who are focused merely on reaching their destination as quickly as possible. The most substantial impacts have recently involved drivers whose bad habits (primarily that of not maintaining safe speeds and following distances) proved to be simply unsustainable under conditions of reduced visibility, resulting in severe crashes and subsequent roadway obstruction. In some circumstances, these conditions of reduced visibility can arise very quickly, although careless drivers, in their desire for fast travel conditions, may erroneously try to ignore the risks from reduced visibilities, in the hope that the condition will suddenly correct itself before any harm is caused. Fog may also increase the threat of hazardous materials (HAZMAT) transportation accidents. That hazard is addressed as a separate hazard in this document.

In addition to creating potentially hazardous automotive and air transportation conditions, fog may cause increased risks to outdoor recreation activities, such as boating, off-roading, and snowmobiling. These outdoor activities are common in Mason County.

Historically Significant and Related Events: There is one fog event listed in the NCDC for Mason County, which took place in January 1995. Dense fog blanketed much of Lower Michigan during the period from the evening on the 11th through the morning on the 13th. The fog caused numerous traffic accidents, which resulted in four fatalities. School openings were delayed in parts of southwest Michigan as visibilities dropped to near zero. Low visibilities caused most of the flights at Detroit's metro airport to be cancelled, delayed or diverted on the 12th. Approximately 75 flights were also delayed or cancelled at Kent County International Airport in Grand Rapids.

Another, more recent fog event in the neighboring county of Manistee demonstrates the potential threat of fog to outdoor recreational activities. On May 22, 2010, dense fog inhibited visibility in the area, and a fishing boat struck a pier and at the entrance to Manistee Harbor. It subsequently took on water and submerged, requiring the rescue of seven persons from the water. The accident led to one indirect fatality, two injuries requiring treatment at a Manistee hospital, and four minor injuries that were treated on-site.

Frequency of Occurrence: According to the Michigan Hazard Mitigation Plan, one major fog event is estimated to occur in Michigan approximately every two years. Property damage can be significant for vehicles, although real property and structures are usually unaffected.

Although Mason County was included in one dense fog event reported to the NCDC, there is insufficient fog data from which to derive a frequency of occurrence. Fog is possible at any time of the year; and especially during the winter and spring seasons when relatively warm and moist air is most likely to encounter a melting snowpack from recent snowfall.

1.07 GREAT LAKES SHORELINE HAZARDS

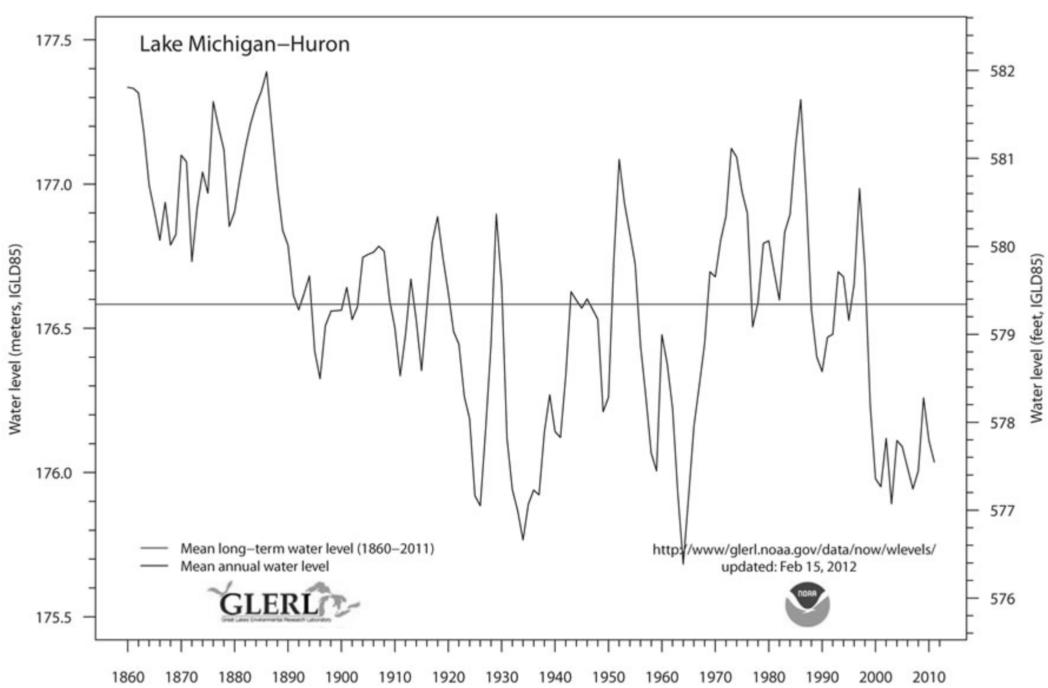
High or low water levels that cause flooding or erosion, and other threatening shoreline conditions, including storm surges, rip currents, and shoreline recession.

Summary: Shoreline flooding and erosion are natural processes that occur constantly, regardless of water levels. However, during periods of high water, the effects of flooding and erosion are more evident, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Low water levels can also present hazards, such as shallow shipping and recreation channels or increased exposure of polluted lake-bottom debris. Other shoreline hazards include severe winds, seiches, and rip currents. These conditions can be life-threatening for boaters and swimmers, and are often exacerbated by the presence of structures such as breakwalls, piers, and river mouths.

With about 28 miles of Lake Michigan coastline, Mason County is at risk from Great Lakes shoreline hazards. According to the 2010 U.S. Census, approximately 2,706 citizens reside within census blocks located within a half-mile of the Lake Michigan shoreline. There are approximately 2,538 housing units within the same area. Communities that border Lake Michigan include the City of Ludington, and the townships of Grant, Hamlin, Pere Marquette, and Summit. Each community has a number of popular public access points for recreation on Lake Michigan. In addition, Mason County has a harbor at Pere Marquette Lake that hosts a number of commercial and recreational activities and has breakwalls that shield its connection to Lake Michigan.

Hazard Description: The Great Lakes occupy an area of 95,000 square miles and drain an amount of land twice that size. They hold nearly one-fifth of the world's fresh surface water. Because the Great Lakes' watershed is so vast, seasonal changes in precipitation within the basin have a direct effect on water levels. However, this relationship is not immediately evident because of the delay between the time precipitation falls within the drainage basin and the time that runoff waters enter the lakes.

Long-term and seasonal variations in precipitation and evaporation rates primarily determine the fluctuation of water levels on the Great Lakes. Over one hundred years of record keeping have not indicated a simple, easily-predictable cycle of water levels on the Great Lakes. Geologic research has indicated quasi-periodic cycles of 33 years and 160 years for lake level fluctuations; e.g. Baedke and Thompson's article in the Journal of Great Lakes Research, v.26 p. 416-426, 2000. The time between periods of high and low water levels can vary widely.



In addition to natural causes of water level fluctuation, there are four man-made factors that can also affect water levels to some degree: (1) diversion of water for power generation, municipal water supply and navigation; (2) regulation of water levels via dams and other control structures; (3) dredging of connecting waterways for navigation purposes; and (4) covering land surfaces with impervious materials that cause storm runoff to be delivered to water bodies more quickly than the pre-development runoff rates. Although these man-made factors do impact water levels, natural factors such as precipitation, evaporation, and wind have a far greater overall impact. The vast majority of shoreline flooding and erosion that occurs along the Great Lakes is caused by natural factors. However, it should be remembered that it is humans who place themselves in harm's way by building structures in dynamic coastal areas. If that did not occur, the natural processes of flooding and erosion would not be viewed as problems.

Under Part 323, Shorelands Protection and Management, the Michigan Department of Environmental Quality (MDEQ) has determined communities with high-risk erosion areas. A high-risk erosion area is defined by the MDEQ as an area where erosion studies have indicated that the erosion hazard line is receding at an average of one foot or more per year over a minimum 15-year period. The erosion can be caused from one or several factors, including high water levels, storms, wind, ground water seepage, surface water runoff, and frost. The high risk erosion area regulations require a setback distance to protect new structures from erosion for a period of 30 to 60 years, depending on the size, number of living units, and type of constructions. All shoreline communities of Mason County except for the City of Ludington contain one or more sections of high-risk erosion areas. These areas can be viewed on the Hazard/Risk maps found within Appendix B. In addition, the MDEQ also designated flood risk areas along Michigan's shoreline, meaning that they have floodplain-like areas with a 1% annual chance of a designated flood level being exceeded. Most of Mason County's coastline has received this designation. In general, low-lying lands along the coastline are prone to shoreline flooding during both high and low lake water periods. For more information about flooding, see section "1.05 Flooding: Riverine/Urban."

The intent of these and other applicable building restrictions is to minimize the extent and magnitude of shoreline flooding and serious erosion problems along the Great Lakes shoreline. Although shoreline flooding and erosion is inevitable, severe damage can be avoided if prudent shoreland management practices are followed and adequate emergency procedures are implemented. Coordination of federal, state and local shoreland management and emergency preparedness efforts is vital to keeping shoreline areas as safe and undamaged as possible. The recession of the Great Lakes water levels is also inevitable, but there is not much, other than dredging, that can be done to combat the negative effects. That is why it is important for all those involved in water transportation to be prepared for all types of water fluctuations.

Much of Mason County's character is defined by Lake Michigan, as well as inland water features. The beaches provide numerous recreational opportunities and are considered prime real estate. Unfortunately, the inherent hazards of coastal areas are not always apparent. Development activities along the shoreline significantly alter the natural ebb and flow of coastal dynamics. Development of coastal areas threatens to exacerbate the shoreline flooding and erosion problem. As more people and structures are put in harm's way, the problem of shoreline flooding and erosion will continue to grow in frequency and significance.

The MDEQ administers programs aimed at balancing the impact of shoreline flooding and erosion with the development pressures facing the Great Lakes shoreline by implementing non-structural approaches, such as construction setbacks and lowest floor elevation requirements. These types of approaches do not interfere with the natural processes of erosion and flooding, but instead take what is known about the coastal hazard and develop construction standards to prevent the premature collision between homes and nature.

The MDEQ has the responsibility of administering the permitting programs that implement the coastal construction standards. However, under Part 323, local governments have the authority to take over the permitting programs for high-risk erosion and flood risk areas. In the area of floodplain management, permitting responsibility is handled at the local level due to the overlap of regulations found in Part 323, the NFIP, and the building codes. However, few communities have shown an interest in adding the regulatory responsibility of the erosion program to their already busy building and zoning departments. As with many regulatory programs that address private property development rights, the potential for conflict in these areas is high. This is especially true in the realm of expensive shoreline real estate where a view of the water can outweigh the threat of future flood or erosion damage. Political pressure can also come into play in some situations. Compliance with these regulations has best been achieved through cooperation between the State and local governments. Public understanding and support of these programs can be increased by improved communication with property owners regarding natural shoreline hazards.

While high water levels generally increase the risk of flooding and erosion, low water levels can cause significant economic impacts as well. Among those most affected by the low water levels are the shipping companies that operate massive, 1,000-foot-long iron ore and coal carriers on the Great Lakes. Low water levels can force these cargo ships to lighten their loads by as much as 6,000 tons to reduce their drafts and avoid running aground in channels and ports. Also, ferry services that transport people to and from islands may be forced to shut down because of low water depths. Significant drops in water levels can also result in an increase in demand for dredging projects, which can be very expensive. In addition to the high cost of the dredging itself, homeowners and marina operators are faced with the cost of safely disposing of sediments that have been contaminated with heavy metals, pesticides, diesel fuel and other toxic substances. Under strict environmental laws, such dredged material must be deposited in confined disposal facilities.

Aside from precipitation rates and human influences, weather-related events can also cause water level fluctuations lasting from several hours to several days. For example, windstorms combined with differences in barometric pressure can temporarily tilt the surface of a lake up at one end as much as eight feet. This phenomenon, known as storm surge, can drive lake waters inland over large areas. After the storm surge, an oscillation phenomenon called a seiche (pronounced sigh-shh or saysh) is likely to take place. As the water level retreats on one shore, it then shifts back to the opposite side of the lake, but with less intensity. This oscillation is repeated until the body of water becomes calm again and water levels return to normal. Seiches can produce dangerous shoreline conditions called rip currents.

A rip current is a strong flow of water returning seaward from the shore. When wind and waves push water towards the shore, the previous backwash is often pushed sideways. This water streams along the shoreline until it finds an exit back to the sea. The resulting rip current is usually narrow and located between sandbars, under piers, or along jetties. The current is strongest at the surface, and can dampen incoming waves, leading to the illusion of a particularly calm area. Rip currents cause approximately 100 deaths annually in the United States, more than all other natural hazards except excessive heat.

From 2002 through 2012, Lake Michigan has the highest number of rip current-related fatalities and rescues of all the Great Lakes, with 77 fatalities and at least 230 rescues. The majority of these incidents occurred along the eastern and southern shoreline. There are numerous factors, but the primary explanation is that the prevailing wind direction is westerly, or onshore, across the eastern shore of Lake Michigan, making it more prone to rip current development. Secondly, there are a higher number of recreational locations on the Michigan side of the lake; therefore more people are at risk. Rip currents occur less frequently on the western side of Lake Michigan. The main type of rip current on Lake Michigan is the structural rip current, where the longshore current interacts with a pier or breakwall extending out into the lake, such as the piers at White Lake. The typical weather pattern for the development of these rip currents is any that involves onshore flow or flow parallel to the shore, which enhances the longshore current. This typically manifests itself as an approaching or exiting cold front, where onshore winds are either southwesterly (ahead of the front) or northwesterly (behind the front). Lastly, seiches can cause uneven distributions of water in the nearshore environment, leading to rip current development.

In May 2012, the National Weather Service began testing a new warning product, called a Beach Hazards Statement, in certain areas of the United States. Mason County is located within one of those areas. This warning informs beach goers and local authorities about a multitude of hazards in a single statement and provides safety information on these hazards. Some examples of the types of hazards (but not limited to) which may be included in the Beach Hazards Statement are…dangerous currents in the surf zone or unusual surf/wave/water conditions. In coordination with other agencies (as needed), the product may also inform users of various types of environmental hazards such as chemical spills, harmful algal blooms, and other unusual hazards.

For swimmers experiencing a rip current, the most important action is to conserve one's strength so as to stay afloat (rather than expending one's strength in an over-desperate struggle to "fight the current"). Once out of the rip current's pull, head back to shore at a pace that is appropriate to one's strength. In some circumstances, a swimmer may have been observed by beach lifeguards while being pulled by the current, and in such a case, if waves and weather are not too severe to allow a rescue, a swimmer may simply need to stay afloat until the lifeguards can bring aid.

Another Great Lakes hazard is the potential effect of severe winds and waves upon boating activities. Although some discussion of marine accidents can be found in the Transportation Accidents section of this chapter, it must be noted here that severe winds tend to be felt more strongly on open waters (winds from an approaching storm front often strike in advance of the storm itself, by 5 minutes or even more). Waterspouts (which are like a tornado involving contact with water instead of land) are another occurrence posing a great threat to marine traffic and recreation.

Historically Significant and Related Events: According to the Michigan Hazard Mitigation Plan, there have been 10 major periods of flooding/erosion on the Great Lakes since 1918. Extremely high water level peaks occurred in 1929, 1952, 1973, 1986, and 1997. During one of these periods in 1972-1973, high water levels caused shoreline flooding in over 30 Michigan counties that border the Great Lakes, resulting in an excess of $50 million in public and private damage. Thousands of people were forced to evacuate their homes. Similar high water level flooding occurred in the early 1950s and late 1960s, also resulting in millions of dollars in damage to shoreline communities. The record high water levels in 1986, when Mason County was granted a Presidential Disaster Declaration for Riverine and Shoreline Flooding, caused severe erosion that required the relocation of homes away from Lake Michigan. In 1997-1998, high Great Lakes water levels occurred again, approaching the record levels set in the 1980's.

Low water levels are also cyclical and can have severe economic impacts in the form of dredging and sediment disposal costs and marine transportation hazards. Extreme low water levels occurred in 1926, 1934, 1964, and 2003. The low water levels in lakes Michigan, Huron and Erie between 1998 and 2004 were the fastest decline in water levels in the Great Lakes in nearly a century and a half. Between the summer of 1997 and the spring of 2003, the lakes Michigan, Huron, and Erie each dropped by almost five feet. In December 2012, the water level on Lake Michigan was the lowest ever recorded for that month. The following January, a new all-time recorded low level was achieved, eclipsing the previous record low established in March 1964.

In addition, notable seiches are known to have affected the Lake Michigan shoreline at Ludington in 1956 and either 1962 or 1963. Both of these events occurred during the summertime with many people sunbathing, swimming, and fishing on the Pere Marquette Lake pier. Fortunately, no reports of fatalities or injuries were identified during research for this report.

According to the Great Lakes Current Incident Database (National Weather Service, Marquette, MI) there were 77 rip current fatalities and 230 rescues (307 incidents) on Lake Michigan from 2002 through 2012. Incidents along Mason County's Lake Michigan shoreline have contributed to these totals; such as those in Ludington in September 2010 and in May 2011.

Frequency of Occurrence: Though water levels on the Great Lakes are known to be cyclical, the timing, extent, and duration of high and low periods can only be estimated. According to the Michigan Hazard Mitigation Plan, about 10 major periods of flooding/erosion have occurred on the Great Lakes since 1918, or approximately once per decade.

In the 11-year period 2002-2012, there was an annual average of seven fatalities and 21 rescues (28 total incidents) on the shores of Lake Michigan related to rip currents. Most of these incidents occurred on the southern and eastern shores of Lake Michigan due in part to prevailing onshore or longshore winds. Drownings and rescues are expected to happen each year in Mason County; however the number of incidents cannot be estimated.

1.08 HAIL

Conditions where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth.

Summary: Hail is a hazard that often coincides with thunderstorms, and may occur simultaneously with other hazards such as lightning, severe winds, tornadoes, and heavy rains. Mason County experiences between 32 and 34 thunderstorms annually, many of which produce hail. There are numerous records of hail in the county documented by the National Climatic Data Center from 1996 through 2012. In addition, approximately $80,000 in property damage and $25,000 in crop damage has been attributed to hail events during that period.

The impacts of hail in Mason County can vary greatly, depending on location. In rural areas of the county, crops and livestock may be most-impacted; property damage is more likely in developed areas; and harm to people is possible in areas of outdoor recreation and activity. It is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm watches and warnings to minimize the effects on people and property.

Hazard Description: Hail is a product of the strong thunderstorms that frequently move across the Midwest. As one of these thunderstorms passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened. Downdrafts produced by thunderstorms may also accelerate the descent of hail, thereby increasing the potential for damages.

Most hailstones range in size from a pea (¼ inch) to a golf ball (1¾ inches), but hailstones larger than softballs have occurred with the most severe thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger until their weight can no longer be supported by the winds. They finally fall to the ground, battering crops, denting autos, and injuring wildlife and people. Large hail is a characteristic of severe thunderstorms, and it may precede the occurrence of a tornado.

Hail Size Chart

Diameter	Description
1/4"	Pea
1/2"	Plain M&M
3/4"	Penny
7/8"	Nickel
1" (severe)	Quarter
1¼"	Half Dollar
1½"	Ping Pong Ball
1¾"	Golf Ball
2"	Lime
2½"	Tennis Ball
2¾"	Baseball
3"	Teacup
4"	Grapefruit
4½"	Softball
4¾" – 5"	Compact Disk

Source: National Weather Service

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage on vehicles and some property. However, little can be done to prevent damage to agriculture, natural vegetation, and wildlife. In addition, hail can damage some fruit and vegetable plants, rendering them unsuitable for human consumption, and leading to an increased risk of bacteria that can kill healthy trees and nearby wildlife. Hail can also potentially exacerbate flooding and flash flooding through increased soil erosion, as well as jamming or reduced effectiveness of drainage paths, culverts, and grates.

In 2009, the NWS increased the definition of severe hail from ¾ inch to 1 inch in central and western U.S. states, including Michigan. This was implemented nationwide on January 5, 2010.

Historically Significant and Related Events: The NCDC shows that hail ¾ inch in diameter or greater was reported on 15 separate days from 1991 through 2013. Severe hail (1 inch diameter or greater) was observed on seven of those days. Hail days occurred in every month from March through October, with August being the only exception. Damages attributed to hail (both sub-severe and severe) during this period were noted on seven different days, totaling $95,000 to property and $40,000 to crops.

Since 1991, the largest hail reported to the NCDC fell on May 3rd, 2012. A training line of thunderstorms produced 1.75 inch hail in Scottville and dumped five to seven inches of rain over sections of Mason and Lake counties. The hail was blamed for $25,000 of property damage. Other notable property and crop damage occurred in the Scottville area on July 13, 2000, when 1 inch hail caused $20,000 of property damage and $10,000 of crop damage. On October 3, 2006, ¾ inch hail in Hamlin Township caused $15,000 of property damage and $15,000 of crop damage. This instance shows that hail need not be "severe" to cause damage to property and crops.

Hail 1.0" or Greater
Mason County
1991 - 2012

Date	Location	Size
7-7-91	Pere Marquette Twp	1.00"
9-26-96	Ludington	1.00"
7-13-00	Scottville	1.00"
4-18-02	Ludington	1.00"
6-14-08	Hamlin & Custer twps	1.00"
9-21-10	Bass Lake	1.00"
5-3-12	Scottville	1.75"

Source: National Climatic Data Center

Frequency of Occurrence: Mason County experiences hail on a regular basis. With between 32 and 34 thunderstorm days per year, it is highly likely that Mason County will experience multiple sub-severe hail events annually. In most cases, these events will cause little or no damage. In the 23 years encompassing 1991 though 2013, the NCDC has noted seven days with severe hail (one inch or greater). If this pattern continues, the county may expect to experience severe hail approximately one day every three. Hail is possible in Mason County any month of the year; however it is most likely to occur in the warmer months from March through September.

1.09 INVASIVE SPECIES

A species that has been introduced by human action to a location where it did not previously occur naturally, becomes capable of establishing a breeding population in the new location without further intervention by humans, and becomes a pest by threatening the local biodiversity and causing human health impacts, significant economic costs, and/or ecological effects.

Summary: Historically, invasive species has not been considered as a significant hazard in Mason County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

Mason County boasts a wide variety of land uses and land cover, and is therefore susceptible to a wide range of exotic species. Invasive aquatic species also pose a threat to water features in the county. In addition, Mason County welcomes a significant number of visitors each year, thereby increasing the opportunities for accidental importation of non-native species.

Hazard Description: An invasive species is defined as a species that is (1) non-native (alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm, or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary consideration here as a means of invasive species' introduction (thus distinguishing the situation from natural shifts in the distribution of species). Nationally, the current environmental, economic, and health costs of invasive species were estimated as exceeding the costs of all other natural disasters combined.

Invasive species can be transported in many ways, such as on animals, vehicles, ships, commercial goods, produce, and clothing. Although non-native (exotic) species are the foundation of U.S. agriculture, and also are used to prevent erosion, to provide fishing and hunting opportunities, and as ornamental plants and pets, occasionally a non-native organism flourishes too well and causes unwanted economic, ecological, or human health impacts. The terms "invasive" or "nuisance" are used to describe such species. New environments may affect rates of reproduction, susceptibility to disease, and other features that affect a species' success. Consequently, a plant or animal that causes little damage to agriculture or natural ecosystems in one area may cause significant problems in another. Certain nonnative species are very successful in their new habitats because they out-compete native plants or animals and have no natural controls (predators, diseases, etc.) in the new area. At least 200 well-known, high-impact, non-native species presently occur in the United States. They range from the European gypsy moth and emerald ash borer to crabgrass, dandelions, and German cockroaches, annually costing well over a billion dollars to control. Some even pose human health risks. Others, like the zebra mussel, threaten widespread disruption of ecosystems and the displacement or loss of native plants and animals.

Hundreds of new species from other countries are introduced intentionally or accidentally into the United States each year. These invasive species may arrive in a variety of ways. Transportation efficiencies that make it possible to travel around the globe in hours rather than weeks enable organisms to survive transportation from one continent to another.

As more adaptable and generalized species are introduced to environments already impacted adversely by human activities, native species are often at a disadvantage to survive in what was previously a balanced ecosystem. There are many examples of decreased biodiversity in such areas. One of the primary threats to biodiversity is the spread of humanity into what were once isolated areas, with land clearing and habitation putting significant pressure on local species. Agriculture, livestock, and fishing can also introduce changes to local populations of indigenous species and may result in a previously innocuous native species becoming a pest, due to a reduction of natural predators. This threat intensifies the need for scientists, managers, and stakeholders to cooperate to build better systems to prevent invasion, improve early detection of invaders, track established invaders, and to coordinate containment, control, and effective habitat restoration.

Although invasive species, in most cases, primarily cause environmental damage and degradation, there are situations in which serious threats to public health, safety, and well-being can occur due to animal disease or plant/animal infestations. For example, certain diseases could wipe out large segments of an animal population, creating a potentially serious public health emergency and the need to properly (and rapidly) dispose of the dead animal carcasses.

Similarly, a widespread insect infestation, such as that of the Emerald Ash Borer, can create serious public safety threats (especially in densely populated urban areas) due to dead and dying trees being fire prone (because of their dry, brittle nature) or to partial/total collapse due to high winds or ice/snow accumulation. The falling trees or limbs can also bring down power lines, cause damage to public and private structures, and cause injuries or even death.

County and local officials should cooperate closely with state agencies that actively monitor and manage invasive threats, such as the U.S. Forest Service, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, and the Michigan State Police, Emergency Management Division.

Historically Significant and Related Events: There are hundreds of known invasive species in Michigan and the Great Lakes. There are hundreds of potential threats as well. The effects of these invaders are often a mere nuisance; however, cases exist where effects are costly and damaging. The discussion below provides a small sample of the overall invasive species threat.

Though not a significant issue in Mason County, the Emerald Ash Borer has caused extensive damage to trees in parts of Michigan. Weakened trees have often collapsed and caused property damage, or required removal at considerable expense. A disaster declaration request was sent to FEMA, but the request was not accepted by that agency, leaving state and local budgets, residents, and insurance companies to try to cover the considerable expenses and efforts involved in dealing with the problem.

Sea lampreys are an aquatic invader that is a constant threat to the rivers and streams in Michigan, including Mason County. According to the Great Lakes Science Center (GLSC), "the sea lamprey is one of the few aquatic invasive species that is being successfully controlled." Numerous techniques have been attempted in Michigan, including screen weirs, electric screens, and chemicals. Beginning in 1989, an electric weir was employed on the Pere Marquette River by the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources. It was located near Custer Road in Custer Township. By 2010 however, the electric weir was deemed cost-ineffective and subsequently retired. A more effective method, a lampricide known as TFM, is now used in its place to control the sea lamprey population. TFM treatments cost $500,000 every three to four years.

The character of Mason County is closely tied to, and influenced by, the presence of Lake Michigan. The Great Lakes provide a potential conduit for the transportation of exotic and invasive species from other regions in North America and world-wide. The table to the right lists examples of invasive species in the Great Lakes.

Invasive Species in the Great Lakes Region

Current Invaders	
Crustaceans:	Rusty Crayfish, Spiny Water Flea
Fish:	Round Goby, Tubenose Goby, Rudd, Ruffe, Sea Lamprey, White Perch
Mollusks:	Quagga Mussel, Zebra Mussel
Plants:	Curly-leaf Pondweed, Eurasian Waterfoil, Phragmites, Purple Loosestrife
Viruses:	Viral Hemorrhagic Septicemia Virus (VHSv)
Potential Invaders	
Fish:	Asian Carp

Source: Great Lakes Information Network, http://www.great-lakes.net/envt/flora-fauna/invasive/invasive.html

Frequency of Occurrence: The effects of invasive species are inherently unpredictable. Insufficient data exists regarding significant impacts of invasive species in Mason County. However, it should be recognized that invasive and exotic species are a constant threat, primarily to the environment and the economy.

1.10 LIGHTNING

Discharge of electricity from within a thunderstorm.

Summary: Lightning is a hazard produced by thunderstorms, and may occur simultaneously with other hazards such as hail, severe winds, tornadoes, and heavy rains. Mason County experiences between 32 and 34 thunderstorms annually, all of which produce lightning.

It is virtually impossible to provide complete protection to individuals and structures from lightning, therefore this hazard will continue to be a risk for Mason County's residents. However, lightning deaths, injuries, and property damage can be reduced through a combination of public education, human vigilance, technology, proper building safety provisions, and simple common sense. It is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm watches and warnings to minimize the effects on the population.

Hazard Description: Lightning is a random and unpredictable product of a thunderstorm's tremendous energy which produces an intense electrical field like a giant battery, with the positive charge concentrated at one end and the opposite charge concentrated at the other. Lightning strikes when a thunderstorm's electrical potential (the difference between its positive and negative charges) becomes great enough to overcome the resistance of the surrounding air. Bridging that difference, lightning can jump from cloud to cloud, cloud to ground, ground to cloud, or even from the cloud to the air surrounding the thunderstorm. Lightning strikes can generate current levels of 30,000 to 40,000 amperes, with air temperatures often superheated to higher than 50,000 degrees Fahrenheit (hotter than the surface of the sun) and speeds approaching one-third the speed of light.

Globally, about 2,000 thunderstorms are occurring at any given time, producing approximately 100 lightning strikes to earth each second. In the United States, approximately 100,000 thunderstorms occur each year, and every one of those storms generates lightning. It is not uncommon for a single thunderstorm to produce hundreds or even thousands of lightning strikes. However, to the majority of the general public, lightning is perceived as a minor hazard. That perception lingers despite the fact that lightning damages many structures and kills and injures more people in the United States per year, on average, than tornadoes or hurricanes. Many lightning deaths and injuries could be avoided if people would have more respect for the threat lightning presents to their safety.

Lightning deaths are usually caused by the electrical force shocking the heart into cardiac arrest or throwing the heartbeat out of its usual rhythm. Lightning can also cut off breathing by paralyzing the chest muscles or damaging the respiratory center in the brain stem. It takes only about one-hundredth of an ampere of electric current to stop the human heartbeat or send it into ventricular fibrillation. Lightning can also cause severe skin burns that can lead to death if complications from infection set in.

As an indicator of the circumstances involving lightning fatalities, injuries and damage in the U. S., consider the following statistics compiled by the National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) for the period of 1959-1994:

Location of Lightning Strikes
· 40% at unspecified locations
· 27% in open fields and recreation areas (not including golf courses)
· 14% to someone under a tree (not including golf courses)
· 8% water-related (boating, fishing, swimming, etc.)
· 5% golf-related (on golf course or under tree on golf course)
· 3% related to heavy equipment and machinery
· 2.4% telephone-related
· 0.7% radio, transmitter and antenna-related

Gender of Victims
· 84% male; 16% female

Months of Most Strikes
· July (30%); August (22%); June (21%)

Most Likely Time Period of Reported Strikes
· 2:00 PM – 6:00 PM

Number of Victims
· One victim (91%); two or more victims (9%)

The NLSI has estimated that 85% of lightning victims are children and young men (ages 10-35) engaged in recreation or work-related activities. Approximately 20% of lightning strike victims die, and 70% of survivors suffer serious long-term after-effects such as memory and attention deficits, sleep disturbance, fatigue, dizziness, and numbness.

In terms of property losses from lightning, statistics vary widely according to source. The Insurance Information Institute (a national clearinghouse of insurance industry information) estimates that lightning damage amounts to nearly 5% of all paid insurance claims, with residential claims alone exceeding $1 billion. Information from insurance companies shows one homeowner's damage claim for every 57 lightning strikes. The NLSI has estimated that lightning causes more than 26,000 fires annually, with damage to property exceeding $5-6 billion. Electric utility companies across the country estimate as much as $1 billion per year in damaged equipment and lost revenue from lightning. The Federal Aviation Administration (FAA) reports approximately $2 billion per year in airline industry operating costs and passenger delays from lightning. Because lightning-related damage information is compiled by so many different sources, using widely varying collection methods and criteria, it is difficult to determine a collective damage figure for the U.S. from lightning. However, annual lightning-related property damages are conservatively estimated at several billion dollars per year, and those losses are expected to continue to grow as the prevalent use of computers and other lightning-sensitive electronic components continues.

Because it is virtually impossible to provide complete protection to individuals and structures from lightning, it will continue to be a problem for Michigan's residents. However, lightning deaths, injuries, and property damage can be reduced through a combination of public education, human vigilance, technology, proper building safety provisions, and simple common sense.

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the risks of lightning. Large outdoor gatherings (e.g., sporting events, concerts, campgrounds, fairs, festivals, etc.) are particularly vulnerable to lightning strikes that could result in many deaths and injuries. This vulnerability underscores the importance of developing site-specific emergency procedures for these types of events, with particular emphasis on adequate early detection, monitoring, and warning of approaching thunderstorms. Early detection, monitoring, and warning of lightning hazards, combined with prudent protective actions, can greatly reduce the likelihood of lightning injuries and deaths. In addition, close coordination between event organizers, local emergency management officials, and response agencies (i.e., police, fire, emergency medical care) can help prevent unnecessary (and often tragic) delays and mistakes in rendering care should a lightning incident occur.

In addition to the significant risks to individuals, lightning may also damage buildings, electrical and communications infrastructure, and trees, as well as spark wildfires. Statewide statistics derived from NCDC data lend additional historical credence to the risk of lightning in Mason County. The tables below detail lightning-related injuries and deaths in Michigan from 1959 to 2005.

Lightning-Related Deaths in Michigan
- 1959-July 2005 -

Lightning Deaths: 101		
Number of Deaths	Location	Percent of Total
29	Open fields, ball fields	29%
26	Under trees, not golf	26%
11	Boats / water-related	11%
10	Golf course	10%
4	Near tractors / heavy equipment	4%
2	At telephone	2%
19	Other location / unknown	19%

Source: Storm Data, National Climatic Data Center

Lightning-Related Injuries in Michigan
- 1959-July 2005 -

Lightning Injuries: 711		
Number of Injuries	Location	Percent of Total
243	Open fields, ball fields	34%
104	Under trees, not golf	15%
35	Golf course	5%
26	Boats / water-related	4%
19	At telephone	3%
20	Near tractors / heavy equipment	3%
264	Other location / unknown	37%

Source: Storm Data, National Climatic Data Center

Historically Significant and Related Events: NCDC has documented one lightning event in Mason County since 1993. An August 13, 1995 occurrence caused $30,000 in property damage when lightning struck a church and started an attic fire.

Additional internet research for lightning-related events revealed a number of instances where lightning had caused damage or had sparked a damaging fire in Mason County. The Ludington Daily News reported lightning-related fires occurred on May 30, 2002; May 8 and 9, 2004; June 19, 2007; and May 29, 2012. Examples of damage from these events include a destroyed home, a damaged church amphitheater, and a tree fire.

Frequency of Occurrence: Because lightning is inherently unpredictable, it is impossible to predict the frequency of lightning-related damage, fatalities, and injuries. Lightning is possible in any month; however it is most likely to occur in the spring, summer, and early fall months. Identified lightning-sparked fires appear to be common in late spring and early summer. Unfortunately, these are also the peak seasons for many popular outdoor activities in Mason County. Statistics show that individuals engaged in outdoor activities are generally at a higher risk from lightning during a thunderstorm. Mason County typically experiences between 32 and 34 thunderstorm days per year according to the Michigan State Police (see Thunderstorm Hazards map in Appendix C), all of which produce lightning.

1.11 SEVERE WINDS

Non-tornadic winds of 58 miles per hour or greater.

Summary: Severe winds are a fairly common occurrence in Mason County. Although possible any time throughout the year, severe winds are most likely to occur in association with severe thunderstorms during the summer. Strong weather systems, generally in the fall, can also produce damaging winds. Though these high wind events may not reach a magnitude of 58 mph (severe wind criteria), they are often characterized by sustained strong winds, with occasionally severe gusts, affecting large areas for hours or even days.

Severe winds are the most common thunderstorm hazard to cause damage in Mason County and may occur simultaneously with other hazards such as lightning, hail, tornadoes, and heavy rains. Mason County annually experiences between 32 and 34 thunderstorms which produce some or all of these hazards.

Advanced warning and weather monitoring are effective ways to mitigate the effects of severe winds. Therefore, it is incumbent upon public safety officials and county residents to monitor forecasts from the National Weather Service, and to heed severe thunderstorm and high wind watches and warnings to minimize the effects on people and property.

Hazard Description: Severe winds spawned by thunderstorms or other storm events have had devastating effects on Michigan, including 118 deaths, nearly 700 injuries, and hundreds of millions of dollars in damage to public and private property and agricultural crops since 1970. Severe wind events are characterized by wind velocities of 58 miles per hour or greater, with gusts sometimes exceeding 74 miles per hour (hurricane velocity), but do not include tornadoes.

Severe winds, including those produced by thunderstorms and high wind events produced by strong weather systems, can be very damaging to communities. Severe winds have the potential to cause loss of life from property damage and flying debris, but do not produce as many deaths as tornadoes. However, the property damage from severe wind events can be just as extreme as that of a tornado, since the damage can be widespread rather than isolated.

According to NOAA's National Severe Storms Laboratory, damage from severe thunderstorm winds account for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 miles per hour and can produce a damage path extending for hundreds of miles. These winds are often called "straight-line" winds to differentiate the damage they cause from tornado damage. The following narrative describes a number of different processes that can produce strong thunderstorm winds.

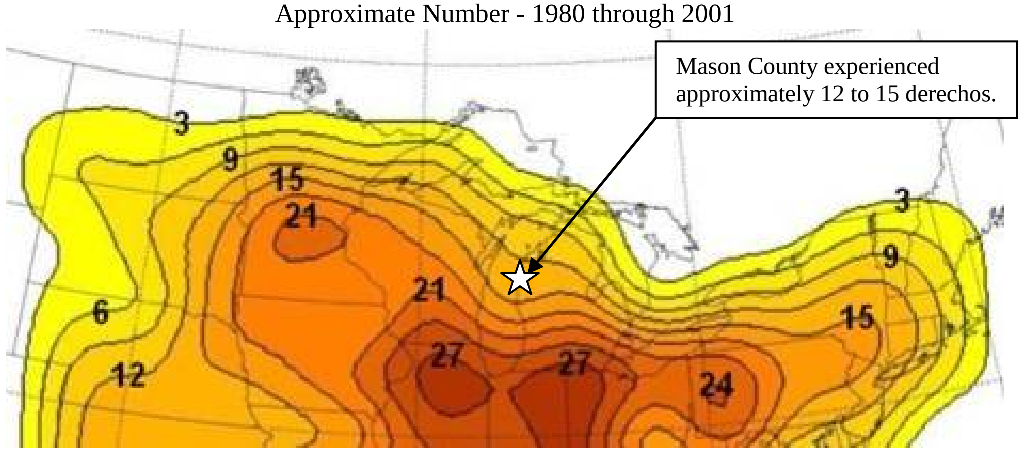
<u>Types of damaging winds</u>

- *Straight-line winds* – a term used to define any thunderstorm wind that is not associated with rotation, and is used mainly to differentiate from tornadic winds.
- *Downdrafts* – A small-scale column of air that rapidly sinks toward the ground. A downburst is a result of a strong downdraft.

- *Downbursts* – A strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst or damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- *Microbursts* – A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- *Gust front* – A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- *Bow Echo* – A radar echo which is linear but bent outward in a bow shape. Damaging straight-line winds often occur near the "crest" or center of a bow echo. Bow echoes can be over 300km in length, last for several hours, and produce extensive swaths of wind damage at the ground.
- *Derecho* – A derecho is a widespread thunderstorm wind event caused when new thunderstorms form along the leading edge of an outflow boundary (a surface boundary formed by the horizontal spreading of thunderstorm-cooled air). The thunderstorms feed on this boundary and continue to reproduce themselves. Derechos typically occur in the summer months when complexes of thunderstorms form over the plains and northern plains states. Usually these thunderstorms produce heavy rain and severe wind reports as they rumble across several states during the night. The word "derecho" is of Spanish origin and means "straight ahead." They are particularly dangerous because the damaging winds can last a long time and can cover such a large area. For more information on derechos, go to http://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.

"Moderate and High Intensity" Derechos

Approximate Number - 1980 through 2001



Source: NOAA webpage- http://www.spc.noaa.gov/misc/AbtDerechos/climatologypage.htm

The National Weather Service (NWS) issues severe thunderstorm watches for areas when the meteorological conditions are conducive to the development of severe thunderstorms. People in the watch area are instructed to stay tuned to National Oceanic and Atmospheric Administration (NOAA) weather radio and local radio or television stations for weather updates, and watch for developing storms. Once radar or a trained Skywarn spotter detects the existence of a severe thunderstorm, the NWS will issue a severe thunderstorm warning. The warning will identify where the storm is located, the direction in which it is moving, and the time frame during which the storm is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

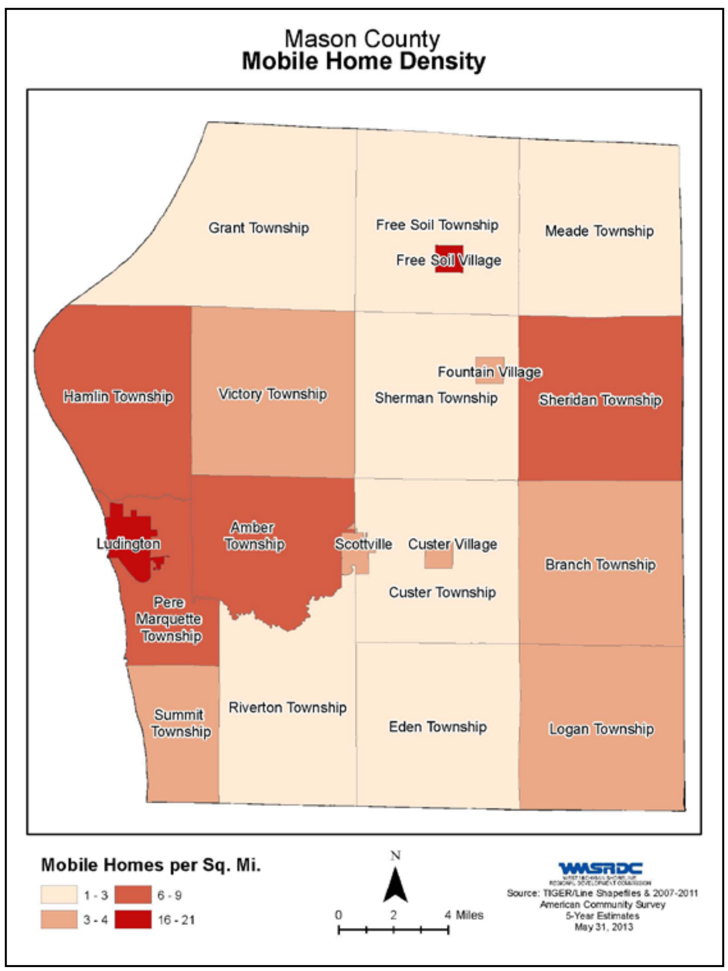
The State and local government agencies are warned via the Law Enforcement Information Network (LEIN), NOAA weather radio, and the Emergency Managers Weather Information Network (EMWIN). Public warning is provided through the Emergency Alert System (EAS). The NWS stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The NWS also provides detailed warning information on the Internet at www.weather.gov, where an interactive map can be used.

Severe thunderstorm and high wind forecasts by the NWS usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of wind damage on people and some property. A particular concern with severe winds is the presence of buildings without basements, which may be overturned or damaged by strong winds. Such buildings include mobile and manufactured homes, seasonal homes, workplaces, remote hunting lodges, campgrounds, etc. According to the 2007-2011 American Community Survey 5-year Estimates, mobile homes make up 10.7% of Mason's housing. This type of housing may either be concentrated in mobile home parks or scattered (generally in rural areas). According to FEMA's Building Performance Assistance Team, newer manufactured housing anchored to permanent foundations performs better than older manufactured housing in windstorms. Such mitigation measures must be taken well prior to issuance of a severe thunderstorm watch or warning.

Mobile Homes in Mason County

Community	# Mobile Homes	% of Homes in Municipality
Mason County *	1,855	10.7
Ludington City	78	1.7
Scottville City	6	1.2
Custer Village	3	2.2
Fountain Village	3	3.1
Free Soil Village	17	16.5
Amber Township	**240**	20.2
Branch Township	153	15.4
Custer Township	75	11.7
Eden Township	37	9.5
Free Soil Township	85	15.2
Grant Township	83	14.9
Hamlin Township	**293**	13.5
Logan Township	150	**36.7**
Meade Township	44	**21.2**
Pere Marquette Township	97	6.9
Riverton Township	51	9.6
Sheridan Township	**267**	**25.4**
Sherman Township	93	16.5
Summit Township	50	5.5
Victory Township	108	15.8

** total of city and townships only; village totals already included within township totals*
Source: American Community Survey 2007-2011 5-year Estimates



In addition to property damage to buildings (especially unsecured and less sturdy structures such as storage sheds, outbuildings, etc.), there is a risk for infrastructure damage from downed power lines due to falling limbs and trees. Downed power lines also carry the risk of electrocution to people and animals. Large-scale power failures, with hundreds of thousands of customers affected, are common during straight-line wind events.

The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four winds zones and identifies areas that are susceptible to hurricanes and special wind regions (see map in Appendix C). The zones range from I – IV, with the highest potential winds in Zone IV. According to the map, Mason County is located within zone IV; meaning winds are capable of reaching speeds of up to 250 miles per hour. Wind speeds of this magnitude are possible in extreme tornadoes.

Historically Significant and Related Events: Mason County has been repeatedly buffeted with strong winds. The NCDC has documented 39 days with strong wind incidents from 1996 through 2013; 32 from thunderstorm wind reports and 7 from high wind reports.

Perhaps the worst wind related disaster in Mason County history occurred on May 31, 1998. The storm resulted in the county's only federal major disaster declaration due to high winds. According to the MSPEMD Damage and Injury Assessment Report, Mason County sustained $398,000 in public damage costs from this storm. An estimated total of three homes were destroyed, 66 homes were damaged, and four businesses were damaged. In addition, five injuries were reported, one of which required hospitalization; and 12 vacation/secondary residences incurred major damage and 9 had minor damage. Newspaper and media reports indicated public and private damage costs combined exceeded $1.0 Million in Mason County. A local state of emergency was declared and the county was granted a Governor's disaster declaration to activate state assistance. On June 24th, President Clinton granted a Major Disaster Declaration for Mason County, making federal disaster assistance available. Statewide, total public and private costs were estimated at $166 million, with four deaths and 146 minor injuries. Consumers Energy reported the derecho event was the most destructive weather event in its history, with over 600,000 of its customers without power.

A review of National Weather Service Doppler Radar indicates that "the widespread and severe damage, which occurred with the fast-moving line of thunderstorms during the early morning hours of May 31st, was caused primarily by strong straight-line winds (60-90 mph) and isolated wet microburst winds (120-130 mph)". A gust of 78 miles per hour was reported by the Coast Guard in Ludington and a gust of 66 miles per hour was reported by an official NWS Cooperative Observer in Scottville. This particular "derecho" formed in South Dakota on the evening of May 30 and raced across Minnesota, Iowa and Wisconsin, before striking the Lower Peninsula around 4:30 a.m. An in-depth analysis and maps of this derecho, along with documented wind strengths can be found at http://www.spc.noaa.gov/misc/AbtDerechos/casepages/may30-311998page.htm.

In addition, NCDC has documented a significant number of less destructive thunderstorm wind events in Mason County. About half of the thunderstorm days occurred in the months of June and July, and over two-thirds of them occurred from June through August. A few notable thunderstorm wind events are listed below. Refer to Appendix C for the complete list of NCDC storm events.

September 16, 1997 – Ludington and Fountain

Thunderstorms caused $25,000 of property damage in the Ludington area and $10,000 in the Village of Fountain. The Mason County Road Commission reported trees and power lines were downed across the county, cutting power to 500 customers of Consumers Energy and Western Michigan Electric Cooperative. One tree, nine feet in circumference, toppled onto the roof of the Ludington Outboard Club building along the Pere Marquette Lake. Trees and power lines were downed in Fountain.

September 11, 2000 – Ludington and Scottville

An isolated severe thunderstorm during the late evening hours also produced gusty winds that blew down several trees in Scottville. As a result of the thunderstorm, $25,000 of property damage was incurred and 190 customers were left without power in Scottville, and 305 people lost power in the Ludington area.

July 24, 2005 – Scottville and Free Soil

Thunderstorms caused $40,000 of property damage in Free Soil, while Scottville sustained $20,000 of damage. There were numerous trees and limbs blown down across the area, as well as several reports of downed power lines. Law enforcement in Free Soil reported a few trees were blown onto houses.

August 2, 2012 – Hamlin Township

An isolated severe thunderstorm produced wind gusts estimated at 60 to 70 mph that brought down numerous trees in Ludington State Park overnight, some of which fell on camper trailers, vehicles and a park building. The storm caused $100,000 of property damage.

Mason County has also experienced numerous wind events associated with strong weather systems. Seven "high wind" events listed by the NCDC have involved Mason County from 1996 through 2013. Five of the seven high wind events occurred in the months of October and November. One of these events happened on November 10, 1998 when a low pressure system of historic dimension caused widespread 50 mph winds and a 87 mph gust in Mason County. Over 167,000 homes in Michigan were without power and cleanup efforts were extensive. Another happened on October 30, 2004, when widespread high winds swept across Lower Michigan downing trees and power lines. Wind gusts between 58 and 60 miles per hour caused approximately $1.15 million in property damages in southwest Michigan, and cut off power to approximately 100,000 people statewide. Mason County sustained $50,000 of property damage from the event.

Frequency of Occurrence: Mason County is subjected to between 32 and 34 thunderstorms per year according to the Michigan Hazard Mitigation Plan. Since most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft, anyone living in Mason County is at risk of experiencing this phenomenon. Locations along the immediate Lake Michigan shoreline are particularly at risk of experiencing the strongest winds approaching unimpeded from western directions.

In the 18 year period 1996 through 2013, Mason County averaged two to three severe wind days per year (39 events in 18 years). Severe thunderstorm winds are possible year-round, however most likely during the summer. Strong winds produced by weather systems are also possible year-round, but are most commonly observed in the fall.

According to the NOAA Storm Prediction Center's webpage titled "About Derechos," Mason County is situated in a zone that typically experiences one derecho every two years.

1.12 SUBSIDENCE

The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove sub-surface support.

Summary: Overall, subsidence is not considered a significant threat in Mason County. In Michigan, the primary cause of subsidence is underground mining. Mining for minerals such as coal and copper is not a part of Mason County's past. Because residents in rural areas of the county use groundwater for potable water and for agriculture, excessive groundwater withdrawal might be considered a subsidence threat to the county. Broken water and sewer pipes and the improper discharge of rainwater are other possible causes of water-related subsidence in Mason County.

Hazard Description: Natural subsidence occurs when the ground collapses into underground cavities produced by the dissolution of limestone or other soluble materials by groundwater.

Human-induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining. In the United States, these activities have caused nearly 17,000 square miles of surface subsidence, with groundwater withdrawal (10,000 square miles of subsidence) being the primary culprit. In addition, approximately 18% of the United States' land surface is underlain by cavernous limestone, gypsum, salt, or marble, making the surface of these areas susceptible to collapse into sinkholes. Generally, subsidence poses a greater risk to property than to life. Nationally, the average annual damage from all types of subsidence is conservatively estimated to be at least $125 million. The National Research Council estimates of annual damage from various types of subsidence are outlined in the table below:

Land Subsidence: Estimated Annual National Damage

Type of Subsidence	Annual Damage ($)
Drainage of organic soils	40,000,000
Underground fluid withdrawal	35,000,000
Underground mining	30,000,000
Natural compaction	10,000,000
Sinkholes	10,000,000
Hydrocompaction (collapsible soils)	N/A
TOTAL:	**$125,000,000**

Source: National Research Council, Multi-Hazard Identification and Risk Assessment, FEMA

In Michigan, the primary cause of subsidence is underground mining. Although mine subsidence is not as significant a hazard in Michigan as in other parts of the country, many areas in Michigan are potentially vulnerable to mine subsidence hazards. Mine subsidence is a geologic hazard that occurs when the ground surface collapses into underground mined areas. It can strike with little or no warning and can result in very costly damage to buildings and disruption of underground utilities. In extreme cases, mine subsidence can literally swallow whole buildings or sections of ground into sinkholes, endangering anyone that may be present at that site. Mine subsidence may take years to manifest. Examples of collapses occurring 100 years after mines were abandoned have been documented in several areas of the country. Records of abandoned mines are often sketchy and sometimes non-existent. Therefore, it is often difficult to determine exactly where the mines were located. Many areas of Michigan may have developed over abandoned mines and may not even be aware of it. Oftentimes, the one way a community or home/business owner becomes aware of a potential hazard is when subsidence actually occurs and damage or destruction results.

Compaction of soils in some aquifer systems can accompany excessive ground-water pumping and cause subsidence. Excessive pumping of such aquifer systems has resulted in permanent subsidence and related ground failures. In some systems, when large amounts of water are pumped, the subsoil compacts, thus reducing in size and number the open pore spaces in the soil that previously held water. This can result in a permanent reduction in the total storage capacity of the aquifer system. More than 80% of the identified subsidence in the United States is a consequence of human impact on subsurface water. Three distinct processes account for most of the water-related subsidence: compaction of aquifer systems, drainage and subsequent oxidation of organic soils, and dissolution and collapse of susceptible rocks.

- *Mining Groundwater* - Groundwater in the pore spaces of an aquifer supports some of the weight of the overlying materials. When groundwater is depressurized or even removed from aquifers, where the materials are very compressible and pore pressures can be high, compaction may occur. This subsidence may be partially recoverable if pressures rebound, but much of it is not. Thus the aquifer is permanently reduced in capacity, and the surface of the ground may also subside.

- *Drainage of Organic Soils* - Land subsidence may occur when soils rich in organic carbon are drained for agriculture or other purposes. The most important cause of this subsidence is microbial decomposition, which, under drained conditions, readily converts organic carbon to carbon-dioxide gas and water. Compaction, desiccation, erosion by wind and water, and prescribed or accidental burning can also be significant factors.

- *Collapsing Cavities* - This type of subsidence is commonly triggered by ground-water-level declines caused by pumping and by enhanced percolation of groundwater. Collapse features tend to be associated with specific rock types, such as evaporites (salt, gypsum, and anhydrite) and carbonates (limestone and dolomite). These rocks are susceptible to dissolution in water and the formation of cavities. Salt and gypsum are much more soluble than limestone, the rock type most often associated with catastrophic sinkhole formation. Evaporite rocks underlie about 35 to 40% of the United States, though in many areas they are buried at great depths. Collapse sinkholes may develop over a period of hours and cause extensive damage.

In the past there has been pressure for the Great Lakes states to export bulk quantities of water to various locations in the United States. If plans to withdraw large amounts of water from the Great Lakes ever took place, it may have a major affect on the level of the groundwater tables in Michigan, which may make subsidence a more common occurrence.

There is a network of infrastructure in Mason County which includes water, wastewater, and stormwater pipes and culverts. Failure of any of these has the potential to cause erosion-related subsidence hazards. Currently, broken water pipes and the improper discharge of rainwater are the most common causes of water-related subsidence in Michigan. It primarily occurs when water from the leak washes out the fine particles beneath the foundation causing voids that result in collapse or subsidence.

Historically Significant and Related Events: There are no documented incidences of significant subsidence in Mason County, and subsidence is not currently considered a serious threat. However, risks in Mason County warrant a cursory analysis of subsidence as a potential hazard. Such risks include excessive groundwater withdrawal (especially during periods of low water levels); the presence of hundreds of abandoned oil, gas, and brine wells; and subsidence related to stormwater or infrastructure failure.

Frequency of Occurrence: Lack of documented subsidence events in Mason County prohibits the prediction of its frequency.

1.13 TORNADOES

An intense rotating column of wind that extends from the base of a severe thunderstorm to the ground.

Summary: Although just five tornadoes have been observed in Mason County between 1950 and 2012, tornadoes occur in Michigan every year with grim regularity. The Federal Emergency Management Agency (FEMA) has produced a wind zone classification map for the United States that divides the country into four winds zones (see map in Appendix C). The zones range from I to IV, with IV having the highest potential winds. According to the map, Mason County is located within zone IV; meaning winds are capable of reaching speeds of up to 250 miles per hour. Wind speeds of this magnitude are possible in extreme tornadoes.

Tornado damages can range from minor to devastating. Deaths and property loss are frequent by-products of these events. Improved public education in tornado safety, through community efforts and media coverage, has increased the public's awareness of potential hazards from tornadoes and their response to those hazards. The current average lead-times for tornado warnings by the National Weather Service is 13 minutes. Local TV stations can also provide advanced warning with Doppler radar. Education and early awareness need to be continually improved to mitigate tornado hazards. Injuries can also occur during rescue and clean-up efforts after a tornado strikes.

Hazard Description: Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind known as funnel clouds. Michigan lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana, and Ohio. Most of a tornado's destructive force is exerted by the powerful winds that knock down walls and lift roofs from buildings in the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles.

A tornado may have winds up to 300+ miles per hour and an interior air pressure that is 10-20% below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles, but tracks much longer than that – even up to 200 miles – have been reported. Tornado path widths are generally less than one-quarter mile wide. Typically, tornadoes last only a few minutes on the ground, and can result in tremendous damage and devastation. Historically, tornadoes have resulted in tremendous loss of life, with the mean national annual death toll being around 87 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year.

Enhanced Fujita (EF) Scale of Tornado Intensity

EF Rating	Wind Speeds	Expected Damage
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.

Source: NOAA, National Weather Service

Tornado intensity is measured on the Enhanced Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, other man-made structures, and trees. The scale rates the intensity of a tornado based on damaged caused, not by its size. It is important to remember that the size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is very difficult to judge the intensity and power of a tornado while it is occurring. Generally, that can only be done after the tornado has passed, using the Enhanced Fujita Scale as the measuring stick. The Enhanced Fujita Scale, presented below, is a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 different indicators.

Although tornadoes cannot be predicted, prevented or contained, their potential impacts on Michigan's citizens and communities can certainly be reduced. In general, improved surveillance and warning systems implemented by the National Weather Service and emergency management agencies, coupled with extensive public education campaigns, have been very effective in keeping the death toll down in recent years. However, this is not to say that a major death toll could not occur again if a strong tornado should strike a highly populated area. History has clearly shown that tornadoes must always be treated with the utmost respect and caution. Other initiatives, such as structural bracing, urban forestry practices, manufactured home anchoring, and strengthening electrical system components, can help to reduce public and private property damage. Regardless of any amount of preparation, ample warning is the best way to save lives in the event of a tornado.

There is a concern for mobile and manufactured homes just as there is for mobile homes undergoing severe winds. Every community in Mason County is susceptible to tornados and should have an availability of secure shelter areas for those who live in mobile homes, or at temporary and seasonal locations. This need is backed by the fact that there are 1,855 mobile homes in the county according to the 2007-2011 ACS 5-Year Estimates. The jurisdictions with the highest number of mobile homes include Hamlin Township (293), Sheridan Township (267), and Amber Township (240). From another perspective, mobile homes make up over 20% of the housing stock in four jurisdictions: Logan Township (36.7%), Sheridan Township (25.4%), Meade Township (21.2%), and Amber Township (20.2%).

Historically Significant and Related Events: According to NCDC storm data, there have been five tornadoes in Mason County since 1950. One was rated an F2, three were rated F1, and one was an F0. The first was an F0 observed just south of Scottville on August 15, 1966. The only tornado damage resulted from the F2, which touched down in Eden Township on April 12, 1972 causing $2.5 million in property damage and eight injuries. This was one of three tornadoes that were recorded on that date. The most recent tornado confirmed in Mason County was an EF1 that struck the Nordhouse Dunes area in Grant Township on June 12, 2008. The track was about 1.3 miles long with a maximum path width of about 300 yards. It touched down on the beach at 8:26 PM EST and was on the ground for about two minutes before lifting.

The surrounding counties of Lake, Manistee, Newaygo, and Oceana have seen 21 tornadoes (26 including Mason) over the same 63-year period. Therefore the total number of observed tornadoes in Mason County, as it relates to the county's overall tornado risk, is misleading.

Tornado Touchdowns by Month
- 1950 through 2012 -

Mason County and Adjacent Counties*							
Month	Mar.	Apr.	May	June	July	Aug.	Sept.
Tornadoes	2	6	2	6	3	4	3
Percentage	7.7%	23.1%	7.7%	23.1%	11.5%	15.4%	11.5%

**Includes Lake, Manistee, Mason, Newaygo, and Oceana counties*
Source: Storm Data, National Climatic Data Center

Frequency of Occurrence: In 63 years from 1950 through 2012, there have been five tornadoes observed in Mason County and documented by the NCDC. These occurred on three separate days. Therefore the historical frequency within the county is one tornado every 12 to 13 years, or one tornado day every 21 years.

However, since Mason County and its adjacent counties have seen 26 tornadoes over that span, the actual chance of tornado activity in the area is somewhat greater. Records since 1950 show that, on average, a tornado is observed in or near Mason County once every two to three years. With more than half of the observed tornadoes occurring between April and June, observations in this area reflect the statewide tendency of tornadoes to be most common in the spring and early summer. April and June share the greatest frequency of tornadoes around Mason County, with each claiming 23.1 percent of all tornado touchdowns in the area.

1.14 WILDFIRE

An uncontrolled fire in grass lands, brush lands, or forested areas.

Summary: Most Michigan wildfires occur close to where people live and recreate, which puts people, property, and the environment at risk. Development within and around forested areas often increases the potential for loss of life and property from wildfires, since most fires are caused by human activities, such as outdoor burning.

According to the Mason County Data Book (September 2005), forest covers over half of Mason County's land area, and is the county's most predominant land cover. The vast forest cover is a boon for both industry and recreation. However, it also makes many areas of the county potentially vulnerable to wildfires. Particular areas of concern include portions of the Manistee National Forest, as well as the county's many camping areas, namely Ludington State park. Large portions of the county's forest land are both publicly and privately held. There are also wooded areas of higher risk where fairly steep slopes exist, such as along the Lake Michigan shoreline.

Hazard Description: Wildfires are a normal ecological phenomenon and serve long-term functions for vegetation and the natural environment. Wildfires can burn excessive brush, maintain large savannah-like openings, and restore wetlands by forcing out unwanted brush and vegetation. The natural function of fires within the environment can be considered a renewal or "cleansing process" as long as the fire is not too severe.

The negative impacts and immediate danger from wildfires are destruction of timber, property, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. A wildland-urban interface (WUI) occurs where nature meets development. People and development residing within these areas are at greater risk from wildfires. Long-term and corollary effects of wildfire may include:

- Increased erosion and flooding, due to the disappearance of vegetation that would otherwise protect soils and slow surface runoff of water;
- Smoke (low visibilities and reduced air quality), closed roadways, and infrastructure impacts that may interfere with ordinary life, an area's economy, and planned tourism-based events; and
- Structural fires, particularly near areas of outdoor recreation and along wildlife-urban interfaces.

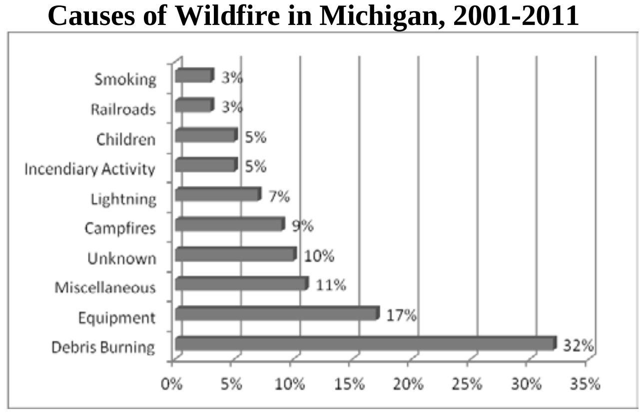
The threat of wildfire may be elevated in times of drought, high heat, high wind, and/or low humidity. Unfortunately these conditions often coincide with attractive conditions for outdoor activity and recreation. This only compounds the fact that most wildfires are induced by human activity, rather than as a part of natural processes. Other factors that may increase the risk or severity of wildfire include: mild winters with abnormally low precipitation, allowing brush and other wildfire fuels to dry out; wind storms and frost/freeze damage, increasing the availability of dead fuels; and slow/late green-up in the spring. Conversely, a harsh winter with a heavy deep snowpack can mitigate wildfire risk in the spring. Such conditions compact dead fuels, reducing their surface-to-mass ratio and allowing them to retain moisture longer.

An additional caveat of the wildfire hazard is the slight potential for it to be used maliciously due to the low cost and limited technical expertise required, the potential for causing large-scale damage, and the low risk of apprehension. This aspect of wildfire may be related to the "Terrorism and Similar Criminal Activities" hazard which is discussed in section 3.05.

Historically Significant and Related Events: Contrary to popular belief, lightning strikes are not the primary cause of wildfires in Michigan. Between 2001 and 2010, only about 7% of all wildfires in Michigan were caused by lightning strikes, while most other causes were attributed to human activity. Outdoor debris burning is the leading cause of wildfires in Michigan in recent years, comprising nearly one-third of the total. Most Michigan wildfires occur close to where people live and recreate, placing both people and property at risk.

Wildfires occur annually in Mason County, and have had significant effects on the area. The first recorded catastrophic fire in Michigan occurred in October of 1871 after a prolonged drought over much of the Great Lakes region in the preceding summer months. Logging waste and debris, dried from the drought, greatly contributed to the spread of the fire. A similar series of wildfires burned in the spring and summer months of 1891. These fires played a role in dismantling Michigan's logging industry, and subsequently weakening the economy.

Causes of Wildfire in Michigan, 2001-2011



Source: Michigan Hazard Mitigation Plan, 2011

Wildfire incidents have continued to occur in Mason County and nearby areas of the state since the late 1800's despite advances in firefighting technology and methodology. These advances have drastically reduced the number of acres burned per year and have helped prevent major wildfires such as those of 1871 and 1891. Firebreaks installed in sections of the forests may help manage and contain any future wildfires. Spotters and planes are alert for signs of wildfire, and response to sighted fires has been very good, with many trained fire fighters prepared to respond. According to the West Michigan Blueways and Greenways Plan (WMSRDC, 2012) about 22 percent of Mason County's land area is owned by state or federal entities. Therefore, the county has state and federal assistance for wildfire response in and around those areas.

In June 2012, a lightning-induced wildfire in Luce County in the Upper Peninsula (known as the Duck Lake fire) proved that wildfires are still a significant threat in Michigan. It burned over 21,000 acres and destroyed 136 structures including 47 homes and cabins, one hotel and one store. It was the third largest wildfire in Michigan history. A total of 300 personnel served on the Duck Lake Fire from agencies including Michigan State Police, Luce County Sheriff's Department, Red Cross, Luce County Emergency Management, Wisconsin DNR, American Red Cross, and Salvation Army.

While Mason County has not experienced a wildfire of that magnitude in recent memory, smaller scale wildfires happen numerous times each year. An example of a human-caused wildfire happened in Custer Township in March 2012. A bonfire left unattended caused a 40-acre wildfire in a swampy area bounded by Johnson, Stephens, Hansen, and Reek roads. Warm temperatures, dry vegetation, and high winds all helped the blaze. Firefighters responded from Custer, Branch, and Fountain, but more were needed due to the unique conditions in the area.

There were a total of 8 wildfires **reported** by the MDNR in Mason County that burned 80 acres between 1981 and 2000. However, between 1981 and 2010, the number of reported wildfires under MDNR jurisdiction increased to 32, with a total of 154.6 acres burned. Over this 30-year period, the county annually averaged about 1 wildfire and nearly 5 burned acres per year. Since many minor wildfires over Mason's landscape may go unreported to the MDNR, these statistics likely underscore the actual amounts.

Frequency of Occurrence: Recent trends, such as above average temperatures, low water levels, long stretches of below average precipitation (both rain and snow), and the occasional addition of fuel to the forests from the fallen trees by wind storms all help to ensure that wildfires will occur annually. It is difficult, however, to determine their frequency due to unpredictable weather patterns and human activity. In addition, wildfire statistics for Mason County are difficult to pin down because the United States Forest Service, Michigan Department of Natural Resources, and local fire departments all respond to wildfires in the area.

Statistics show that over 90 percent of wildfires are human-induced in Michigan. Mason County has many developed areas that abut and/or intermix with forested settings. There are also numerous opportunities for outdoor recreation (especially in warmer months conducive to both recreation and wildfire) which increase the concentration of people in the county, as well as the number of people interacting with nature. Therefore, wildfires are almost certain to occur numerous times each year within Mason County. The severity of each occurrence will depend greatly upon the time of year, climatological conditions, geographic location of the fire, as well as the response efforts and capabilities of federal, state, and local fire suppression resources.

1.15 WINTER STORMS

Severe winter weather hazards include snowstorms, blizzards, and ice and sleet storms.

Summary: Severe winter hazards include snowstorms, blizzards, sleet, and ice storms. Extreme cold is another winter hazard that is addressed in the Extreme Temperatures section. Winter-like storms are possible from late October through April in Mason County; however they are most likely from mid November through early April. As a northern state, Michigan is vulnerable to all of these hazards as the result of arctic air interaction with any number of meteorological factors. It is not unusual for an area to experience any combination of these hazards in a given winter storm, thereby enhancing their effects. In addition, Mason County is susceptible to significant lake effect snow accumulations due to its close proximity to Lake Michigan. Annual costs of snow plowing, snow removal, vehicle damage from snow and ice-related accidents, and damage from ice storms have a significant economic impact on the county.

Hazard Description: Winter storms typically cover large areas, leading to millions of dollars worth of estimated damage. Snowstorms involve the rapid precipitation and accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility. Blizzards are the most dramatic and perilous of all snowstorms, characterized by low temperatures and strong winds (35+ miles per hour) bearing profuse amounts of snow. Snow accompanying a blizzard is wind-blown in such great quantities that visibility can be reduced to only a few feet, and snow drifts many feet deep can develop. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be debilitating to a community.

Ice storms, also known as freezing rain, are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Massive traffic accidents and power outages from downed tree limbs and utility lines are common when an ice storm occurs. Ice storms usually have a regional effect whereas groups of counties are affected instead of just one county or community. Often times, ice storms are accompanied by snowfall, which camouflages accumulated ice and creates treacherous transportation conditions. Sleet storms, which involve small pellets of ice accumulating on surfaces, are less dangerous than ice storms, but can still prove hazardous to transportation and electrical systems. Both ice and sleet storms occur when the temperature is close to 32°F, but are far more severe with temperatures in the 20s.

The western half of the Lower Peninsula experiences heavy snowfall and a significant number of snowstorms. One reason for this is the "lake effect," a process by which cold winter air moving across Lakes Michigan and Superior picks up moisture from the warmer lake waters, resulting in greater snowfall amounts in the western part of the state.

All winter hazards exist in Mason County and may be exacerbated in rural areas of the county. People may be snowed in for days before all of the roads can be cleared, potentially causing problems for special populations who have immediate needs. The County Road Commission is alert to trees that may be downed across roads in forested areas, and has equipment that can deal with such problems. Efforts taken by the County Road Commission and local municipalities, such as salting, de-icing and plowing, help maintain safe road conditions in order to reduce hazardous impacts of winter weather. However, rural areas may be subjected to longer durations of impacts on transportation routes; depending on the road clearing strategies employed by the county road commission. The greatest concern with winter hazards seems to be the potential impacts upon transportation, electrical, and/or water and sewer infrastructure. When electric lines are downed, households may be without power for several days, resulting in significant economic loss and disruption of essential services in affected communities.

By observing winter storm watches and warnings, adequate preparation can usually be made to reduce the impact of snowstorms on Michigan communities. Providing for the mass care and sheltering of residents left without heat or electricity, and mobilizing sufficient resources to clear blocked roads, are the primary challenges facing community officials. Severe winter weather has a propensity to affect Mason County. It should therefore plan and prepare for winter emergencies; including the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as snow clearance and removal equipment and services. In addition, communities should develop debris management procedures (to include the identification of multiple debris storage, processing and disposal sites) so that the tree and other storm-related debris can be handled in the most expedient, efficient, and environmentally safe manner possible.

Historically Significant and Related Events: The NCDC lists 99 severe winter weather events in the 19 years from 1996 through February 2014 in Mason County. These events include blizzards, heavy snow, lake-effect snow, ice storms, winter storms, and winter weather. They all occurred in the months of November through April, with nearly two-thirds striking in December and January. During this period there were three blizzards, and ice accumulation of at least one-tenth of an inch was noted five times.

Winter Weather Events
- 1996 through 2012 -

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr	Tot.
# of Events	5	27	36	19	10	2	99
Percentage	5.1%	27.3%	36.4%	19.2%	10.1%	2.0%	100%

Source: Storm Data, National Climatic Data Center

In Mason County, there has been a Declaration of Statewide Emergency by the President and a Declaration of Statewide Disaster by the Governor for a snowstorm and blizzard on January 26-27, 1978. That blizzard caused $18.7 million in public damage and $4.3 million in private damage across Michigan.

On April 3-5, 2003 a major ice storm affected Lower Michigan. The weight of the ice brought down thousands of trees, tree limbs, and power lines, causing hundreds of thousands to lose power. The event caused $4.9 million property damage statewide and $200,000 of property damage in Mason County.

Frequency of Occurrence: There is little doubt that winter hazards will occur a number of times every year in Mason County. A graphic within the Michigan Hazard Mitigation Plan (included in Appendix C) shows that the county annually receives anywhere from 80 inches of snow over the eastern reaches of the county, to over 100 inches near the Lake Michigan shoreline.

Mason County has been granted one Presidential Declaration and one Gubernatorial Declaration due to winter storms; therefore it is difficult to ascertain the frequency of such storms. Less powerful, yet still significant, storms should impact the county numerous times a year. Based on 92 severe winter weather reports collected by the NCDC from 1996 through 2012, Mason County should expect five to six episodes of severe winter weather every year. Though winter-like storms can happen from October through April, the most likely time for severe winter weather appears to be during the months from December through February. Significant ice/ freezing rain events are less frequent, occurring once every three to four years. Blizzards have also appeared, on average, once every five to six years.

2.0 TECHNOLOGICAL HAZARDS

2.01 DAM FAILURE

The uncontrolled release of impounded water resulting in downstream flooding.

Summary: Dams can fail as a result of both natural and human influences. Either case may result in downstream flooding with the potential to harm people, property, and the environment. The relatively sudden increase of downstream flow can have a similar effect as a flash flood; and impacts may also be incurred upstream, as well as downstream from a failed dam.

Because dam failures are a byproduct of the intentional impoundment of water (thus not occurring naturally), this hazard is considered a technological hazard in this plan, rather than a natural hazard. Although the risks and threats associated with dam failures are similar to those of flooding and flash flooding, mitigation actions are primarily focused on proper maintenance and regular monitoring of dams prior to failure, as well as monitoring development within the hydraulic shadow of a dam.

There are six dams in Mason County listed in the U.S. Army Corps of Engineers, National Inventory of Dams (NID). The hazard potential of these dams range from low to high.

Hazard Description: A dam failure can result in loss of life and extensive property or natural resource damage within many miles downstream from the dam, with no regard for jurisdictional boundaries. Dam failures occur not only during times of excessive precipitation, which may cause overtopping of a dam, but also as a result of poor operation, vandalism, and/or lack of maintenance and repair. Dam failures can be catastrophic if they occur unexpectedly, allowing little or no time for evacuation.

Dams may serve any number of functions, such as recreation, scenery, and the production of hydroelectricity. They can create reservoirs that are desirable locations for humans to live and recreate, and if lost, can have negative impacts on the local economy. The loss of a reservoir may reduce the value of residential properties, and eliminate recreational uses such as boating, swimming, and fishing. An emptied reservoir may also lead to public health issues if people come into contact with newly exposed sediment that is polluted. A suddenly emptied reservoir may also be a breeding ground for insects and disease.

Dams in Michigan are regulated by Part 315 of The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Part 315, Dam Safety provides for the inspection of dams. This statute requires the MDEQ to rate each dam as either "high," "significant," or "low" hazard potential, according to the potential downstream impact if the dam were to fail (not according to the physical condition of the dam). The MDEQ has identified and rated over 2,400 dams. Dams over 6 feet in height that create an impoundment with a surface area of 5 acres or more are regulated by this statute. Dam owners are required to maintain an Emergency Action Plan (EAP) for "high" and "significant" hazard potential dams. Owners are also required to coordinate with local emergency management officials to assure consistency with the local emergency operations plan (EOP).

A report from the American Society of Civil Engineers, Michigan Section released in 2009 discusses some serious threats associated with dams in Michigan. For example, over 90% of Michigan's 2,581 dams will reach or exceed their design life by 2020; many dams are abandoned, no longer serve any useful purpose, and pose safety hazards to downstream residents. Limited, if any, funding is currently available in Michigan to help dam owners repair, rehabilitate, or remove aging dams. In addition, with the exception of 110 hydropower dams, only a few dams in Michigan (mostly lake level control structures) produce any income or have a mechanism for funding needed maintenance or repairs. Owners of dams that do not generate revenue generally do not set aside funds for their eventual repair, rehabilitation or removal; and often cannot afford to properly care for their dams. This combined with a lack of State or other public-funding mechanisms to assist dam owners causes inadequate or crumbling dams to go unattended, posing significant safety hazards to downstream residents and local and regional economies.

Mason County has six dams that are identified in the National Inventory of Dams (NID), which classifies dams as high, significant, or low hazard potential. See Appendix C for more information on the hazard potential class definitions. Of the Mason County dams, two are rated high and four are rated low. The high hazard potential dams are located in Hamlin Township and Pere Marquette Township. The four low hazard potential dams are located in Amber, Eden, and Victory (2 dams) townships. In addition, local sources have identified additional dams at Bass Lake in Summit Township and at Gun Lake in Free Soil Township. These two dams are not listed in the NID.

A dam failure at the Ludington Pumped Storage Plant Dam could present a significant threat to the southwest corner of Mason County. Mason County Emergency Management has an emergency plan in place to respond in this unlikely emergency. There are no dams in neighboring counties that are considered a threat to Mason County, should they fail.

Historically Significant and Related Events: The MDEQ has documented approximately 287 dam failures in Michigan since 1888. Since 1970, two of these failures have been in Mason County but the specific dates, reasons, and locations for the failures are not available. It is assumed that one was the Silver Creek Dam failure in 1986.

Frequency of Occurrence: Mason County is somewhat vulnerable to dam failures since there are dams in the county and they do age. Dam failures in the past have not been memorable but might have occurred during the 1986 flooding event. If all failures occurred then, there would have been only one event in 43 years in 1970.

According to the MSP-EMHSD, there is no correlation between hazard potential and the number of documented failures in Michigan. Dams in Mason County are believed to be in good shape and are monitored constantly. However future failures in the county are expected. With two known failures between 1970 and 2012, the county averaged up to one failure every twenty years. However, since records of dam failures are incomplete, this estimated frequency might be inaccurate. It is possible that some or all of the recorded dam failures were the direct or indirect result of one weather event (floods of 1986). It is therefore possible that there will be approximately one weather event every 43 years severe enough to cause dam failures.

2.02 ENERGY EMERGENCIES

An actual or potential shortage of gasoline, electrical power, natural gas, fuel oil, or propane of sufficient magnitude and duration to potentially threaten public health and safety, and/or economic and social stability.

Summary: Historically, energy emergencies have not been considered as a significant hazard in Mason County. However, this hazard is discussed by the Michigan Hazard Mitigation Plan and is summarized in this plan to increase awareness among emergency responders, public safety officials, and community leaders. The following hazard description is only a portion of the information contained within the state plan, which can be referenced for additional information.

Energy supplies in Mason County are largely at the mercy of events beyond the county's borders, as well as greater regional and national trends. This hazard is addressed in order to raise awareness of this vulnerability and highlight the fact that Mason County's energy needs are closely connected to statewide and national issues. For more detailed information about this potential hazard, please refer to the Michigan Hazard Mitigation Plan.

Hazard Description: An adequate energy supply is critical to Michigan's (and the nation's) economic and social well-being. The American economy and lifestyle are dependent on an uninterrupted, reliable, and relatively inexpensive supply of energy that includes gasoline to fuel our vehicles, and electricity, natural gas, fuel oil and propane to operate our homes, businesses and public buildings. Energy emergencies became a serious national issue in the 1970s when two major "energy crises" exposed America's increasing vulnerability to long term energy disruptions. Americans have always dealt with short term energy disruptions caused by severe weather damage (i.e., downed power lines and poles), broken natural gas and fuel pipelines, and shortages caused by the inability of the energy market to adequately respond to consumer demand and meet needed production levels. However, the Oil Embargo of 1973-74, the natural gas shortage of 1976-77, the 1979 major price increases in oil resulting from the Iranian Revolution, the Gulf War in 1991 (after Iraq invaded Kuwait and destroyed many of its oil fields) and the aftermath of the September 11, 2001 terrorist attacks in the U.S. forced the country to recognize its vulnerability to energy disruptions. That vulnerability was again exposed during the Great Blackout of 2003 when about 50 million electric customers in the northeast United States lost power due to a power grid malfunction. The oil price increases during 2007 and 2008 pushed American gasoline prices to over $4 a gallon and caused major economic and energy related issues as well.

There are three types of energy emergencies. The first and most frequent type of energy emergency involves physical damages to energy production or distribution facilities, caused by severe storms, tornadoes, floods, earthquakes, or sabotage. Michigan has experienced a number of these short-term energy disruptions in recent history, mostly due to high winds associated with severe thunderstorms or damage caused by ice storms. While there have been only a few incidents of sabotaged energy systems in this country, networks supporting terrorist activity exist throughout the world and the possibility of more frequent incidents in the United States is always present. This category of energy emergency also covers short-term disruptions caused by human error, accidents or equipment failure, such as the power outages that occurred in Detroit in December 1998 and the Summer of 2000, the Wolverine Pipeline Company pipeline rupture in Jackson County in June 2000, the Mackinac Island power failure in July 2000, and the Great Blackout of 2003 that affected over 50 million energy customers. (Refer to the Infrastructure Failures, Severe Winds, and Ice/Sleet Storms sections of this document for additional information on short-term energy emergencies caused by weather, accidents, and equipment failure.)

The second type of energy emergency involves a sharp, sudden escalation in energy prices, usually resulting from a curtailment of oil supplies. Michigan experienced this type of energy emergency in the mid- and late 1970s due to events in the world oil market, and in 1991 following Iraq's invasion of Kuwait. The winter of 2000/2001 saw a sharp spike in natural gas costs due to reduced availability. However, many Michigan customers were unaffected, due to a price freeze on Michigan's major gas utilities. When oil reserves in Louisiana were blocked during Hurricane Katrina (August 2005), the effects were felt in Michigan and the Governor issued a State of Energy Emergency due to a gasoline shortage. Since 2001, energy costs for the average U.S. household have more than doubled, and sharply escalating gasoline prices have again strained the budgets of lower and middle class families. The summer of 2008 had the highest oil prices on record, following a dramatic rise in prices from 2007 to 2008. Gasoline prices peak at more than $4 per gallon. This contributed to the economic downtown beginning in 2007, as well as a move toward more fuel-efficient vehicles.

The third type of energy emergency is a sudden surge in energy demand caused by a national security emergency involving mobilization of U.S. defense forces. National defense, in a time of crisis, will demand an increase in energy. Although the regulated natural gas and electric utilities have approved state and federal priority allocation systems that are in place, regulatory changes to introduce competition into natural gas and electric markets have not fully addressed how such shortages might be managed once these markets are fully opened.

Historically Significant and Related Events: Listed below are a few examples of energy emergencies that may have affected Mason County residents.

December 2000 – State of Michigan: Propane Supply Problems

Going into the winter of 2000 - 2001, propane supplies were very tight and inventories were low. In the Midwest, propane inventories in mid-October 2000 were 44% below levels of one year earlier. In December 2000, the state experienced record cold weather. Heating degree-days showed temperatures were 27 degrees colder than normal, the second coldest December on record and the snowiest on record. The propane industry found it increasingly difficult to maintain deliveries in light of the high levels of demand. In response to industry requests and in view of the heavy snows and very cold weather, the Chair of the Michigan Public Service Commission, in consultation with the Emergency Management and Homeland Security Division of the Michigan State Police, requested a 10-day waiver of limits on driver hour restrictions from the Regional Administrator of the Federal Motor Carrier Safety Administration. Waivers were granted for Michigan (and also Indiana, at their request). The extremely tight supply coupled with additional demand to use propane as a substitute for natural gas (which also had a sharp run up in prices) caused residential propane prices to reach a record high in Michigan of $1.76 per gallon in January 2001 before declining to $1.00 per gallon by the end of the heating season. A significant warming trend in January allowed the industry time to replace seriously depleted supplies. Had this not occurred, the situation could have become much more serious.

February 2003 – Western Lower Peninsula

A break in a major transmission line caused a 60-mile electrical blackout that stretched over parts of six counties. The break cut electricity to tens of thousands of customers in the counties of Montcalm, Mecosta, Oceana, Newaygo, Muskegon, and northern Kent. The customers included hospitals, retirement homes, and schools. The power outage apparently started in the Croton-Hardy Dam area in Newaygo County. The power line that was cut normally supplies electricity to about 70 substations in the affected counties.

August 2005 – State of Michigan: Petroleum Product Supply Problems

On August 31, 2005, Governor Granholm issued three executive orders to address energy-related issues in Michigan caused by Hurricane Katrina. The massive hurricane blocked off oil refineries stationed in Louisiana and affected the supply in Michigan. Executive Order 2005-16 declared a State of Energy Emergency in accordance with 1982 PA 191. Executive Order 2005-17 temporarily waived regulations relating to motor carriers and drivers transporting gasoline, diesel fuel, and jet fuel. Executive Order 2005-18 provided for a temporary suspension of rules for gasoline vapor pressure. The State of Energy Emergency was in effect until November 29, 2005.

2007-2008 – United States: Oil Price Increases

Crude oil prices reached an all-time high in Michigan in July-September 2008. During 2003, the price rose above $30 a barrel in the peak summer months, and reached $60 a barrel by August 2005 nationally. The dramatic rise in oil prices began in March of 2007 with a steady increase that included little break during the 2007-2008 winter's traditional low point. March of 2008 started the very large increase in oil prices, starting at just over $80 a barrel, eclipsing $100 a barrel in May 2008, and finally peaking at $147 a barrel in July 2008. Following the July 2008 peak, oil prices then took a dramatic dive, and by November 2008 returned to just under $40 a barrel, the lowest level since March 2005. The increase in prices led to gasoline prices of over $4 a gallon during the summer of 2008. Commentators attributed these price increases to many factors, including reports from the United States Department of Energy and others, such as the decline in petroleum reserves, concern about high demand for oil, Middle East tension, and oil price speculation. Also, an unusual number of fires and other outages among U.S. refineries in the summer of 2007 disrupted supplies. A reduction in routine refinery maintenance was made necessary by the need to operate near full capacity to make up for a loss in refinery capacity from the 2005 Atlantic hurricane season; and deferred maintenance on refineries that escaped hurricane damage led to an increase in fires and accidents in 2007. Hurricane Ike in 2008 played a role in the price spike. Also, rising demand from U.S. consumers stretched refinery capacity to the limit and made the whole system more vulnerable to disruptions.

Frequency of Occurrence: Localized interruptions of electrical service are the most likely type of energy emergency in the county (see section 2.07 Infrastructure Failures for more information regarding power outages). However, the short list of energy emergencies presented above shows that county residents are occasionally exposed to other types of energy emergencies as well.

2.03 FIRE: SCRAP TIRES

A large and uncontrolled fire that burns scrap tires being stored for recycling/re-use.

Summary: Scrap tire fires produce a slew of complications, including toxic smoke and groundwater contamination, and require significant resources to extinguish. In addition, scrap tire piles pose a threat to public health by providing shelter and breeding grounds for mosquitoes and small animals.

There may be a few small concentrations of scrap tires in Mason County. However thanks to annual cleanup grants awarded by the MDEQ, significant concentrations may have already been addressed. Even so, the threat remains for concentrations to redevelop, and careful steps should be taken to ensure proper disposal of scrap tires.

Hazard Description: With the disposal of an estimated 290 million vehicle tires annually in the United States, management of scrap tires is a major economic and environmental issue. Michigan generates approximately 10 million scrap tires each year. Although responsible means of storage and disposal have become more common, tire dumps of the last forty years still present environmental and safety hazards. In November 2009, the State identified a total of over 990,400 tires (those that pose the greatest fire danger) in outdoor stockpiles scattered around the state. Since the MDEQ Michigan Scrap Tire Program began in 1991, the total amount of Michigan's scrap tire stockpile has gone from 31 million to about 3,400,000. The department estimated that most of the remaining tires could be disposed of before the program's ending date in December 2012.

Issues pertaining to the management of scrap tire disposal sites are difficult and diverse. Whole tires are difficult to landfill because they tend to float to the surface. Whole tires are banned from disposal in Michigan landfills due to their associated problems. Scrap tires are breeding grounds for mosquitoes, which can reproduce at thousands of times their natural rate in a scrap tire disposal site. These mosquitoes can carry and transmit life-threatening diseases. Stockpiles also are home to snakes and small mammals such as rats, opossums, skunks, and raccoons. Stockpiled tires are often soiled with mud, dirt, or other foreign materials that limit potential markets and increase processing costs. From an emergency management perspective, the most serious problem that scrap tire disposal sites pose is that they can be a tremendous fire hazard if not properly designed and managed.

Tire disposal sites can be serious fire hazards due to the sheer number of tires typically present at a site. This large quantity of "fuel," coupled with the fact that the shape of a tire allows air to flow into the interior of a large tire pile, renders standard fire fighting practices nearly useless. Flowing burning oil released by the tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems.

Deep stockpiles of compacted tire shreds can undergo a progressive series of exothermic reactions that increase pile temperatures and generate combustible gases. Surface symptoms of this phenomenon can be subtle, such as a slight sulfur odor, vapor steaming from isolated sections of the pile surface, or a slight oil sheen on adjacent standing water after rainfall. Due to the potential for auto-ignition, surface fires can ignite on a shredded tire stockpile, especially as shreds are removed from the area near the hot zone. Gases and shreds are then exposed to air and may ignite.

Scrap tire fires differ from conventional fires in several respects: 1) even relatively small scrap tire fires can require significant resources to control and extinguish; 2) the costs of fire management are often far beyond that which local government can absorb; 3) the environmental consequences of a major tire fire are significant; and 4) as alluded to earlier, the extreme heat converts a standard passenger vehicle tire into about two gallons of oily residue, which can leach into the soil or drain into streams.

Current technologies are sufficient to address the reuse of newly generated scrap tires, but some waste tires still migrate to the least expensive disposal method, which usually means they end up in legal and illegal scrap tire disposal sites. Lightning strikes, equipment overheating or sparks, unattended burning of debris/refuse, and arson are the leading causes of tire fires. Fires are also sometimes started by site operators or local residents in the wake of publicity over clean-up activities. This publicity can include enforcement proceedings or initial abatement activities, suggesting that a landowner may be acting out of frustration or attempting to avoid costs associated with tire abatement.

Much work still needs to be done to mitigate the impacts of scrap tire fires. Incident management planning, recognition of the hazardous material potential of fires at scrap tire sites, and improving and enhancing disposal site selection and design processes are all critical pre-incident preparedness factors that must be addressed by government and the private sector. In light of the potential consequences of scrap tire fires, prevention must become a primary goal in the treatment of scrap tire disposal sites. The Rubber Manufacturers Association maintains a website that contains extensive information regarding scrap tires that may be useful to local officials. This website can be accessed at: http://www.rma.org/scrap_tires/.

In Mason County, it is doubtful that a fire involving scrap tires would in itself cause a severe emergency or disaster. Rather, scrap tires are more likely to add problems to an already existing fire. In 2012, the Michigan Department of Environmental Quality estimated 6,500 total scrap tires at one "Registration Non-Compliant" sites in Mason County. One scrap tire cleanup grant for $10,444 was awarded in Mason County in Fiscal Year 2012 to dispose the passenger tire equivalent (PTE) of 8,325 tires. It is possible that other, undocumented concentrations exist within the county.

To prevent the scrap tire fire hazard, as well as threats to public health from scrap tire piles, mitigation measures must involve the prevention of indiscriminate scrap tire dumping and include proper disposal, recycling, and reuse practices. Various "junk days" are held at various places throughout the county to encourage the disposal of garbage, such as scrap tires. This type of service helps to control mass accumulations of scrap tires within the county. Though Mason County does not have a registered outdoor scrap tire collection site, numerous tire retailers and municipal transfer stations accept tires for a small fee.

Historically Significant and Related Events: Although research for this document was unable to reveal a history of scrap tire fires in Mason County, the possibility of one cannot be ignored. Because automobiles are the primary mode of transportation in Mason County, there is a constant potential for accumulation of discarded tires. Therefore this hazard should be monitored as a potential threat to public health and safety.

In 2012, there were an estimated 6,500 scrap tires in Mason County, though it is likely most have been or will be cleaned up thanks to grants awarded in fiscal year 2012.

The nearby counties of Mecosta and Osceola have experienced the following significant scrap tire fires in the recent past:

April 16, 1997 – Osceola County

The worst tire fire ever in Michigan occurred in Osceola County. The salvage yard where the blaze started contained over 6 million tires. All of the fire departments in a five county area were contacted. Residents within a three-mile radius were evacuated. The fire was extinguished in about two and one-half days by digging a trench around the perimeter of the fire to prevent its spread, and capping the fire with sand. In all, 478 firefighters from 34 different departments fought the blaze. The final cost of putting the fire out came to approximately $300,000. Over 1.5 million tires, two buildings and some trailers were lost in the fire.

February 24, 2000 – Mecosta County

A fire broke out at a tire recycling plant located in Hinton Township in Mecosta County. The fire had started in a pole barn that contained approximately 50,000 shredded tires. Nearby structures that also contained scrap tires were in danger of catching fire as well. Approximately 150 fire personnel from 13 local fire departments fought the blaze. Eventually, sand was brought in by a local contracting firm to smother the flames. Investigators determined that the apparent cause of the fire was a machine that had caught fire earlier and had not been adequately extinguished. The fire had then spread from the machine to the tires.

Frequency of Occurrence: Although there is no record of a serious scrap tire fire in Mason County, the possibility of one cannot be entirely discounted as a threat in the future. It is doubtful that a fire involving scrap tires would in itself cause a severe emergency or disaster, therefore scrap tire fires are not considered a significant hazard in Mason County.

2.04 FIRE: STRUCTURAL

A fire, of any origin, that ignites one or more structures, causing loss of life and/or property.

Summary: Every 23 seconds, a fire department responds to a fire somewhere in the nation. A structural fire occurs at the rate of one every 65 seconds, and in particular a residential fire occurs every 85 seconds. In 2011, structure fires represented 34.9% of all fires across the United States.

In terms of average annual loss of life and property, structural fires – often referred to as the "universal hazard" because they occur in virtually every community – are by far the most common hazard facing most communities in Michigan and across the country. In Mason County, developed areas have a greater risk of experiencing widespread structural fires than rural areas. In addition, the county's stock of historical structures increases the threat of conflagration, especially in downtown areas. Historic buildings increase this risk because they often do not meet today's fire protection standards.

Hazard Description: Structural fires are most threatening when they occur in densely developed or urban environments, where there is a potential for a single fire to become a conflagration. According to the National Fire Protection Association (NFPA), in 2011, there were 2,640 civilian deaths and 15,635 civilian injuries as a result of structural fire in the United States. There were 21 fatalities in 2011 where firefighters became ill or injured while on the scene of a structure fire. There were an estimated 484,500 structural fires in 2011, while direct property damage due to fires was estimated at $9.7 billion.

The 2011 statistics continue a declining trend in fires, casualties, and injuries over the past few decades. For example, from 1977 to 1979, the nation averaged 1,065,500 structural fires, 6,275 civilian deaths, 25,382 civilian injuries, and property damages of about $14.8 billion (when adjusted for inflation).

Unfortunately, although the United States has made great strides in lessening deaths and injuries caused by other types of disasters, structural fires are a worse problem in this country than in many other industrialized countries (even those with a more densely-developed population pattern). The

United States Centers for Disease Control (CDC) figures indicate that fire-associated mortality rates in the United States are approximately 2-3 times greater than those in many other developed countries. According to the Federal Emergency Management Agency's National Fire Data Center, residential fires represent 78% of all structural fires and cause 80% of all fire fatalities. Approximately 83% of those fatalities occur in single-family homes and duplexes. Perhaps the most tragic statistic of all is that over 40% of residential fires and 60% of residential fatalities occur in homes with no smoke alarms. (Studies have repeatedly shown that a working smoke alarm dramatically increases a person's chance of surviving a fire.)

Michigan's fire experience generally mirrors the national fire situation. According to statistics compiled by the Fire Marshal Division of the Michigan Department of Energy, Labor and Economic Growth for 2003, nearly 19,000 structural fires occurred in Michigan, resulting in 161 deaths and 624 injuries. The dollar loss for all fires was estimated at over $230 million. The Fire Marshal Division estimated that a structural fire occurred in Michigan about every 28 minutes in 2003. The U.S. Fire Administration reports that Michigan's fire death rate was 15.4 persons per million in 2007 and 16.4 per million in 2009. In 2009, Michigan ranked 11th among states in the nation, and was well above the national average of 11.0 deaths per million population.

Structural fires are especially likely to happen in the winter when wood stoves and sub-standard heating implements are most often used. Rural homes are more likely to use wood stoves, fireplaces and liquid propane heating equipment, and they may also have a greater exposure to wildfire threats during warm seasons. A special concern for many rural homes is the fact that emergency personnel cannot adequately respond to emergencies due to complications such as: 1) home addresses that are not visible from main roads; 2) driveways, two-tracks, or dirt roads that are too narrow for large vehicles to enter, turn around, or pass other vehicles; or 3) driveways that are "gated." These complications may be more common within coastal dune areas along Lake Michigan and in densely wooded areas.

Another concern is the potential for large structural fires in the "core" of the county's old commercial districts. Aging wooden framed multi-story commercial buildings with common walls, substandard electrical systems and remodeled 2nd and 3rd floors, done with little or no regard for fire code, present a fire chief with his worst nightmare, especially if the higher stories are tenant occupied. Mobile home fires also present a significant threat to life. There are many mobile home concentrations scattered throughout the county. See the "Severe Winds" hazard section for mobile home statistics in Mason County.

Historically Significant and Related Events: Structural fires are a common occurrence in Mason County. Statistics from the Michigan State Police, Fire Marshal Division estimated that the county's fire incident rate was 4.63 fires per 1,000 in population in 1998, about average for Michigan counties. If this rate held true for the 2010 county population (28,705), Mason would have experienced approximately 133 fire incidents in that year. It should be noted that this estimate includes all types of fire incidents and it is not known how many of these fires would be structural.

In 2003, Michigan fire departments reported 43,509 fires to the National Fire Incident Reporting System (NFIRS), with 18,759 of them (43%) involving "structures." The remaining fires are listed as "outside/other" (15,285) or "mobile properties" (9,475). Therefore, in Michigan in 2003, there was a fire of any origin once every 12 minutes and 7 seconds, and one structural fire every 28 minutes and 6 seconds. These fires resulted in 161 civilian deaths, 624 civilian injuries, and 514 fire service on-duty injuries. There were 134 fires in Mason County in 2003 which caused property and contents losses of $764,565. Based on the proportion of structural fires to all types of fire in Michigan, it is likely that approximately 58 (43%) of the reported fires involved structures. Fortunately, none were reported as causing fatalities.

Perhaps the worst structural fire in Mason County history occurred on June 11, 1881, when a conflagration swept through the City of Ludington. As a circus parade was making its way through town, most of the town's citizens and firefighters had turned to watch the parade. A small wisp of flames appeared on West Loomis Street, and spread quickly to a saloon, a meat market, and a shoe store. Due to a crack in the city's fire warning bell, the sound did not carry very far and firefighters were slow to answer the call. Mills, factories, and shops closed and their workers rushed to help fight the growing fire. Even the circus performers joined in to help try to save the city, but it was to no avail. By the end of the day, 67 building including the fire station had burned to the ground, devastating downtown Ludington. The Ludington Fire Department, as it exists today, was established in 1881 as a direct result of this event.

More recently, an apartment house fire in the City of Ludington resulted in nine deaths on February 28, 1993. The U.S. Fire Administration issued a technical report after the event. Rapid smoke and flame spread throughout the second floor, claiming the lives of nine occupants and injuring one. The fire department used 44 firefighters and police personnel and eight units. The fire resulted in $50,000 in damages to the building which was constructed in 1882.

Frequency of Occurrence: There will certainly be structural fires each year in Mason County. Fortunately most of these fires will be confined to a single site and widespread damages will likely be limited. Based on the 2003 and 2010 fire estimates discussed above (estimated 133-134 fires per year), Mason County should expect to average one fire approximately every other day. The actual number of fires experienced in the county can vary greatly from season to season, and year to year.

2.05 **HAZARDOUS MATERIAL INCIDENTS: FIXED SITE** (including industrial accidents)

An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment.

Summary: The potential release of hazardous materials exists wherever that material may be located. Hazardous materials are chemical substances which, if released or misused, can pose a threat to people, property, or the environment. These chemicals are used in industry, agriculture, medicine, research, and consumer goods. As many as 500,000 products pose physical or health hazards and can be defined as "hazardous chemicals." Each year, over 1,000 new synthetic chemicals are introduced.

As of 2013, there were 26 SARA Title III sites in Mason County (known to store potentially dangerous amounts of hazardous materials).

Also included in this section are industrial accidents, defined as a fire, explosion, or other severe accident (especially if it involves hazardous materials) at an industrial facility that results in serious property damage, injury, or loss of life.

Hazard Description: Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities in our communities. Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. A facility is subject to SARA Title III provisions if extremely hazardous substances, as determined by the US Environmental Protection Agency (EPA), are present at the Facility in quantities at or above the minimum threshold quantities established in Section 302 of the Act.

Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. Whereas hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may require evacuations or in-place sheltering of the affected population, the impacts from industrial accidents are often confined to the site or facility itself, with minimal physical outside impacts. Nonetheless, industrial accidents, such as fires, explosions, and excessive exposure to hazardous materials, may cause injury or loss of life to workers at the facility, and significant property damage. Industrial accidents may result in severe economic disruption to the facility and surrounding community, as well as significant long-term impacts on the families of the workers injured or killed.

Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidents do occur. Often, these incidents can cause severe harm to people or the environment if proper action is not immediately taken. Most incidents are the result of human error. Occasionally, incidents can be attributed to natural causes, such as a flood that washes away barrels of chemicals stored at a site. However, those situations are the exception rather than the rule.

As of 2013, there were 26 sites in Mason County designated as a SARA Title III, Section "302 Site." Should there be any future site designations, law requires each site to have an emergency plan on file with the Local Emergency Planning Committee (LEPC), fire department, and at the facility. The LEPC's are responsible for developing emergency response plans for communities that have facilities in their jurisdiction that are subject to SARA Title III Emergency Planning Requirements. The LEPC is the primary mechanism through which local SARA Title III planning, training and exercising activities are implemented. Despite such extensive guidelines, the possibility of human error in complying with these plans means that a hazard would still exist in the event that a location in the county becomes designated as a "302 Site." When a "302 Site" is located near other developments, compliance with LEPC planning is especially important.

Historically Significant and Related Events: Research for this hazard revealed one fixed site hazardous materials release, while no industrial incidents were identified. The Ludington Daily News reported an accidental spill of cyanide acid into the Ludington sewer system by Straits Steel and Wire Company occurred on Sunday, April 5, 1970. Fortunately the spill happened on the weekend. City officials said if the spill occurred on a weekday, it could have killed anyone working in the city sewer system. At the time of the spill, the city sewage treatment plant was notified and the full amount of chlorine was added in attempt to treat the acid before it was discharged into the lake.

Frequency of Occurrence: Without a complete history of fixed site hazardous materials incidents or industrial accidents, it is not possible to identify a frequency of occurrence. However, the possibility of an incident or accident certainly exists, as there are numerous SARA Title III sites and industrial operations within Mason County. The 2001 Mason County Hazard Analysis described this hazard as an ongoing threat.

2.06 HAZARDOUS MATERIAL INCIDENTS: TRANSPORTATION

An uncontrolled release of hazardous materials during transport, capable of posing a risk to life, health, safety, property or the environment.

Summary: The transportation of hazardous materials along highways, roads, and rails is a common occurrence, both passing through and directly to sites within Mason County. As of 2012, there were 26 SARA Title III sites in Mason County (see discussion in 2.05 Hazardous Material Incidents: Fixed Site); many of which host industrial activities in urban settings. Hazardous materials may also be transported to rural areas of the county for agricultural purposes.

Hazard Description: As a result of the extensive use of chemicals in our society, all modes of transportation - highway, rail, air, marine, and pipeline - are transporting hazardous materials on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency with the potential to affect many people. Smaller incidents, while problematic for the affected community, are fairly common in Michigan, and are effectively dealt with by local and state emergency responders and hazardous material response teams. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material (or have the potential for such a release) can adversely impact the life safety and/or health and well-being of those in the area surrounding the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show that nearly every hazardous material transportation incident is the result of an accident or other human error. Incidents are rarely caused solely by mechanical failure of the carrying vessel.

There have been many minor petroleum and hazardous materials spills throughout the years on highway systems in Michigan. Mason County has two highways, US 31 and US 10. With exception of US 31 south of Ludington, these trunklines are primarily two-lanes, and can be heavily congested in the summer months and often icy or impassable in the winter. In addition to the roadways, the Marquette Rail owned by RailAmerica, is a major freight railroad that makes daily runs between Grand Rapids (Kent County) and Manistee (Manistee County). The rail runs north and south between Grand Rapids and Baldwin (Lake County), and then east and west between Baldwin and Walhalla in Mason County. From there, separate spurs connect to Ludington and Manistee. The Mason County Airport provides a variety of local transportation services. Freighters and barges use Ludington's port for receiving raw materials and shipping products.

Bordering the Great Lakes and containing a commercial port, one of the most dangerous hazardous material transportation scenarios that could occur in the county would be a spill or release of oil, petroleum, or other harmful material from a marine cargo vessel. Such an incident, if it involved a large quantity of material, could cause environmental damage of unprecedented proportions. Fortunately, the Great Lakes states, working in partnership with oil and petroleum companies and other industries, have taken significant steps to ensure that a spill of significant magnitude is not likely to occur on the Great Lakes. Low water levels may increase the possibility of a ship running aground and releasing harmful amounts of contaminants into the environment.

Historically Significant and Related Events: Research for this hazard did not reveal any major hazardous materials incidents occurring on Mason County transportation routes.

Frequency of Occurrence: Without a history of transportation-related hazardous materials incidents, it is not possible to identify a frequency of occurrence. However, the possibility of an incident certainly exists, as there are numerous modes of transportation active within Mason County.

2.07 INFRASTRUCTURE FAILURES

The failure of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services.

Summary: As reported in a 2009 study by the National Academy of Sciences, an electrical blackout "has the potential to affect virtually all sectors of society: communications, transportation, banking and finance, commerce, manufacturing, energy, government, education, health care, public safety, emergency services, the food and water supply, and sanitation."

Power loss is the most common form of infrastructure failure in Mason County, often occurring as a result of natural hazards. Isolated residences in rural areas may be exceptionally vulnerable to extended power loss events, especially during the winter months. Mason also has a network of roads and municipal water and wastewater infrastructure.

Hazard Description: Michigan's citizens are dependent on public and private utility infrastructure to provide essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent, yet interrelated, systems fail due to disaster or other cause - even for a short period of time - it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can literally die in their homes if immediate action is not taken. When the water or wastewater treatment systems in a community are inoperable, serious public health problems may arise and require immediate attention in order to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur. These are just some examples of the types of infrastructure failures that can occur, and all of these situations can lead to disastrous public health and safety consequences if immediate mitigation actions are not taken.

Typically, special populations such as the elderly, children, impoverished, and people in poor health are the most impacted by infrastructure failures and must receive special consideration when failures occur. If the failure involves more than one infrastructure system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted.

Although Michigan has in place many codes and standards that govern the design, construction, and operation of public and private utility infrastructure, these codes and standards are often inadequate to protect the infrastructure from disaster-related damage. In many cases, the codes and standards call for the minimum level of structural integrity and operational performance recommended in accepted engineering practice, when a higher level would result in less disaster damage. Obviously, a balance must be reached between structural integrity, operational reliability, and short- and long-term costs associated with upgrading facility codes and standards.

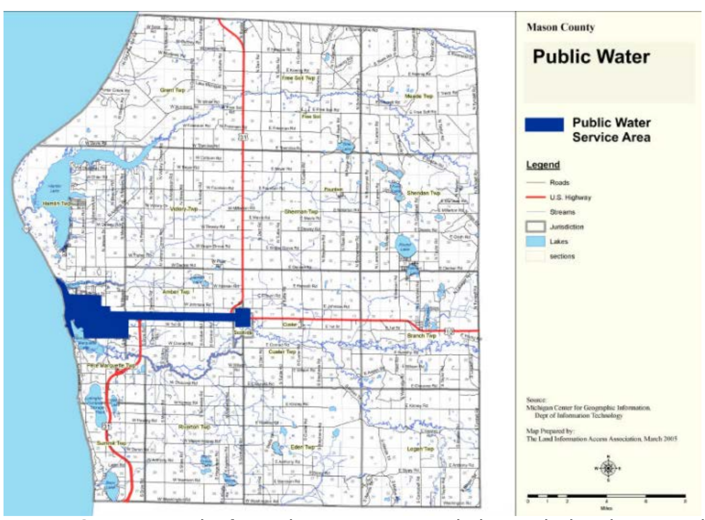
Though it is possible to design and operate facilities that are virtually "disaster-proof," in many cases it is not economically feasible. Extensive increases in integrity and reliability can result in prohibitive increases in cost. It is often too expensive to upgrade infrastructure codes and standards much beyond their current levels. However, in those cases where recurring, severe damage and system down-time occur due to natural or technological hazard events, it makes sense to explore the possibility of enhancing infrastructure design, construction, and operational codes and standards.

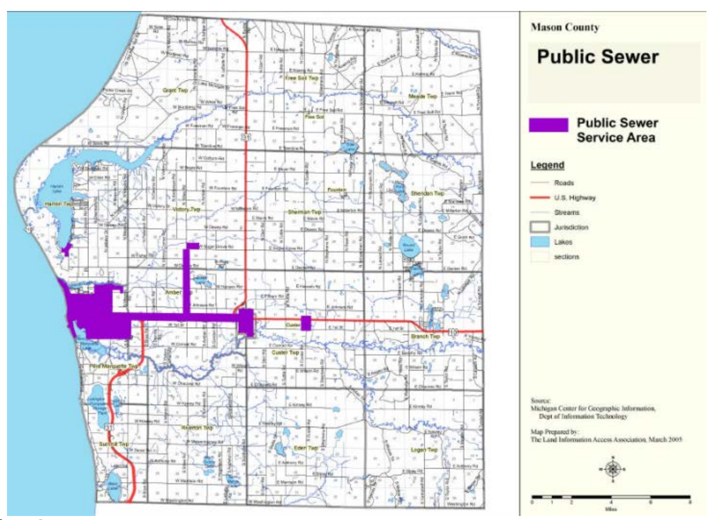
As Michigan's public and private utility infrastructure systems continue to age, infrastructure disasters will undoubtedly become more common. Because many of these systems were developed decades ago, the costs of repairing and replacing aging sections and/or components have greatly increased. As a result, many communities cannot afford to do the maintenance work necessary to keep the system in ideal operational mode. Increasing demands on the systems also lead to increased deterioration and in many cases pipes have far exceeded their useful service life. This creates a situation of increasing risk for infrastructure-related disasters, either as a primary event, or as a secondary event to floods, windstorms, snow and ice storms, or other natural or technological hazards. When those disasters do occur, they cause great inconvenience to the affected population and they can also create subsequent public health and safety concerns.

The Mason County Road Commission website states there are 237 miles of primary roads, 716 miles of local roads, and 164 miles of state roads in Mason County. According to the Michigan Asset Management Council, the condition of 10,000 miles of Michigan's federal aid eligible roads went from either "good" or "fair" to "poor" between 2004 and 2007. According to the US Census Bureau, Michigan has been ranked in the bottom ten of all states for over 40 years in its level of funding. After a decade of stagnant revenues in road funding, the Michigan Department of Transportation (MDOT) showed an additional 15 percent decline in funding between 2008 and 2011. Another challenge for Michigan's roads and bridges is the annual winter freeze-and-thaw cycle that causes a continual breakdown of road and bridge surfaces. According to the July 2008 report by the Citizens Advisory Committee on Transportation Funding, Michigan's roads and bridges will require an estimated annual investment of $6.1 billion, which is nearly two times the current funding level, for basic improvements to its road and bridge system.

Drinking water supplies in Mason County come from two basic sources: groundwater and surface water. Municipal water services in Ludington, Scottville and portions of Amber and Pere Marquette townships, originate from Lake Michigan. Type I public water supplies in the county; including systems that service apartment buildings, nursing homes, and mobile home parks; originate from groundwater sources. In addition to Type I public water supplies, there are Type II public water supplies (also called Noncommunity Water Systems) serving area schools, industry, hotels, restaurants, campgrounds, and churches. There are also private water wells serving individual single family homes. Aging water lines in Ludington's system have recently been replaced.

The Ludington Sewage Treatment System receives wastewater from collection systems in the cities of Ludington and Scottville; and the townships of Amber, Pere Marquette, and Victory. The Ludington system has a capacity of 7.5 million gallons per day. The Village of Custer operates its own public sewer system with a capacity of 60,000 gallons per day. Maps showing municipal water and sewer service areas are shown below.





Source: Land Information Access Association and Planning & Zoning Center, Inc.

Historically Significant and Related Events: Infrastructure failures are common in Mason County, with power loss affecting the greatest portion of the population. The NCDC Storm Events Database mentions downed power lines or power outages 27 times for Mason County between 1996 and 2013; all of which were either caused by thunderstorms (56%), winter weather (22%), or high wind events (50%). Notable power outages that affected Mason County to some degree are listed in the table below.

Widespread Power Outages Affecting Mason County, 1996-2012

Date	Event	Number of Outages	Area Affected
April 6-7, 1997	Windstorm	180,000-200,000	Michigan
May 31, 1998	Thunderstorms	861,000	Michigan
November 10, 1998	Windstorm	167,000	Southern Lower Michigan
April 3, 2003	Ice Storm	Hundreds of thousands	Southwest Lower Michigan
October 30, 2004	Windstorm	100,000	Michigan

Source: NCDC Storm Events Database, Local Reports

Examples of localized power outages in Mason County include:

- September 16, 1997: over 500 customers without power due to thunderstorm winds;
- March 9, 1998: 600 outages due to blizzard conditions;
- June 25, 1998 with 274 residents in the Hamlin Lake area without power due to thunderstorm winds.
- September 11, 2000: 305 customers without power in Ludington and 190 without power in Scottville due to thunderstorm winds;

Public sewer systems in Mason County have failed a number of times in recent years. According to the Michigan Department of Environmental Quality, there were five sewage releases caused by sewer line breaks or ruptures from 2000 through 2012. The most egregious release occurred in Ludington as a result of the flooding disaster of June 2008. Fifteen million gallons of diluted raw sewage escaped when a road and bridge washed out and damaged a sanitary force main. The flood triggered gubernatorial and presidential disaster declarations. In Scottville, 81 releases of diluted raw sewage were reported to the MDEQ between 2000 and 2004. All but two of these were the result of the city's combined sewer/stormwater system, which would release the wastewater into the Pere Marquette River after a rain or snowmelt. As of 2004 however, the city has separated sewer and stormwater pipes.

In the rural areas of the county, infrastructure failures other than power failures seldom cause widespread problems. Most residents rely on site-based sewage, water and heating facilities rather than those provided by urban utility providers. They have been known to fail, as they did in January 1994 during a prolonged period of severe cold weather that caused ground frost to increase well beyond normal depths and affecting many site-based sewage systems. In addition, extremely low water levels and drought conditions may cause some water wells to go dry.

Transportation infrastructure in Mason County is also susceptible to failure or interruption. There are numerous examples within the NCDC Storm Data documenting road closures, most of which were the result of severe winter weather. Excessive rains and flash flooding also have a propensity to render roads impassable; or even washout roads, bridges and culverts completely. The flooding disaster of June 2008 caused significant disruption to automotive transportation, including the shutdown of U.S. 31 from Scottville to Manistee; four washouts on M-116; and 47 road closures by the Mason County Road Commission. Damage to public infrastructure in Mason County by this flood was estimated at $3 million.

Frequency of Occurrence: Natural hazards, especially thunderstorms, windstorms and winter weather, are the primary cause of infrastructure failure in Mason County. Since these hazards are expected to affect the county a numerous times per year, infrastructure failures are possible virtually anywhere in the county in any given season.

NCDC Storm Data lists 27 instances of downed power lines or outages for Mason County in the 18-year period from 1996 through 2013. At this rate, Mason County experienced one to two incidents per year. Of the total number of events, five were regionally significant events, occurring once every three to four years on average. Isolated or localized power failures can be resolved in a matter of hours, while widespread events may take days to fully recover.

In the period from 2000-2012, there were 6 sewer system overflows due to infrastructure failure. The frequency of this happening was once every other year.

2.08 NUCLEAR POWER PLANT EMERGENCIES

An actual or potential release of radioactive material at a commercial nuclear power plant or other nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population.

Summary: The nearest nuclear power plants are more than 50 miles away from Mason County, well beyond the facility's Emergency Planning Zone. Nuclear power plant emergencies are therefore not considered a significant threat to Mason County.

Hazard Description: Though the construction and operation of nuclear power plants are closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents at these plants are considered a possibility and appropriate on-site and off-site emergency planning is conducted. An accident could result in the release of potentially dangerous levels of radioactive materials into the environment that could affect the health and safety of the public living near the nuclear power plant. A nuclear power plant accident might involve both a release of air borne radioactive materials and radioactive contamination of the environment around the plant. The degree and area of environmental contamination could vary greatly depending on the type and amount of radioactivity and weather conditions. Response to a nuclear power plant accident requires specialized personnel who have been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

The previous edition of this plan stated that the closest nuclear facility is more than 50 miles from the county's southern edge. (This was in reference to the Palisades plant in Van Buren County, which is just over 100 miles from Mason County's southern border.) However, it has since been realized that the Point Beach Nuclear Power Plant in Wisconsin is slightly over 50 miles to the northwest of Big Sauble Point in Hamlin Township. Because both plants are more than 50 miles away from Mason County, and beyond the facilities Emergency Planning Zones, they are not considered to be a threat in Mason County. The impacts of a major emergency at Point Beach may have long-term effects on Mason County by virtue of potential impacts on Lake Michigan. Regarding the Palisades plant, it is believed that even if a major plume cloud were to be released, most radioactive materials would probably disperse into relatively harmless quantities over the long distance between the county and that site.

History: Mason County has never experienced damage from a nuclear power facility.

Frequency of Occurrence: Nuclear power plant accidents are not considered a significant threat in Mason County.

2.09 OIL AND NATURAL GAS WELL ACCIDENTS

An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells.

Summary: There are a number complications and hazards that may be associated with oil and gas wells, highlighted by the potential for uncontrolled releases of hydrogen sulfide. Mason County has a history of oil and natural gas production. Subsequently, abandoned and insufficiently capped wells are likely to exist in the county as a byproduct of oil and gas exploration.

Hazard Description: Oil and natural gas are produced from fields scattered across 63 counties in the Lower Peninsula. From 1927 to January 2009, there have been 56,525 oil and natural gas wells drilled in Michigan, of which roughly half have produced oil and gas. To date, Michigan wells have produced over 1.4 billion barrels of crude oil and 6 trillion cubic feet of gas.

The petroleum and natural gas industry is highly regulated and has a fine safety record, but the threat of accidental releases, fires and explosions still exists. In addition to these hazards, many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide (H2S) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions. Over 1,300 wells in Michigan have been identified as having H2S levels exceeding 300 parts per million (ppm).

As the table below indicates, at concentrations of 700 ppm, as little as one breath of hydrogen sulfide can kill. Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm to 150 ppm, larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. Within humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe for use in sour gas well response.

Physiological Response to H_2S

10 ppm	Beginning eye irritation
50-100 ppm	Slight conjunctivitis and respiratory tract irritation after 1 hour exposure
100 ppm	Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, eye pains and drowsiness after 15-30 minutes followed by throat irritation after 1 hour. Several hours of exposure results in gradual increase in severity of symptoms and death may occur within the next 48 hours.
200-300 ppm	Marked conjunctivitis and respiratory tract irritation after 1 hour of exposure.
500-700 ppm	Loss of consciousness and possibly death in 30 minutes to 1 hour.
700-1000 ppm	Rapid unconsciousness, cessation of respiration and death.
1000-2000 ppm	Unconsciousness at once, with early cessation of respiration and death in a few minutes. Death may occur even if the individual is removed to fresh air at once.

Source: American National Standards Institute, Standard: 237.2-1972

An unplugged abandoned well, also known as an orphan well, can be a hazard to the health and safety of the surrounding people and environment. There are many situations where an unplugged well can become dangerous. For example, a rusted-out casing in a gas well can let natural gas flow underground and accumulate in the basement of a nearby building, possibly causing an explosion. Occasionally, gas leaking from an old well can contaminate a nearby water well. An old well might also be a conduit for salt brine from deeper formations to pollute fresh groundwater, or to discharge at the surface. In some cases, oil leaks from abandoned wells, polluting soil and water. It has been reported to cost nearly a million dollars to properly plug one abandoned or out of use well.

According to the Michigan DEQ, Office of Oil, Gas and Minerals in October 2012, there are 710 total oil and gas wells in Mason County. While a vast majority of these wells are inactive, abandoned or capped, 52 of them were "active" or "producing." Forty-three wells are known to have detectable levels of hydrogen sulfide in the following Mason County townships: Amber (1), Eden (5), Grant (3), Hamlin (13), Riverton (3), and Victory (18). It is important to note that any type of oil or gas well, even one that has been capped, is capable of leaking dangerous levels of hydrogen sulfide.

In 1929, Mason County's first recorded hydrocarbon production came in the form of natural gas in Grant Township. The next significant discovery, also natural gas, came from the Logan Field following a 1941 discovery. The county's oil production began in 1948 in Eden Township. As of 1982, this first oil field was the county's largest in terms of the number of wells and in oil production. Through 1982, Mason County was the state's 20th largest producer of natural gas and the 28th largest producer of oil among the 59 hydrocarbon-producing counties in Michigan.

A cursory analysis of well locations in Mason County shows that some may be located fairly close to major roads, homes, or developed areas, such as U.S. 10 and Scottville. This in itself is not cause for undue alarm, but the locations merit increased precautions and awareness. Continued monitoring and investigation should ensure that these wells do not pose any threat to any nearby developments. Field investigation may determine that these wells and processing plants are far enough from other developments that the risks of harmful incidents are minimal. The Michigan Department of Environmental Quality has information on all permitted wells in the state.

An additional concern in Mason County is the fact that as many as 32 (in 2005) different organizations and individuals own the wells. As a general rule, most gas companies prefer to respond to incidents involving their wells themselves; and in the vast majority of cases that is what happens. Because gas companies often have controlled burns, and deal with wells on a daily basis, it is impossible to ascertain how many incidents have actually occurred in Mason County. However, there is still the possibility that an emergency response agency could find itself in the situation of responding to an incident at a well. Responders must understand the dangers associated with H_2S and must have a working knowledge of the wells that are in their areas of responsibility. In rare cases, gases may be released in a way that affects adjacent areas.

Historically Significant and Related Events: There are two identified oil or gas well incidents in Mason County. The Michigan Land Use Institute lists two oil and gas well accidents, both in Victory Township. According to the Institute, the first was on May 13, 1994 when a blown gasket at a compression station allowed hydrogen sulfide emissions causing a number of self-evacuations and at least 11 emergency hospitalizations. The second was on January 5, 1996 when a well experienced a stuck valve, causing 18 emergency calls.

Frequency of Occurrence: Because Mason County has a moderate number of oil and gas wells, the occurrence of a significant accident remains a possibility. Although it is difficult to determine a frequency of occurrence for this hazard, it is likely the county will continue to experience effects of oil and gas wells; especially as former and orphan wells continue to age. Oil and natural gas well accidents are listed as an "on-going" hazard in the March 2003 Mason County Hazard Analysis.

2.10 PIPELINE ACCIDENTS

An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline.

Summary: Pipeline accidents are a real and constant threat to countless communities across the country. There are natural gas pipelines, as well as numerous distribution lines, and a sour gas pipeline in Mason County. According to the 2006-2010 American Community Survey, just over half of the housing units in Mason County rely on utility natural gas as their primary heating fuel.

Hazard Description: Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or erupt and cause property damage, environmental contamination, injuries, and even loss of life. The vast majority of pipeline accidents that occur in Michigan are caused by third-party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations. Many structures are located right next to pipelines and thus may be at-risk. Pipelines can also cross through rivers, streams, and wetlands, thus posing the possibility of extensive environmental damage in the event of a major failure.

Michigan is both a major consumer and producer of natural gas and petroleum products. According to the federal Energy Information Administration, Michigan's consumption of petroleum products, particularly liquefied petroleum gases (LPG) is high; Michigan is the largest residential LPG market in the nation, due mostly to high residential and commercial propane consumption. The state has a single petroleum refinery but a large network of product pipelines. More than 78% of the overall home heating market uses natural gas as its primary fuel. With over one-tenth of U.S. capacity, Michigan has the greatest underground natural gas storage capacity in the nation and supplies natural gas to neighboring states during high-demand winter months. Driven largely by the residential sector, Michigan's natural gas consumption is high. Nearly four-fifths of Michigan households use natural gas as their primary energy source for home heating.

The State Energy Data System (SEDS) released data in August 2009 that describes energy consumption by source and total consumption per capita. Michigan ranks 13th in the nation in production of natural gas with 264.9 billion cubic feet and 7th in consumption at 847.8 billion cubic feet. These figures underscore the fact that vast quantities of petroleum and natural gas are extracted from, transported through, and stored in the state, making many areas vulnerable to petroleum and natural gas emergencies. Michigan's gas and petroleum networks are highly developed and extensive, representing every sector of the two industries – from wells and production facilities, to cross-country transmission pipelines that bring the products to market, to storage facilities, and finally to local distribution systems. Pipeline users have response and recovery systems in place for all the pipelines under their control, and continually monitor the status of pipelines in the county, state, and throughout the country.

While it is true that the petroleum and natural gas industries have historically had a fine safety record, and that pipelines are by far the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills nevertheless exists. In addition to these hazards, there is the danger of hydrogen sulfide (H_2S) release. These dangers (fully explained in section "2.08: Oil and Gas Well Accidents") can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

Mason County has major pipelines actively transmitting natural gas through the area. MichCon, a subsidiary of DTE Energy, operates high-pressure natural gas transmission pipelines that run north-south, and east-west through the county. There are also numerous smaller gathering or distribution pipelines, such as lines that deliver natural gas to homes and businesses. Much of the distribution pipeline system is aging and will require significant investments to avoid serious leaks and/or explosions. MichCon natural gas service is available in more than half of the municipalities in Mason County. There is also a sour gas pipeline that runs north-south that connects sour gas wells in Oceana and Mason County to a sweetening plant northeast of Manistee. Mason County has approximately 10 wells that produce sour gas, and two compressor sites that are associated with the sour gas pipeline.

Historically Significant and Related Events: Major natural gas explosions in recent years have highlighted the danger of aging natural gas pipelines. In 2011, a large crack in an 83-year-old, cast-iron gas main caused a gas explosion in Allentown, Pa. The incident killed five and damaged nearly 50 homes. More recently on February 27, 2013, a natural gas explosion rocked a neighborhood in Royal Oak, Michigan as a Consumers Energy work crew replaced pipelines dating to 1929. The incident killed a man, leveled his house, and damaged 30 other homes nearby.

The Michigan Land Use Institute lists five pipeline accidents in Victory Township, four from ruptures and one from replacement. According to the Institute, the September 1996 replacement caused one illness. The February 1995 rupture caused one evacuation while the April 1995 rupture caused 50 evacuations. The July 1996 rupture caused self-evacuations as did the August 1996 rupture.

There have also been significant incidents in neighboring counties in recent years. The following records provide examples of events that are possible in Mason County.

June 23, 1999 – Lake County

A broken gas main near the intersection of M-37 and US-10 in Pleasant Plains Township prompted the evacuation of nearby residents, including senior and low-income housing complexes.

October 21, 2000 – Newaygo County

A propane explosion in the unincorporated community of Woodland Park demolished a summer home, killing four members of a family shortly after they arrived for a weekend visit. Two other family members survived the blast, which may have originated in the basement of the home.

Frequency of Occurrence: Past pipeline accidents; in Mason, nearby counties, and across the country; have demonstrated how similar accidents may affect Mason County in the future. The frequency of this hazard is nearly impossible to determine, although five minor natural gas pipeline incidents have been identified in Mason County. However, if aging pipelines are not maintained or replaced, the risk of a leak, spill, or explosion is certain to persist. Pipeline accidents are listed as an "on-going" concern in the March 2003 Mason County Hazard Analysis.

2.11 TRANSPORTATION ACCIDENTS

A crash or accident involving an air, land or water-based commercial passenger carrier.

Summary: Minor transportation accidents along the county's road network are frequent and inevitable; especially during inclement weather and along roads that are in disrepair. The primary emphasis of this hazard description, however, is placed upon commercial and larger-scale modes of transportation.

Possible accidents involving commercial passenger transportation in Mason County include air transport, marine transport, and buses including public transportation, school buses, and tour buses. Natural weather hazards, as well as high traffic volumes, occasionally increase the risk of accident involving any of these modes of transportation.

Hazard Description: Communities vulnerable to transportation accidents would contain an airport offering commercial passenger service, railroad tracks on which commercial rail service is provided, commercial inter-city passenger bus or local transit bus service, school bus service and/or commercial marine passenger service. A serious accident involving any of modes of passenger transportation could result in a mass casualty incident requiring immediate life-saving community response. When responding to any of these types of transportation accidents, emergency personnel may be confronted with a number of problems, such as: 1) suppressing fires; 2) rescuing and providing emergency first aid for survivors; 3) establishing mortuary facilities for victims; 4) detecting the presence of explosive or radioactive materials; and 5) providing crash site security, crowd and traffic control, and protection of evidence. In addition, a marine transportation accident could require a water rescue operation, possibly under dangerous conditions on Lake Michigan. There are concerns that a major transportation accident could cause many injuries or deaths and might occupy all area responders.

A land transportation accident in Michigan could involve a commercial intercity passenger bus, a local public transit bus, a school bus, or an intercity passenger train. These modes of land transportation have a good safety record, however accidents do occur. Nationally, an average of about six persons die each year in charter and commuter bus crashes, and 11 school children die in school bus accidents. About 8,500 children are injured each year in school bus crashes. Typically, bus accidents are caused when buses slip off the roadway in inclement weather, or collide with another vehicle. Intercity passenger train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks before the train arrives at the crossing. Unless the train accident results in a major derailment, serious injuries are usually kept to a minimum. Bus accidents, on the other hand, can be quite serious; especially if the bus has tipped over. Major land transportation accidents are more likely to occur in areas of heavy traffic, industrial activity, decrepit roads, and during periods of inclement weather.

Buses are the primary mode of commercial passenger transportation on land in Mason County, as there is no passenger rail service. The county has one public transit system, the Ludington Mass Transportation Authority (LMTA), which owns 21 vehicles and serves residents in the cities of Ludington, Scottville and Pere Marquette Charter Township. As a special service, LMTA provides contract service to clients of West Michigan Community Health, Senior Meals Program, Ludington and Scottville Schools. The system carried 171,320 passengers in 2012 (MDOT, 2013).

In addition to the LMTA services, school districts provide bus transportation service during the school year. School buses travel routes throughout the county, often along rural routes that are easily impacted by inclement weather. Finally, charter and tour buses frequently travel to and through the county, especially along highways US 31 and US 10.

Statistics from the National Transportation Safety Board (NTSB) and the airline industry show that over 75% of airplane crashes and accidents occur during the takeoff or landing phases of a flight. As a result, developed areas that are adjacent to major airports, and along airport flight paths, are particularly vulnerable to this hazard. Accordingly, the probability of a crash or accident increases as the number of landings and takeoffs increase. The challenge for jurisdictions with a passenger air carrier airport is to develop adequate procedures to handle a mass casualty incident that could result from an airplane crash or accident.

Mason County Airport, a general utility airport, is the only airport in the county.

Mason County Airport Operational Statistics

Aircraft based on the field: 26	Aircraft operations: 27/day *
Single engine airplanes: 23	46% transient general aviation
Multi engine airplanes: 3	34% local general aviation
	21% air taxi
	* for 12-month period ending December 31, 2011

Source: www.airnav.com, 7-3-13; Based on FAA information effective June, 27, 2013.

The Lake Michigan Carferry (S.S. Badger) makes round trips between Ludington and Manitowoc, Wisconsin from May through October, with one trip per day in the spring and fall and two a day in the summer. It carries 50 to 60 crew members per trip and can accommodate 600 passengers, 180 automobiles, tour buses, RVs, motorcycles, and commercial trucks. In addition, small-scale fishing charters are available out of the Ludington harbor.

Historically Significant and Related Events: Although minor traffic accidents are frequent and inevitable, no significant transportation accidents were identified during research for this hazard.

Frequency of Occurrence: Even though there are no identified incidences of major transportation accidents in Mason County, the possibility of a land, air, or marine transportation accident can't be overlooked. Minor traffic accidents are a common occurrence, and take place daily in Mason County. Periods of heavy traffic are most likely around holidays, especially during warm weather seasons. Inclement weather is possible any time during the year; however treacherous traveling conditions are most common during the winter months.   Other types of transportation accidents are possible, but not common in the county. The frequency of accidents with commercial carriers within the county is indiscernible. This hazard is ranked as an "on-going" threat in the March 2001 Mason County Hazard Analysis.

3.0 HUMAN RELATED HAZARDS

3.01 CATASTROPHIC INCIDENTS (National Emergencies)

A large-scale event that has severe effects upon large numbers of persons, across a wide area, and immediately overwhelms State, tribal, and local response capabilities. Such incidents are likely to require coordination activities from many states, including Michigan, even if the event took place in a distant location.

Summary: Many of the hazards addressed in this chapter may achieve "catastrophe" status. Inclusion of catastrophic incidents as a stand-alone hazard is intended to highlight the extraordinary circumstances that such events produce, with the hope that it will assist planners and analysis in further developing mutual aid arrangements at all levels, to accommodate a wider variety of needs, and to suggest some possible repercussions that may not have previously been considered in existing planning and exercise scenarios.

Hazard Description: Within the past decade, the nation has been affected by disastrous events that have caused various states, including Michigan, to undertake significant actions to respond to, assist, or help accommodate the impact of events that took place well outside of their borders. Mutual aid agreements are in place between states to provide one another with supplemental resources and capabilities that are needed to help respond to and recover from a disastrous event. It is also possible that certain types of events outside of U.S. territory may require coordinated response, as well.

The National Response Framework (aka Federal Response Plan) involves a recognition of, and reaction to, events of national significance. This was observed during the terrorist events of September 11, 2001—along with the federal government, all states went into a mode of heightened alert and exchanged various information and resources in a coordinated manner. More recently, Hurricanes Katrina and Rita caused such disruption in the southern states that nation-wide assistance and coordination was needed. Not only were resources deployed to the disaster areas themselves, but distant states such as Michigan also needed to accommodate large numbers of evacuees who were temporarily displaced from their homes, jobs, businesses, and even families. Some evacuees even chose to permanently change their residence to new homes in other communities across the U.S.

In some disaster scenarios, although the State of Michigan may experience some direct impacts, it may turn out that much greater effects in other states or nations (e.g. Canada) may require extensive additional actions to be taken by Michigan government and personnel. In recognition of these extra tasks, a Catastrophic Incident hazard is now identified, in addition to the many hazards that are known to potentially have a direct impact within Michigan.

FEMA has (in its Catastrophic Incident Annex of November 2008) defined the nature of the catastrophic disaster situation. It "will result in large numbers of casualties and/or displaced persons, possibly in the tens to hundreds of thousands… The nature and scope of a catastrophic incident will immediately overwhelm State, tribal, and local response capabilities and require immediate Federal support… A catastrophic incident will have significant international dimensions, including impacts on the health and welfare of border community populations, cross-border trade, transit, law enforcement coordination, and others."

Special aspects that may be part of catastrophic incidents include the possibility of occurrence without warning, the occurrence of multiple incidents over a wide-ranging area (or even without any clearly defined incident site), may involve large-scale evacuations (whether organized or self-directed), may cause widespread homelessness and displacement (either temporary or permanent), may overwhelm existing health-care systems, and may produce severe environmental impacts that exceed governmental abilities to achieve a timely recovery.

There are a great many possible situations that can result in nationwide activation of mutual aid and other response and recovery mechanisms, so it is not intended that this section will provide an exhaustive list of everything that may happen. Below are a number of situations that may arise and be considered to be a catastrophic incident.

- Major Hazardous Materials Incidents
- Energy Emergencies and "Great Blackouts"
- A "Supervolcano" Event
- Major Terrorist Attack
- Major Earthquakes
- Celestial Impact
- Hurricanes
- Tsunami Events
- Pandemics or other Public Health Emergencies

A catastrophic incident may require the coordination of emergency responders (and associated personnel) between states, and even from across the nation or between nations (e.g. Canada, or its Ontario province). The most direct impact of a national emergency upon responders would be dealing with the logistics of interstate mutual aid (or even its international equivalents). In an event such as the 9-11-2001 terrorist events, or the 2005 Hurricane events, numerous response personnel may have to juggle their time, resources, and efforts involving activities that assist other states or jurisdictions with disaster response and recovery, while simultaneously ensuring that their own jurisdictions' preparedness and response needs are also met. An additional potential impact may arise from events that occur in one's home jurisdiction after various aid has been granted to some other area—various staff, equipment, expertise, and funds may suddenly be needed "back at home" in the midst of complicated and important response or recovery operations abroad. Extra complexity would also be entailed in the tracking of expenses and the paperwork involved in reimbursement procedures, which might ordinarily be used on activities that are of clearer importance to the home jurisdiction's own emergency needs.

Another effect of national emergencies is the potential need to deal with evacuees coming from affected areas, who would need food, shelter, and other types of assistance under conditions of displacement and even duress. Such evacuees would tend to have numerous financial and material needs, since the emergency event may have caused severe material hardships for them (or at least temporarily denied them access to their homes and wealth). In addition, various disaster and emergency events tend to cause emotional, social, and psychological hardships, as well as material and economic ones, since various trauma may have been experienced during the emergency events (including the loss of family and friends), and the uncertainties and stresses of relocations, job loss, etc. would often require a social and psychological support structure to be sought (and often provided by the host community) in order to restore a degree of security to the evacuees conditions and lifestyle. As a part of long-term recovery, such evacuees would ideally be able to restore their lifestyles to some sort of normalcy, perhaps even including successful relocation back to their original homes and the resumption of their previous circumstances.

Historically Significant and Related Events: There have been a number of catastrophic events to affect the United States in the recent past. Some of these events are listed below. Their precise effects upon Mason County are unknown.

- Major warfare, such as World War II
- Great Blackouts, such as those of 1965 and 2003
- Anticipated or threatened infrastructure breakdowns (such as "Y2K")

- Major terrorist incidents or threats, such as 9/11 and the subsequent anthrax events
- Hurricanes, such as Katrina and Rita in 2005 (with many displaced evacuees) – A gubernatorial disaster declaration and a presidential emergency declaration were issued in Michigan in September 2005 for hurricane evacuation. These declarations made certain types of financial assistance available to communities providing assistance to hurricane evacuees.

Frequency of Occurrence: National emergencies are bound to occur from time to time, and could break out at any time of the year. However, the frequency of a catastrophic event having a significant impact on Mason County cannot be estimated.

3.02 CIVIL DISTURBANCES

Collective behavior that results in a significant level of lawbreaking, perceived threat to public order, or disruption of essential functions and quality of life.

Summary: Two notable major civil disturbance are known to have happened in Mason County within the last 50 years. Although future incidents are certainly possible, civil disturbance is not considered to be a significant hazard at this time.

Hazard Description: Civil disturbances can be classified within the following four types: (1) act or demonstration of protest, (2) hooliganism, (3) riot, or (4) insurrection. Most of these share similarities with each other, and the classifications presented here are not absolute and mutually exclusive.

Types of civil disturbance

- *Protest* – Usually contains some level of formal organization or shared discontent that allows goal oriented activities to be collectively pursued. This includes political protests and labor disputes.
- *Hooliganism* – relatively unorganized and involves individual or collective acts of deviance inspired by the presence of crowds, in which the means (and responsibility) for ordinary levels of social control are perceived to have slackened or broken down. Examples include disorder following a sporting event or college parties.
- *Riot*– may stem from motivations of protest, but lacks the organization of formal protests. Although legitimate and peaceful protests may spontaneously form when people gather publicly for a mutually shared cause, riots tend to involve violent gatherings of persons whose level of shared values and goals is not sufficiently similar to allow their collective concerns or efforts to coalesce in a relatively organized manner.
- *Insurrection* – involves a deliberate collective effort to disrupt or replace an established authority or its representatives, by persons within a society or under its authority. An insurrection has the deliberate goal of either replacing established authorities or power structure with anarchy or a smaller-scale set of recognized criminal, ethnic, or other group networks and power structures.

Although destructive civil disturbances are rare, the potential is always there for an incident to occur. It is possible that risks for future disturbances may be exacerbated today by the ability of modern mass media (television, radio, the Internet, and various wireless communication devices) to instantly relay information (factual or not), in real time, to large numbers of people. That coverage may help to spread awareness of protests, discontent, riots, disorderly "parties," or other incidents to other areas or interested groups and persons, potentially exacerbating an already difficult situation. For example, media coverage of certain events has, in the past, spurred uprisings inside prisons. Real-time media coverage of unfolding events is a fact of modern life that is inescapable. As a result, law enforcement officials must be skilled in monitoring all forms of media coverage to anticipate public and perpetrator actions and event progression.

It is always a good idea for important community facilities and functions, such as schools and festival areas, to be aware of individuals or organizations that may create a disturbance. It is also important for correctional facilities to plan for disruptions. Good labor-industrial relations are helpful in preventing incidents of labor unrest, but incidents of such unrest may be possible at some point in the future.

Mason County has one jail in the City of Ludington. In addition, the county hosts an annual county-wide fair, several festivals, several theaters and museums, and many campgrounds. Although large groups gather at these places and events, they generally are not groups that cause disturbances. Most of the controversial political issues that could generate violent protest do not originate from the local or county level government.

Historically Significant and Related Events: There have been two documented civil disturbances in Mason County. Two years of civil unrest occurred in Ludington during the summers of 1970 and 1971 with numerous arrests due to a local law enforcement issue. On a different occasion, a confrontation occurred between ethnic/special interest groups but it did not escalate into full civil unrest. The involved issues could precipitate another civil disturbance should they be pushed to the limits of either group's tolerance.

Frequency of Occurrence: The limited nature of documented civil disturbances in Mason County makes it difficult to establish a frequency of occurrence. Although there have been no documented civil disturbances in recent history, the chance of a civil disturbance cannot be entirely discounted. Any disturbance would likely be restricted to a single site.

3.03 NUCLEAR ATTACK

A hostile act taken against the United States which involved nuclear weapons and results in destruction of property and/or loss of life.

Summary: The possibility of a nuclear attack is a serious and grim consideration. The effects of such an occurrence on United States' soil would have a wide range of social, economical, political, and environmental impacts well beyond the immediate location of detonation.

Hazard Description: Nuclear weapons are explosive devices that manipulate atoms to release enormous amounts of energy. Compared to normal chemical explosives such as TNT or gunpowder, nuclear weapons are far more powerful and create harmful effects not seen with conventional bombs. A single nuclear weapon is able to devastate an area several miles across and inflict thousands of casualties. Although nuclear attack is an unlikely threat, the severe damage that would be caused by even one weapon requires the danger to be taken seriously.

World events in recent years have greatly changed the nature of the nuclear attack threat against the United States. In the last half of the 20th Century, this threat has primarily been associated with the Cold War between the United States and the Soviet Union. Although the Cold War has ended, there remains a threat of nuclear attack. A greater number of nations have developed nuclear weapons and there is also the possibility that terrorists could obtain a nuclear weapon for use against the United States.

A nearby strike with a one-megaton bomb would have a clear impact on those within Mason County. Sheltering would be required during the initial explosion, and if detonation occurred on the ground, a sheltering/evacuation plan would have to be followed to protect residents from the effects of fallout. Electronic equipment and communications would be damaged by the electromagnetic pulse created by such a blast, which may include a breakdown in transportation, fire and EMS systems if their computerized equipment and vehicular ignition systems fail to operate as a result. Finally, although Mason County may lack "attractive" nuclear attack targets, consideration must be given to the county's ability to facilitate and/or accommodate mass evacuations from other areas in Michigan and perhaps around the country.

Historically Significant and Related Events: There have been no incidences involving nuclear weapons in Mason County.

Frequency of Occurrence: Although unlikely, the significant threats associated with this hazard seem to offset its low probability and therefore merit consideration when planning for the protection of large numbers of people, necessary agricultural processes, and the community's "lifeline" services.

3.04 PUBLIC HEALTH EMERGENCIES

A widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to or otherwise negatively impacts the general health and well being of the public.

Summary: The public health emergencies category includes a wide range of potential causes, from naturally occurring epidemics; to failure of infrastructure; to malicious releases of harmful agents. Such events pose threats to individuals' health and well-being of the population, as well as the economy and delivery of services. A widespread public health emergency may strain Mason County's medical facilities, and require the assistance of resources from outside the county.

Hazard Description: Public health emergencies can take many forms such as: disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents. Public health emergencies can occur as primary events, or they may be secondary events to another disaster such as a flood, tornado, power outage, or hazardous material incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

Michigan has had several large-scale public health emergencies in recent history, but fortunately nothing that caused widespread severe injury or death. The 1973 PBB contamination incident is unprecedented in U.S. history, but the long-term implications of contamination on that level so far appear minimal. Similarly, the northern Michigan water and sewer infrastructure disaster of 1994 is also unprecedented in scope, magnitude, and public health and safety implications for the affected communities. These events, though unusual, have heightened awareness of the broad nature of threats that can result in a public health emergency. Such emergencies no longer simply involve the spread of disease, but rather can arise out of a variety of situations and circumstances.

In 2001, Michigan health officials were introduced to the emerging health threats posed by foot-and-mouth disease and the West Nile encephalitis virus. Foot-and-mouth disease is a highly contagious disease that only affects animals. A widespread disease outbreak among animal populations, such as the foot-and-mouth outbreak that occurred in the United Kingdom in 2001, could have significant public health implications for humans due to the potentially large numbers of dead animal carcasses that would have to be disposed of to prevent subsequent disease outbreaks. According to the Michigan Department of Agriculture and Rural Development, foot-and-mouth disease rarely infects humans and the disease is not considered a public health problem.

The West Nile encephalitis virus, which arrived in Michigan in August 2001, presents an equally challenging scenario for public health officials. Transmitted to humans by the bite of an infected mosquito, the West Nile virus is commonly found in Africa, West and Central Asia, and the Middle

East. Health officials do not know how the virus was introduced to the United States. However, in 1999 and 2000, it caused an outbreak of human encephalitis in and around New York City that created a national stir and raised fears across the country that it would cause a full-blown public health emergency. The virus eventually spread to Michigan in 2001, peaking in 2002 with 644 probable cases, including 51 deaths. The disease is now considered endemic to Michigan.

Pertinent information regarding the spread of vector-borne and zoonotic disease (passed from animals or insects to humans) was found in the Muskegon County Health Profile 2012 produced by Public Health Muskegon County. The document states that the threat of such disease has been on the rise in human populations throughout the world. According to scientific estimates, as many as 75 percent of all emerging infectious diseases are zoonotic and/or vector-borne, meaning the disease is passed from animals or insects to humans. Of 1,400 different microbes that cause disease in humans, nearly 60 percent can be linked to animals (MDEQ). While, historically, Michigan has only been threatened by a small number of vector-borne diseases, the number is growing due to increasing globalization, genetic changes in organisms, and the threat of biological weapons of destruction. For further information on some of the known threats in Michigan (Bovine Tuberculosis, Rabies, West Nile virus, Lyme Disease, Bed Bugs, and Eastern Equine Encephalitis virus), the Muskegon County Health Profile can be viewed at the Health Department's website (www.muskegonhealth.net).

Michigan is fortunate to have an excellent public health system that constantly monitors the threats that could lead to a widespread or significant public health emergency. However, even the best monitoring and surveillance programs cannot always prevent such incidents from occurring. When they do occur, Michigan's public health agencies have shown the ability to effectively muster the resources necessary to identify and isolate the problem, and mitigate its effects on the population. In addition, if the problem is such that a multi-agency and jurisdictional response is required, the emergency management system in Michigan can be utilized to enhance coordination and effectiveness of the response and recovery effort.

Although no area is completely immune to public health emergencies, areas with high population concentrations will always be more vulnerable. In addition, densely populated areas will tend to have more vulnerable members of society who are more at risk than the general population, such as the elderly, children, impoverished individuals, and persons in poor health. This not only applies to dense urban areas; it also applies to resident camps and nursing homes.

The primary types of public health impacts involve the threat or presence of disease, contamination, or sanitation problems. Disease epidemics or pandemics have the potential to cause widespread debilitation or loss of life, associated medical expenditures, and decreases in productivity and quality of life. Contamination can at least temporarily lower property values, as well. Sanitation problems require effort and expense to resolve. Contamination and sanitation issues increase the probability and variety of diseases that may affect the population. Facilities may be shut down, as a means of preventing disease transmission or of containing contamination, and thus cause a loss of the services being provided to the public (by schools, for example). District Health Department #10 continually monitors health threats in Mason County and enforces strict regulations for septic systems in resort and summer-surge population areas.

Mason County has one hospital that serves the regional population, as well as visitors to the area. If a large health emergency occurs, especially during "surge" population seasons, medical resources may become overwhelmed and unable to deal with any additional needs. Generally speaking, as traditional medical services become increasingly difficult to access (or if their quality declines due to overwork or understaffing) then increasing numbers may turn to less responsible and effective alternative means of treatment (or may forego treatment entirely). Close cooperation with medical resources from outside the county may be needed. Even a public health emergency on a local scale would have potential to strain existing medical resources, and interrupt businesses and services.

Historically Significant and Related Events: Like the rest of the United States and the world, Mason County has had serious outbreaks of diseases like smallpox, measles, mumps, and influenza. It has been many years since the county has had to deal with diseases like polio, which gripped the country in the '50's. If a health epidemic of large proportions were to occur in the area, responders may have serious staffing problems.

Since 2001, there has been one human case of West Nile virus documented in Mason County. This was observed in 2006. In 2012, Michigan experienced the worst season of human West Nile virus since 2002 with 201 cases and 15 deaths.

The County has experienced many instances of power outages that could have created unhealthy conditions, as documented in Section 2.06. Fortunately, none have caused widespread health problems.

Frequency of Occurrence: This is a difficult hazard to assess because there are many undefined factors; such as the unexpected development of new diseases such as influenza outbreaks, and the threat of an intentional release of a radiological, chemical or biological agent intended to adversely impact a large number of people.

Each year brings a unique and relatively unpredictable strain of the flu to county residents. It has been over 50 years since an incidence such as polio has threatened residents.

3.05 TERRORISM AND SIMILAR CRIMINAL ACTIVITIES

Terrorism: "…activities that involve violent… or life-threatening acts… that are a violation of the criminal laws of the United States or of any State and… appear to be intended (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping" Federal criminal code. 18 U.S.C. §2331

Summary: Terrorism is the use of violence by individuals or groups to achieve political goals by creating fear. The political motives of terrorism distinguish it from ordinary crime. Terrorism is carried out for a cause; not for financial gain, personal revenge, or a desire for fame.

Hazard Description: Terrorism is a long-established strategy that is practiced by many groups in many nations. The United States is threatened not only by international terrorists such as Al Qaeda, but also by home-grown domestic terrorist groups including racist, ecological, anti-abortion, and anti-government terrorists.

A wide range of techniques can be used by terrorists, including bombings, shootings, arson, and hijacking. Regardless of the specific tactics used, terrorists seek the greatest possible media exposure. The goal of terrorists is to frighten as many people as possible, not necessarily to cause the greatest damage possible. Media coverage allows terrorists to affect a much larger population than those who are directly attacked.

Non-terrorist criminal activity may resemble terrorism, but lacks a political objective. Emergency management is typically not concerned with routine, individual crimes, but does need to prepare for crimes that impact large portions of the population. Such attacks may require resources not available to local law enforcement agencies. Crimes of this sort include mass shootings, random sniper attacks, sabotage of infrastructure, and cyber-attacks. The types of criminal attacks considered in this section are those that resemble terrorism or that may cause widespread immediate disruption to society.

In today's world, sabotage/terrorism can take on many forms, although civilian bombings, assassination and extortion are probably the methods with which we are most familiar. Cyber-attacks appear to be an increasingly eminent threat. Internationally, such acts have become commonplace as various religious, ethnic, and nationalistic groups have attempted to alter and dictate political and social agendas, seek revenge for perceived past wrongdoing, or intentionally disrupt the political, social and economic infrastructure of individual businesses, units of government, or nations. The Middle East and European continent, in particular, have been hard hit by acts of sabotage and terrorism over the past several decades. Parts of Asia and South America have also experienced a high level of activity.

Unfortunately, with advances in transportation and technology, sabotage/terrorism has now crossed the oceans into the United States. Equally alarming is the rapid increase in the scope and magnitude of sabotage/terrorism methods and threats, which now include: 1) nuclear, chemical and biological weapons; 2) information warfare; 3) ethnic/religious/gender intimidation (hate crimes); 4) state and local militia groups that advocate the overthrow of the U.S. government; 5) eco-extremism designed to destroy or disrupt specific research or resource-related activities; and 6) widespread and organized narcotics (and other contraband) smuggling and distribution organizations. Just as the methods and potential instigators have increased, so too have the potential targets of sabotage/terrorism.

As recent events across the country have shown, virtually any public facility, segment of infrastructure, or place of public assembly can be considered a target of sabotage. In addition, certain types of businesses engaged in controversial activities are also potential targets. With the advent of the information age and growth in the number of computer "hackers", computer systems (especially those of government agencies, large businesses, financial institutions, health care facilities, and colleges/universities) are potential targets as well. One of the primary common denominators of most saboteurs is their general desire for organizational recognition, but not necessarily individual recognition. They often seek publicity for their "cause" or specific agenda, but they go to great lengths to avoid individual detection by law enforcement agencies. The exception to this might be individuals and organizations involved in narcotics or other contraband smuggling and distribution, which seek to keep their clandestine operations out of public and law enforcement scrutiny. Another commonality is that innocent people are always the ones that suffer the most in these senseless and cowardly criminal acts.

Historically Significant and Related Events: Although Mason County has never experienced a significant act of terrorism or major criminal incident, recent high profile national events have increased concern among local officials for this hazard. Examples of such events have included: 1) school and workplace violence; 2) cyber terrorism; 3) sabotage/arson; and 4) domestic/international terrorism.

Frequency of Occurrence: Although it might appear Mason County is an unlikely target for terrorism, it cannot be totally discounted. A more detailed study may be performed by Mason County Emergency Management to ascertain whether the county's preparedness matches the estimated risk from terrorism and large-scale criminal activities. Consequently, this hazard is not addressed beyond the cursory level in this document.

Part D
HAZARD RISK & VULNERABILITY ASSESSMENT

The primary goal of the Risk & Vulnerability Assessment is to utilize information regarding the previous occurrences, locations and extent of hazards to gain some idea of how often they might arise, where they might occur, and how much harm they might do in the future. When hazards affect the entire county, it is important to consider potential impacts they might have on different parts of the county, especially areas that may have a harder time preparing for and responding to an event (for instance, severe snowstorms and blizzards could close roads throughout the county but the most remote and least traveled roads are plowed last, leaving their residents snowed in for days). It is also important to consider "worst-case scenarios", wherein one hazard causes others (such as severe winds causing infrastructure failures causing public health concerns), and to assess the limits of response capabilities (for example, a public health emergency may temporarily overwhelm medical service capabilities).

The simplest technique to assess risk and vulnerability is to: (1) compare the community profile map with hazard maps for the same area and (2) determine areas where hazards overlap with the locations of people, structures, and infrastructure. Areas where hazards might overlap with development are examined more closely to estimate what kinds of damages might occur during an emergency event. Maps throughout this document can be used to help facilitate this process. County-level maps at the end of this section show critical facilities/infrastructure and hazards, respectively. Other county-level maps are included in Part B for Natural Features and Land Cover. Appendix A contains municipal-level USGS Topographic maps which provide some information about locations of man-made structures. Appendix B includes municipal-level Hazard Risk maps which show critical facilities/infrastructure and mappable hazards. Altogether, the maps in this document are useful for conducting cursory hazard risk and vulnerability assessments. However, a detailed assessment would likely require additional means of investigation because some maps may lack a requisite level of accuracy and/or currency.

Another technique, which is more effective when hazards tend to be area-wide rather than location specific, is to rate and rank hazards in each community according to a standard set of variables. Such rankings will help to prioritize mitigation efforts according to the severity of a given hazard's risks in a given community. A quantitative assessment helps to measure the potential threats of each hazard; however, there is no need to reach perfect accuracy with these measurements. They are mainly used to compare hazards with each other, to prioritize them and determine the ones to which the community is most vulnerable.

The previous edition of this plan employed a "weighted average" technique of assessing and prioritizing hazards to quantify and compare the different hazards facing each community. While this is an effective technique for comparing hazards against each other, some individuals found it to be too subjective and rather complicated. Therefore, an alternative methodology was sought for this plan update. The first step involved a review of numerous hazard assessment techniques employed by other FEMA-approved hazard mitigation plans. A unique system was then devised, reviewed by MSP-EMHSD, and finally reviewed and accepted by the Mason County LEPC.

The revised rating and ranking methodology used in this plan factors the probability of each hazard's occurrence, as well as its likely impact on people, impact on property, and impact on the economy of the community. These four *hazard metrics* are each rated on a scale of 0 to 3, according to a unique set of benchmarks, for each hazard in each municipality in the county. Ratings were influenced by 1) hazard identification and analysis (Part C of this document); 2) ratings assigned in the previous edition of this plan; 3) input obtained through the survey questionnaire (described in Part A); and 4) input from the Mason County LEPC and the Advisory Team. Listed below is the schedule of metrics and benchmarks used to rate hazards in this plan.

Hazard Assessment Rating Benchmarks		
Hazard Metric	Benchmark	Rating
Probability of Occurrence	Unlikely Occurrence	0
	Not likely within 50+ years	1
	Likely within 50 years	2
	Likely within 10 years	3
Population Impact	No one affected	0
	<10% of population	1
	10-50% of population	2
	50-100% of population	3
Property Impact	No effects	0
	Isolated location	1
	Multiple locations	2
	Widespread	3
Economic Impact	No effects	0
	Mere Inconvenience	1
	Slight disruption of Services and Commerce	2
	Extended disruption of Services and Commerce	3

Once rated, each hazard is then ranked. However, each metric has a unique degree of influence upon a community's overall risk and vulnerability to a given hazard. To help account for the varying importance of each metric, unique values (or weights) are applied. The three "impact" metrics receive such weights: *population impact* gets a weight of 3; *property impact* gets a weight of 2; and *economic impact* gets a weight of 1. A higher number shows greater importance. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions; which helps to develop a more compelling comparison of hazards as they relate to the selection of potential mitigation actions. *Probability of occurrence* is assumed to be the most significant component, one which magnifies the potential impacts of a hazard. To quantify this relationship, the sum of the *weighted impacts* is multiplied by the hazard's probability of occurrence.

Hazard Vulnerability Ranking Formulas
Weighted Impacts = (Population Impact x 3) + (Property Impact x 2) + (Economic Impact x 1)
Hazard Vulnerability Score = Probability of Occurrence x Weighted Impacts

The result is a standardized list of *hazard vulnerability* scores; a tool with which to rank the hazards facing a community. It can be used to 1) establish priority, 2) provide a way to build consensus about these priorities, and 3) explain decisions that have been made from these priorities. It fulfills the requirements of a Vulnerability Assessment.

The Hazard Assessment Ratings and Hazard Vulnerability Rankings for Mason County are revealed in the following. Ratings and rankings for individual municipalities in the county have been placed in Appendix B – Hazard Identification and Analyses.

MASON COUNTY
Hazard Assessment Ratings

Natural Hazards	Probability of Occurrence	Population Impact	Property Impact	Economic Impact
1.01 Celestial Impacts	1	2	0	2
1.02 Drought	2	2	2	3
1.03 Earthquake	0	-	-	-
1.04 Extreme Temperatures	3	2	1	2
1.05 Flooding: Riverine/Urban	3	1	2	1
1.06 Fog	3	1	0	1
1.07 Great Lakes Shoreline	3	1	2	1
1.08 Hail	3	1	1	1
1.09 Invasive Species	2	1	1	2
1.10 Lightning	3	1	2	1
1.11 Severe Winds	3	2	2	2
1.12 Subsidence	1	1	1	1
1.13 Tornadoes	2	1	2	2
1.14 Wildfire	3	2	2	1
1.15 Winter Storms	3	3	2	2
Technological Hazards				
2.01 Dam Failure	2	1	2	3
2.02 Energy Emergencies	2	2	0	2
2.03 Fire – Scrap Tires	1	1	1	1
2.04 Fire – Structural	3	1	2	2
2.05 HAZMAT – Fixed Site	2	1	1	2
2.06 HAZMAT – Transportation	2	1	1	2
2.07 Infrastructure Failures	3	2	1	2
2.08 Nuclear Power Emergencies	0	-	-	-
2.09 Oil/Natural Gas Well Accidents	2	1	1	1
2.10 Pipeline Accidents	2	1	1	2
2.11 Transportation Accidents	2	1	1	2
Human-Related Hazards				
3.01 Catastrophic Incidents (National Emergencies)	1	3	3	3
3.02 Civil Disturbances	1	1	1	1
3.03 Nuclear Attack	0	-	-	-
3.04 Public Health Emergencies	2	2	0	3
3.05 Terrorism & Similar Criminal Acts	1	1	1	1

MASON COUNTY
Hazard Vulnerability Rankings

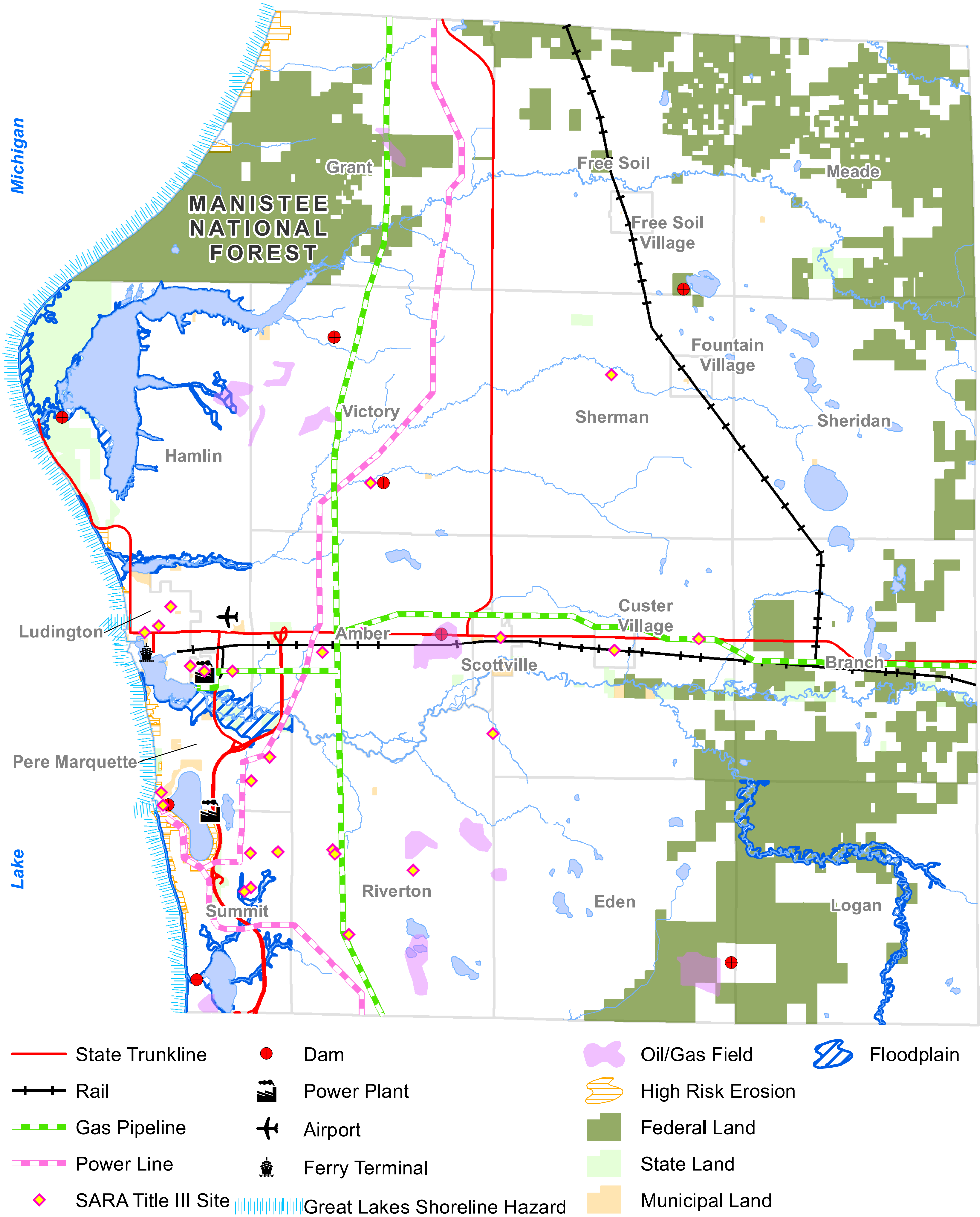
Rank	Hazard	Probability of Occurrence	x	Sum of Weighted Impacts	=	Hazard Vulnerability Ranking
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		10		30
6	Fire – Structural	3		9		27
7	Drought	2		13		26
8	Flooding: Riverine/Urban	3		8		24
8	Great Lakes Shoreline	3		8		24
8	Lightning	3		8		24
11	Dam failure	2		10		20
12	Catastrophic Incidents	1		18		18
12	Hail	3		6		18
12	Public Health Emergencies	2		9		18
12	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	HAZMAT – Fixed Site	2		7		14
17	HAZMAT – Transportation	2		7		14
17	Invasive Species	2		7		14
17	Pipeline Accidents	2		7		14
17	Transportation Accidents	2		7		14
22	Fog	3		4		12
22	Oil/Natural Gas Well Accidents	2		6		12
24	Celestial Impacts	1		8		8
25	Civil Disturbances	1		6		6
25	Fire – Scrap Tires	1		6		6
25	Subsidence	1		6		6
25	Terrorism & Similar Criminal Acts	1		6		6
n/a	Earthquake	0		-		-
n/a	Nuclear Attack	0		-		-
n/a	Nuclear Power Emergencies	0		-		-

The revised rating and ranking system produced results similar to the previous edition of the Mason County Hazard Mitigation Plan. The county's top six hazards remain the same, with *winter storms* in the #1 slot. *Severe winds* was promoted to #2 and *wildfire* was raised to #3. *Extreme temperatures*, *infrastructure failures*, and *structural fire* were respectively dropped to numbers 4, 5, and 6. The largest change in ranking for any hazard was the promotion of *Great Lake Shoreline* (formerly known as *Flooding: Shoreline*) from #16 to #8. This dramatic increase in priority is partly because the scope of the hazard analysis was broadened to include additional aspects, such as "rip currents" and the impacts of low water levels on the Great Lakes.

The individual community level hazard rankings, located in Appendix B, are similar to the county rankings. For all villages and townships, the top three priority hazards are *winter storms, severe winds*, and *extreme temperatures*. After that, some variations in hazard ranking and priorities occur mainly between urban and rural areas. For example, *structural fire* is more of a concern in more developed communities rather than in rural areas. Likewise *drought* may be more of a concern to a predominately agricultural community, rather than one that is more commercialized.

2014 Rank	Hazard	2006 Rank	Change
1	Winter Storms	1	*- no change -*
2	Severe Winds	3	**↑1**
3	Wildfire	6	**↑3**
4	Extreme Temperatures	2	**↓2**
4	Infrastructure Failures	4	*- no change -*
6	Fire – Structural	5	**↓1**
7	Drought	8	**↑1**
8	Flooding: Riverine/Urban	10	**↑2**
8	Great Lakes Shoreline	16	**↑8**
8	Lightning	12	**↑4**
11	Dam failure	7	**↓4**
12	Catastrophic Incidents	-	**new hazard**
12	Hail	15	**↑3**
12	Public Health Emergencies	13	**↑1**
12	Tornadoes	9	**↓3**
16	Energy Emergencies	-	**new hazard**
17	HAZMAT – Fixed Site	11	**↓6**
17	HAZMAT – Transportation	18	**↑1**
17	Invasive Species	-	**new hazard**
17	Pipeline Accidents	17	*- no change -*
17	Transportation Accidents	14	**↓3**
22	Fog	-	**new hazard**
22	Oil/Natural Gas Well Accidents	19	**↓3**
24	Celestial Impacts	-	**new hazard**
25	Civil Disturbances	20	**↓5**
25	Fire – Scrap Tires	*not ranked*	**-**
25	Subsidence	21	**↓4**
25	Terrorism & Similar Criminal Acts	*not ranked*	**-**
not ranked	Earthquake	*not ranked*	**-**
not ranked	Nuclear Attack	*not ranked*	**-**
not ranked	Nuclear Power Emergencies	*not ranked*	**-**

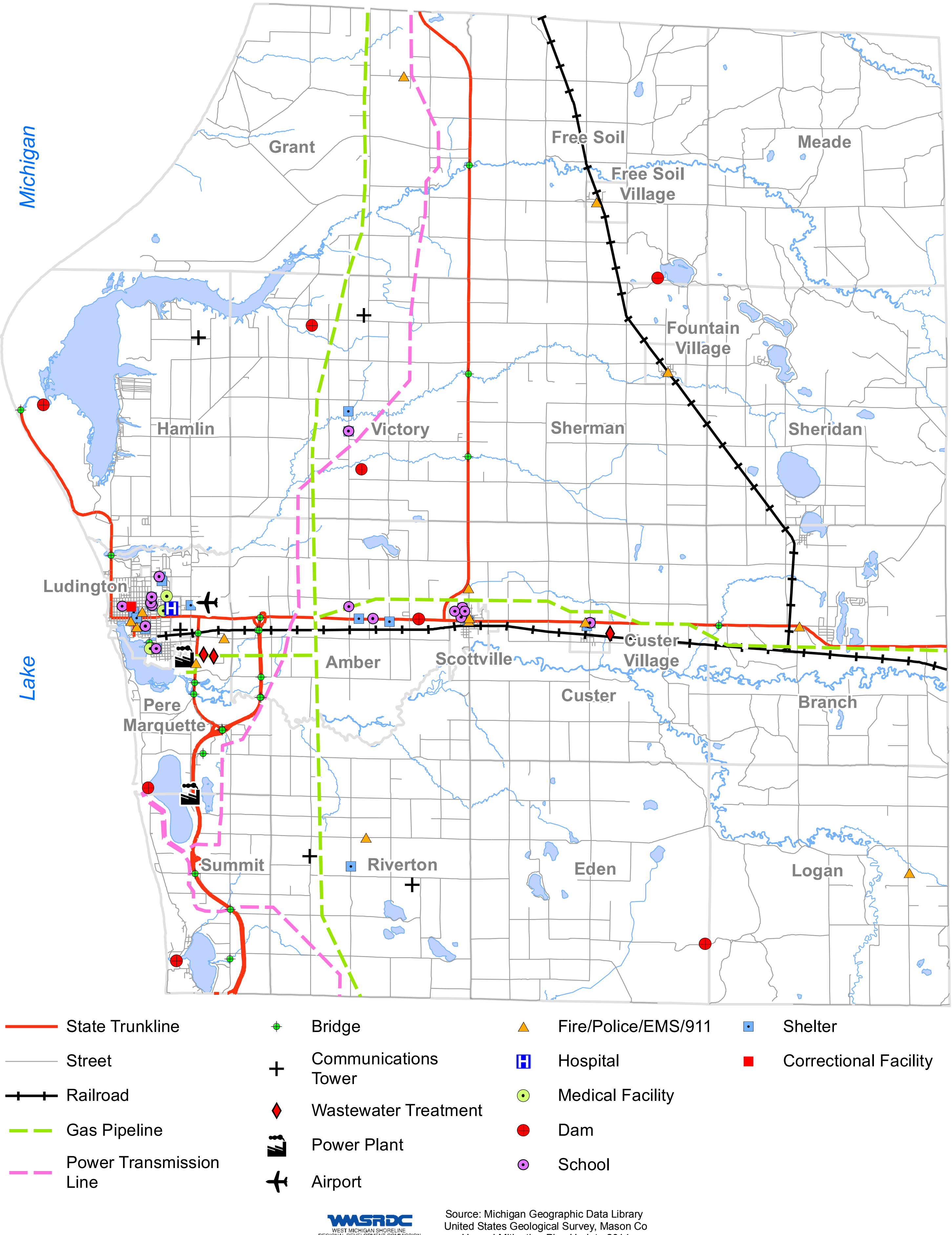
MASON COUNTY
Potential Hazards



WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library
Michigan Department of Environmental Quality,
Mason Co. Hazard Mitigation Plan Update 2014

MASON COUNTY
Critical Facilities



Source: Michigan Geographic Data Library
United States Geological Survey, Mason Co
Hazard Mitigation Plan Update 2014

Part E
HAZARD MITIGATION GOALS AND OBJECTIVES

Goals are general guidelines that explain what the county wants to achieve. They are usually long-term and represent global visions such as "protect public health and safety". Objectives define strategies or implementation steps to attain the identified goals. Objectives are more specific and measurable than goals, making them more likely to have a defined completion date.

The development of clear goals and objectives helps clarify problems, issues, and opportunities in hazard mitigation as well as other areas. An important feature of developing them is raising community awareness of the relationship between community development practices and the level of hazard vulnerability and risk. Also, raising citizen awareness can help gain support for ongoing mitigation planning efforts.

The following goals and objectives have been established for hazard mitigation efforts in Mason County. They are based on the county's hazard analyses, as well as on input from the Emergency Management Coordinator, LEPC members, governmental officials and administrators, planning staff, emergency responders (including 911, fire, and police), and other interested entities.

For the 2014 edition of this plan, the goals and objectives from the 2006 edition were reviewed by the Mason County LEPC prior to, and then discussed at its December 17, 2013 meeting. It was determined that the goals and objectives remain valid, and therefore no significant changes or additions were proposed. The two foremost factors contributing to this conclusion were that: 1) conditions within the county have remained generally the same; and 2) the revamped risk assessment findings were comparable to the 2006 risk assessment.

OVERALL HAZARD MITIGATION GOAL:
Reduce or eliminate the long-term risk to human life and property from the full range of disasters.

GOAL 1. Promote growth in a sustainable, hazard-free manner.

Objective 1.1. Incorporate hazard provisions in building code standards, ordinances, and procedures.
Objective 1.2. Incorporate hazard mitigation into land use and capital improvement planning and development activities.
Objective 1.3. Incorporate hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.
Objective 1.4. Research, recommend, adopt and enforce programs, plans, and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

GOAL 2. Protect existing and new properties.

Objective 2.1. Use the most cost-effective approaches to keep hazards away from existing buildings and facilities.
Objective 2.2. Use the most cost-effective approaches to protect existing buildings and sites from hazards.
Objective 2.3. Maximize insurance coverage to provide financial protection against hazard events.
Objective 2.4. Maximize the resources for investment in hazard mitigation, including the use of outside sources of funding.

GOAL 3. Protect public health and safety.

- Objective 3.1. Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.
- Objective 3.2. Protect infrastructure and services.
- Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.
- Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

GOAL 4. Increase public understanding, support, and participation in hazard mitigation.

- Objective 4.1. Heighten public awareness of the full range of existing natural and man-made hazards and actions they can take to prevent or reduce the risk to life or property from them.
- Objective 4.2. Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process.
- Objective 4.3. Encourage cooperation and communication between planning and emergency management officials.

In order for these goals and objectives to succeed, they must be integrated into and compatible with other community goals. They must also be divided into manageable components, or actions, that can be accomplished and they must be prioritized so local officials can better focus their attention on developing alternatives.

The following sections guide and encourage concrete actions to be taken. Parts F and G contain alternatives that can be utilized by the county to accomplish hazard mitigation. Also included in Part F is information about the known employment of those alternatives within Mason County. Part H explains how the recommended action items are selected from the list of potential actions; and Part I reveals the recommended action agenda for plan implementation.

Part F
Hazard Mitigation Alternatives

The identification of risks and vulnerabilities, paired with established goals and objectives, should lead planners directly to a consideration of various mitigation alternatives that might be applied to improve the safety and security of residents, property, the environment, the economy, and quality of life. A mitigation alternative is not the same as a project or specific action that will definitely be implemented. Rather, an alternative is one in a set of potential actions or strategies that will be evaluated and compared.

It is important to recognize that "hazard mitigation" is often presented as something entirely distinct from "preparedness, response, and recovery," (known together as the four phases of emergency management). However, state planners in Michigan prefer to not place clear limits or distinctions around the mitigation alternatives, since all phases of emergency management share the same ultimate goals of protecting life and property, etc. Many of the mitigation alternatives discussed in this section may seem to include other aspects of emergency management.

There is a multitude of alternatives for mitigating hazards, which can be organized into the five basic strategies summarized in the table below.

Basic Hazard Mitigation Strategies

Mitigation Strategy	Description	Examples of Measures	Advantages / Limitations
MODIFYING THE HAZARD	Modifying the hazard itself (which involves removing or eliminating the hazard), reducing its size or amount, or controlling the rate of release of the hazard. In the right circumstances, this strategy can be successful but it is often difficult to do.	• Cloud seeding to modify precipitation • Slope planting to prevent erosion or collapse • Stream modification or widening to divert or improve water flow • Dredging to deepen water channel or body to improve water flow and capacity	• Can be cost-effective in many situations • Application is limited and therefore may not be as effective as other strategies • Does not always reduce or eliminate damage on a wide scale • Some hazards simply cannot be modified
SEGREGATING THE HAZARD	Attempts to "keep the hazard away from people." Primarily for flood hazards but also has applicability to other hazards. Measures are designed to redirect the impacts of a hazard away from people and development	• Dams • Dikes / Levees • Floodwalls • Flood drainage channels • Debris basins • Designated routes for hazardous transport • Buffer zones around hazard sites • Defensible space around development • Safe rooms (indoor shelter space) to protect building occupants from harm	• Can be effective for some hazard situations • Some measures can be expensive • Some measures may cause or exacerbate environmental problems • May protect one community but cause problems for adjacent communities • Economically marginal for many situations and locations
PREVENTING OR LIMITING DEVELOPMENT	Preventing or limiting development in locations where people and development would be at risk. This strategy is based on "keeping the people away from the hazard" and includes a variety of land use planning and development regulation tools. Attempts to reduce or eliminate community hazard vulnerability through wise and prudent land use and development decision-making.	• Comprehensive planning • Zoning ordinances • Building codes • Subdivision regulations • Floodplain management ordinances and other special area, use and design regulations • Capital improvements planning • Disclosure laws • Acquisition and relocation of hazard prone properties	• Can be highly effective in promoting safe, sustainable development • Widespread application (i.e., statewide, regional, local) • Proactive – seeks to prevent or reduce future vulnerabilities • Reduces future incident response / recovery costs • Administrative tools have minimal associated costs • May in some cases reduce future tax revenue if development does not occur
ALTERING DESIGN OR CONSTRUCTION	Altering the design or construction of development to make it less vulnerable (more resilient) to disaster damage. This strategy allows hazards to interact with human systems that have been designed and planned to withstand potentially destructive impacts. This strategy allows development in hazard prone areas, but requires that the development meet stringent disaster resistant performance criteria.	• Elevating flood-prone structures • Wet / dry flood proofing to improve flood damage resistance • Defensible space (vegetation buffer zones) in urban / wildland intermix areas • Wind bracing to improve wind damage resistance • Insulating water and sewer lines to prevent ground freeze damage	• Balances the dual needs of enhancing a community's economic base while at the same time reducing community hazard vulnerability • Can result in safe, sustainable development if done properly • Reduces future incident response / recovery costs • Allows for maximum land use potential • Resilient structures "rebound" better from incident impacts
EARLY WARNING AND PUBLIC EDUCATION	Seeks to ensure that the public is aware of the hazards it faces, and that proper warning and communication systems and practices are in place to save lives and protect property.	• Community hazard identification / analysis • Early warning systems (indoor and outdoor) • Tailored public awareness / education campaigns regarding hazards, warning systems and protective actions • Warning devices in congregate facilities • Special needs population warning systems	• Universal strategy – should be applied in all communities • Typically the last line of defense against serious disaster related injury, loss of life and property damage • Recognizes that some hazards cannot be prevented and therefore must be dealt with using proper safety precautions • Enhances community awareness of and support for emergency management efforts

Source: MSP/EMHSD Pub. 106a, Michigan Hazard Mitigation Success Stories, 2011

The remainder of this chapter considers a variety of mitigation alternatives for the county's top hazards. They are presented in one or more of the following groups: Preventative Measures, Corrective Measures, Resource Protection, Emergency Services, and Public Education and Awareness. Much of the following narrative was either borrowed from, or supplemented by information compiled in the Michigan Hazard Mitigation Plan.

For the 2014 edition of this plan, descriptions of mitigation alternatives were reviewed and updated as needed. How alternatives are being utilized within Mason County (the capabilities of the community) were also reviewed and updated. Other updates to this chapter include a revised description of basic mitigation strategies (see table on previous page), and the inclusion of common mitigation funding sources.

1. Preventive Measures.

Preventive mitigation is desirable because it seeks to prevent future problems from occurring. Wise land use planning and building design, small-scale retrofitting, and early warning and public education fall under this category. Doing it right the first time is almost always preferable to going back and trying to correct recurring problems at a later date. Preventive mitigation is generally easier to implement than other types of mitigation because the administrative mechanisms that guide the land development process – planning and plan review, zoning, capital improvements programming, building codes and standards, etc. – are available to every local community and only require adoption and consistent application to be highly effective in reducing or eliminating hazard vulnerability. Prevention is also generally more flexible and cost-effective and can significantly reduce or eliminate future hazard vulnerability. Preventive mitigation can help ensure that, at the very least, responsible agencies do not contribute to the increasing severity of the problem through unwise decision-making.

Preventive measures protect new construction from hazards and assure that future development does not increase the potential for losses. They are particularly important where there is an abundance of undeveloped land, such as in Mason County. Planning, zoning, and code-enforcement officials usually administer preventive measures.

A. Building Codes. Building codes are designed to ensure that a structure will be constructed in such a manner as to be safe for occupancy and use. These codes also regulate health and sanitation requirements for water, ventilation, plumbing, electricity, mechanical equipment, and air conditioning, and contain minimum construction standards for natural hazard resistance. Building codes, used in concert with other available land use / development guidance measures, can be effective in reducing or eliminating damage caused by many natural hazards such as high winds, wildfire, and flooding. In communities where comprehensive planning is not done or not done properly, the building code may essentially be the only land use regulatory measure available.

Building codes provide one of the best methods of addressing the hazards in this plan, and are a prime measure to protect new construction from damage caused by natural hazards. Many times, minimum building code requirements make the difference between a structure that suffers minimal or no damage and one that suffers major damage or is a total loss. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Such standards may include:

- Making sure roofing systems will handle high winds and expected snow/ice/sleet/hail loads;
- Making sure windows, doors and siding can handle high winds;
- Providing special standards for tying the roof, walls and foundation together (crossbracing and anchoring walls to foundations, and roof rafters to walls) to resist the effects of wind;
- Requiring new buildings to have tornado "safe rooms";
- Making sure electrical systems are grounded and fire walls and sprinklers are installed in attached structures;

- Including insulation standards that ensure protection from extreme heat and cold;
- Securing the "envelope" of a structure, to reduce water-related damage; and
- Mandating overhead sewers for all new basements to prevent sewer backup.

Mason County follows the Michigan Residential Code and the Michigan Building Code for commercial construction. The City of Ludington and Pere Marquette Township administer and enforce the International Building Code with State amendments. These codes incorporate standards for building, plumbing, electrical and mechanical work and provide the basis for good building safety programs, especially protection from fire and electrical hazards. They can be complemented by rehabilitation codes, such as the Michigan Rehabilitation Code for Existing Buildings or the Property Maintenance Code used by the City of Ludington. They are constantly being evaluated and updated to reflect new information and recommended practices.

Pursuant to 1972 PA 230, adopted November 5, 1974 and amended by 1999 PA 245, all communities in Michigan are subject to the State Construction Code, which establishes general minimum construction standards for buildings and structures in all Michigan municipalities. The State Construction Code is a compilation of the International Residential Code, the International Building Code, the International Mechanical Code, the International Plumbing Code published by the International Code Council, the National Electrical Code published by the National Fire Prevention Association, and the Michigan Uniform Energy Code with amendments, additions, or deletions as the Michigan Department of Energy, Labor and Economic Growth determines appropriate. The Code became effective statewide on July 31, 2001. The State Construction Code provides for statewide uniformity of application and implementation of rules governing the construction, use, and occupancy of buildings and structures.

FEMA, the Insurance Institute for Business and Home Safety (IBHS), and Insurance Services Office (ISO) are three national organizations that conduct evaluations, and then suggest revisions for insufficient or inappropriate codes. For example, FEMA often utilizes a Building Performance Assistance Team (BPAT) to assess tornado damages to code-conforming structures. If building performance is deemed inadequate, the BPAT may then recommend revisions to the codes to protect structures from future hazard damage.

The IBHS is a non-profit insurance industry research center that is dedicated to maintaining specific building code standards to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters such as wildfire, tornadoes, freezing weather, and hail. Its "FORTIFIED for Safer Living" program is one component of the IBHS suite of "FORTIFIED" programs dedicated to improving the quality of residential and light commercial buildings. The "Safer Living" section specifies construction, design, and landscaping guidelines to increase a new home's resistance to disaster from the ground up. A bevy of FORTIFIED resources for governments, business owners, and homeowners are available on the IBHS website, www.http://www.disastersafety.org/fortified/.

The ISO administers the Building Code Effectiveness Grading Schedule (BCEGS), a program designed to foster better building code enforcement and thereby reduce natural hazard damage. Local building departments are "graded" on their building codes and how those codes are enforced, with special emphasis on mitigation of losses from natural hazards. Communities with good codes and code enforcement programs in place will receive a better grade than those communities that don't, and property owners in the higher-graded communities will be rewarded with homeowners' insurance premium credits. ISO began implementing the program in states with high exposure to wind (hurricane) hazards, then moved to states with high seismic exposure, and then continued through the rest of the country. Code enforcement is done by the county in all areas of the county except Pere Marquette Township and the City of Ludington, including inspections during construction to ensure that builders understand code requirements and are following them. The county employs a building inspector, an electrical inspector, and a mechanical & plumbing inspector.

The BCEGS was developed after determining that much of the construction failure resulting from natural disasters was due, in large part, to construction not built to comply with codes. The insurance industry's experience has shown that communities with effective codes and code enforcement have a more favorable (lower) insurance loss experience because they have less disaster-related damage to structures. BCEGS is modeled after a similar and long-standing ISO fire-grading program, which assesses local fire departments and water supplies. It is similar to and acknowledged by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), which awards CRS credit according to BCEGS rating. The BCEGS and CRS operate under the assumption that communities with well-enforced, up-to-date codes will experience fewer damages. Homeowners within the participating communities can therefore receive lower insurance rates. This often provides communities with enough incentive to rigorously enforce their building codes.

Over 1,100 Michigan communities have received a BCEGS rating. Fire chiefs, chief building officials, and community chief administrative officials may request a single copy of the BCEGS free of charge. If a community has not yet received a BCEGS grading, or if the community has recently made improvements in its building code enforcement services, it may be eligible for a BCEGS survey.

B. Standards for Manufactured Homes. Manufactured or "mobile" homes are usually not regulated by local building codes since they are built in out-of-state factories and then shipped to sites. However, they must comply with the U.S. Department of Housing and Urban Development's National Manufactured Home Construction and Safety Standards (effective June 15, 1976) and meet local standards for on-site installation, both in terms of location and technique. The greatest mitigation concern with manufactured housing is protection from wind damage, which is best achieved through appropriate installation. FEMA's Building Performance Assistance Team (BPAT) found that newer manufactured housing, designed to better transmit wind up-lift and overturning forces to the foundation, performed better when anchored to permanent foundations. Unfortunately, they also found that building officials were often unaware of manufacturer's installation guidelines with respect to permanent foundations.

The Michigan Manufactured Housing Commission Act of 1987 (PA 96, as amended) and its implementing Administrative Rules provide regulation on the placement of manufactured homes and establishes construction criteria. Manufactured homes are prohibited from being placed within a floodway, as determined by the Department of Environmental Quality. In addition, manufactured homes sited within a floodplain must install an approved anchoring system to prevent the home from being moved from the site by floodwaters (or by high wind), and be elevated above the 100-year elevation. These provisions are highly effective when properly carried out and enforced.

Recent figures show that mobile homes account for about 10.7% of the housing stock in Mason County.

C. Planning, Zoning, and Capital Improvements. While building codes provide guidance on *how* to build in hazardous areas, planning and zoning activities direct development *away* from these areas, especially floodplains and wetlands. They do this by designating land uses that are compatible to the natural conditions of the land, such as open space or recreation in a flood plain, or by simply allowing developers more flexibility in arranging structures on a parcel of land through the planned development approach.

The purpose of a comprehensive plan is to establish an orderly, convenient, efficient and enjoyable environment in a community, and to improve the quality of life for all its citizens. A comprehensive plan provides for future development or improvement of the land use pattern and public service program of the community. In Michigan, planning commissions are required to prepare and adopt a comprehensive plan if the community is enforcing a zoning ordinance. (The zoning ordinance must be based on an adopted comprehensive plan to be legally defensible and enforceable.) This is may be the most significant responsibility of the planning commission. Once adopted (by the planning commission and/or the community's legislative body), the comprehensive plan serves as the foundation document for the preparation and subsequent implementation of other land use / development measures such as the zoning ordinance, capital improvements planning, subdivision regulations, and special area use or design regulations. All of these other measures can be used to implement hazard mitigation measures, so the importance of the comprehensive plan in relation to mitigation cannot be understated.

The 2013 Mason County Master Plan Update includes numerous goals, objectives, and strategies that are intended to "guide decisions by the Mason County Planning Commission and County Board of Commissioners in review of proposed rezoning requests by landowners under County Zoning; and on whether or not to approve local plans and rezoning approvals submitted for review under the appropriate planning or zoning enabling act. The Plan will also guide recommendations made by the County Planning Commission to county and state authorities on roads, parks, county buildings and other infrastructure."

A zoning ordinance is probably the most effective measure a community has for guiding and regulating development and the land use pattern, and it can be very effective in mitigating hazard risk and vulnerability. The zoning ordinance provides a mechanism for implementing the policy decisions articulated in the comprehensive plan concerning the desired locations of various land uses and public facilities. The zoning ordinance is based on the comprehensive plan and therefore is developed and adopted after the comprehensive plan has been formally adopted by the community. One major difference between the two mechanisms is the timeframe upon which they are based. Generally, the comprehensive plan is designed to guide development for the next 20-30 years, whereas the zoning ordinance will typically be adopted on the basis of a 7-10 year land use development need projection.

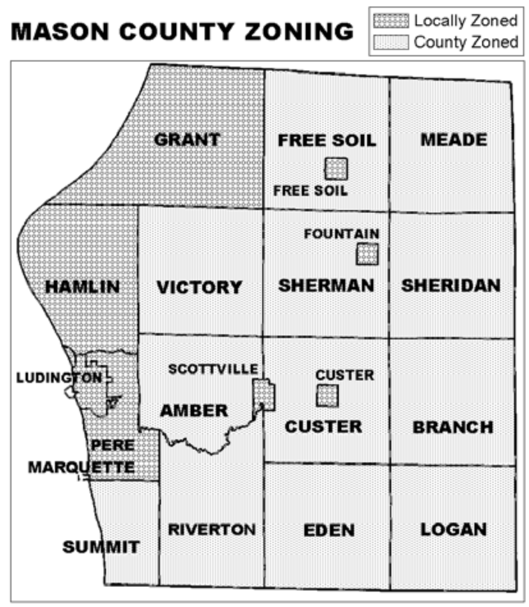
A zoning ordinance typically addresses three areas: 1) the use of land and structures and the height and bulk of structures; 2) the density of population and intensity of land and structural use; and 3) the provision for space around structures (i.e., requirements for side yards, rear yards, open space, building setback lines, etc.).

Some zoning ordinances may specifically address potential hazards to life and property, although there is no requirement to do this. The ordinance itself consists of a map or maps delineating the zoning districts in the community where various land uses will be allowed, and an accompanying set of administrative procedures, standards and methods for enforcing the zoning regulations. Zoning districts typically include various types of industrial, commercial, residential, agricultural, and public facility uses. Specific zoning districts are tailored to the particular needs of the community. For example, communities that have a significant amount of lakefront properties may have a special zoning district for residential development around lakes.

Through zoning, communities can also prohibit development in some areas; such as in flood plains, along shorelines or in the hydraulic shadow of dams (where flooding would occur if a dam failed). Zoning ordinances usually set minimum lot sizes for each zoning district but communities can allow flexibility in lot sizes and location so that developers can avoid hazardous areas. One way to encourage such flexibility is to use the planned unit development (PUD) approach, which allows the developer to easily incorporate flood hazard mitigation measures into the project. Open space and/or floodplain preservation can be accommodated with site design standards and adjusted land use densities. Granting larger minimum lot sizes, i.e., four or five acres, for areas next to water courses allows streams to run near lot lines, and gives developers flexibility to build on higher ground while still including floodplains in backyards.

The Mason County Zoning Ordinance (2012), which covers twelve of Mason County's fifteen townships, contains the following statements of purpose:

1. To promote the public health, safety, morals, and general welfare.
2. To encourage the use of lands in accordance with their character and capabilities and to limit the improper use of land.
3. To avoid overcrowding of population.
4. To lessen congestion on the public roads and streets.
5. **To reduce hazards to life and property.**
6. To reasonably consider the character of each district, its peculiar suitability for particular uses, the conservation of property values and natural resources, and the general and appropriate trend and character of land, building, and population development.



Source: Mason County Zoning Ordinance
Created by: WMSRDC October 2004

A Capital Improvements Plan (CIP) is the mechanism through which a community identifies, prioritizes, and establishes financing methods for needed public improvements such as new or improved public buildings, roads, bridges, treatment plants, water and sewer infrastructure, etc. Under Michigan law, planning commissions are required to annually prepare and adopt a CIP and recommend it to the legislative body for their use in considering public works projects. Generally, public improvements included in the CIP are those that require a substantial expenditure of public funds. (Each jurisdiction must decide what constitutes a substantial expenditure.) The CIP can be an effective implementing mechanism for the community's comprehensive plan and zoning ordinance because it dictates the nature and timing of public facility expenditures. Normally, the CIP is established for a six-year period. The first year of the CIP becomes the year's capital budget and is the basis for making appropriations for capital improvements. As a result, the annually approved items are the highest priority public improvements to be built in planned areas.

From a hazard mitigation perspective, the CIP, if coordinated with the community's comprehensive plan and zoning ordinance, can be an effective mechanism for creating a desirable, less vulnerable land use and development pattern. Planning commissions, because they create and adopt each of the three mechanisms, are instrumental in ensuring that public investment is done in such a way that it helps reduce or eliminate the community's risk and vulnerability to hazards. Capital expenditures may include acquisition of open space within hazardous areas; extension of public services into hazardous areas; installing or improving storm sewers and drainage ditches, culverts and spillways; increasing the depth of water lines; retrofitting existing public structures to withstand hazards; tree management; water detention and retention basins, debris detention basins, debris removal, bridge construction and modification, etc.

D. Subdivision Regulations. Subdivision regulations are the legally established standards of design and construction for dividing a land parcel into smaller ones for the purpose of selling or leasing the property**.** The Land Division Act (1967 PA 288, as amended by 1996 PA 591, 1997 PA 87, and 2004 PA 524) governs the subdivision of land in Michigan. The Act requires that the land being subdivided be suitable for building sites and public improvements, that there be adequate drainage and proper ingress and egress to lots, and that reviews be conducted at the local, county and state levels to ensure that the land being subdivided is suitable for development. The Act also requires conformance with all local planning codes. From a hazard mitigation standpoint, that point is important because it gives the local planning commission the authority to approve subdivision development in accordance with the local comprehensive plan and regulatory standards.

In terms of process, the subdivision of land has three major phases. The first involves a preliminary review of the engineering aspects of the project – roads, drainage, utilities, and other necessary services, by local and county reviewing agencies. The second phase involves a review of the proposal by the Michigan Department of Environmental Quality, the Michigan Department of Transportation, and the Michigan Department of Energy, Labor and Economic Growth to ensure compliance with state standards regarding location and engineering. At the end of this phase, the developer can obtain tentative approval from the local governing body of the jurisdiction in which the project is located. The final phase involves preparation of the final plat or map of the subdivision. Local and state reviewing agencies again review the final design to ensure compliance with local and state standards. Once approved, the plat is registered with the county register of deeds.

Subdivision regulations can be an effective tool in reducing risk and vulnerability to certain hazards, such as flooding and wildfires, if mitigation factors are incorporated into the subdivision process through mechanisms such as local planning codes. For example, a community may allow a subdivision to be placed in a heavily wooded area susceptible to wildfire if proper engineering measures are taken regarding lot size and ingress and egress, thereby providing a basic level of protection to developed home sites and the residents occupying those home sites.

From a flood hazards viewpoint, proposed subdivisions are typically reviewed by the County Drain Commissioner for proper drainage. The Michigan Department of Environmental Quality / Land and Water Management Division reviews subdivisions for floodplain impacts. (Refer to the Riverine Flooding chapter of the Michigan Hazard Analysis section in the MHMP for specific MDEQ provisions that directly address flood mitigation.)

Like any regulation, the Land Division Act can be effective if it is enforced and coordinated with other land use / development mechanisms in an effort to reduce overall community risk and vulnerability to hazards.

The subdivision rules relating to flooding are implemented through a review process and use of restrictive deed covenants. However, the restrictive deed covenants that are filed under the Act are only effective if the local building official is aware of and enforces the restrictions. Continuing education for the local building officials is essential for effective implementation of the Act.

The rules currently allow the construction of basements below the 100-year flood elevation, but these basements must be flood proofed, or it must be demonstrated by an engineering analysis that the basement will not be adversely impacted by hydrostatic pressures exerted by floodwaters. The developer must also obtain a letter of map revision (LOMR) from FEMA, certifying that the property has been filled above the 100-year flood elevation and the soil has been properly compacted. The LOMR officially removes the property from the 100-year floodplain.

The design standards for a flood proofed basement are fairly involved. Unless the building official is aware of the restrictive deed covenants and the design standards, and is enforcing these requirements, there is considerable potential for flood damage to basements even in subdivisions platted under the current act. Thus, as noted earlier, continuing education is essential.

Other examples of hazard protection standards that may be addressed through subdivision regulation may include:

- Identification of all hazardous areas;
- Road standards that allow passage of firefighting equipment and snow plows and are no more than one foot below flood elevation;
- Buried power or phone lines; and
- Minimum water pressures adequate for firefighting.

E. Open Space Preservation. The best approach to preventing damage to new developments is to limit, prevent, or remove development within flood plains and other hazard areas. Open space can be maintained in agricultural use or can serve as parks, greenway corridors, and golf courses. Capital improvement plans and comprehensive land use plans can identify areas to be preserved through any or all of the following means:

- Acquisition;
- Dedication by developers;
- Dedicating or purchasing an easement to keep the land open; or
- Specifying setbacks or buffer zones where development is not allowed.

Additional examples of special area, use and design regulations include:

- Local floodplain management ordinances;
- Coastal zone management regulations;
- Watershed management regulations;
- Special infrastructure design standards and regulations;
- Drainage regulations;
- Housing regulations;
- Wetland protection regulations;
- Natural rivers protection regulations;
- Farmland and open space protection regulations;
- Endangered species / habitat regulations; and
- Historic preservation regulations (among many others).

These regulations (most of which are administered by a state or federal agency in cooperation with local officials) are designed to regulate a certain aspect of the natural or built environment to ensure protection of the public health, safety and welfare, or some significant or unique natural feature. Not surprisingly, most of the regulations have goals that are remarkably similar to those of hazard mitigation. They provide valuable mechanisms for achieving mitigation objectives. These regulations are discussed in greater detail in the following sections of this plan.

To be effective, the provisions of these special regulations must be fully integrated into the comprehensive planning process at the local level. Major provisions of pertinent regulations must be included or addressed in the comprehensive plan and primary implementing mechanisms such as the zoning ordinance, capital improvements plan, etc. The 2013 Mason County Master Plan Update helps set the table for open space preservation in the county. A stated goal of the document is to "preserve Mason County's natural resources and the beauty of its landscape."

Two programs administered by the State of Michigan provide good examples of special area / use measures that, while originally designed to accomplish something else, also contribute to a reduction in a community's risk and vulnerability to hazards (flooding and wildfires in these two instances):

Natural Rivers Program

This program, administered by the Michigan Department of Environmental Quality, seeks to establish a system of outstanding rivers in Michigan and to preserve, protect and enhance their wildlife, fisheries, scenic, historical, recreational and other values. Through the natural rivers designation process, a natural river district is established and a zoning ordinance is adopted. Within the natural river district, permits are required for building construction, land alteration, platting of lots, cutting of vegetation, and bridge construction. Not all of the zoning ordinances on the natural rivers have the same requirements, although they all have building setback requirements and vegetative strip requirements.

Although not specifically designed to reduce flood losses, the program nonetheless has flood hazard mitigation benefits by requiring building to be constructed away from the river and out of the floodplain. The program is very effective when administered as intended. Like any regulatory program, if the administrator and the variance board are aware of the requirements of the program and their duties, it is very effective.

In Mason County, the Pere Marquette River is the lone river currently designated by the Michigan Natural Rivers Program. This river also happens to be a National Wild and Scenic River.

Farmland and Open Space Preservation Program
This program, administered by the Michigan Department of Agriculture and Rural Development, has the primary goal of preserving unique and beneficial open space. It does this by transferring development rights and acquiring easements. There are two categories of land eligible. The first category makes up historic, riverfront, and shoreland areas. The second category includes land that conserves natural or scenic resources, enhances recreational opportunities, promotes the conservation of soils, wetlands and beaches, or preserves historic sites and idle farmland.

The largest component of the program provides landowners with an opportunity to get a break on their property taxes for designating parcels of land that will remain undeveloped. Thus, this mechanism could be used to reduce risk and vulnerability to wildfires by preventing development in heavily forested areas. It could also reduce vulnerability to flooding by preventing development along rivers and in floodplains. However, the program does have a drawback in that the agreements are not in perpetuity and may be relinquished under certain circumstances. The land can be removed from the program under certain circumstances, with the payment of a penalty. Over the short-term, the program is very effective at slowing the development of the special open spaces. It does not, however, necessarily eliminate future development on the parcels and therefore should not be considered an effective long-term mitigation tool. However, there is also a Purchase of Development Rights program, which does purchase development rights in perpetuity. In addition, landowners may donate development rights to the State and to local conservation programs.

F. Stormwater Management. New construction in a floodplain increases the amount of development exposed to damage and can aggravate flooding on neighboring properties. Development outside a floodplain can also contribute to flooding problems since stormwater runoff is increased when natural ground cover is replaced by development. Land use and land cover changes anywhere within a watershed can increase water runoff and/or inhibit natural water infiltration, increasing the frequency and/or severity of flooding downstream within that watershed. Development in a watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality. Stormwater management encompasses two approaches to protecting new construction from damage by surface water:

- Regulating development in the floodplain to ensure that it will be protected from flooding and that it won't divert floodwaters onto other properties; and
- Regulating all development to ensure that the post-development peak runoff will not be greater than under pre-development conditions.

The National Flood Insurance Program (NFIP) and the Michigan Department of Natural Resources (MDNR) set minimum requirements for regulating development in its identified floodplains. All new buildings must be protected from base elevations or 100-year floodplains and no development may cause an increase in flood heights or velocities. Eleven communities in Mason County are currently participating in the National Flood Insurance Program: the City of Ludington and the townships of Amber, Branch, Eden, Hamlin, Logan, Meade, Pere Marquette, Sheridan, Sherman, and Summit. Three additional communities have flood areas identified, but are not participating at this time: Custer, Grant, and Riverton townships.

There is currently no state law that regulates stormwater runoff quantity. Any regulation that exists is done at the local/county level. The MDEQ has prepared a stormwater management best management practices guidebook to assist local governments in their stormwater management efforts.

The Michigan Drain Code (1956), administered by county drain commissioners, contains regulations regarding set-backs from the established drain channels to assure proper carrying capacity of the drains. Officially, the code "establishes laws relating to the laying out of drainage districts, the consolidation of drainage districts, the construction and maintenance of drains, sewers, pumping equipment, bridges, culverts, fords, and the structures and the mechanical devices to properly purify the flow of drains". It also "gives authority to provide for flood control projects, to provide for water management, water management districts and sub-districts, and for flood control and drainage projects within the districts."

The Mason County Stormwater Runoff, Soil Erosion, and Sedimentation Control Ordinance (February 1997) is described in the preamble as being an ordinance to protect the health, safety, and welfare of the residents of Mason County; to prevent water quality degradation, siltation, flooding, and drainage problems from stormwater runoff; to prevent soil erosion and off-site sedimentation during and after site development; to reduce the need for public expenditures related to flooding and pollution control; to identify requirements for stormwater runoff, soil erosion, and sedimentation control; and to provide for maintenance assurances and county inspections. This ordinance is not currently enforceable due to a ruling by the Attorney General. However guidelines contained within the ordinance are used by the county and many local municipalities.

Stormwater runoff regulations add to these efforts to regulate development by requiring developers to build retention or detention basins to minimize the increases in the run-off rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a rate higher than it did under pre-development conditions.

Stormwater ordinances set requirements for managing runoff from new developments and may require storage facilities based on the size of the development and capacity. The ordinance and proper site planning reduce runoff and the impact of the development on the surrounding area. Examples include:

- Promoting the use of native vegetation within the runoff storage basins;
- Requiring buffers along streams, lakes, wetlands, etc.;
- Requiring retention or infiltration of the initial runoff; and
- Requiring existing depressional storage (areas not designated as floodplains) to be compensated for at a 1:1 ratio.

Stormwater ordinances may also provide for the development of watershed plans. Watershed plans examine the unique characteristics of each watershed and may adopt more or less stringent requirements. The ordinances can also provide for a fee, in lieu of site runoff storage, in the event a watershed plan recommends the use of a larger central basin.

2. Corrective Measures.

Corrective mitigation can be expensive, resource intensive, time consuming, and sometimes only marginally effective. Structural protection measures, hazard modification, and large-scale retrofitting fall under this category. Attempting to go back and fix something that is problematic is almost always more difficult than doing it right the first time. However, when dealing with hazard prone property (i.e., structures in a floodway, floodplain or other hazard area), it is often necessary to go back and try to correct the problem in order to protect the affected community and individual property owners from future harm.

When structures and communities are located in hazardous areas, corrective measures are directed at working with current conditions. They are emphasized for areas that suffer recurring or particularly severe disaster damages and impacts or that offer unique mitigation opportunities that can be addressed with existing resources. Examples of the more common corrective measures include:

Modifications. Modifications to a site and/or to a structure. Examples include landscape grading, or retrofitting existing structures to be damage resistant (i.e. floodproofing existing buildings, adding structural braces to buildings to improve earthquake or wind resistance, etc.).

Relocation. Permanent evacuation of hazard-prone areas through movement of existing hazard-prone development and population to safer areas. The two common approaches to relocation are physical removal of buildings to a safer area with future use of the vacated area limited to permanent open space, and replacing existing land uses with others that are less vulnerable to the hazard.

Acquisition. Public acquisition and management of lands that are vulnerable to damage from local hazards. Following acquisition, land uses more appropriate to the degree of risk may be chosen. Public acquisition has been achieved by: a) purchase at full market value; b) purchase at less than full market value through such methods as foreclosure of tax delinquent property, bargain sales, purchase and lease back, etc.; c) donation, through reserved real estate, donation by will, donation and lease back; d) leases; and e) easements.

Modification measures are normally implemented by property owners and include actions to modify the site to keep the hazard from reaching the building; to modify the building/site, or retrofit it, so that it can withstand the impacts of the hazard; and to insure the property to provide financial relief after damage occurs. Relocation and acquisition measures can be implemented by property owners and/or governments through technical and financial assistance.

A. Site Modification (Keeping the Hazard Away). Natural hazards generally do not damage vacant areas but instead threaten people and improved property. In some cases, properties can be modified so the hazard does not reach the damage-prone improvements.

For example, a home may survive a wildfire because a "defensible space" was created and maintained between it and adjacent wild lands. This "defensible space" is similar in concept to that of "firebreaks", wherein brush and other fuel are cleared away in areas of state and national forests. A clearing around homes for at least 30 feet on all sides will discourage wildfires from spreading directly to them. Proper maintenance of adjacent property (short grass, thinned trees, removal of low-hanging branches, selection of fire-resistant vegetation, etc.) is also helpful in keeping wildfires away. Restricting campfires to controlled areas, away from homes, and requiring burn permits lowers risks to occupied properties. Homes should also be set back from slopes (which allow fires to spread faster than on flat terrain). The need for local homeowners to "fireproof" their properties is probably the county's primary wildfire vulnerability.

Four common methods used to "keep flooding away" include:

- Erect a barrier between the building and the source of flooding;
- Move the building out of the floodprone area;
- Elevate the building above the flood level; and
- Demolish the building.

A flood protection barrier can be built of dirt or soil (berm or levee), or concrete or steel (floodwall). Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on the porosity of the ground, if floodwaters stay up for more than an hour or two, the design must account for leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water, and a pump and pipe to remove the internal drainage over the barrier. Barriers can only be built so high and can therefore be overtopped by floods higher than expected. Berms can settle over time, and are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and maintained, lowering their protection level. Floodwalls can crack, weaken, and lose their watertight seals. Therefore, barriers need careful design and maintenance and should be insured in case of failure.

The surest and safest way to protect a building from flooding is to move it to higher ground. Almost any building can be moved but the cost climbs for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. In areas subject to flash flooding, deep waters, or other high hazard, relocation is often the only safe approach. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation. On the other hand, elevating a building will change its appearance. If the required amount of elevation is low, the result is similar to putting a building on a 2’ or 3’ high crawlspace. If the building is raised 4’, 6’, or more; owners are often concerned about its appearance and may decline to implement an elevation project. Another problem with this approach is with basements. Only the first floor and higher are elevated. The basement remains as the foundation. All utilities are elevated and the basement is filled in to protect the walls from water pressure. The owner loses the use of the basement, which may deter him or her from trying this approach. A third problem with elevation is that it may expose the structure to greater impacts from other hazards. If not braced and anchored properly, an elevated building may have less resistance to the shaking of an earthquake and the pressures of high winds. A fourth problem is that access can be lost when floodwaters overtop local roads, driveways, and culverts or ditches. If this happens frequently and alternate access is not available, roadways might have to be elevated and crossing points improved.

Some buildings, especially heavily damaged or repetitively flooded ones (such as those in the floodways, the most dangerous portions of the floodplains that naturally carry the majority of fast moving waters), are not worth the expense to protect them from future damage (floodways have many code requirements for repair, expansion or replacement of structures). It is cheaper to demolish them and either replace them with new, flood-protected structures, or relocate the occupants to a safer site. In general, demolition projects are undertaken by a government agency so the cost is not borne by the property owner. The land may then be converted to public use, such as a park. Acquisition, followed by demolition, is most appropriate for buildings that are difficult to move (such as larger, slab foundation, or masonry structures) and for dilapidated structures that are not worth protecting. One problem sometimes resulting from an acquisition and demolition project is a “checkerboard” pattern in which non-adjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to relocate.

B. Building or Site Modification (Retrofitting). An alternative to modifying the site to keep the hazard away is to modify or "retrofit" the site or building to minimize or even prevent damage. There are a variety of techniques to do this. This section looks at the measures that can be implemented to protect existing buildings from damage by wildfires, structural fires, floods, sewer backup, tornadoes, high winds, winter storms, hail, and extreme temperatures.

Modifications to prevent damages from wildfires not only include the creation of a "defensible space" but also a number of other very effective actions such as the use of fire-resistant siding and roofing materials as well as functional shutters and heavy fire-resistant drapes. Homeowners can sweep clean their roofs, decks and eaves to prevent blowing embers from igniting twigs and leaves. They can move woodpiles and combustibles away from buildings, enclose eaves and any openings under structures that would allow blown embers in, and clean up yard and house waste and flammable oils and spills, which are generally in garages and driveways. Homeowners can also keep private roads and driveways accessible to vehicles and fire equipment. Driveways should be relatively straight and flat, with at least some open spaces to turn, bridges that can support emergency vehicles, and clearance wide and high enough for two-way traffic and emergency vehicle access. This is especially true in areas where space is limited by the local topography. In addition, spare keys to gates around property should be provided to the local fire department, addresses should be clearly visible from the main road, and homeowners can make sure that adequate water supply is available for fire-fighters (small pond, cistern, well, swimming pool, garden hoses, etc.).

The National Fire Protection Association administers the Firewise Communities Program, which encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk. The program is co-sponsored by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters.

The Firewise Communities/USA Recognition Program is a process that empowers neighbors to work together in reducing their wildfire risk. Communities may pursue this using a five-step process to develop an action plan that guides their residential risk reduction activities, while engaging and encouraging their neighbors to become active participants:

- Obtain a wildfire risk assessment as a written document from your state forestry agency or fire department.
- Form a board or committee, and create an action plan based on the assessment.
- Conduct a "Firewise Day" event.
- Invest a minimum of $2 per capita in local Firewise actions for the year.
- Submit an application to your state Firewise liaison.

Modifications to prevent damages from structural fires include: the safe installation and maintenance of electrical outlets and wiring; the installation of firewalls; and provision of equipment needed to inhibit fire dangers (such as sprinkler systems, smoke alarms, and fire extinguishers). In urban areas, the denser pattern of development may allow a fire in one structure to spread to one or more other structures. Appropriate firewall use in connected units or downtown commercial/pedestrian strips can help to protect property against the spread of fire. Older attached structures especially should be checked for safety and code compliance. Any special facility such as a nursing home, day care center, or health clinic should ensure that it has a workable fire plan and is equipped with the equipment needed to inhibit fire dangers, such as sprinkler systems, functioning smoke alarms, and usable fire extinguishers. In rural areas, proper education on and maintenance of non-utility heat sources will help allay this hazard. The National Fire Protection Association has information available for homeowners on how to prevent fires. Proper cleaning of chimneys, fire places and wood stoves, keeping objects away from heating sources to prevent malfunction or ignition, and proper installation and fueling of heaters are all important. Space heaters should be at least three feet from objects.

Flood retrofitting measures include dry floodproofing where all areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings (doors, windows, and vents) are closed, either permanently, or with removable shields or sandbags. Sump pumps are used to remove any water that enters. Dry floodproofing of new and existing non-residential buildings in the regulatory floodplain is permitted under state, FEMA and local regulations. Dry floodproofing existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Dry floodproofing is also a viable option for homes located outside the regulatory floodplain.

The alternative to dry floodproofing is wet floodproofing, where water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater, and laundry facilities are permanently relocated to a higher floor or raised on blocks or platforms where the flooding is not deep. Simply moving furniture and electrical appliances out of a basement can prevent a great deal of damage.

A third flood protection modification addresses flooding caused by overloaded sanitary or combined sewers. Four approaches may be used to protect a structure against sewer backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from discharging out of the lowest opening into the building, the floor drain, and are inexpensive. However, if water becomes deep enough in the sewer system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain. The other two measures, overhead sewers and backflow protection valves, keep water in the sewer line during a backup. They are more secure but more expensive.

Other considerations for the minimization of flooding damages include: stronger anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway; assurance of proper location, cleaning and maintenance of septic tanks; and back-up power for sump pumps. Critical facilities should have written flood response and recovery plans to identify the equipment and materials necessary to protect them. Cost-sharing programs, such as rebates, to encourage low cost (under $10,000) property protection measures on private property (surface and sub-surface drainage, sewer back-up protections, berms and regrading, sewer back-up protection, furnace and water heater relocations, lightning rods, etc.) should be considered.

Tornado and severe wind retrofitting measures include constructing underground shelters or “safe rooms” in residences and constructing shelter areas for those who live in mobile homes or temporary, seasonal locations. Another retrofitting approach for tornadoes and high winds is to secure the roof, walls, and foundation with adequate fasteners or tie downs and cross-bracing. These devices help hold the building together when the combination of high wind and barometric pressure differences work to pull the building apart. A third tornado and high wind protection modification is to strengthen garage doors, windows (with laminated glass panes) and other large openings. If winds break the building’s “envelope,” the pressures on the structure are greatly increased. Trailers and mobile homes can be secured to foundations, functional wind shutters can be installed over windows, and yard items can be secured or brought inside to avoid damage. Inter-locking shingles on roofs can offer much additional protection against wind and hail damage. Workplaces, remote hunting lodges, campgrounds, fairgrounds, mobile homes, and other such facilities may still have vulnerabilities for proper warning and shelter. It is important to provide inhabitants with safe and accessible sheltering options before, during and after severe weather events.

Retrofitting approaches to protect buildings from the effects of thunderstorms include storm shutters, lightning rods, and strengthening connections and tie-downs (similar to tornado retrofitting). Roofs could be replaced with materials less susceptible to damage by hail, such as modified asphalt or formed steel shingles. Loose materials and yard and patio items should also be secured so that they can't blow away.

Burying utility lines is a retrofitting measure that addresses the impacts of severe winds, tornadoes, and winter storms. Installing or incorporating backup power supplies minimizes the effects of power losses caused by downed lines. Surge suppressors protect delicate appliances from lightning damage. "Retrofitting" trees that hang over power lines, as discussed later in the discussion on Urban Forestry, is yet another option.

Winter storm retrofitting measures include improving insulation on older buildings and relocating water lines from outside walls to interior spaces. Windows can be sealed or covered with an extra layer of glass (storm windows) or plastic sheeting. Roofs can be retrofitted to shed heavy loads of snow and prevent ice dams that form when snow melts. Water and sewer lines can be buried below the frost line or insulated to protect against ground freeze. Roads can be protected from blowing snow by the installation of snow fences beside them, especially along highways and in residential developments with limited access. These fences can be "living" fences (lines of trees).

Air conditioning is probably the most effective measure for mitigating the effects of extreme summer heat on people. Unfortunately, those most vulnerable to heat often do not live or work in air-conditioned environments. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals. However, air circulation is important and is limited for those unwilling to open windows because of security concerns. In these instances, inexpensive safety latches can be installed to allow windows to be opened far enough for air to circulate, while at the same time preventing them from being completely opened from the outside.

C. Insurance. Technically speaking, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild and (hopefully) afford to incorporate some of the other mitigation measures in the process.

A standard homeowner's insurance policy will cover a property for the hazards of tornado, wind, hail, and winter storms. Separate endorsements are usually needed for damages from sump pump failure, sewer back-up, and earth movement and can be added to a homeowner's insurance policy. Each company has different amounts of coverage, exclusions, deductibles, arrangements, and costs. Most exclude damage from surface flooding and owners must purchase such coverage through the National Flood Insurance Program, which is available if they live in communities participating in the program. Banks and mortgage companies require flood insurance when loans are for purchase or repair of properties located in flood plains if the loans are federally insured. Agricultural insurance is available to protect growers from crop loss in the event of a drought.

Critical facilities should be inventoried and proper insurance coverage should be reviewed (both types and amount, including deductibles and policy limits) and assured. Larger local governments can self-insure and absorb the cost of damage to one facility, but if many properties are exposed to damage, self-insurance can be a major drain on the treasury. Communities cannot expect federal disaster assistance to make up the difference. Under Section 406(d) of the Stafford Act "if an eligible insurable facility damaged by flooding is located in a [mapped floodplain] … and the facility is not covered (or is underinsured) by flood insurance on the date of such flooding, FEMA is required to reduce Federal disaster assistance by the *maximum* amount of insurance proceeds that would have been received had the buildings and contents been fully covered under a National Flood Insurance Program (NFIP) standard flood insurance policy". Generally, the maximum amount of proceeds for a non-residential property is $500,000. In other words, the law expects public agencies to be fully insured as a condition of receiving federal disaster assistance.

D. Technical and Financial Assistance. Property protection measures are usually considered the responsibility of the property owner. However, there are various roles the county or a municipality can play in encouraging and supporting implementation of these measures.

One of the first duties of a local government is to protect its own facilities. Critical facilities should be a high priority for retrofitting projects and insurance coverage. Often public agencies discover after the disaster that their "all-hazard" insurance policies did not cover the property for the type of damage incurred. Flood insurance is even more important as a mitigation measure because of the Stafford Act provisions discussed above.

Providing basic information to property owners is an important action that can be taken to support property protection measures. Another step is to help pay for a retrofitting project. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups, street flooding, and other problems that arise from an inadequate public sewer or public drainage system. Less expensive community programs include low-interest loans, forgivable (after a certain period of occupancy) loans and rebates. These approaches don't always fully fund the project but they either cost the community less or increase the owner's commitment to the retrofitting project. In addition, communities can assist residents with referrals to home repair programs and heating assistance programs.

Mandates are considered a last resort if information, funding, and incentives aren't enough to cause protective actions. Examples of retrofitting mandates are the requirements that downspouts be disconnected from sanitary sewer lines or that buildings in flood plains be elevated or brought up to current flood protection codes if "substantial" repair costs equal or exceed 50% of the value of the original building. Another possible mandate is to require less expensive hazard protection steps as a condition of a home improvement project. If a person were to apply for a permit for electrical work, the community could require that the service box be moved above the base flood elevation or that separate ground fault interrupter circuits be installed in the basement. An extreme mandate would be to "Fill your Basement with Water". For example, if the mandate is issued in an NFIP community during flood conditions under FEMA procedures, FEMA funds would later be made available to assist with repairs. However, those repairs would be less expensive since filling the basement would equalize pressure from saturated soils on building walls with water tight, near water tight, or pumped out basements. It would also facilitate clean-up because there is clean water instead of silt and sewage-laden muddy water in the structure.

Repetitive Loss properties deserve special attention because they are more prone to damage by natural hazards than other properties and protecting such buildings is a priority with FEMA and EMD/MSP mitigation funding programs. As of October 2013, there had been two repetitive losses in Mason County; both of which were in Meade Township. Appropriate property protection measures are based on studies of flood and building conditions. General guidelines, which are not site specific, are as follows.

- Buildings in high hazard areas (in the floodway or where the 100-year flood is two or more feet over the first floor) or in less than good condition should be acquired and demolished.
- Buildings with basements and split level foundations in high hazard areas should be acquired and demolished. They are too difficult to elevate and the hydrostatic pressures on the walls from deeper flooding make them too risky to protect in place.
- Buildings subject to shallow flooding from local drainage should be protected through area-wide flood control or sewer improvement projects.
- Buildings in good condition on crawlspaces should be elevated or relocated.
- Buildings in good condition on slab, basement or split level foundations subject to shallow flooding (less than 2 feet) can be protected by barriers and dry floodproofing.

The most common sources for hazard mitigation assistance are listed in the table below. Unfortunately, some are only available after a disaster, not before, when damage could be prevented. Following past disaster declarations, FEMA, the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD), and the Michigan Department of Natural Resources have provided advice on how to qualify and apply for these funds. A detailed listing of potential federal and state funding sources for hazard-specific measures is included in Appendix F.

Common Hazard Mitigation Sources

Program	Eligibility	Eligible Activities	Program Type / Cost Share
HAZARD MITIGATION GRANT PROGRAM (HMGP) HMGP grants are provided to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments · Private nonprofit orgs	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Structural / non-structural retrofitting · Safe room construction · Infrastructure retrofitting · Soil stabilization · Wildfire mitigation · Post-disaster code enforcement · Hazard mitigation planning	Disaster Based (Stafford Act Major Disaster Declaration Required) 75% Federal 25% Non-Federal
PRE-DISASTER MITIGATION PROGRAM (PDMP) PDMP funds are provided for hazard mitigation planning and the implementation of mitigation projects prior to a disaster. Funding these plans and projects reduces overall risks to the population and structures from future hazard events, while also reducing reliance on federal funding from future major disaster declarations.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments · Universities	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Structural / non-structural retrofitting · Safe room construction · Infrastructure retrofitting · Soil stabilization · Wildfire mitigation · Hazard mitigation planning	Annual Appropriation 75% Federal 25% Non-Federal 90% Federal 10% Non-Federal if subgrantee is a small impoverished community
FLOOD MITIGATION ASSISTANCE PROGRAM (FMAP) FMAP funds are provided to implement measures that reduce or eliminate the long term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). The goal of the FMAP is to reduce or eliminate claims under the NFIP.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects · Hazard mitigation planning	Annual Appropriation 75% Federal 25% Non-Federal
REPETITIVE FLOOD CLAIMS PROGRAM (RFCP) RFCP funds are provided to reduce flood damages to insured properties that have had one or more claims under the NFIP and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period of time. (Note: RFCP funds are only available to sub- applicants who cannot meet the cost share requirements of the FMAP.)	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Dry floodproofing of historic residential structures · Dry floodproofing of non-residential structures · Minor localized flood reduction projects	Annual Appropriation 100% Federal
SEVERE REPETITIVE LOSS PROGRAM (SRLP) SRLP funds are provided to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the NFIP, and that will result in the greatest amount of savings to the NFIF in the shortest period of time.	Eligible Subapplicants: · State agencies · Tribal governments · Local governments	· Property acquisition / structure demolition or relocation · Structure elevation · Mitigation reconstruction · Dry floodproofing of historic residential structures · Minor localized flood reduction projects	Annual Appropriation 75% Federal 25% Non-Federal
*States, Territories and Indian Tribal Governments are eligible HMA applicants. Interested and eligible subapplicants must apply to the applicant for HMA funding consideration. Individuals and businesses are not eligible to apply for HMA funds; however, an eligible subapplicant may apply for funding to mitigate private structures.			

Source: MSP/EMHSD Pub. 106a, Michigan Hazard Mitigation Success Stories, 2011

3. Resource Protection.

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas as development occurs so that these areas can, in turn, provide hazard protection. For instance, watersheds, floodplains, and wetlands can reduce run-off from rainwater and snow melt in pervious areas; reduce overland flood flow and store floodwaters; remove and filter excess nutrients, pollutants and sediments; absorb flood energy and reduce flood scour; and recharge groundwater.

These natural benefits can be preserved though regulatory steps for protecting natural areas or natural functions. General regulatory programs are discussed in the section on Preventive Measures. This section covers resource protection programs and standards, including the following:

- Wetland protection;
- Erosion and sedimentation control;
- River restoration;
- Best management practices;
- Dumping regulations;
- Urban forestry;
- Farmland protection;
- Sand dune protection and management; and
- Shorelands protection and management.

A. Wetland Protection. Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as natural filters, helping to improve water quality. Wetlands that are part of the waters of the United States are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Proposed development in these wetlands requires a "404" permit, which can't be issued until plans are reviewed and approved by several agencies including the Corps and the U.S. Fish and Wildlife Service. Small projects that meet certain criteria, as well as projects that are not in the Corps' wetlands, may proceed under nationwide permits instead of under individual permits and are regulated by local authorities (i.e. the Michigan Department of Environmental Quality). In either case, the impact of the development must be mitigated.

Wetland mitigation, as defined in each issued permit, can include creation, restoration, enhancement or preservation of wetlands on the site or elsewhere – even in another watershed. It should be noted that, when a wetland is mitigated at another site, there are drawbacks to consider. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it's in a different watershed) will not have the same flood damage reduction benefits as the original one did. Some developers and government agencies mitigate by buying into wetland banks, which are large wetlands created for the purpose of mitigation. The bank accepts money to reimburse the owner for setting the land aside from development.

B. Soil Erosion and Sedimentation Control. Farmlands and construction sites typically contain large areas of exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along streambanks and shorelines as water flow and wave action wash away the soil. Suspended sediment tends to settle out where flowing water slows down and can clog storm sewers, drain tiles, culverts and ditches and can reduce the transport and storage capacity of water channels. When they are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging or "channelization" (straightening, deepening, or widening the channel) costs.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground and slopes as soon as possible with vegetation and other soil stabilizing practices (geo-textile fabrics, rip-rap boulders, etc.). Techniques to control sedimentation include: silt fences, sediment traps and vegetated filter strips. Runoff can be slowed down by terraces, contour strip farming, no-till farm practices, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds) to reduce the volume of topsoil eroded from the site.

Erosion and sedimentation control regulations, which are usually oriented toward construction sites, mandate that these types of practices be incorporated into construction plans. They also require applicants for permits to submit erosion and sedimentation control plans for construction projects. Michigan's Soil Erosion and Sedimentation Control (Part 91) ordinance requires permits for projects or activities (not crop production) involving earth changes that disturb one or more acres of land or are located within 500 feet of a lake or stream. Enforcement of the ordinance can be handled by a designated county department, with assistance from the Conservation District, or a municipality. In Mason County, the county enforcing agency is the Mason County Department of Public Works, the authorized public agency is the Mason County Road Commission, and the Conservation District is the Mason-Lake Conservation District. Municipalities have the opportunity to adopt and enforce more stringent regulations, as long as they don't conflict with the state ordinance and have state approval. Mason County addresses these issues through its Stormwater Runoff, Soil Erosion, and Sedimentation Control Ordinance (September 1997) as described in the section on Preventative Measures.

C. River Restoration. Approaches such as "stream conservation," "bioengineering," and "riparian corridor restoration" aim to return streams, streambanks and adjacent lands to more natural conditions. "Ecological restoration" aims to restore native indigenous plants and animals to an area. Native plantings along banks; such as willow cuttings, wetland plants, and/or rolls of landscape material covered with natural fabric that decomposes after plants take root; resist erosion. Studies have shown that, after establishing appropriate vegetation on banks, long-term maintenance costs are lower than for maintenance of concrete banks or conventional landscape (e.g., mowing turf grass). These approaches are not required but are recommended by economics.

Another restoration option is to improve culverts. Restoring the natural flow of a watercourse through culvert improvements and streambank treatments around the culvert can have numerous benefits that may appeal to a variety of governmental and environmental groups. Potential benefits include: water quality improvement; coldwater tributary protection / restoration; fish habitat improvement; and decreased risk of culvert failure which may lead to flooding and washouts.

There are numerous watershed groups that include Mason County within their borders, including: Big Sable Watershed Restoration Committee (c/o Conservation Resource Alliance); Little Manistee River Watershed Conservation Council; and Pere Marquette River Watershed Council.

D. Best Management Practices. *Point source* pollutants are discharged from pipes (such as the outfall of a municipal wastewater treatment plant) and are regulated by the U.S. EPA and the Michigan Department of Environmental Quality. *Non-point source* pollutants come from non-specific locations and are harder to regulate. Examples of non-point source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. The term "best management practices" (BMP's) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff, prevent erosion, protect natural resources and capture non-point source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, maintain natural base flows, and provide multiple uses of drainage and storage facilities.

E. Dumping Regulations. BMP's usually address pollutants that are liquids or are suspended in water while dumping regulations address solid matter, such as shopping carts, appliances, and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater. Nuisance ordinances can prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations can prohibit "non-objectionable" waste (grass clippings or tree branches) which can kill ground cover or cause obstructions in channels. These regulations can be enforced with penalties but programs should have public information components since property owners might not be aware of the impact of their actions (i.e. re-grading their yards, discarding leaves or branches in a watercourse, etc.). Voluntary compliance by property owners and annual "clean-up" programs by local communities can be quite effective.

F. Urban Forestry. The major damage caused by wind and snow/ice/sleet storms is to trees. Downed trees and branches break utility lines and damage buildings, parked vehicles, and anything else under them. An urban forestry program, developed by a municipality, can reduce the damage potential of trees by addressing proper tree care prior to a storm and recommend actions for managing trees before, during, and after a storm. Urban foresters or arborists can select hardier trees that better withstand high wind and ice accumulation and trees that are shorter than utility lines for use in power and telephone line rights-of-way. They can review damaged trees to determine if they should be pruned or removed.

A properly written and enforced urban forestry plan can lessen the frequency of fallen trees and limbs caused by wind and ice build-up, reduce liability, assist in assuring that utility lines are not damaged, and provide guidance on repairs and pruning after a storm. Such a plan helps a community qualify to be a "Tree City USA." The "Tree City USA" program is sponsored by The National Arbor Day Foundation, in cooperation with the USDA Forest Service and the National Association of State Foresters, to ensure that every qualifying community has a viable tree management plan and program. It provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs.

In addition, utility companies are heavily involved in tree management. A recent Consumers Energy brochure states that; since the company is responsible for providing safe, reliable electricity; employees (and companies hired to help) "are sent out on a planned, rotating schedule to clear trees and bushes from electric rights-of-way." Following guidelines from the American National Standards Institute (ANSI) and working under required permits, Consumers Energy promises the following actions.

- Trees next to distribution lines, which carry electricity from pole to pole, will be trimmed a safe, clear distance from lines.
- The safety of employees and the public, particularly children, may require removal of a tree. A tree may have to be removed because it is dead, dying, damaged, or subject to falling because of wind or a shallow root system-making it a safety and power outage threat. Some fast-growing trees can be a continuing hazard and may have to be removed.
- Trimming methods are aimed at helping the tree heal, decreasing future trimming needs, and directing future growth away from electric lines.

The need for these activities is eliminated when utility lines are buried. Burying the lines is recommended when they are being upgraded or installed for new developments.

G. Farmland Protection. The purpose of farmland protection is to provide planning and zoning mechanisms for preserving prime, unique, or important agricultural land from conversion to non-agricultural uses. Farm owners feel forced to sell their land to residential or commercial developers if it is taxed based on the value of the property, if developed, instead of farmed and the increased taxation can't be afforded. The ensuing development brings more buildings, roads, and other infrastructure that can create additional stormwater runoff and emergency management difficulties. To offset this situation, the Farmland Protection Program in the U.S. Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to states, tribes, local governments, and non-profit organizations to help purchase easements on agricultural land to protect against the development of the land. Eligible lands include cropland, range land, grass land, pasture land, and forestland that are part of an agricultural operation. Certain lands with historical or archaeological resources are also included. The hazard mitigation benefits of farmland protection are similar to those of open space preservation.

In addition to protecting farmland, efforts can be made to protect crops. These efforts can include the support of agricultural programs that promote soil health, preserve soil moisture, and monitor soil moisture levels to help minimize loss of crops and topsoil during drought conditions. They can also include recommendations for water supply infrastructure that is not vulnerable to drought and planting crops tolerant of low moisture levels. Drought ordinances can prioritize or control water use during drought conditions. Drought mitigation plans can be developed which include:

- Collection and analysis of drought-related information;
- Criteria for declaring drought emergencies and triggering various mitigation and response activities;
- Information flow between and within levels of government;
- Definition of the duties and responsibilities of all agencies with respect to drought;
- A current inventory of state and federal programs used in assessing and responding to drought emergencies;
- Identification of drought-prone areas and vulnerable economic sectors, individuals, or environments;
- Identification of mitigation actions to address vulnerabilities and reduce drought impacts; a mechanism to ensure timely and accurate assessment of drought's impacts on agriculture, industry, municipalities, wildlife, tourism and recreation, health, and other areas;
- Public information methods; and
- A strategy to remove obstacles to the equitable allocation of water during shortages and establish requirements or provide incentives to encourage water conservation.

H. Sand Dune and Shorelands Protection and Management. According to MDEQ, Michigan's sand dunes are a resource of global significance since they are the largest assemblage of fresh water dunes in the world. The Michigan Legislature has found that critical dune areas of this state are "unique, irreplaceable, and fragile resources that provide significant recreational, economic, scientific, geological, scenic, botanical, educational, agricultural, and ecological benefits to the people of this state and to people from other states and countries who visit this resource."

Construction in these areas is carefully controlled. In addition to the required local building permits, MDEQ permits are required for all proposed new uses in designated areas of Mason County, as contained in its "Atlas of Critical Dune Areas" (www.michigan.gov/deq under "sand dunes"). There are designated areas in the townships of Grant, Hamlin, Pere Marquette, and Summit.

In addition, Michigan's Shorelands Protection and Management legislation determines if a high-risk erosion area shall be regulated to prevent property loss or if suitable methods of protection shall be installed to prevent property loss. A permit is required for the erection, installation, or moving of a permanent structure on a parcel of land where any portion is a designated high risk erosion area. Examples include homes, porches, septic systems, additions, substantial improvements of existing structures, and out buildings. With the exception of Alcona, Charlevoix, Macomb, Monroe, and Wayne Counties, all coastal counties in Michigan have some designated high risk erosion areas.

This careful control of development can assist in the prevention of hazards such as increased wildfire risk (caused by the wildland/urban interface and increased erosion potential. It can also assist in assuring fire-fighting access to development.

4. Emergency Services.

Emergency service measures protect people during and after a disaster. A good emergency management program addresses all hazards and involves all departments. At the state level, programs are coordinated by the Michigan State Police, Emergency Management and Homeland Security Division (MSP-EMHSD); while at the county level, programs are coordinated through Mason County Emergency Management. These measures can be divided into four stages:

- Threat Recognition (Watch);
- Warning;
- Response; and
- Post-Disaster Recovery and Mitigation.

A. Threat Recognition (Watch). The first step in responding to a snowstorm, windstorm, tornado, flood, or other natural hazard is to know when weather conditions are such that an event could occur and issuing a "watch." Proper and timely threat recognition systems allow for adequate warnings to be disseminated. Systems are described below for flooding, tornadoes and thunderstorms, and winter storms.

A flood threat recognition system predicts the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels. On smaller rivers, local rainfall and river gauges are needed. In the absence of gauges, local personnel and/or volunteers monitor rainfall and stream conditions. While specific flood crests and times are not predicted, advance notice of potential local or flash flooding is provided.

On larger rivers, measuring and calculating is done by the National Weather Service (NWS), which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), with support from cooperating state and local partners. Forecasts are made through the Advanced Hydrologic Prediction Service (AHPS), which utilizes river gauges for information. In Mason County, a gauge is located on the Pere Marquette River near Scottville.

Flood threat predictions are broadcasted on the NOAA Weather Wire and Weather Radio, the official source for weather information, to those who have equipment to receive it (state police, 911 and dispatch centers, municipalities, and critical facilities). Weather radios can be tone-activated through the Emergency Alert Radio System (EARS). Predictions are also transmitted through social media, and by television, radio, and cable television through the Emergency Alert System (EAS), previously known as the Emergency Broadcast System.

The National Weather Service (NWS) is the prime agency for detecting meteorological threats, such as tornadoes and thunderstorms. The NWS uses a transmitter located at Wolf Lake in Lake County to reach receivers in Mason County. Severe weather warnings are transmitted through the NOAA Weather Radio System and, subsequently, through the Michigan State Police's Law Enforcement Information Network (LEIN). The network includes law enforcement agencies and emergency service providers such as "911" who then issue their own warnings. However, NWS coverage is done on a large scale and only considers if conditions are appropriate for formation of a tornado or thunderstorm. More site-specific and timely recognition is provided by sending out NWS trained spotters to watch and report on the weather when the NWS issues a watch or warning. Training for spotters is provided annually, usually in the spring, by Mason County Emergency Management and NWS.

The NWS is also the prime agency for predicting winter storms. Severe snow storms can often be forecasted days in advance of the expected event, which allows time for warning and preparation. The NWS can also forecast ice storms, issue dense fog advisories, and give notice when conditions are conducive for rip currents in Lake Michigan.

In summation, Mason County receives threat recognition information from NOAA weather radios or from the Michigan State Police who monitor the NOAA Weather Wire. The NWS also activates public notice through EAS when the hazard impacts a large area. The Michigan State Police disseminate weather threats through the LEIN system to 911 and other dispatch centers around the state. Police and fire stations, schools and other public facilities may also receive alerts from 911. When conditions are appropriate, Mason County Emergency Management and NWS use their formal organization of storm spotters.

B. Warning. When the NWS determines that a flood, tornado, thunderstorm, winter storm or other hazard has been observed or is coming, a warning is issued to take immediate action and the systems described above are again utilized to notify police, 911 and dispatch centers, municipalities, the public, and staff of other agencies and critical facilities. Early warning allows for a greater number of people to implement protection measures.

More specific warnings may be issued by communities and are included on the following list, which contains methods already discussed, as well as common and cutting edge methods.

- NOAA All Hazards Radio;
- The Weather Channel;
- Commercial or public radio or TV stations;
- Cable TV emergency news inserts;
- Tone activated receivers in key facilities;
- Outdoor warning sirens and fire department call-in sirens;
- Sirens on public safety vehicles;
- Mobile public address systems;
- E-mail notifications;
- Broadcast faxes;
- Pocket paging services for the hearing impaired;
- AT&T language line for those who speak a different language;
- Automated telephone notification services;
- Telephone trees/mass telephone notification;
- Mobile device text messages and apps;
- Social media outlets; and
- Door-to-door contact.

Warning systems need to be continually evaluated, updated to include new technologies, and expanded to include warnings to people with "special needs" and should include warnings for slow onset as well as fast onset hazards. Different warning systems are required for different hazards, some of which are location-specific and some of which are area-wide. In addition, any confusion over warnings needs to be eliminated. The public is often confused by fire station alarms and doesn't know if the alarm indicates a hazard or is just calling in fire fighters.

Mason County does not have any outdoor warning sirens. There is a siren in the City of Ludington, however it goes off at noon and 10 pm every day and is not typically used for warnings. In the past, the county has estimated that it needs 11 sirens, at a cost of $18,000 each ($198,000), to provide countywide coverage. In areas not serviced by existing sirens, the most effective means of warning are radio, television, and cable systems (EAS), the EARS tone alert radios, NOAA Weather Radios, and mobile device alerts.

Multiple or redundant systems are most effective. If people do not hear one warning, they may still get the message from another. Also more effective are warnings that provide public information about the hazard and what to do. However, each method has advantages and disadvantages that are partially described below.

- Radio and television, when turned on, provide useful information.

- NOAA Weather Radio, where available, can provide short messages of any impending weather hazard or emergency and advise people to turn on their radios or televisions, or to access the internet.
- Outdoor warning sirens can quickly reach many people, particularly those who are outside, and trigger them to turn on a radio or television or to access the internet to find out what hazard is coming. They do not reach people in tightly insulated buildings or those surrounded by loud noise, such as in a factory, during a thunderstorm, or near an air conditioning unit.
- Automated telephone notification services are also fast, but can be expensive and do not work when phone lines are down or for unlisted numbers and calling screener services.
- Going door-to-door and conducting manual "telephone trees" can be effective but require a longer lead time.
- Social media alerts require individuals to be active on those networks and require access to the internet.
- Mobile device alerts are only effective if there is adequate cell phone service, and when devices are turned on.

In areas not serviced by existing sirens, the most effective means of warning are radio, television, and cable systems (EAS); the EARS tone alert radios; and NOAA Weather Radios. Mason-Oceana 911 maintains and operates three Homeland Security Region 6-funded emergency communication systems.

1. *CityWatch*- a reverse 911 system that allows the general public of geographical based emergencies through land-line telephones.
2. *EMnet*- Secure, satellite based communication and warning system soon to interface with various media (TV, radio) outlets.
3. *Codespear*- Mobile radio system that allows connecting various radio bands to each other and the internet.

The NWS established the "StormReady" program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. A community must satisfy a set of guidelines to receive "StormReady" recognition. The guidelines are organized into six categories:

- Communications;
- NWS Information Reception;
- Hydrometeorological Monitoring;
- Local Warning Dissemination;
- Community Preparedness; and
- Administrative.

Certain requirements for each guideline may vary depending on the population of the community. More information on the program is available at http://www.stormready.noaa.gov/index.html. Ludington State Park in Hamlin Township achieved StormReady status in 2012.

NWS also established the Turn Around Don't Drown (TADD) campaign "to warn people of the hazards of walking or driving a vehicle through flood waters." One activity is to warn motorists of the dangers of flooded roads, particularly when there are barricades, since it is impossible to tell the depth of the water or the condition of the road under the water. Barricades are very definite warnings and should never be ignored. An additional and inexpensive warning technique is the use of PVC markers on roads prone to flooding which show the depth at which motorists should not attempt passage.

C. Response. The protection of life and property is the foremost task of emergency responders. A community should respond to hazards with threat recognition, warnings and actions that can prevent or reduce damage and injuries. Typical actions and responding parties in a flooding event include the following:

- Activating the emergency operations center (emergency management);

- Closing streets or bridges (police or public works);
- Shutting off power to threatened areas (utility company);
- Passing out sand and sandbags (public works);
- Ordering an evacuation (governor upon local recommendation);
- Holding children at school/releasing children from school (school district);
- Opening evacuation shelters (Red Cross);
- Activating volunteers to check on/assist vulnerable populations;
- Monitoring water levels (engineering); and
- Security and other protection measures (police).

Additional activities for different types of events include: advertising heating and cooling shelters when extreme temperatures occur; having volunteers check on those needing assistance when there are infrastructure failures; sending vulnerable folks (in parks, campgrounds, mobile home parks, shopping malls, and large public or private buildings) to tornado shelters when high winds are predicted; etc.

An emergency action plan ensures that all bases are covered and that response activities are appropriate for the expected threat. These plans can be developed for municipalities, critical facilities, SARA sites, businesses, etc. and should include coordination with all of the agencies, offices, first responders and service providers that are given various responsibilities. They should consider the possibility of "mutual aid" and utilize volunteer groups such as Radio Amateur Civil Emergency Services (RACES). Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions.

The Mason County Emergency Action Guidelines document is designed to present a common platform for coordination of major response activities for all types of natural and technological hazards. It establishes the Incident Command System that assigns responsibilities during a disaster, such as communications, evacuation and public health. Implementation of the plan relies on the combined effort of Mason County departments and local communities. The Emergency Action Guidelines are augmented with annexes (including terrorism), standard operating procedures and other guidance documents that cover the details of various aspects of emergency response, such as communications, evacuation, sheltering, damage assessment, and severe weather. There are only a few additional documents that provide specific guidance for responding to natural hazards on an individual basis (Site Emergency Response Plans and Standard Operating Procedures or road closures, etc.).

The Incident Command System is required for Mason County's participation in the Michigan Emergency Management Assistance Compact (MEMAC), an initiative of the Michigan State Police, Emergency Management and Homeland Security Division (MSP/EMHSD). MEMAC creates an organized process and structure spelled out in advance for jurisdictions large and small across the state to render or receive assistance in times of crisis. It addresses problematic issues concerning workmen's compensation insurance, expense reimbursement and liability coverage before assistance is needed and requested. Designed to be flexible, MEMAC is also intended to supplement rather than replace existing, local mutual aid agreements already in place to handle "routine" public safety services among neighboring jurisdictions and fire departments. It is important to note that the implementation of MEMAC helps to facilitate the receipt of state or federal disaster funds through the Public Assistance Program.

Planning is best done with adequate data. One of the best tools in a flooding event is a flood stage forecast map that shows what areas would be under water at various flood stages. Emergency management staff can identify the number of properties flooded, which roads will be under water, which critical facilities will be affected, etc. With this information, an advanced plan can be prepared that shows problem sites and determines what resources will be needed to respond to the predicted flood level.

A Geographic Information System (GIS) allows for this type of analysis as it works with digitized layers of geographic data. For instance, the locations of buildings can be overlaid with areas of concern for development (topography, infrastructure, land use, zoning, fire service areas, etc.) and areas of concern for flooding (floodplains, hydraulic shadows of dams, etc.). GIS can model the effects of different levels of flooding and be used for hydrologic monitoring and modeling of the effects of removing/raising bridges over rivers to remove constriction to the flow of floodwater.

Protecting critical facilities during a disaster is the responsibility of the facility owner or operator. Some critical facilities have their own emergency response plans. Michigan law requires hospitals, nursing homes, and other public health facilities to develop such plans. Many facilities would benefit from early warning, response planning, and coordination with community response efforts. If critical facilities are not prepared for an emergency and are damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If they are adequately prepared by the owner or operator, the community's emergency response efforts will be better supported.

D. Recovery and Mitigation. After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and help prepare people and property for the next disaster. Throughout the recovery phase, everyone wants to get “back to normal.” However, “normal” can’t mean the way things were before the disaster or there would again be the same exposure to future disasters. Here are some examples of potential recovery actions:

- Patrolling evacuated areas to prevent looting (police).
- Providing safe drinking water (public works).
- Monitoring for diseases (health department).
- Vaccinating residents for tetanus (health department).
- Clearing streets (road commission).
- Cleaning up debris and garbage (road commission).
- Providing referrals to recovery vendors for post-disaster goods and services (emergency services).
- Regulating reconstruction to ensure that it meets all code requirements (building inspectors).

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to re-enter and repair. There is a special requirement to do this in identified floodplains, regardless of the type of disaster or cause of damage. The National Flood Insurance Program (NFIP) directs local officials to enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building’s market value, the building must be retrofitted to meet the standards of a new building in the floodplain. In most cases, this means that a substantially damaged building must be elevated above the base flood elevation. This requirement can be very difficult for understaffed and overworked offices after a disaster. If these activities are not carried out properly, not only does the community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

A chance is also available to assess the strength of buildings; the effectiveness of emergency action plans for communities, critical facilities, and businesses; and the readiness of responders. Should efforts be deemed inadequate, improvements can be recommended such as revisions to building codes, increased training for responders, and improvements to existing plans or creation of sample plans.

Reviews of emergency response plans and programs should focus on whether all involved communities had coordinators and liaisons, if all information was provided (flood plain map, critical facilities, etc.), if there were post-disaster procedures for public information, and if adequate warnings were provided. Model business disaster plans can include details on response such as evacuation plans; data protections, security, and recovery; property security; drills; and first-aid training and CPR. They could also include post-disaster mitigation actions such as facilities management; damage assessment;

relocation of both services and people; insurance; contractors; list of resources for public and private assistance; and evaluate, test, and update plans.

Reviews of building strengths should be similar to FEMA's, wherein a Building Performance Assessment Team (BPAT) may recommend revisions after a disaster. Other considerations for revisions could include the following.

- Did fire fighters have adequate detection and firefighting equipment?
- Did critical facilities have necessary back-up generators?
- Did electrical distribution systems have built-in redundancies to limit the impact of failures?
- Did the Road Commission have the equipment and personnel to be able to clear the roads?
- Was there a place to store personal property?
- Were there detention areas for debris disposal (snow, ice, branches, power/phone lines, etc.)?
- Were critical facilities protected with lightning rods and surge protection devices?
- Was the Health Department able to monitor threats and take the necessary steps to prevent or limit the scope and magnitude of threats?
- Were emergency responders sufficiently trained and able to communicate?

An assessment of damages is necessary and can be provided by state and federal officials, as is the case in flooding events, or by local emergency responders and emergency staff. Assessments can be facilitated by GIS, which could detail damages, identify mitigation projects, establish environmental baselines, and monitor changes in land use. FEMA offers courses, free of charge, to emergency staff for evaluation training.

In addition to identifying the amount of damage, communities can acquire substantially or repeatedly damaged properties from willing sellers, plan for long-term mitigation activities, and apply for post-disaster mitigation funds.

5. Public Education and Awareness.

Public education and awareness programs are necessary to periodically inform the public (property owners, renters, businesses and local officials) about the county's hazards, the measures necessary to minimize potential damage and injury, and what actions are being taken. This information is primarily intended to precipitate appropriate actions.

Information can be disseminated through the media (newspapers, newsletters, websites, television, radio, etc.) and at public forums and civic meetings. It can be distributed through schools and made available in public buildings or shopping areas. Brochures can be available at libraries and government offices, including building inspection offices. Special populations can be reached through direct mailings, workshops, and seminars. Signage along hazardous areas can also be effective.

A. Distribution of Existing Information. There is a great deal of information regarding hazards and hazard mitigation available to communities and the public on the national level. Both FEMA and American Red Cross present information on the Internet and in documents and brochures. The National Weather Service makes information available through its "Storm Ready" and "Turn Around Don't Drown" programs, to name just a few.

Insurance companies and non-profit programs have been heavily involved in identifying and responding to hazards. The Institute for Business and Home Safety (IBHS) gives detailed information on how to increase a home, business, or new construction's resistance to disaster through its suite of FORTIFIED programs. The National Fire Protection Association (NFPA) provides information about co-existing with wildfire along with mitigation information through its Firewise Communities program. The NFPA also has information available for homeowners on how to prevent fires. The National Arbor Day Federation provides direction on tree management.

Unfortunately, this information doesn't always reach the intended target audience; whether that audience is communities, the general public, or specific populations. Local efforts can be made to select pertinent information and get it out to places and people where it is needed (such as information on wildfire hazards to campers). Programs and web sites can be publicized. Brochures can be stockpiled and distributed. This information can be very helpful, although it is not specific to the community.

B. Distribution of Local Information. In addition to the national-level information discussed above, there is an abundance of information available locally to educate and warn the public of hazards. Local newspapers and television stations frequently update the public on hazards. Mason County Emergency Management is an excellent source of information on a variety of topics as varied as the location of shelters or financial assistance in hazard response and mitigation. Local building inspectors can provide advice regarding protection measures, property compliance, and required building permits.

Mitigation efforts the county takes to protect its residents, including the creation and adoption of this plan to qualify itself (and local communities which participate in the planning process and adopt the plan) for federal disaster funding, can be publicized. The general public, or eligible target groups, can be notified when financial resources for hazard response and mitigation become available.

C. Technical Assistance. Communities often have information that can assist homeowners. If they have FEMA's Flood Insurance Rate Maps and Flood Insurance Studies available, they can provide information to residents and can assist them in submitting requests for map amendments and revisions (Letter of Map Revision, or LOMR) when a building is not in the flood plain but a part of the property is. Lenders will notify applicants for federally insured loans if the involved property is in the flood plain and require flood insurance as a condition of the loan.

Local building inspectors can provide advice regarding protection measures, property compliance and required building permits.

Emergency Management can recommend that residents develop Family Emergency Plans, including the preparation of Disaster Supply Kits, identification of emergency telephone numbers, and the preparation of pre-planned escape routes. The county can assist local communities through the provision of local information regarding hazards, risks and protections. For example, a GIS system could lay out the location of homes in floodplains so that mitigation measures can be considered. It can also assist communities in the development of the plans identified in this document by researching and providing model plans to them.

Part G
POTENTIAL HAZARD MITIGATION ACTIONS

The previous chapter identified a multitude of alternatives for addressing hazard concerns; some of which may not be economically feasible or appropriate for a county, such as Mason, with limited resources and without professional in-house planning staff. In addition, many of Mason County's top hazards are natural and weather-related and cannot be easily mitigated. Nothing can be done to eliminate severe winds or snow/ice/sleet storms or to alter their frequency, intensity or spatial distribution across the landscape. Mitigation actions associated with natural hazards must focus on limiting the impacts on the populations or structures that are being affected. For instance, power failures caused by severe winds and snow/sleet/ice storms can be reduced by several mitigation activities and the impacts on residents and properties from the power failures can be alleviated.

The potential actions in this section are presented because they may potentially help to save lives and protect communities and important agencies, rather than because they are considered pure "mitigation actions" distinct from other types of emergency management actions. However, in the final selection of strategies for any hazard mitigation plan, care should be taken to ensure the inclusion of at least some strategies that are clearly hazard mitigation. That is, a true hazard mitigation strategy is an effort to prevent hazard impacts, or to take advance, proactive steps toward the long-term reduction of the impacts of hazards on a community. If some of these take place during the response or recovery phases of a disaster, or happen to also increase an agency's preparedness, the existence of such overlap is primarily of academic interest so long as the community's safety is being served. On occasion, specific criteria for hazard mitigation must be met to satisfy the requirements of a given grant. Thus it is useful to be aware of both the distinctions and the overlap between hazard mitigation and other types of emergency management activities.

Identification of a possible mitigation measure does not necessarily mean that it can or even should be implemented. Implementation (and the desirability) of a mitigation measure is highly dependent on a number of factors – environmental, social, economic and political. Just because a measure may reduce or eliminate the effects of a hazard does not necessarily mean that it should be implemented. There may be extenuating factors or circumstances that could (or even should) preclude its implementation. Those decisions will be made in the local and state political arenas and in the land use / land development decision-making processes. Typically, mitigation measures will be implemented if they are able to balance environmental, social, economic and political factors, and are cost-effective. It does not make sense to implement a measure that will not be supported by state and/or local officials and the citizenry, or that cannot be economically justified. Although implementability cannot (and should not) always be the final litmus test for a potential mitigation measure, it certainly should be considered when identifying and developing measures. In general, those mitigation opportunities that could not pass this basic litmus test have been excluded from this plan.

The following potential actions are presented according to the county's hazard mitigation goals and objectives identified in Part E. For each goal, there are several objectives; and under each objective, there are several action items. These potential action items are "snapshots" of some of the alternatives discussed in the previous chapter. The highest priority action items are selected from this set and discussed further in "Part I - Plan Implementation."

For the updated edition of this plan, many of the potential action items remain the same, though minor revisions were made to improve the readability of the action items. A few action items were added and a few were removed according to the preference of the Advisory Team / LEPC. Care was taken to ensure that there are numerous potential action items presented to address each of the county's top priority hazards.

Goal 1. Promote growth in a sustainable, hazard-free manner.

Objective 1.1. Incorporate hazard provisions in building code standards, ordinances, and procedures.

Action Item 1. Review local building codes to determine if revisions are needed to improve structural ability to withstand greater wind velocities, snow weight, ice, and hail; to provide better protection against structural fires and flooding; and to provide better protection from extreme temperatures.

Action Item 2. Contact Insurance Services Office (ISO) to request a copy of the community's Building Code Effectiveness Grading Scale (BCEGS), and work to improve the BCEGS rating through improvements to building codes and enforcement.

Action Item 3. Utilize the Institute for Business and Home Safety (IBHS) guidelines provided through the "FORTIFIED" programs to guard new and existing structures against hazards (such as structural fire, wildfire, tornadoes, and freezing weather), and consider incorporating them into existing codes.

Action Item 4. Review code requirements for the installation of mobile homes and manufactured homes to assure protection against severe winds and tornadoes.

Action Item 5. Assess the need to strengthen anchoring requirements for propane tanks and hazardous materials in the floodplain/floodway.

Action Item 6. Assure proper location, installation, cleaning and maintenance of septic systems, particularly in the floodplain/floodway and around lakes.

Objective 1.2. Incorporate hazard mitigation into land use and capital improvement planning and development activities.

Action Item 7. Incorporate mitigation provisions into comprehensive plans and land use plans; such as identification of acceptable land uses and densities based on consideration of flood-prone areas, soil types, topography, and etc.

Action Item 8. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas and so that possible set-asides for planned and engineered structural projects (berms, levees, floodwalls, detention and retention ponds, debris storage areas, culvert replacement, etc.) are considered.

Objective 1.3. Incorporate hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.

Action Item 9. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances and resolutions as they restrict or direct development; with consideration given to dams, floodplains, soil type and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Action Item 10. Enforce the existing Michigan Drain Code requirement for "set-back" from the drain channel, thereby assuring proper carrying capacity of the drain.

Action Item 11. Enforce Michigan's Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, regarding earth changes affecting an acre or more or within 500' of a lake or stream, and consider adopting and enforcing more stringent local regulations.

Action Item 12. Enforce Michigan's Land Division Act as it furthers the orderly layout and use of land, provides for proper ingress and egress to lots and parcels, controls residential building development within floodplain areas, provides for reserving easements for utilities, and governs internal drainage.

Action Item 13. Enforce Michigan's Sand Dune and Shorelands Protection and Management Programs that control development in high-risk erosion areas and protect dunes.

Action Item 14. Consider regulation of development in the hydraulic shadows of dams (where flooding would occur if there was a severe dam failure).

Objective 1.4. Research, recommend, adopt and enforce programs, plans, and ordinances that protect natural resources so that they can, in turn, provide hazard protection.

Action Item 15. Develop a Stormwater Management Plan to identify best management practices (BMP's), and to assess the efficacy of local stormwater ordinances and rules.

Action Item 16. Develop, adopt, and enforce a Nuisance Ordinance to prevent dumping "objectionable" solid matter into channels and wetlands and Waterway Dumping Regulations to prevent dumping "non-objectionable" waste.

Action Item 17. Develop and enact a Community Forestry Program to reduce the damage potential of trees by addressing proper tree care prior to a storm (pruning, maintenance, removal, and replacement) by communities and property owners and by managing trees before, during, and after a storm. This is a standard for qualification as a "Tree City USA" community.

Action Item 18. Develop policies or ordinances aimed at mitigating the impacts of drought conditions, such as: the promotion of planting crops tolerant of low moisture levels; partner with programs that promote soil health and monitor and preserve soil moisture; and prioritize or control water use during drought conditions.

Goal 2. Protect existing and new properties.

Objective 2.1. Use the most cost-effective approaches to keep hazards away from existing buildings and facilities.

Action Item 19. Assess the capacity of storm water systems to handle both storm waters and high water tables and make necessary improvements and expansions to assure the protection of property and infrastructure.

Action Item 20. Raise or relocate buildings above the 100-year flood level, and/or acquire properties in flood and high-risk erosion areas for demolition and re-use of the land as open space.

Action Item 21. Identify structural projects to channel water away from people and property (e.g. berms, dikes, levees, or floodwalls), or to improve drainage capabilities (e.g. culvert improvements, bridge modifications, spillways, relief drains, or floodgates).

Action Item 22. Identify environmental restoration projects to lessen the impacts of flooding and improve water quality and wildlife habitat, such as erosion control techniques (streambank modification), dredging / clearance of sediment and debris from drainage channels, and protection / restoration of wetlands and natural water retention areas.

Action Item 23. Employ Firewise principles of proper grounds maintenance, equipment storage, vegetation clearance, and other techniques.

Action Item 24. Create firebreaks, wherein brush and other fuel are cleared away, in wildland areas.

Action Item 25. Identify and prioritize fuel reduction projects, especially for wildland-urban interface (WUI) areas.

Action Item 26. Adopt and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.

Action Item 27. Enforce Michigan P.A. 102 of 2012 which prohibits the open burning of household trash that contains plastic, rubber, foam, chemically treated wood, textiles, electronics, chemicals, or hazardous materials.

Objective 2.2. Use the most cost-effective approaches to protect existing buildings and sites from hazards.

Action Item 28. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Action Item 29. Adopt and enforce the Michigan Rehabilitation Code to hold repaired buildings to higher standards for protection against natural hazards, similar to the standards for newly constructed buildings.

Action Item 30. Utilize mandates for upgrading homes, such as requiring upgraded electrical work for substantial rehabilitation of existing properties, or for issuing "Fill Your Basement With Water" orders.

Action Item 31. Review the energy efficiency, winter readiness, and electrical protection of critical facilities and government buildings in the community and consider replacing aged facilities and equipment.

Action Item 32. Install lightning protection devices on the community's communications infrastructure and appropriate public facilities; and lightning grade surge protection devices on critical electronic components used by government, public service, and public safety facilities.

Objective 2.3. Maximize insurance coverage to provide financial protection against hazard events.

Action Item 33. Assure insurance coverage on properties and obtain additional insurance coverage as appropriate (sump pump failure, sewer back-up, wildfire, dam failure, etc.).

Action Item 34. Encourage and assist municipalities that are at risk to flooding, or that have been exposed to flooding in the past, to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.

Action Item 35. Encourage NFIP-participant municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities to reduce the cost of NFIP flood insurance.

Action Item 36. Inventory critical facilities and assure proper insurance coverage, both type and amount, including deductibles and policy limits. Evaluate self-insurance coverage in light of its expense and NFIP policies.

Objective 2.4. Maximize the resources for investment in hazard mitigation, including the use of outside sources of funding.

Action Item 37. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program; to address community needs for hazard mitigation.

Action Item 38. Utilize, and assist those with special needs to utilize, available programs for assistance with home repairs, weatherization, and heating costs to address hazards for persons and properties.

Action Item 39. Facilitate donations for heating assistance through cooperation with local utility providers and local charitable organizations to assure that all residents have heat during the winter, regardless of their ability to pay.

Action Item 40. Establish a cost sharing program to encourage low cost (under $10,000) property protection measures against natural hazards on private property, such as rebates offered through a "flood-proofing" program for instances when acquisition and/or relocation is not required.

Action Item 41. Establish a voluntary floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.

Action Item 42. Tap into state and federal funding and technical assistance for dam/spillway repairs.

Action Item 43. Investigate the availability of resources and need for creating firebreaks and the availability of resources for acquiring land, as necessary, to achieve continuity of firebreak areas.

Goal 3. Protect public health and safety.

Objective 3.1. Assure that threat recognition (watches) and warning systems are adequate and appropriate and that they utilize the latest technology.

Action Item 44. Regularly evaluate the effectiveness of the public warning system including the threat detection process, management system, communications links, and methods of dissemination. Evaluation should consider warning for slow onset as well as short onset hazards, new technologies, public views of the warning system and the effect this has on response to warnings (especially confusion about fire station sirens), disseminating warnings to people with "special needs," redundancies, and effective methods of risk communication.

Action Item 45. Implement improvements to the warning system as deemed necessary for improving coverage and effectiveness.

Action Item 46. Maintain a description of the public warning process and coordinate actions in a section of the Emergency Action Guidelines (EAG).

Action Item 47. Increase the coverage and use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) to people and communities in need.

Action Item 48. Encourage the MDNR, U. S. Geological Survey, National Weather Service, and U. S. Army Corps of Engineers to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.

Action Item 49. Maintain adequate monitoring and surveillance capabilities by the District Health Department to monitor public health threats and take the necessary steps to prevent or limit the scope and magnitude of threats.

Action Item 50. Utilize the NWS "Turn Around Don't Drown" system to warn motorists and pedestrians not to enter or cross flooded areas, and install PVC markers alongside roads to illustrate dangerous water levels.

Objective 3.2. Protect infrastructure and services.

Action Item 51. Encourage electrical utilities to place power lines underground wherever possible, but especially when upgrading them or running power to new developments.

Action Item 52. Recommend design of the electrical distribution system with built-in redundancies such that isolated failures do not lead to wide scale outages; recommend consideration of back-up generators powered with wind, sun, gasoline, or natural gas; and assess and improve electric service system reliability as needed.

Action Item 53. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, hospitals and medical centers, nursing home facilities, schools, shelters, and governmental facilities.

Action Item 54. Bury water/sewer lines below the frost line or insulate and maintain lines to protect against ground freeze.

Action Item 55. Establish safe and appropriate locations for temporary debris disposal sites.

Action Item 56. Assure the county has adequate equipment (road barriers, sand bags, portable lighting, snow plows, etc.) to respond to widespread weather events.

Action Item 57. Continue to refine state, county and local road, bridge and culvert maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff, and maintain the structural integrity of transportation infrastructure.

Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to hazards.

Action Item 58. Adopt this Hazard Mitigation Plan by official resolution to assure both consideration of natural hazards and eligibility for funding through the Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program.

Action Item 59. Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.

Action Item 60. Develop and review coordinated response plans and programs across service providers, agencies and local governments, and assure both mutual aid and the ability to communicate during emergencies.

Action Item 61. Share vital public safety services and resources more effectively and efficiently through county participation in MEMAC, which helps facilitate the receipt of state or federal disaster funds through the Public Assistance Program.

Action Item 62. Refer emergency responders and emergency staff to FEMA and MSP/EMHSD training for conducting Damage Assessments and determining “Substantial Damage” for an efficient and accurate assessment of building damages.

Action Item 63. Design and plan for water supply infrastructure systems that include a consideration of, and are more resistant to, drought events.

Action Item 64. Obtain extra fire-fighting and rescue equipment, including specialized equipment for limited access areas (such as the Lake Michigan shoreline), thermal imaging devices, and special equipment for water and ice rescues.

Action Item 65. Construct concrete storm / tornado safe rooms in homes, public buildings, major industrial sites, shopping malls, and other large complexes; and shelter areas in parks, campgrounds, fairgrounds, mobile home parks, and other vulnerable public areas.

Action Item 66. Coordinate with the Conservation District, local watershed councils, and lake associations to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Action Item 67. Coordinate with fire departments to promote "Firewise" program recommendations and strategies to property owners, especially those within wildland/urban interface areas.

Action Item 68. Meet the criteria to become a NWS-approved "Storm Ready" community.

Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a disaster.

Action Item 69. Utilize volunteer communication networks by amateur radio operators (such as RACES) to facilitate communication during emergencies when phone lines may be inoperable.

Action Item 70. Designate amateur radio operators to relay information on "immediately dangerous" weather situations and storm damage reports to the NWS, Central Dispatch, and/or Emergency Management.

Action Item 71. Create a volunteer outreach program, whereby a network of amateur radio operators and others regularly check on the needs and conditions of elderly, disabled, homebound, and other special-needs groups during and after severe weather conditions; deliver goods / assistance to them; and / or disseminate information about emergency shelters.

Action Item 72. Utilize NWS-trained weather spotters to watch for developing storms, take flood water measurements, and monitor stream conditions.

Action Item 73. Conduct an annual "clean-up" program when trash, limbs, barrels, shopping carts and other potential blockages are removed from drainage culverts, channels and adjacent lands.

Goal 4. Increase public understanding, support, and participation in hazard mitigation.

Objective 4.1. Heighten public awareness of the full range of existing natural and man-made hazards and actions they can take to prevent or reduce the risk to life or property from them.

Action Item 74. Obtain and distribute available information on hazards and cost-effective mitigation actions individuals can implement (for example, Firewise pamphlets), and post-disaster repair and cleanup guidance.

Action Item 75. Produce and distribute local emergency preparedness and safety information to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for information such as fire stations, local radio stations and utilities.

Action Item 76. Produce and distribute information on mitigation measures the county is taking/will take, as identified in this hazard mitigation plan, to local units of government and encourage them to participate in the plan and take mitigation actions.

Action Item 77. Promote educational and informational programming through the media, especially related to the early warning network and individual actions that can be taken to protect citizens, properties, and businesses.

Action Item 78. Provide local schools with information for the classroom regarding severe weather hazards and how families can prepare for and respond to them.

Action Item 79. Incorporate safety strategies for severe weather events in driver education classes and materials.

Action Item 80. Encourage residents to develop a Family Emergency Preparedness Plan; including the preparation of a Disaster Supply Kit, the posting of emergency telephone numbers, and pre-planned escape routes.

Action Item 81. Promote public awareness on fire hazards such as recreational fires (especially in resort/vacation home areas), smoking, fireworks, campfires, wood stoves, and outdoor burning; and support safe disposal of yard and house waste rather than open burning.

Action Item 82. Research availability of local and Michigan-based recovery "vendors" for post-disaster goods and services to support disaster recovery efforts.

Action Item 83. Identify and advertise available heated and cooled shelters to the elderly and other special populations who may be at risk during extreme temperature events and power outages.

Action Item 84. Provide local units of government and builders with information and guidance on methods of protecting new construction from wind damage. Encourage builders and contractors to design wind resistance into the construction of new homes and major home renovation projects.

Action Item 85. Through coordination with the District Health Department, increase public awareness of the causes, symptoms and protective actions for disease outbreaks and other potential public health emergencies.

Objective 4.2. Encourage local communities, agencies, organizations and businesses to participate in the hazard mitigation process.

Action Item 86. Assist local governments in the participation of programs such as NFIP, CRS, Firewise, Tree City USA, Fortified…for safer living, Storm Ready, TADD, etc.

Action Item 87. Develop model hazard mitigation and contingency plans and regulations (such as stormwater ordinance, nuisance ordinance, waterway dumping regulations, community forestry program, drought plan and ordinance, etc.) and provide them to interested communities.

Action Item 88. Develop model business and critical facility disaster plans that include details on disaster response (evacuation plans; data protection, security, and recovery; property security; drills; first-aid training and CPR; and post disaster mitigation actions), facilities management, damage assessment, relocation of both services and people, insurance, contractors, list of resources for assistance, and evaluation, testing, and updating plans. Inform business owners about available disaster-recovery training programs.

Action Item 89. Notify communities of hazard mitigation funds, as they become available, and assist them in applying for funds.

Action Item 90. Encourage meetings between utility providers and local Public Works and Road Commission departments to determine the resources and funding required to mitigate recurring infrastructure failures.

Action Item 91. Support agricultural programs that promote soil health, preserve soil moisture, and monitor soil moisture levels to help to minimize loss of crops and topsoil during drought conditions and promote educational programming relating to water conservation, especially in irrigation and farming, during periods of drought.

Objective 4.3. Encourage cooperation and communication between planning and emergency management officials.

Action Item 92. Assist the LEPC in its activities relating to the development and review of SARA Title III Section 302 site emergency plans, including assistance in updating SARA site plans, and in the appointment of qualified members to the committee.

Action Item 93. Assist the LEPC in its activities related to developing and continually revising Emergency Action Guidelines detailing the response requirements of emergency responders (emergency management, damage assessment, communications, medical services, fire services, public health services, human services, law enforcement, public works, and public information).

Action Item 94. Strengthen the role of hazard mitigation in the land development process, incorporating goals, objectives, and action items into land use plans, comprehensive plans, and zoning ordinances.

Action Item 95. Utilize the County Geographic Information System (GIS) capabilities to support pre-disaster planning (such as the creation of flood stage forecast maps, and maps showing the locations of secluded, gated, and seasonal homes), disaster response activities, and post-disaster recovery activities.

Action Item 96. Coordinate with American Red Cross to ensure the county-wide availability of designated and accessible emergency shelters and assure facilities are inspected, certified, and have back-up power.

Part H
EVALUATION CRITERIA TO SELECT AND PRIORITIZE ACTION ITEMS

The selection of appropriate evaluation criteria is intended to ensure that the recommended implementation action items reflect the values, policies, and desires of the community; and to communicate to governing officials which measures are the most meritorious and desirable.

Local input and planning principles were used to select action items for implementation from the list of potential actions presented in Part G. Common mitigation criteria helped guide the selection process, and included evaluation of each action item's *economic justifiability, technical feasibility, social equitability*, and *environmental soundness*. If, for example, relocation of a structure is proposed, the following conditions must be met in order to satisfy the criteria:

- The cost of relocation must be less than the cost of the repetitive repairs that would be necessary (along with other costs from displacement, loss of services, etc.) if there were no relocation.
- The structures must be able to be moved from their present location to a suitable site.
- The relocation must be acceptable to those who are to participate.
- The relocation must be affordable to all it affects, and not discriminate against those who are unable to bear the cost of either moving the structure, or finding comparable housing.
- In the case of a public facility, such as a fire station, the relocation should not result in an inequitable distribution of fire protection services.
- The relocation project must meet appropriate environmental regulations, and not cause any adverse effects.

Additional considerations used in selecting action items for implementation included: 1) ensuring an appropriate number of mitigation actions be selected to address each of the county's top-priority hazards; and 2) ensuring that an appropriate number of measures be selected to accomplish each of the four hazard mitigation goals established by this plan. Bonus consideration was given to action items that also addressed the goals of other community planning initiatives, and action items that provide clear and obvious solutions for hazard mitigation. Lastly, it should be noted that some of the potential action items are already being implemented and, were consequently not considered for implementation.

The next chapter presents a schedule of recommended action items for implementation. For each measure, the plan identifies basic details needed in order for it to be accomplished, including who will take the action and when it will be taken. Possible sources of technical or financial assistance, as previously discussed in Part F - Identification of Alternatives for Solving Problems, are matched to the actions as well.

In some cases, a local government may be able to implement an action, while the county can only make recommendations. Therefore applicability of each action item is assigned to the appropriate governments in a table on the last page. As a result, objectives will work on multiple scales and can be overseen by several governments. The benefits of combining all of the objectives into one plan include: the ability to recognize contradictions in policy more easily; the ability to cooperate in shared objectives; the ability to eliminate or reduce redundancy in efforts; and the fact that local governments will have a local-level plan for adoption and implementation, qualifying those governments for hazard mitigation funding.

Part I
<u>PLAN IMPLEMENTATION</u>

The previous edition of this hazard mitigation plan (2006) included 18 action items that were recommended for implementation and then assigned to the appropriate jurisdictions within Mason County. This chapter contains a review of the 2006 Action Agenda, as well as a revised Action Agenda for this updated edition.

Review of Hazard Mitigation Progress

To identify any mitigation progress that had been made on the 2006 Action Agenda, discussions were held with county officials and the LEPC / Advisory Team. A questionnaire was also sent to Mason County Emergency Management, LEPC / Advisory Team, and the chief elected official of each village and township that had adopted the 2006 plan. The questionnaire listed the 2006 Action Agenda, along with a place for the respondent to identify whether each item on the agenda was *Complete*, *Ongoing or In-Progress*, *Action Pending*, or *Incomplete* within his or her jurisdiction. If a particular action item was incomplete, the respondent was encouraged to explain why. This review process revealed the following:

1) At least some progress has been made on most of the action items. Many inherited items on the Action Agenda remained priorities as of the time this plan was updated. Examples include Action Item 43 (NOAA radios) and Action Item 49 (generators).
2) Action Item 38, addressing dam failures, is no longer a priority action item due to the progress that has been made since 2006. The dam on Hamlin Lake was rebuilt in 2005 and has withstood a number of high water tests since then. The Bass Lake spillway was rebuilt in 2011. The Custer Weir was scheduled for removal in 2014.
3) Action Item 39 (involving firebreaks) and Action Item 54 (hazard mitigation coordinator), are no longer priority action items. Numerous sources cited these actions as desirable, yet unrealistic due to a lack of resources at this time.

Three units of government in Mason County responded to the questionnaire: Mason County, the City of Ludington, and Riverton Township. Ten LEPC / Advisory Team members took part in the exercise, including Mason County Emergency Management, Mason County Road Commission, Mason County Building & Zoning Department, Mason County Drain Commissioner/DPW, Mason County Equalization, Mason-Oceana 911 Dispatch, Oakview Medical Care Facility, Mason-Lake Conservation District, District #10 Health Department, and United Way of Mason County. At least some progress was reported for 15 out of the 18 items on the Action Agenda. The results of the questionnaire exercise are compiled into the two tables following this narrative. The "Status Report" table summarizes the status of items on the 2006 Action Agenda, and reports any additional comments or information gleaned from the questionnaire. The "Progress by Jurisdiction" table shows the known degree of progress that has been made towards the 2006 Action Agenda, by jurisdiction, in Mason County.

2006 Action Agenda
STATUS REPORT

2006 Hazard Mitigation Plan Action Items	Action Status: Complete	Action Status: Ongoing or In-Progress	Action Status: Pending	Action Status: Incomplete or Unknown	Comments
#2 - Consider and encourage participation in ISO's Building Code Effectiveness Grading Schedule (BCEGS), as recognized by FEMA for the Community Rating System of the NFIP.	X			X	(The City of Ludington was the only entity to report that this action has been completed. No additional information was provided by the City.)
#7 - Incorporate mitigation provisions into comprehensive plans and land use plans, especially as they address open space preservation and development restrictions (particularly in flood plains and the hydraulic shadows of dams).		X			**Mason Co. Building & Zoning Dept –** Development in flood zones, steep slopes, etc. is discouraged in county Master Plan. **Mason-Lake Conservation District –** Open Space and development restrictions pertaining to PA 116 (farmland preservation) are closely monitored by the conservation district. **Oakview Medical Care –** has an Emergency Preparedness Plan which addresses a number of emergent events, including natural hazards. Written agreements are in place with other facilities to receive evacuated residents.
#8 - Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas and so that possible set-asides for planned and engineered structural projects (berms, levees, floodwalls, detention and retention ponds, debris storage areas, etc.) are considered.		X			**Mason Co. Road Commission –** Ongoing, or In-Progress. **Mason-Lake Conservation District –** Ongoing, or In-Progress. **City of Ludington –** Ongoing, or In-Progress.
#9 - Incorporate hazard mitigation provisions and recommendations into local zoning ordinances as they restrict or direct development; with consideration given to dams, flood plains, soil type, and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).		X			**Mason County Road Commission –** Ongoing, or In-Progress. **City of Ludington –** Ongoing, or In-Progress.
#24 - Maximize the participation of property owners in protecting their properties from natural hazards; such as the promotion of Firewise principles to protect against wildfires; or usage of stronger roofing materials to protect against wind, hail, and winter weather hazards.		X	X		**Mason-Lake Conservation District –** Actively promoting FIREWISE in rural eastern Mason County; future collaboration with county LEPC needed. **Oakview Medical Care–** Staff have been instructed in their own family emergency plans.
#30 - Encourage municipalities to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.		X	X		**Mason Co. Building & Zoning Dept –** Included in 2013 county Master Plan update. **Mason Co. Drain Commission –** Ongoing, or In-Progress. **City of Ludington –** Action Pending.
#31 - Encourage municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities (such as the adoption of this plan) to reduce the cost of NFIP flood insurance.		X			**Mason Co. Emergency Mgmt –** Ongoing, or In-Progress. **Mason Co. Road Commission –** Ongoing, or In-Progress.
#38 - Assess the need for and use of state and federal funding for dam/spillway repairs.	X	X			**Mason Co. Road Commission –** Ongoing, or In-Progress. **Mason Co. Drain Commission –** Ongoing, or In-Progress. **Mason-Lake Conservation District –** Custer Weir to be removed in 2014; dam on Hamlin Lake has been rebuilt as recently at 2005; and Bass Lake Outlet spillway has been rebuilt as recently as 2011.
#39 - Investigate the availability of resources and need for creating firebreaks in forested areas to help protect them and nearby properties from forest fires and the availability of resources for acquiring land, as necessary, to achieve continuity of needed firebreak areas.				X	(Lack of resources widely cited as reason for incompletion.)
#43 - Increase the use of NOAA All-Hazards radios and weather alert Systems (Emergency Alert Radio System, etc.) to maximize the use and benefits of the new NWS radio tower at Wolf Lake.		X			**Mason Co. Emergency Mgmt –** Ongoing, or In-Progress. **Mason Co. Road Commission –** Ongoing, or In-Progress **Oakview Medical Care –** 3 NOAA radios in place.
#44 - Encourage the MDNR, USGS, NWS, and USACE to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.	X	X			**Mason Co. Emergency Mgmt –** Complete. **Mason Co. Road Commission –** Ongoing, or In-Progress **Oakview Medical Care –** Water well on site is capable of serving the facility. Well is checked annually and metered by the City of Ludington.

#49 - Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, road commissions, hospitals and medical centers, nursing home facilities, schools, shelters, governmental facilities, and correctional facilities.	X	X			**Mason Co. Emergency Mgmt –** County courthouse, hospital and county medical care facility are generated; schools need generators. **Mason Co. Drain Commission –** Ongoing, or In-Progress. Lack of resources. **Mason-Oceana 911** – Complete for 911. **City of Ludington –** Ongoing, or In-Progress. **Oakview Medical Care –** Facility has a generator.
#52 - Continue and refine State, County, and local road and bridge maintenance programs, assure that road commissions have adequate equipment to respond to widespread weather events, and promote living snow fences beside highways and other roads to decrease snow on roads.		X			**Mason Co. Road Commission –** Ongoing, or In-Progress **Mason-Lake Conservation District –** Interested and willing to help with road-stream crossing improvements, and if deemed appropriate, will help to actively promote and even help plant living snow fences in Mason County. **City of Ludington –** Ongoing, or In-Progress.
#53 - Adopt this Hazard Mitigation Plan by official resolution to assure both consideration of natural hazards and eligibility for FEMA funding through the Pre-Disaster Mitigation Program and Hazard Mitigation Grant Program.	X				2006 HMP adopted by: Mason County, Ludington City, Scottville City, Custer Village, Fountain Village, Free Soil Village, Grant Township, Hamlin Township, and Pere Marquette Township.
#54 - Explore funding options for a Hazard Mitigation Coordinator position, either on a county or regional level, to facilitate the actions contained in this plan.				X	(Lack of resources widely cited as reason for incompletion.)
#68 - Distribute already produced information on hazards and cost-effective mitigation actions individuals can implement to residents and/or targeted groups most at risk to experience significant impacts due to natural hazards.		X			**Mason Co. Emergency Mgmt –** General preparedness information is distributed; lack hazard mitigation-specific info to distribute. **Mason Co. Drain Commission –** Ongoing, or In-Progress. Lack of resources.
#69 - Produce and distribute local emergency preparedness and safety information concerning all natural hazards to the general public and/or targeted groups (seasonal population, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.).		X			**Mason Co. Emergency Mgmt –** Have been active with this for the last 2-3 years. **Mason Co. Building & Zoning Dept –** Would have brochures available for developers and builders if available. Floodplain info also could be made available if we had it. **Mason Co. Drain Commission –** Ongoing, or In-Progress. **Mason-Lake Conservation District –** Works with farms to produce emergency plans. **Oakview Medical Care –** The facility's staff has been educated in home emergency preparedness through the Emergency Preparedness Plan.
#80 - Assist communities in participating in mitigation, safety, and preparedness programs such as National Flood Insurance Program, Community Rating System, Firewise Communities/USA, Tree City USA, BCEGS, Fortifed…for safer living, Storm Ready, Turn Around Don't Drown, and so on.		X			**Mason Co. Emergency Mgmt –** Ludington State Park is a StormReady partner; the county is not currently seeking StormReady status. Turn Around Don't Drown is utilized during spring flooding seasons. **Mason Co. Building & Zoning Dept –** Ongoing, or In-Progress (with NFIP). **Mason Co. Drain Commission –** Ongoing, or In-Progress. **Oakview Medical Care –** Received assistance from county EM in preparing emergency plans.

2006 Action Agenda

PROGRESS BY JURISDICTION

Governmental Unit		2 B.C.E.G.S.	7 COMP/LAND-USE PLAN	8 CAPITAL IMPROVEMENT	9 ZONING ORDINANCES	24 OWNER PARTICIATION	30 N.F.I.P.	31 C.R.S.	38 DAM REPAIRS	39 FIREBREAKS	43 NOAA RADIOS	44 STREAM GAUGES	49 GENERATORS	52 ROAD /BRIDGE MAINTENANCE	53 HMP APPROVAL	54 MITIGATION COODINATOR	68 HAZARD AWARENESS	69 PREPAREDNESS INFORMATION	80 COMMUNITY ASSISTANCE
County	Mason	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cities	Ludington	•	•	•	•		•	•					•	•	•				
	Scottville		•	•	•		•	•					•	•	•				
Villages	Custer			•	•		•	•							•				
	Fountain			•	•		•	•							•				
	Free Soil			•	•		•	•							•				
Townships	Amber		•	•			•	•	•	•			•						
	Branch			•			•	•		•									
	Custer			•			•	•		•									
	Eden			•			•	•	•	•									
	Free Soil			•			•	•	•	•									
	Grant			•	•		•	•		•					•				
	Hamlin		•	•	•			•	•	•					•				
	Logan			•				•		•									
	Meade			•				•		•									
	Pere Marquette	•	•	•	•			•	•	•			•		•				
	Riverton			•			•	•		•									
	Sheridan			•			•	•		•									
	Sherman			•			•	•		•									
	Summit			•				•	•	•									
	Victory			•			•	•	•	•			•						

• *Action Item applicable to municipal jurisdiction*

Complete

Ongoing or In Progress

Action Pending

Revised Action Agenda

The action items highlighted in this section were selected from the list of potential hazard mitigation actions presented in Part G and are presented below as the Action Agenda for 2015-2019. The selection process was guided by criteria described in Part H. All items on this revised Action Agenda are considered to be of the highest priority. Implementation of these action items may be appropriate on the county level and / or the local level. The "List of Hazard Mitigation Actions Applicable to Governmental Units" at the end of the chapter assigns action items to appropriate jurisdictions within Mason County. Each action item includes the following information to help facilitate implementation:

Priority Level
All identified action items are considered priorities within this Hazard Mitigation Plan. In order to help structure implementation of the Plan, a further prioritization of high, medium, or low is assigned to each measure. This is intended to convey a sense of importance relative to the other action items from a countywide perspective.

Timeframe
Generally identifies when an action item might begin. Where appropriate, prerequisite activities are discussed.

Applicable Governmental Unit(s) / Responsible Person (s)
Identifies key players for initiating and implementing each action. Often the work will be shared by a number of individuals and agencies.

Potential Technical / Financial Assistance
Identifies common sources of technical and financial assistance. In many cases, identified parties will provide referrals to currently available or specialized assistance and / or guidance. Detail provided is not intended to be exhaustive because opportunities for assistance may come and go; such as following a disaster declaration. **A detailed listing of potential federal and state funding sources for hazard-specific measures is included in Appendix F.**

Comments
Additional details or helpful information about the action item. This feature was added for the revised edition of this plan.

Action Item 2. Contact Insurance Services Office (ISO) to request a copy of the community's Building Code Effectiveness Grading Scale (BCEGS), and work to improve the BCEGS rating through improvements to building codes and enforcement.

Priority Level: Low

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
County Building Inspectors; City of Ludington; Pere Marquette Township.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
A free copy of the community's BCEGS report is available upon the request of a community's chief elected official or building official. This information can be used to identify deficiencies in existing building codes and enforcement. Addressing those deficiencies can enhance the resiliency of new and rehabilitated structures.

Action Item 7. Incorporate mitigation provisions into comprehensive plans and land use plans; such as identification of acceptable land uses and densities based on consideration of flood-prone areas, soil types, topography, and etc.

Priority Level: Medium

Timeframe: To be completed when land use plans are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government; Mason County Planning Commission.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Land use planning helps provide rationale for local rules and policies, so it is important to integrate principals of hazard mitigation into this process. Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this hazard mitigation plan when writing or updating local plans. State law in Michigan requires that master plans must be reviewed, and updated if necessary, every five years.

Action Item 8. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas and so that possible set-asides for planned and engineered structural projects (berms, levees, floodwalls, detention and retention ponds, debris storage areas, culvert replacement, etc.) are considered.

Priority Level: High

Timeframe: To be completed during planning for capital improvements

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government; Mason County (e.g. Road Commission, Public Works, Drain Commission, etc.).

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Local adoption of this plan (Action Item #58) is the first step towards completing this measure. Mason County Emergency Management (MCEM) will then promote the utilization of this plan to local governments and county departments to help coordinate hazard mitigation activities across county departments and local governments.

Action Item 9. Incorporate hazard mitigation provisions and recommendations into local zoning ordinances and resolutions as they restrict or direct development; with consideration given to dams, floodplains, soil type and topography; and as they allow flexibility in lot sizes and locations, such as in Planned Unit Developments (PUD).

Priority Level: Medium

Timeframe: To be completed when zoning ordinances are written or updated

Applicable Governmental Unit(s)/Responsible Person(s):
Mason County Planning and Zoning Department; Local units of government that practice zoning.

Potential Technical/Financial Assistance Sources:
Local resources.

Comments:
Following adoption of this plan, local units of government and the county will be encouraged to consider the contents of this plan when writing or updating local ordinances. Zoning is an effective tool for mitigating hazards because it can be used to direct new development away from known hazardous areas, such as floodplains. Resources such as the IBHS suite of FORTIFIED programs can provide additional guidance for increasing the resistance of new and existing structures to hazards.

Action Item 25. Identify and prioritize fuel reduction projects, especially for wildland-urban interface (WUI) areas.

Priority Level: Low

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
Mason County Emergency Management (MCEM); Local units of government; Fire chiefs; Michigan DNR; U.S. Forest Service.

Potential Technical/Financial Assistance Sources:
U.S. Forest Service; Michigan DNR; MSU Extension.

Comments:
This action item is a new addition to the Action Agenda, and may be accomplished through strategies established during the creation of a Community Wildfire Protection Plan.

Action Item 26. Adopt and enforce local ordinances that require burn permits and restrict campfires and outdoor burning.

Priority Level: Medium

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
Local units of government; Local fire departments.

Potential Technical/Financial Assistance Sources:
Michigan Department of Environmental Quality (MDEQ).

Comments:
A state law enacted in 2012 prohibits the open burning of household trash that contains plastic, rubber, foam, chemically treated wood, textiles, electronics, chemicals or hazardous materials. In lieu of a local ordinance, the law contains penalty provisions which may be enforced by local units of government. This provides a tool for local governments to address trash burning and mitigate unintentional fire starts.

This action item is a new addition to the Action Agenda.

Action Item 28. Encourage property owners and public facility operators to increase their property's resilience and resistance to hazards.

Priority Level: High

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
Local elected officials; Local zoning administrators; County building inspectors.

Potential Technical/Financial Assistance Sources:
Michigan State Police – Emergency Management and Homeland Security Division (MSP-EMHSD); Mason County Emergency Management (MCEM).

Comments:
Hazard mitigation concepts and strategies will be incorporated into the day-to-day activities of elected officials, zoning officials, and building inspectors; especially those activities that involve interaction with local land owners and facility operators. Local officials should refer to Part F (Hazard Mitigation Alternatives) for information about potential mitigation strategies.

Action Item 34. Encourage and assist municipalities that are at risk to flooding, or that have been exposed to flooding in the past, to join the National Flood Insurance Program (NFIP) so that residents can obtain flood insurance.

Priority Level: Medium

Timeframe: Following adoption of this plan

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Mason County Planning and Zoning Department.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDEQ NFIP Coordinator.

Comments:
All municipalities are eligible to participate in the program, even if there are no floodplains or flooding issues. NFIP flood insurance can only be acquired in communities that participate in the program. Municipalities that are currently listed as "Not Participating" in the NFIP by FEMA include: Custer, Grant, and Riverton townships. Other communities that do not participate in the NFIP are: City of Scottville; villages of Custer, Fountain, and Free Soil; and townships of Free Soil and Victory.

Action Item 35. Encourage NFIP-participant municipalities to join the NFIP's Community Rating System (CRS), implement the CRS minimum standards, and implement additional flood loss reduction activities to reduce the cost of NFIP flood insurance.

Priority Level: Low

Timeframe: 2015-2016

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Mason County Planning and Zoning Department.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDEQ NFIP Coordinator.

Comments:
Current NFIP participants include the: City of Ludington; and townships of Amber, Branch, Eden, Hamlin, Logan, Meade, Pere Marquette, Sheridan, Sherman, and Summit.

Action Item 37. Utilize federal programs; such as but not limited to FEMA's Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program; to address community needs for hazard mitigation.

Priority Level: High

Timeframe: As funding becomes available, and especially following a disaster declaration

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Local units of government that participate in the development and then adopt this plan.

Potential Technical/Financial Assistance Sources:
Federal Emergency Management Agency (FEMA); MSP-EMHSD.

Comments:
HMGP funding opportunities are made available following a disaster declaration. Annual funding opportunities may be made available through the PDM and FMA programs, which are nationally competitive. Refer to Appendix F for lists of potential state and federal sources of hazard mitigation funding. This action item is a new addition to the Action Agenda.

Action Item 47. Increase the coverage and use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) to people and communities in need.

Priority Level: Medium

Timeframe: As funding becomes available

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM.

Potential Technical/Financial Assistance Sources:
Homeland Security Grant Program (HSGP); Local resources.

Comments:
Although a number of NOAA radios have been acquired and distributed in recent years, increasing their use and availability in Mason County remains a priority.

Action Item 48. Encourage the MDNR, U. S. Geological Survey, National Weather Service, and U. S. Army Corps of Engineers to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.

Priority Level: Low

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; MDNR; USGS; NWS; USACE.

Comments:
Mason County Emergency Management will maintain communication with agencies involved with monitoring water levels; including the NWS, which operates a gauge on the Pere Marquette River near Scottville.

Action Item 50. Utilize the NWS "Turn Around Don't Drown" (TADD) system to warn motorists and pedestrians to not enter or cross flooded areas, and install PVC markers alongside roads to illustrate dangerous water levels.

Priority Level: Low

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Mason County Road Commission.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; NWS.

Comments:
This action item is a new addition to the Action Agenda.

Action Item 53. Install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, hospitals and medical centers, nursing home facilities, schools, shelters, and governmental facilities.

Priority Level: High

Timeframe: 2015

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Critical facility managers.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources.

Comments:
Though many facilities in Mason County have generators, some remain in need of backup power, such as schools. MCEM may consider developing an inventory of the critical facilities that are in need of back-up power.

Action Item 57. Continue to refine state, county and local road, bridge and culvert maintenance / vegetation management programs to maintain visibilities, provide for living snow fences, reduce erosion, slow stormwater runoff, and maintain the structural integrity of transportation infrastructure.

Priority Level: High

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Mason County Road Commission; DPWs of Ludington, Scottville, Custer, and Pere Marquette Twp.

Potential Technical/Financial Assistance Sources:
MDOT; Mason-Lake Conservation District.

Comments:
Numerous opportunities exist to incorporate hazard mitigation provisions into management programs to protect new and existing infrastructure. This is action item is new for the Action Agenda.

Action Item 58. Adopt this Hazard Mitigation Plan by official resolution to assure both consideration of natural hazards and eligibility for funding through the Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, and Hazard Mitigation Grant Program.

Priority Level: High

Timeframe: Immediately following FEMA conditional approval of this plan

Applicable Governmental Unit(s)/Responsible Person(s):
Mason County; Local units of government.

Potential Technical/Financial Assistance Sources:
West Michigan Shoreline Regional Development Commission (WMSRDC).

Comments:
Mason County Emergency Management, with assistance from WMSRDC, will facilitate local adoptions of this plan immediately following FEMA approval.

Action Item 66. Coordinate with the Conservation District, local watershed councils, and lake associations to maintain healthy, free-flowing watercourses with minimal erosion and sedimentation, and to restore / preserve wetlands.

Priority Level: Medium

Timeframe: Annually

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; Local resources; US Fish & Wildlife Service; MDNR; HMGP.

Comments:
MCEM will utilize the Mason County LEPC to identify areas where opportunities exist for cooperation between infrastructure projects and environmental projects. Culvert repairs / replacements provide a terrific example of where the interests of multiple organizations overlap. This action item is a new addition to the Action Agenda.

Action Item 74. Obtain and distribute available information on hazards and cost-effective mitigation actions individuals can implement (for example, Firewise pamphlets), and post-disaster repair and cleanup guidance.

Priority Level: Medium

Timeframe: Seasonally

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Local units of government.

Potential Technical/Financial Assistance Sources:
MSP-EMHSD; FEMA; MSUE; NFIP; Red Cross; Salvation Army.

Comments:
Mitigation and disaster recovery information may be distributed via social media, public meetings, newsletters, etc. MCEM will consider distributing such information in the days and weeks ahead of a given season; e.g. the dissemination of fire safety information in the early spring.

Action Item 75. Produce and distribute local emergency preparedness and safety information to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for information such as fire stations, local radio stations and utilities.

Priority Level: Medium

Timeframe: Ongoing

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM; Mason County Departments.

Potential Technical/Financial Assistance Sources:
HMGP; HSGP; MSP-EMHSD; Local resources; Utilities.

Comments:
Many county departments are implementing this action item. It is stated here to support efforts that are currently in effect, and to encourage MCEM to distribute pertinent information via 211, social media, public meeting, etc.

Action Item 86. Assist local governments in the participation of programs such as NFIP, CRS, Firewise, Tree City USA, Fortified…for safer living, Storm Ready, TADD, etc.

Priority Level: Low

Timeframe: Ongoing; or as funds / time allow

Applicable Governmental Unit(s)/Responsible Person(s):
MCEM.

Potential Technical/Financial Assistance Sources:
MCEM; MSP-EMHSD; Local resources.

Comments:
MCEM should respond to concerns regarding program requirements and obstacles to participation. As funding and time permit, MCEM should also identify appropriate programs for the county and local municipalities; explain the benefits of these programs; and facilitate participation.

Action Agenda 2015-2019

List of Hazard Mitigation Actions Applicable to Governmental Units

ACTION AGENDA	Action Item	BCEGS	COMP. PLAN/ LAND USE	CAPITAL IMP. PLANS	ZONING ORDINANCES	FUELS REDUCTION	REGULATE / ENFORCE BURNING	OWNER MITIGATION	NFIP	CRS	FEDERAL FUNDING	NOAA WEATHER RADIOS	STREAM GAUGES/ AHPS	TADD	GENERATORS	ROAD MAINTENANCE	HMP ADOPTION	ENVIRONMENTAL COORDINATION	HAZARD AND MITIGATION INFO.	PREPAREDNESS AND SAFETY INFORMATION	COMMUNITY ASSISTANCE
	Action Item #	2	7	8	9	25	26	28	34	35	37	47	48	50	53	57	58	66	74	75	86
APPLICABLE LOCAL GOVERNMENT	Mason County	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
	Ludington City	•	•	•	•	•	•	•		•					•	•	•		•		
	Scottville City		•	•	•	•	•	•	•		•					•	•		•		
	Custer Vil.		•	•	•	•	•	•	•		•					•	•		•		
	Fountain Vil.		•	•	•	•	•	•	•								•		•		
	Free Soil Vil.		•	•	•	•	•	•	•		•						•		•		
	Amber Twp.		•	•		•	•	•		•							•		•		
	Branch Twp.		•	•		•	•	•		•	•						•		•		
	Custer Twp.		•	•		•	•	•	•								•		•		
	Eden Twp.		•	•		•	•	•		•							•		•		
	Free Soil Twp.		•	•		•	•	•	•		•						•		•		
	Grant Twp.		•	•	•	•	•	•	•								•		•		
	Hamlin Twp.		•	•	•	•	•	•		•	•						•		•		
	Logan Twp.		•	•		•	•	•		•							•		•		
	Meade Twp.		•	•		•	•	•		•	•						•		•		
	Pere Marquette T	•	•	•	•	•	•	•		•	•					•	•		•		
	Riverton Twp.		•	•		•	•	•	•		•						•		•		
	Sheridan Twp.		•	•		•	•	•		•							•		•		
	Sherman Twp.		•	•		•	•	•		•	•						•		•		
	Summit Twp.		•	•		•	•	•		•	•						•		•		
	Victory Twp.		•	•		•	•	•	•								•		•		

Part J

PLAN MONITORING, REVISIONS, AND INCORPORATION

Communities and plans are both dynamic entities. Communities grow and change over time. In order to be effective, plans must also grow and evolve to avoid becoming void and obsolete. Planning doesn't stop once the plan is initiated. The plan must be evaluated and updated periodically to ensure the success of the hazard mitigation program.

This section describes a monitoring system that will help in the annual Hazard Mitigation Plan evaluation and periodic update. A monitoring system also helps keep the plan running on schedule even when there are other jobs or duties to perform. Local officials wear different hats and are responsible for multiple assignments. Few have the luxury of focusing on one assignment, task or plan. Because the local community is often involved in administering numerous other programs, it is important to develop a monitoring system (e.g. project work schedule) to help remind each participant of their part in carrying out the plan, as well as when associated tasks should be completed.

Ideally, the system for plan maintenance (monitoring, evaluating, and updating the plan) would be the responsibility of a locally funded Hazard Mitigation Coordinator, with support from Mason County Emergency Management Coordinator and the LEPC. Unfortunately, planning for such a position appears unrealistic at this time. Maintenance of this plan would therefore need to fit into existing schedule and workloads of the Emergency Management Coordinator with assistance from the LEPC.

Monitoring

The Mason County Emergency Management Coordinator would be responsible for monitoring the implementation of the Hazard Mitigation Plan at the end of each calendar year, as work schedules allow. Such monitoring would include noting the following events throughout the year: occurrence of hazards, adoption of the plan by local governments, applications for hazard mitigation funds, grant awards, and project implementation. In addition to county staff and LEPC knowledge, sources of this information would be obtained from comments submitted to the Emergency Management office or to the West Michigan Shoreline Regional Development Commission (WMSRDC). It would also be obtained from declarations of disasters and emergencies by the president and the governor and updates on NOAA and NCDC websites.

Evaluating

The Emergency Management Coordinator would prepare and present a brief annual progress report for the LEPC at its first meeting of the year. This report would include recommendations to achieve goals and objectives of the plan, or explain the need to change them in light of new issues and circumstances. The following outline should be used to guide preparation of the report:

- A review of the goals and objectives of the plan;
- A review of disasters or emergencies that occurred during the year;
- A review of what elements or objectives of the plan were accomplished the previous year;
- A discussion of why any objectives were not reached or why implementation is behind schedule; and
- Recommendations for new projects/action items (with updated information on responsible persons, time schedules and sources of assistance) or revised objectives.

After LEPC review, the report could be submitted to the County Board of Commissioners at the direction of the LEPC. The report could also be made available to local governments and the public through the county's website, and / or the WMSRDC website. In the event that workloads prohibit the preparation of an annual report, a more streamlined version (perhaps verbal) would be presented by the Emergency Management Coordinator to the LEPC and County Board of Commissioners.

Updating

The county would comply with the FEMA requirement that the plan be reviewed every five years and updated if necessary. This work would be done by the Emergency Management Coordinator, with assistance from the LEPC. Projects that were completed over that time would be replaced with new ones. Priorities would be re-assessed. Development patterns would be analyzed to see if they have rendered the previous hazard analysis out-of-date. Lastly, those hazard mitigation goals, priorities and information contained in the most current edition of the Michigan Hazard Mitigation Plan would also be heavily considered during the five-year update.

The mandatory five-year review and update of the community mitigation plan is necessary because of ever-changing circumstances. Risks may change, areas may have increased or decreased risks and vulnerabilities, and therefore goals and priorities might have to be altered. There may even be new hazards that appear in that time. Evaluations of the plan should also assess how well the plan is working and if there are problems (financial, legal, coordination, etc.) with implementing the action items in the document.

While adjustments would be made throughout the process as new issues emerge and evolve, this method would ensure that the county remains on course in implementing the program.

Continued Public Involvement

In addition to the mandatory update and evaluation of the plan, there must be a process by which public involvement can continue to occur as the hazard mitigation plan is updated. Copies of the plan will be available in the Emergency Management office and at the WMSRDC. It will also be presented on the WMSRDC website, www.wmsrdc.org. The website offers an on-going opportunity to input into the plan, its implementation, and its update. All comments received by the WMSRDC will be forwarded to the Emergency Management Coordinator who will receive all other forms of correspondence. The Office of Emergency Management will also be listed as a contact point. The Emergency Management phone number is included in the Letter of Transmittal at the beginning of this document.

During the update of the plan, all methods previously used for assuring public involvement will again be considered: surveys, contacts with neighboring counties, LEPC meetings, public hearings, etc.

Incorporation into Existing Planning Mechanisms

The County's transmittal of the Hazard Mitigation Plan to local governments requests that they incorporate the document into local land use plans and zoning ordinances, as appropriate. Many communities in Mason County have adopted land use plans and regularly update them. According to Public Act 33 of 2008, municipal jurisdictions must notify neighboring jurisdictions, the county, the region, and any registered public utility, railroad, or other governmental entities of the municipality's intention to amend, revise, or create a totally new plan. By law, each of these entities has the opportunity to comment on local land use plans, and is encouraged to do so in order to promote more coordinated land use planning.

Appendix A:
COMMUNITY PROFILES

MASON COUNTY

1.	**major geographic features**	- 58 persons per square mile - 34.9 housing units per square mile - Over 26 miles of Lake Michigan shoreline - Hamlin and Pere Marquette Lakes - Lincoln, Pere Marquette, and Big Sauble Rivers - Manistee National Forest
2.	**Population Concentrations**	
a.	**group homes:**	- Autumn Winds, 676 N Stiles Rd, Ludington (capacity 12) - Care Corner AFC, 805 E US 10, Scottville (capacity 6) - Christian AFC, 4964 S Stiles Rd, Ludington (capacity 3) - Country Care AFC, 5065 S Schwass Rd, Scottville (capacity 6) - Dexter Trail, 5963 W 6th St, Ludington (capacity 6) - Grancare, 2110 E US-10, Custer (capacity 12) - Grandview AFC, 306 E Fifth St, Scottville (capacity 6) - Hill Haven, 3690 N Taylor Rd, Branch (capacity 5) - Krystal Manor AFC, 1859 W Hansen Rd, Scottville (capacity 11) - Lake Home, 920 N Gaylord Ave, Ludington (capacity 6) - Ludington Woods Specialized Care, 502 N Sherman, Ludington (capacity 20) - Ludington Woods Supportive Care, 502 N Sherman, Ludington (capacity 20) - Maplewood Home, 314 N Main St, Scottville (capacity 6) - Orchard View, 3520 US 10, Custer (capacity 12) - Pinecrest, 1316 E Chauvez, Scottville (capacity 6) - Scottville, 309 E James (capacity 6) - Simms House, 208 Thomas, Scottville (capacity 2) - The Manor at Sherman Oaks, 700 Sherman Oaks Dr, Ludington (46 senior units) - Wallager Adult Foster Care, 6030 E US 10 HWY Custer (capacity 6) - Whippoor Will Knoll, 1140 W US 10, Scottville (capacity 12) - Willowbrook Care Home, 2023 W US 10, Scottville (capacity 20)
b.	**large apartment buildings:**	- Birch Lake, 926 E Tinkham, Ludington (48 units) - Cedar Run Apartments LLC, 115 Thornwild Dr, Scottville (40 units) - Evergreen Trail Apartments, 906 N Washington, Ludington (48 units) - Glendale Apartments, 430 W 3rd, Scottville (28 units) - Hamlin Lake Apartments, 3263 N Lakeshore Dr, Ludington (310 units) - Lawndale, 900 Lawndale, Ludington (24 units) - Longfellow Tower, 301 E Court St., Ludington - Pineway Townhomes, 1111 Pineway, Ludington (56 units) - Sherman Oaks, 700 Sherman Oaks Dr., Ludington - The Village House, 1100 E Tinkham, Ludington (32 senior units) - Thornwild Apartments, 115 Thornwild Dr, Scottville (24 units) - Wildwood Meadows Apartments, 153 S Wildwood Trail, Ludington (210 units)

c.	**schools:**	- Covenant Christian School, 243 N Stiles Rd (85 students, 12 staff)
		- Ludington Area Catholic School, 700 E Bryant Rd (146 students, 20 staff)
		- Ludington Area School District (2005 estimates)
		   - Ludington High School, 508 N Washington Ave (819 students, 70 staff)
		   - Journey High School, 1916 W US Highway 10-31
		   - OJ DeJong Middle School, 708 E Tinkham Ave (439 students, 44 staff)
		   - Foster Elementary School, 505 E Foster St (283 students, 31 staff)
		   - Franklin Elementary School, 721 E Anderson St (325 students, 38 staff)
		   - Lakeview Elementary School, 502 W Haight St (252 students, 34 staff)
		   - PM Early Childhood Center, 1115 S Madison St (194 students, 19 staff)

		- Mason County Central Schools - High School, 300 Broadway Ave (449 students, 35 staff) - Middle School 310 W Beryl St (308 students, 23 staff) - Upper Elementary, 505 W Maple Ave (278 students, 25 staff) - Scottville Elementary School, 201 W Maple Ave (315 students, 32 staff) - Mason County Eastern Schools - Elementary School, 18 S Main St (228 students, 29 staff) - Junior High/ High School, 18 S Main St (242 students, 24 staff) - Mason-Lake ISD Career Tech Center, 3000 N Stiles Rd (375 students, 25 staff)
d.	**childcare facilities:**	- Hankins, Linda, 15 W Treml Rd, Freesoil (capacity 12) - Snyder, Esther Elaine, 805 St Catherine, Ludington (capacity 12) - Phillips, Donna Marie, 602 4th St, Ludington (capacity 12) - Tonya, Lynn Beetz, 183 N Meyers Rd, Ludington (capacity 12) - Astrowski, Doris Marie, 603 New William St, Ludington (capacity 12) - Bowman, Leta M, 1260 N Jebavy Dr, Ludington (capacity 12) - Forbes, Vicky Lynn, 706 Sixth St, Ludington (capacity 12) - Enbody, LeAnne, 6693 W Ann St, Ludington (capacity 12) - Nicholas, April, 1005 N Beechwood Dr, Ludington (capacity 12) - KK's Day Care, 809 E Danahar St, Ludington (capacity 12) - Debbies Day Care, Inc., 1649 Victory Corner, Ludington (capacity 12) - Vantassel, Cindy Rae, 901 N Harrison St, Ludington (capacity 12) - Masters, Pamela Sue, 818 S Sherman, Ludington (capacity 12) - Foote, Karen Ann, 5694 Riverview, Ludington capacity 12) - Winey, Melissa Marie, 5411 Victory Park Rd, Ludington (capacity 12) - Smith, Jeannie Marie, 903 Maple St, Ludington (capacity 12) - Persoon, Deanna Marie, 107 N Reinberg Rd, Scottville (capacity 12) - Saucedo, Mary, 2205 S Scottville Rd, Scottville (capacity 12) - Carrier, Renia, 110 W Broadway, Scottville (capacity 12) - Morton, Sheryl Annette, 2580 S Hogenson Rd, Scottville (capacity 12) - Miszewski, Nancy Lynn, 151 W Johnson Rd, Scottville (capacity 12) - Grimes, Theresa Michelle, 288 S Gibson Rd, Walhalla (capacity 12) - Williams, Debra, 7099 E First St, Walhalla (capacity 12) - Smart Start Child Enrichment Center, 203 N Thomas St, Scottville (capacity 17) - Covenant Christian School Developmental Kindergarten, 2980 West US-10, Ludington (capacity 19) - Munchkin Land Day Care, 3850 W First St, Ludington (capacity 30) - M C E Early Childhood Center, 85 Madison St, Custer (capacity 36) - Fountain Child Development Ctr, 3876 E Main St, Fountain (capacity 38) - Ludington Area Catholic Child Care, 700 E Bryant Rd, Ludington (capacity 40) - Small Wonders, 5757 W Johnson Rd, Ludington (capacity 41) - Ludington Area Schools Preschool, 1115 S. Madison, Ludington (capacity 54) - Ludington Area FiveCAP Head Start, 1115 Madison St, Ludington (capacity 60) - Victory Early Childhood Center, 4171 N Stiles Rd, Scottville (capacity 64)
e.	**large office buildings:**	**Refer to individual city, village and township profiles**
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	**Refer to individual city, village and township profiles**
g.	**major employers:**	- Memorial Medical Center, 1 Atkinson Dr, Ludington (368 employees) - Whitehall Industries, 5175 W 6th St, Pere Marquette Twp (372 employees) - Whitehall Industries, 801 S. Madison, Ludington (205 employees) - Ludington Components/Haworth, 5170 Progress Dr, Ludington (252 employees) - Mason Co. Central School District, 300 W Broadway, Scottville (201 employees) - Harsco Track Technologies, 200 S Jackson Rd, Ludington (200 employees) - Indian Summer Co-op, 3958 W Chauvez Rd, Ludington (200 employees) - Lake Michigan Carferry, 701 Maritime Dr, Ludington (190 employees)

		- Ludington Area Schools, 809 E Tinkham Ave, Ludington (175 employees) - Metalworks, 901 6th St, Ludington (175 employees) - Wal-Mart, 4854 U.S. 10, Ludington (173 employees) - Western Land, 1100 Conrad Industrial Dr, Ludington (172 employees) - House of Flavors Manufacturing, 110 N William St, Ludington (160 employees) - Oakview Medical Care Facility, 1001 Diana St, Ludington (158 Employees) - Great Lakes Castings, 800 N Washington Ave, Ludington (155 employees) - Mason Lake ISD, 2130 W U.S. 10, Ludington (154 employees) - FloraCraft, 1 Longfellow Place, Ludington (151 employees) - Mason Co. Fruit Packers Co-op, 3958 W Chauvez Rd, Ludington (150 employees) - Occidental Chemical Corporation, 1600 S Madison, Ludington (135 employees) - Tendercare, 1000 E Tinkham Ave, Ludington (126 employees) - West MI Community Mental Health, 920 Diana St, Ludington (120 employees) - County of Mason, 304 E Ludington Ave, Ludington (107 employees) - Home Depot, 3865 U.S. 10, Ludington (100 employees) - West Shore Community College, 3000 N Stiles Rd, Scottville (82 employees) - Kaines West Michigan Wire, 211 E Downland St, Ludington (80 employees) - Meijer, 3900 U.S. 10, Ludington (80 employees) - City of Ludington, 400 S Harrison St, Ludington (68 employees) - Lowes, 4460 U.S. 10, Ludington (65 employees) - Mason County Eastern School District, 18 S Main St, Custer (65 employees) - Ludington Daily News, 202 N Rath Ave, Ludington (48 employees) - Change Parts, Inc., 185 S Jebavy Dr, Ludington (45 employees) - Consumers Energy Pumped Storage Plant (44 employees) - Cal Chlor North Corporation, 5379 W 6th St, Ludington (40 employees) - Straits Steel, 902 N Rowe St, Ludington (40 employees) - Brill Company, 715 S James St, Ludington (38 employees) - Cone Drive Ludington-Clyde Blower, 5115 Progress Dr, Ludington (34 employees) - McCormick Sawmill, 4431 E Fountain Rd, Fountain (30 employees) - Consumers Energy Service Center, 5035 Progress Dr, Ludington (23 employees) - Hamlin Grocery, 3611 N Sebavy Dr, Ludington (10 employees) - Omimex Energy, 4854 Angling Rd, Ludington (8 employees) - Hamlin Sport Center, 5760 Dewey Rd, Ludington (6 employees) - Vandervest Electric Motor & Fabrication, 5635 Dewey Rd, Ludington (5 employees) - Bruce Mitchell Refrigeration Heating & Air Conditioning, 5634 Dewey Rd, Ludington - Parklanes Bowling Center, 1963 N Lakeshore Dr, Ludington - Sanders Meat Packing, 237 S. Main St., Custer
3.	**Population Shifts**	
a.	**daily:**	- 12,158 commute with an average commuting time of 18.8 minutes - 5,318 school-aged children
b.	**seasonal:**	- 17,293 total housing units: 11,940 occupied/5,353 vacant - Of the vacant, 4,051 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- City of Ludington Police Department, 408 S. Harrison St. - Mason County Sheriff Department, 302 N. Delia St. - Scottville Police, 105 N. Main St.
b.	**fire stations:**	- Branch Township Fire Department, 6697 E. US-10 - Carr Community Fire Department, 4930 S. Masten Rd. - Custer Unit Mason County Fire Department, 2249 E. US 10 - Fountain Area Fire Department, 4108 E. Main St. - Free Soil/Meade Township Fire Department, 2613 E. Michigan St. - Grant Township Fire & Rescue, 835 W. Hoague Rd. - Hamlin Township Fire Dept, 3775 N. Jebavy Dr. - Ludington Fire Department, 201 W. Loomis St.

		- Pere Marquette Township Fire Department, 1040 S. Pere Marquette Hwy - Riverton Township Fire Department, 2104 W Hawley St. - Scottville Fire Department, 110 E Broadway St.
c.	**public works yards:**	- Ludington Department of Public Works, 975 W. 1st St. - Scottville Department of Public Works, 601 W. 1st St.
d.	**pumping stations:**	- Two (unidentified type, water or sewer)
e.	**community shelters:**	- Bethany Lutheran Church, 1110 S Madison St, Ludington, MI - Calvary Baptist Church, 220 N Jebavy, Ludington, MI - Community Church, 109 N Harrison, Ludington, MI - Emanuel Lutheran, 501 E Danaher St, Ludington, MI - Foster Elementary School, 505 E Foster, Ludington, MI - Franklin Elementary, 721 E Anderson St, Ludington, MI - Grace Episcopal Church, 301 N James St, Ludington, MI - Ludington High School, 706 E Tinkham Ave, Ludington, MI - Mason County Central High School, 300 W Broadway, Scottville, MI - Mason County Central Middle School, 310 W Beryl St, Scottville, MI - Mason County Eastern Middle/High School, 18 S Main St, Custer, MI - Mason County Eastern Elementary, 18 S Main St, Custer, MI - Mason County Reformed Church, 45 S Amber Rd, Scottville, MI - Mason/Lake Intermediate School, 2130 W US 10, Ludington, MI - O.J. Dejonge Junior High, 706 E Tinkham Ave, Ludington, MI - Riverton Elementary School, 4964 S Stiles Rd, Ludington, MI - Scottville Optimist Hall, 105 W State St, Scottville, MI - Scottville United Methodist Church, 114 W State St, Scottville, MI - St Mary's Church, 85 Madison, Custer, MI - St Simon Parish, 702 E Bryant Rd, Ludington, MI - Trinity Evangelical Free Church, 1212 Monona Dr, Ludington, MI - United Methodist Church of Ludington, 107 S Harrison St, Ludington, MI - Victory Elementary School, 4171 N Stiles Rd, Scottville, MI - West Shore Community College, 3000 N Stiles Rd, Scottville, MI
f.	**community medical facilities, hospitals:**	- District 10 Mason County Health Department, 916 Diana Ct. - Memorial Medical Center of West Michigan, 1 Atkinson Dr. - Oakview Medical Care Facility, 1001 Diana St. (76 beds) - Tendercare of Ludington, 1100 E. Tinkham (126 beds) - Life EMS of Mason County, 4910 W 1st St. - Life EMS Ambulance- Mason Scottville Base, 480 S Scottville Rd. - West Michigan Community Mental Health System, 920 Diana St.
g.	**historic sites:**	**Refer to individual city, village and township profiles**
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	**Refer to individual city, village and township profiles**
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31, US-10 - SR 116 - Marquette Rail - Bridges: Marquette Railroad over Lincoln River (Fountain), US-31 over Pere Marquette River, US-31 over Big Sable River , US-31 over Lincoln River South Branch, US-31 over Lincoln River North Branch, US-10 over Weldon Creek, Lakeshore Dr. (SR-116) over Lincoln Lake, Pere Marquette Highway over Pere Marquette River South Branch, Pere Marquette Highway over Pere Marquette River North Branch, Jebavy over Lincoln River
b.	**dams, power**	- Brookside Cemetery Dam, Whiskey Creek Dam No. 2, Hamlin Lake Dam,

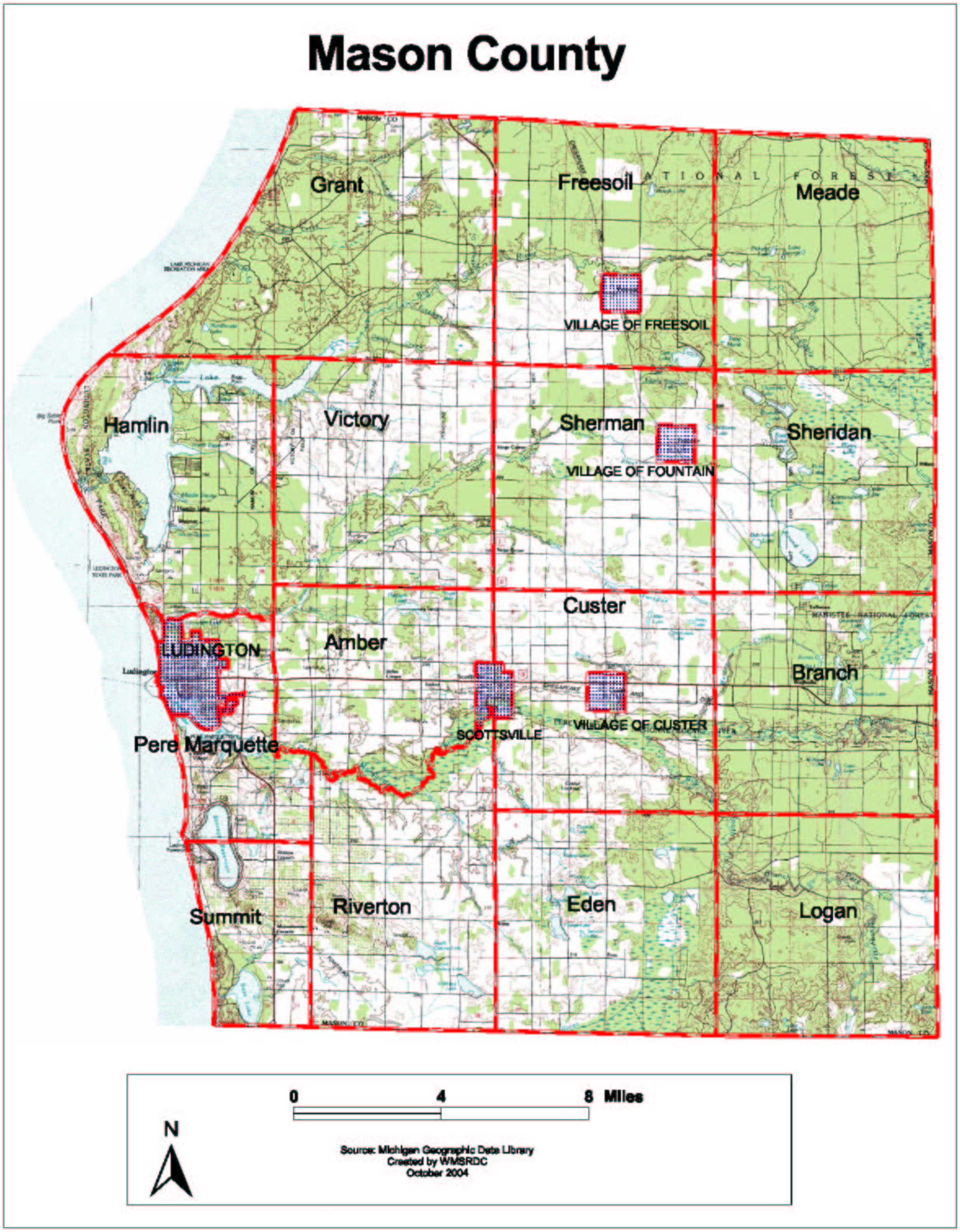
	stations, water treatment plants, sanitary lift stations, etc.	West Shore Community College Dam, Bass Lake Dam, Gun Lake Dam - Ludington Pumped Storage Plant and Dam - Michigan Power, L.P. (natural gas cogeneration facility), 5795 W. 6th St. - Lake Winds Energy Park, 56 wind turbines (Riverton and Summit twps) - Consumers Energy Power Line (Amber Township, Eden Township, Grant Township, Pere Marquette Township, Riverton Township, Summit Township, Victory Township) - Ludington Wastewater Disposal Plant, East 6th - City of Scottville Wastewater System - Village of Custer Wastewater Stabilization Lagoon, Stephens Road - Sanitary Lift Stations: Twenty Four
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- Mason County Airport, 5300 W. US-10 - Victory Township Landing Strip - MichCon Gas Pipeline (Amber Township, Branch Township, Custer Township, Grant Township, Riverton Township, Victory Township) - H2S Gas Pipeline (Amber Township, Grant Township, Pere Marquette Township, Riverton Township, Victory Township) - Brine Pipeline (Amber Township, Grant Township, Pere Marquette Township, Victory Township) - Ludington Mass Transportation Authority, 5545 Carr Street - United States Coast Guard Station, 101 S. Lakeshore Dr. - S.S. Badger Carferry, 701 Maritime Dr. - County-owned transmission tower, 6280 W. Bradshaw, Pere Marquette Twp

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		28,705
b.	**peak population (seasonal):**		38,305
c.	**percent over 65:**		19.2
d.	**percent under 18:**		21.7
e.	**percent that are homeowners:**		76.4
f.	**percent below poverty level:**		11.7
g.	**percent with disability or mobility limitation:**		20.2
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$89,847,800 $160,842,500 $329,747,600 $1,170,031,800 $100,372,700 $1,850,842,400
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	7 $28,893 33 $6,615,000
j.	**location of floodplains:**	**Refer to individual city, village and township profiles**	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A

(Note: Map showing warning siren location and system coverage is contained in Part D.)

Land Use and Natural Features Map (USGS Quad.)



CITY OF LUDINGTON

1.	**major geographic features**	- 2,396.4 persons per square mile - 1,315.1 housing units per square mile - Dense residential area - Moderate commercial area - Lake Michigan shoreline and beach - Coastal sand dunes - Pere Marquette Lake, Lincoln Lake

2. Population Concentrations

a.	**group homes:**	- Lake Home, 920 N Gaylord Ave (capacity 6) - Ludington Woods Specialized Care, 502 N Sherman (capacity 20) - Ludington Woods Supportive Care, 502 N Sherman (capacity 20) - The Manor at Sherman Oaks, 700 Sherman Oaks Dr. (46 units)
b.	**large apartment buildings:**	- Birch Lake, 926 E Tinkham (48 units) - Evergreen Trail Apartments, 906 Washington (48 units) - Lawndale, 900 Lawndale (24 units) - Pineway Townhomes, 1111 Pineway (56 units) - The Village House, 1100 E Tinkham (32 senior units) - Sherman Oaks Apartments, 700 Sherman Oaks Dr. - Longfellow Tower, 301 E Court St.

c.	**schools:**	- Ludington Area Catholic School, 700 E Bryant Rd (146 students, 20 staff)
		- Ludington Area School District (2005 estimates)
		  - Ludington High School, 508 N Washington Ave (819 students, 70 staff)
		  - OJ DeJong Middle School, 708 E Tinkham Ave (439 students, 44 staff)
		  - Foster Elementary School, 505 E Foster St (283 students, 31 staff)
		  - Franklin Elementary School, 721 E Anderson St (325 students, 38 staff)
		  - Lakeview Elementary School, 502 W Haight St (252 students, 34 staff)
		  - PM Early Childhood Center, 1115 S Madison St (194 students, 19 staff

d.	**childcare facilities:**	- Astrowski, Doris Marie, 603 New William St (capacity 12) - Forbes, Vicky Lynn, 706 Sixth St (capacity 12) - KK's Day Care, 809 E Danaher St (capacity 12) - Ludington Area Catholic Child Care, 700 E Bryant Rd (capacity 40) - Ludington Area Schools Preschool, 1115 S Madison (capacity 54) - Ludington Area FiveCAP Head Start, 1115 S Madison St (capacity 60) - Snyder, Ether Elaine, 805 St Catherine (capacity 12) - Masters, Pamela Sue, 818 S Sherman (capacity 12) - Nichols, April, 1005 N Beechwood Dr (capacity 12) - Phillips, Donna Marie, 603 New William St (capacity 12) - Smith, Jeannie Marie, 903 Maple St (capacity 12) - Vantassel, Cindy Rae, 901 N Harrison St (capacity 12)
e.	**large office buildings:**	- See 4.h.

f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Abrahamson Marina, 820 First St (19 slips) - Autumn Festival (October) - Avenue Motel, 410 E Ludington Ave (8 rooms) - Blue Spruce Motel, 109 N. Ferry St. (6 rooms) - Buttersville Park, 991 S Lakeshore Dr (44 campsites) - Carferry Festival (May) - Cartier Park, 1254 N. Lakeshore Dr. (196 campsites) - Crosswinds Condominiums Marina, 96 Harbor Dr (41 slips) - Freedom Festival and Fireworks (July 4) - Four Seasons Lodging & Breakfast, 717 E. Ludington Ave. (32 units) - Gold Coast Artisan Fair (August) - Gus Macker 3-on-3 Basketball Tournament (July) - Harbor View Marina, 400 S. Roth (178 slips) - Hidden Harbor Marina, 1000 S Washington Ave (19 slips) - Hidden Forest Mobile Home Community, 3626 W. Hidden Forest Dr - Karboske's Marina - Lakeside Inn of Ludington, 808 W. Ludington Ave. (52 rooms) - Lakestride Half Marathon (late June early July) - Lighthouse Motel, 710 W. Ludington Ave. (13 units) - Ludington High School Football Stadium, 800 W. Tinkham - Ludington Municipal Marina, 200 W. Filer St. (150 slips) - Ludington Yacht Club, 306 E 2nd St. (45 slips) - Ludington Area Harbor Festival (late June early July) - Marina Amphitheatre, Filer and Rath - Mason County Jail, 302 N. Delia St. (110 capacity) - Nader's Lakeshore Motor Lodge, 612 N. Lakeshore Dr. (33 units) - Oakview Medical Care Facility, 1001 Diana St. (76 beds) - Queen's Cup Sailboat Race (late June) - Ray's Auto Marine, 801 S Washington Ave (10 campsites) - Snyder's Shoreline Inn, 903 W. Ludington Ave. (44 rooms) - Star Port Marina, 846 S Lakeshore Dr (15 campsites) - Stearns Motor Inn, 212 E. Ludington Ave. (50 rooms) - Stearns Park Beach - Tamarac Sportfishing Dock, 105 Water St (20 transient slips) - Tamarac Village Mobile Home Community, 2875 N. Lakeshore Dr - Tendercare of Ludington, 1100 E. Tinkham (126 beds) - The Pier House, 805 W. Ludington Ave. (30 rooms) - Thompson Marina Inc, 510 East Lake St (35 slips) - Ventura Motel, 604 W. Ludington Ave. (25 rooms) - Viking Arms Inn, 930 E. Ludington Ave. (45 rooms) - Vista-Villa Motel, 916 E. Ludington Ave. (40 rooms) - Winter Fun Fest (Feb.)
g.	**major employers:**	- Memorial Medical Center, 1 Atkinson Dr (368 employees) - Whitehall Industries, 801 S. Madison (205 employees) - Lake Michigan Carferry, 701 Maritime Dr (190 employees) - Metalworks, 901 6th St (175 employees) - Ludington Area Schools, 809 E Tinkham Ave (175 employees) - Western Land, 1100 Conrad Industrial Dr (172 employees) - House of Flavors Manufacturing, 110 N William St (160 employees) - Oakview Medical Care Facility, 1001 Diana St (158 employees) - Great Lakes Castings, 800 N Washington Ave (155 employees) - FloraCraft, 1 Longfellow Plc (151 employees) - Occidental Chemical Corporation, 1600 S Madison (135 employees) - Tendercare, 1000 E Tinkham Ave (126 employees) - West Michigan Community Mental Health, 920 Diana St (120 employees) - County of Mason, 304 E Ludington Ave (107 employees) - Kaines West Michigan Wire, 211 E Downland St (80 employees)

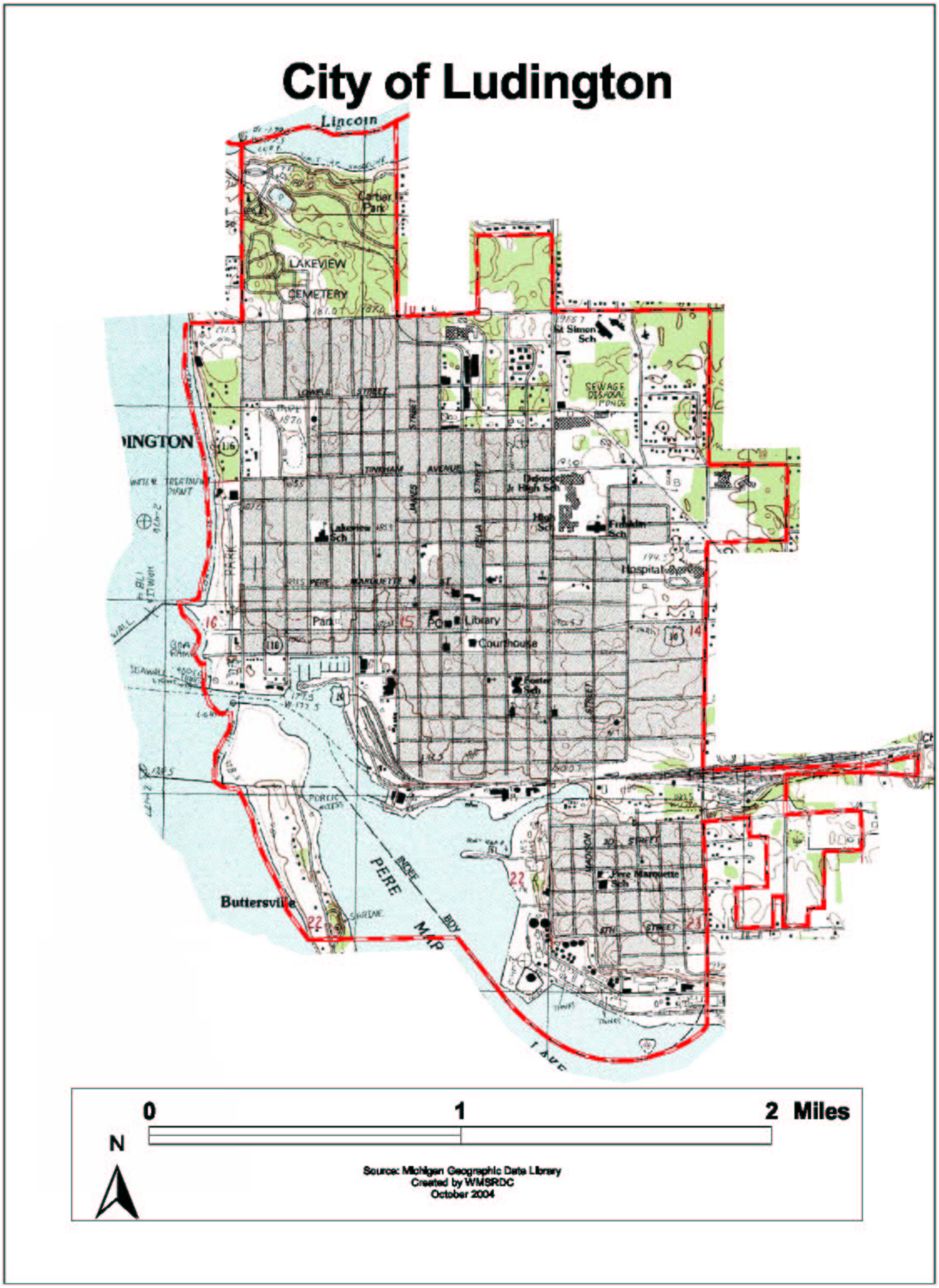
		- City of Ludington, 400 S Harrison St (68 employees) - Ludington Daily News, 202 N Rath Ave (48 employees) - Straits Steel, 902 N Rowe St (40 employees) - Brill Company, 715 S James St (38 employees)
3.	**Population Shifts**	
a.	**daily:**	- 3,546 commute with an average commuting time of 15.1 minutes - 1,396 school-aged children
b.	**seasonal:**	- 4,432 total housing units: 3,549 occupied/883 vacant - Of the 883 vacant, 446 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- City of Ludington Police Department, 408 S. Harrison St. - Mason County Sheriff Department, 302 N. Delia St.
b.	**fire stations:**	- Ludington Fire Department, 201 W. Loomis St.
c.	**public works yards:**	- Ludington Department of Public Works, 975 1st St.
d.	**pumping stations:**	- One
e.	**community shelters:**	- Bethany Lutheran Church, 1110 S Madison St - Community Church, 109 N Harrison - Emanuel Lutheran, 501 E Danaher St - Foster Elementary School, 505 E Foster - Franklin Elementary, 721 E Anderson St - Grace Episcopal Church, 301 N James St - Ludington High School, 508 N Washington - O.J. Dejonge Junior High, 706 E Tinkham Ave - St Simon Parish, 702 E Bryant Rd - Trinity Evangelical Free Church, 1212 Monona Dr - United Methodist Church of Ludington, 107 S Harrison St
f.	**community medical facilities, hospitals:**	- Memorial Medical Center, 1 N. Atkinson Dr. - District 10 Mason County Health Department, 916 Diana Ct. - West Michigan Community Mental Health System, 920 Diana St
g.	**historic sites:**	- Armistice Day Storm Informational Designation, Stearns Park - Emanuel Evangelical Lutheran Church of Ludington, 501 Danaher St - First Mason County Courthouse, S Lakeshore Dr - Fish House, 407 W Filer - Ghost Town of Hamlin Informational Site, Ludington St. Park, M-116 - Goodenough, Daniel W., House, 706 E Ludington Ave - Latimer, Frank N. and Fanny Allen, House, 701 Ludington Ave - Lessard, Ray, House, 110 N Lavinia St - Mason County Courthouse, 300 E Ludington Ave - S.S. Badger, 700 William St - S.S. Pere Marquette 18 Informational Site, Stearns Park
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- City of Ludington, 400 S. Harrison St. - Ludington Library, 217 E. Ludington Ave. - Mason County Department of Human Services, 915 Diana Ct. - Mason County Courthouse, 304 E Ludington Ave
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10

		- Marquette Railroad - Lakeshore Dr. (SR-116) bridge over Lincoln Lake
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Ludington Wastewater Disposal Plant, East 6th - Sanitary Lift Stations: Twelve
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- United States Coast Guard Station, 201 S. Lakeshore Dr. - S.S. Badger Carferry, 701 Maritime Dr. - Pere Marquette Shipping (City of Midland barge), 701 Maritime

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		8,076
b.	**peak population (seasonal):**		9,053
c.	**percent over 65:**		21.1
d.	**percent under 18:**		21.8
e.	**percent that are homeowners:**		55.8
f.	**percent below poverty level:**		20.1
g.	**percent with disability or mobility limitation:**		22.3
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	\$0 \$52,858,900 \$13,378,700 \$191,286,650 \$37,161,500 \$294,685,750
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	- - 7 \$3,509,500
j.	**location of floodplains:**	- Floodplains along Lake Michigan, Lincoln Lake, and Pere Marquette Lake.	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A

Land Use and Natural Feautures Map (USGS Quad.)



CITY OF SCOTTVILLE

1.	**major geographic features:**	- 814.8 persons per square mile - 387.9 housing units per square mile - Dense residential area - Pere Marquette River
2.	**Population Concentrations**	
a.	**group homes:**	- Grandview AFC, 306 E Fifth St (capacity 6) - Maplewood Home, 314 N Main St (capacity 6) - Scottville, 309 E James (capacity 6) - Simms House, 208 Thomas (capacity 2)
b.	**large apartment buildings:**	- Cedar Run Apartments LLC, 115 Thornwild Dr (40 units) - Glendale Apartments, 430 W. 3rd St. (28 family units) - Thornwild Apartments, 115 Thornwild Dr. (24 family units)
c.	**schools:**	- Mason County Central Schools - High School, 300 W Broadway (449 students, 35 staff) - Middle School, 310 W Beryl St (308 students, 23 staff) - Upper Elementary, 505 W Maple Ave (278 students, 25 staff) - Scottville Elementary School, 201 W Maple (315 students, 32 staff) - Journey High School (Ludington Area Schools), 1916 W US Highway 10-31
d.	**childcare facilities:**	- Carrier, Renia, 110 W Broadway (capacity 12) - Miszewski, Nancy Lynn, 151 W Johnson Rd (capacity 12) - Persoon, Deanna Marie, 107 N Reinberg Rd (capacity 12) - Smart Start Child Enrichment Center, 203 N Thomas St (capacity 17)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Henry's Landing, 700 S Scottville Rd (25 campsites) - Mason County Central High School Football Field, 300 W. Broadway - McPhail Park - Riverside Park, 700 S. Scottville Rd. (52 campsites) - Scottville Optimist Hall/Band Shell, 205 W. State St.
g.	**major employers:**	- Mason County Central Schools, 300 W. Broadway (201 employees) - City of Scottville, 105 N. Main St.
3.	**Population Shifts**	
a.	**daily:**	- 406 commute with an average commuting time of 19.5 minutes - 274 school-aged children
b.	**seasonal:**	- 578 total housing units: 483 occupied/95 vacant - Of the 95 vacant, 13 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- Scottville Police, 105 N. Main St.
b.	**fire stations:**	- Scottville Fire Department, 110 E Broadway St.
c.	**public works yards:**	- Department of Public Works, 601 W. 1st St.
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Mason County Central High School, 300 W Broadway - Mason County Central Middle School, 310 W Beryl St

		- Scottville Optimist Hall, 105 W State St - Scottville United Methodist Church, 114 W State St
f.	**medical facilities, hospitals:**	- Life EMS Ambulance-Mason Scottville Base, 480 S Scottville Rd
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- City of Scottville, 105 N. Main St. - Scottville Library, 204 E. State St. - Mason County Road Commission, 510 E. State St. - Michigan State University Extension Office, 111 S. Main St.

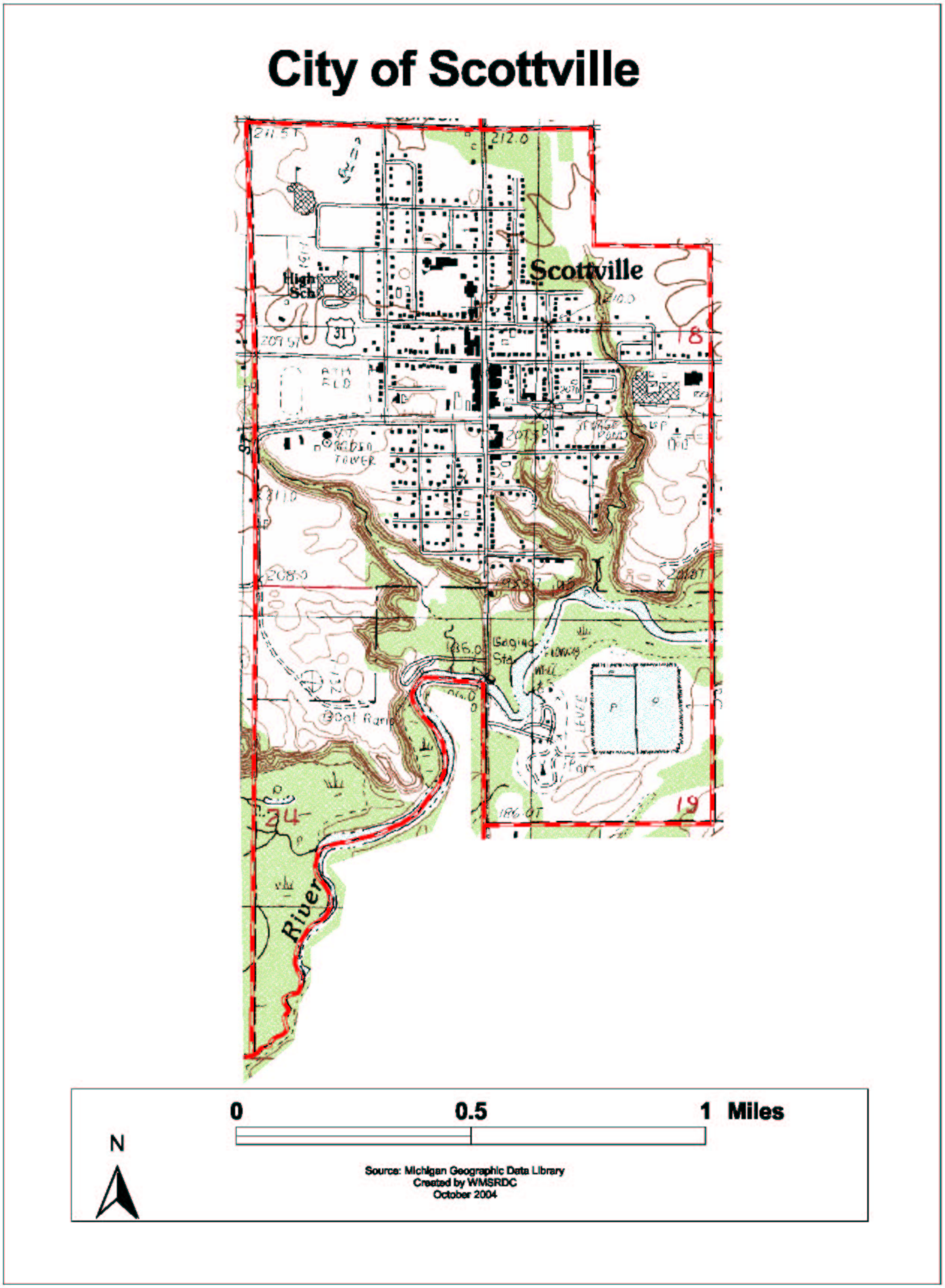
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10 - Marquette Railroad - Scottville Rd. bridge over Pere Marquette River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- City of Scottville Wastewater System - Sanitary Lift Stations: Two
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,214
b.	**peak population (seasonal):**		1,247
c.	**percent over 65:**		13.8
d.	**percent under 18:**		28.2
e.	**percent that are homeowners:**		83.6
f.	**percent below poverty level:**		18.2
g.	**percent with disability or mobility limitation:**		23.7
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$0 $3,429,900 $2,996,600 $14,404,800 $2,003,100 $22,834,400
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A

(Note: Map showing warning siren location and system coverage is contained in Part D.)

Land Use and Natural Feautures Map (USGS Quad.)



VILLAGE OF CUSTER

1.	**major geographic features**	- 286.9 persons per square mile - 138.4 housing units per square mile - 3 to 4 small ponds, 1 creek

2.	**Population Concentrations**	
a.	**group homes:**	- Grancare, 2110 E US-10 (capacity 12) - Willowbrook Care Home, 2023 W US 10 (capacity 20)
b.	**large apartment buildings:**	- S Main St (6 units)
c.	**schools:**	- Mason County Eastern Elementary School, 18 S Main St (228 students, 29 staff) - Mason County Eastern Junior High/High School, 18 S Main St (242 students, 24 staff)
d.	**childcare facilities:**	- Mason County Eastern Early Childhood Center, 85 Madison St (capacity 36)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Mason County Eastern High School Football Field, 18 S. Main St. - Johnny's Skate Center, 2278 E. U.S. 10
g.	**major employers:**	- Mason County Eastern Schools, 18 S. Main St. (65 employees) - Sanders Meat Packing, 237 S. Main St

3.	**Population Shifts** *(also included in Custer Township)*	
a.	**daily:**	- 106 commute with an average commuting time of 16.1 minutes - 57 school-aged children
b.	**seasonal:**	- 137 total housing units: 110 occupied/27 vacant - Of the 27 vacant, 2 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Custer Fire Department., 2249 E. U.S. 10
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- 2660 E U.S. 10 - 230 S Main - 183 S Stephens Rd (Main Street) - 2030 E First St - 486 S Main
e.	**community shelters:**	- Mason County Eastern Middle School/High School, 18 S. Main St - Mason County Eastern Elementary, 18 S. Main St - St. Mary's Church, 85 S. Madison
f.	**community medical facilities, hospitals:**	- None Identified

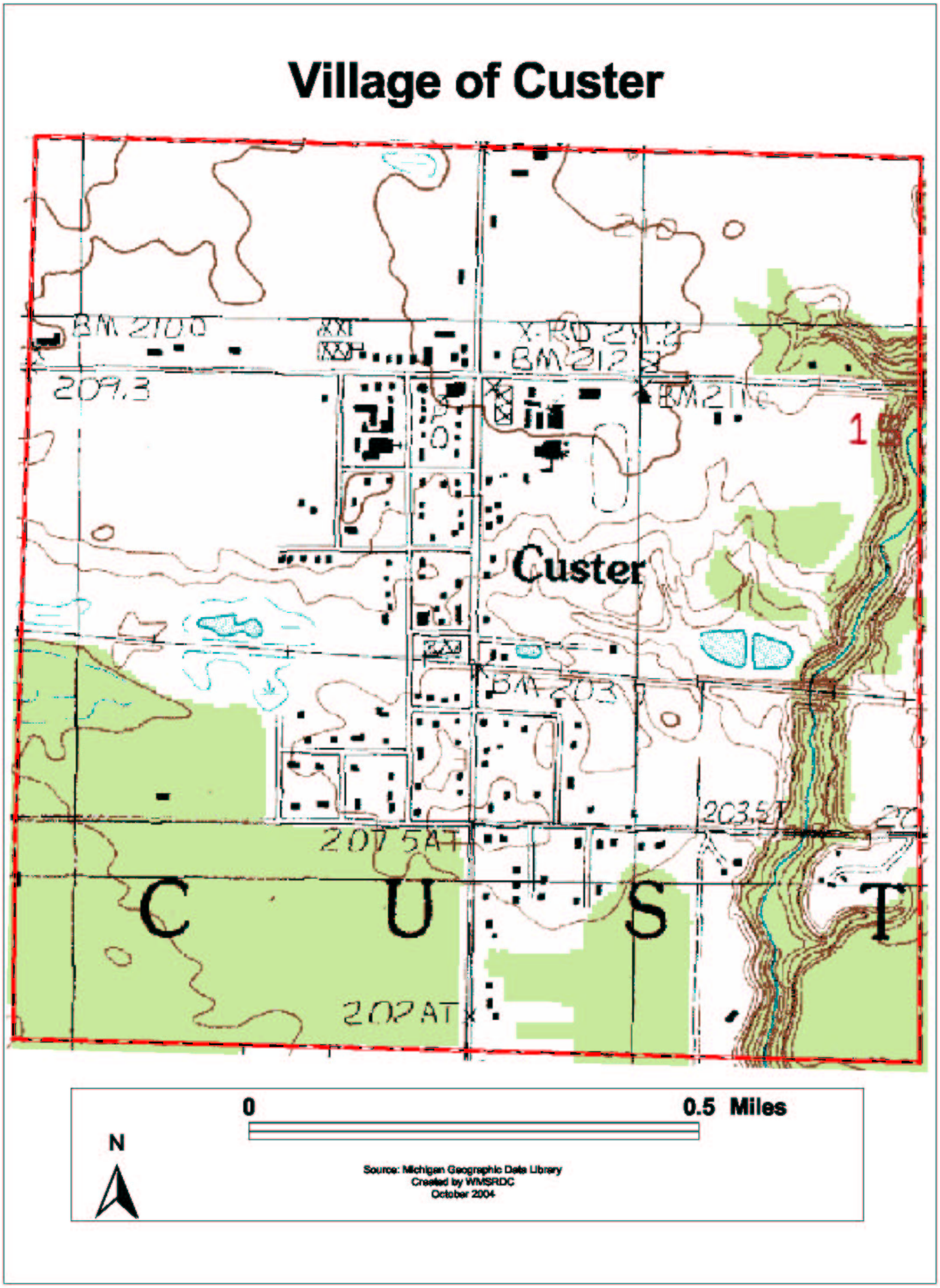
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Village of Custer, 2249 E. U.S. 10

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10 - Marquette Railroad- Main St & Madison St - First Street Bridge - Black Creek Bridge
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Village of Custer Wastewater Stabilization Lagoon, Stephens Road.
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(also included in Custer Township)*	284
b.	**peak population (seasonal):**	*(also included in Custer Township)*	289
c.	**percent over 65:**		16.5
d.	**percent under 18:**		23.6
e.	**percent that are homeowners:**		80
f.	**percent below poverty level:**		13.7
g.	**percent with disability or mobility limitation:**		21
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	N/A N/A N/A N/A N/A N/A
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Feautures Map (USGS Quad.)



VILLAGE OF FOUNTAIN

1.	**major geographic features**	- 173.7 persons per square mile - 88.3 housing units per square mile - Lincoln River - 1 to 2 small ponds
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- Fountain Child Development Ctr, 3876 Main St. (capacity 38)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- None Identified
g.	**major employers:**	- None Identified
3.	**Population Shifts** *(also included in Sherman Township)*	
a.	**daily:**	- 75 commute with an average commuting time of 26.3 minutes - 37 school-aged children
b.	**seasonal:**	- 83 total housing units: 71 occupied/12 vacant - Of the 12 vacant, 7 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Fountain Area Fire Department, 4108 E. Main St.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Sherman Township Hall, 3854 Main St.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Marquette Rail Railroad - Marquette Railroad bridge over Lincoln River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified

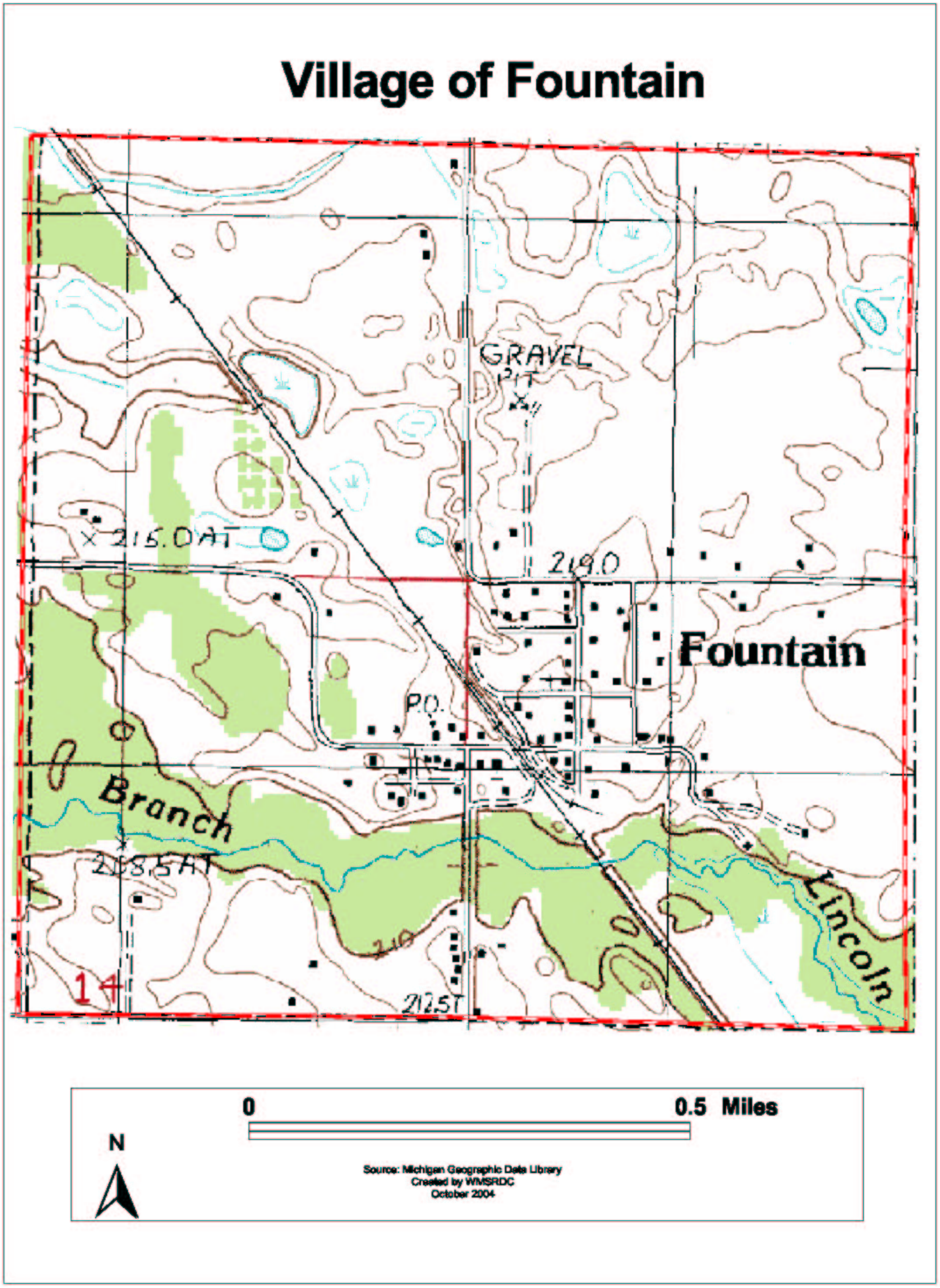
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(also included in Sherman Township)*	193
b.	**peak population (seasonal):**	*(also included in Sherman Township)*	212
c.	**percent over 65:**		9.8
d.	**percent under 18:**		26.9
e.	**percent that are homeowners:**		80.3
f.	**percent below poverty level:**		11.6
g.	**percent with disability or mobility limitation:**		19.9
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	N/A N/A N/A N/A N/A N/A
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A

(Note: Map showing warning siren location and system coverage is contained in Part D.)

Land Use and Natural Feautures Map (USGS Quad.)



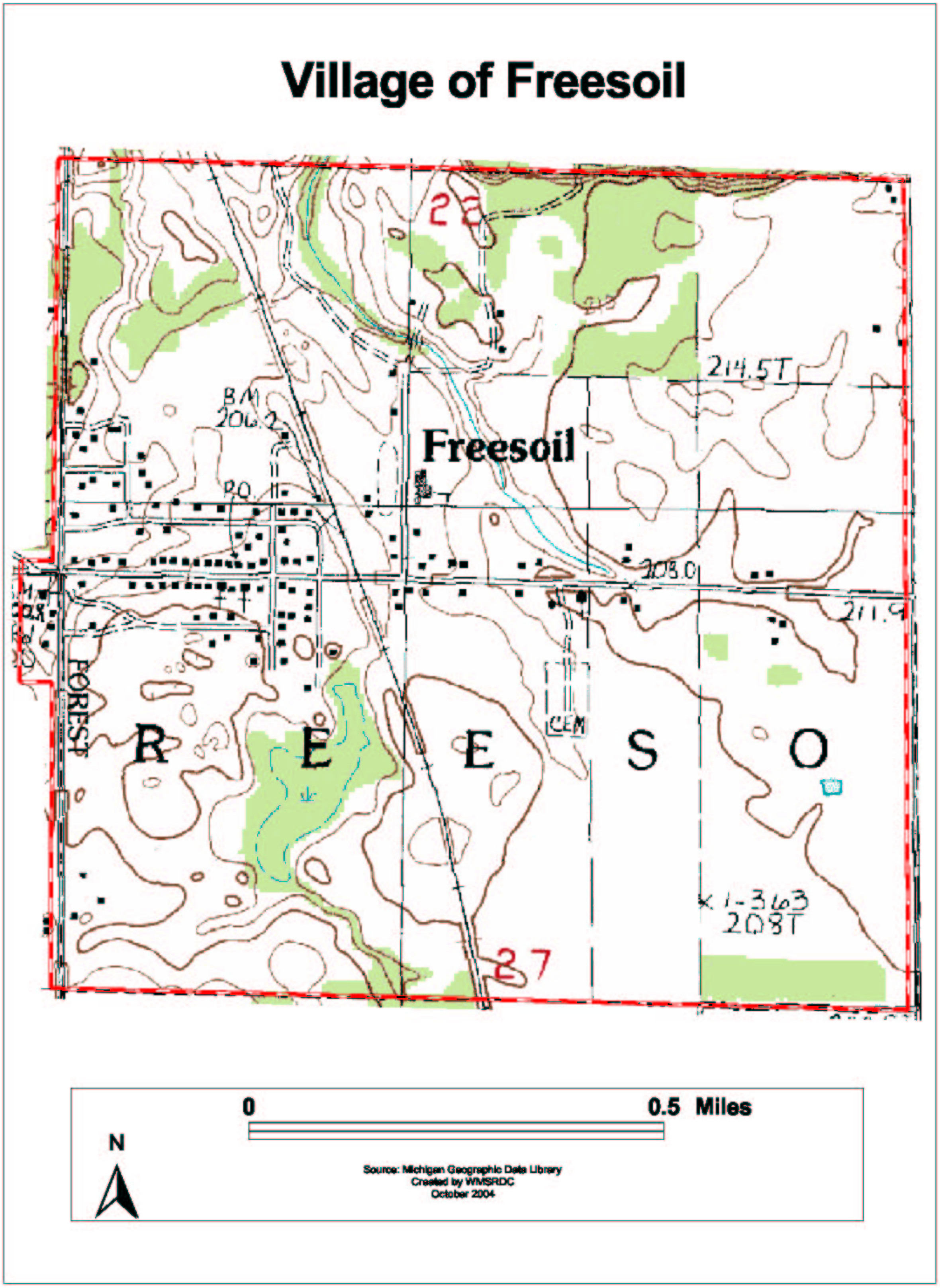
VILLAGE OF FREE SOIL

1.	**major geographic features**	- 138.5 persons per square mile - 80.8 housing units per square mile - 1 to 2 small ponds, 1 creek
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Free Soil Community Hall
g.	**major employers:**	- None Identified
3.	**Population Shifts** *(also included in Free Soil Township)*	
a.	**daily:**	- 71 commute with an average commuting time of 23.2 minutes - 24 school-aged children
b.	**seasonal:**	- 84 total housing units: 64 occupied/20 vacant - Of the 20 vacant, 9 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Free Soil/Meade Township Fire Dept, 2613 E. Michigan St.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- None Identified
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Marquette Railroad
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	Socio-Economic Profile of Sector		
a.	**total population (night):**	*(also included in Free Soil Township)*	144
b.	**peak population (seasonal):**	*(also included in Free Soil Township)*	164
c.	**percent over 65:**		20.8
d.	**percent under 18:**		20.8
e.	**percent that are homeowners:**		84.4
f.	**percent below poverty level:**		15.4
g.	**percent with disability or mobility limitation:**		33.7
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	N/A N/A N/A N/A N/A N/A
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	Emergency Warning System Coverage	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A
	(Note: Map showing warning siren location and system coverage is contained in Part D.)	

Land Use and Natural Feautures Map (USGS Quad.)

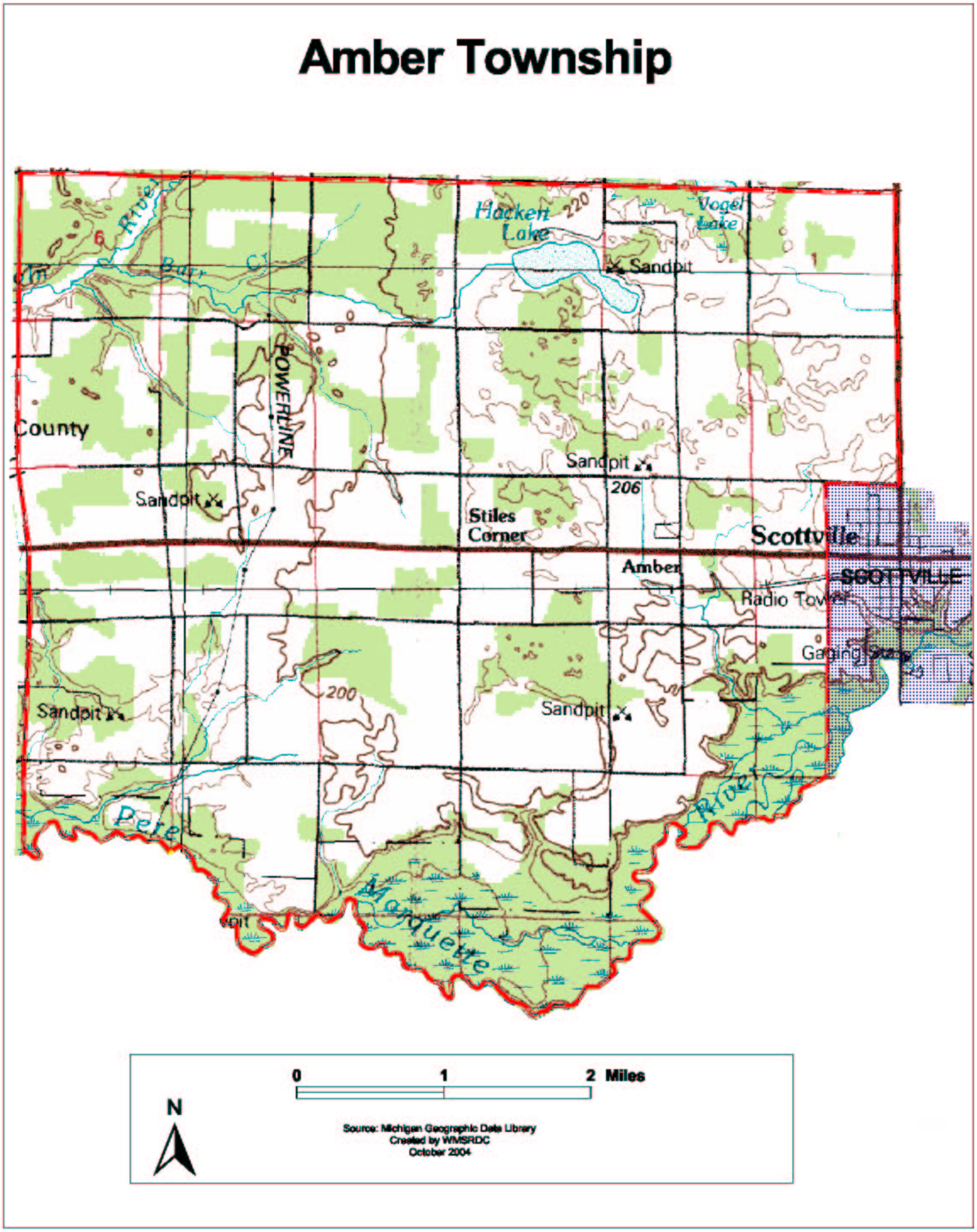


AMBER TOWNSHIP

1.	**major geographic features:**	- 91.9 persons per square mile - 43.8 housing units per square mile - Moderately dense near Scottville - Moderately forested - Pere Marquette River, Lincoln River - Hackert Lake - 1 to 2 small lakes and ponds, 1 to 2 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- Autumn Winds, 676 N Stiles Rd (capacity 12) - Care Corner AFC, 805 E US-10 (capacity 6) - Krystal Manor AFC, 1859 W Hansen Rd (capacity 11) - Wallager Adult Foster Care, 6030 US 10 HWY (capacity 6) - Whippoor Will Knoll, 1140 W US-10 (capacity 12)
b.	**large apartment buildings:**	- Wildwood Meadows, 153 S. Wildwood Trail (210 units)
c.	**schools:**	- Covenant Christian School, 243 N Stiles Rd (85 students, 12 staff)
d.	**childcare facilities:**	- Covenant Christian School Developmental Kindergarten, 2980 W. US-10 (capacity 19) - Debbies Day Care, Inc., 1649 Victory Corner (capacity 12) - Tonya, Lynn Beetz, 183 N. Meyers Rd (capacity 12)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Crystal Lake Best Holiday Trav-L-Park, 1884 W. Hansen Rd. (160 sites) - Greiner Motel & Gift Shop, 4616 W. US-10 (22 units) - Harbor Cinemas, 3860 W. US-10 - Holiday Village of Scottville Mobile Home Park, 1701 W US 10-31 - Ramada Inn & Convention Center, 4079 W. US-10 (116 units) - Riviera Mobile Home Park, 5040 Rasmussen Road - Scottville Riverside Park, 700 S. Scottville Rd (62 campsites)
g.	**major employers:**	- Home Depot, 3865 W. US 10 (100 employees) - Lowe's 4460 U.S. 10 (65 employees) - Meijer, 3900 W. US-10 (80 employees)
3.	**Population Shifts**	
a.	**daily:**	- 1,038 commute with an average commuting time of 16.2 minutes - 479 school-aged children
b.	**seasonal:**	- 1,210 total housing units: 1,033 occupied/177 vacant - Of the 177 vacant, 68 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- One
e.	**community shelters:**	- Mason County Reformed Church, 45 S Amber Rd - Mason/Lake Intermediate School, 2130 W US 10

f.	**community medical facilities:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Amber Township Hall, 144 S. Amber Rd. - Hardman Construction Company, 242 S. Brye Rd.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - US-10 - Marquette Railroad - US-31 bridge over Pere Marquette River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Brookside Cemetery Dam - Consumers Energy Power Line - Sanitary Lift Stations: Two
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- Brine Pipeline - H2S Gas Pipeline - MichCon Gas Pipeline
6.	**Socio-Economic Profile of Sector**	
a.	**total population (night):**	2,535
b.	**peak population (seasonal):**	2,699
c.	**percent over 65:**	17.7
d.	**percent under 18:**	20.5
e.	**percent that are homeowners:**	72.1
f.	**percent below poverty level:**	8.8
g.	**percent with disability or mobility limitation:**	20.1
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	 $3,933,300 $35,813,500 $1,692,800 $57,739,400 $11,038,000 $110,217,000
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	 - - 1 $189,000
j.	**location of floodplains:**	- Floodplains along Pere Marquette River
7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



BRANCH TOWNSHIP

1.	**major geographic features**	- 37.5 persons per square mile - 29.2 housing units per square mile - Moderately dense near various lakes - Densely forested (Manistee National Forest) - Pere Marquette River - Long Lake - 8 to 10 small lakes and ponds, 1 to 2 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- Grimes, Theresa Michelle, 288 S. Gibson Rd (capacity 12) - Williams, Debra, 7099 E. First (capacity 12)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Alpine Motel & Cabins, 7831 E. US-10 (13 units) - Maymaygwayshi Lodge, 1080 Taylor Rd. - Outlands Long Lake Resort, 7410 E. US-10 (9 units) - Fox Lake Resort, 7683 E. US-10
g.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 479 commute with an average commuting time of 25.1 minutes - 270 school-aged children
b.	**seasonal:**	- 1,033 total housing units: 565 occupied/468 vacant - Of the 468 vacant, 403 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Branch Township Fire Department, 6697 E. US-10
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	-Branch Township Hall, 6688 1st St.

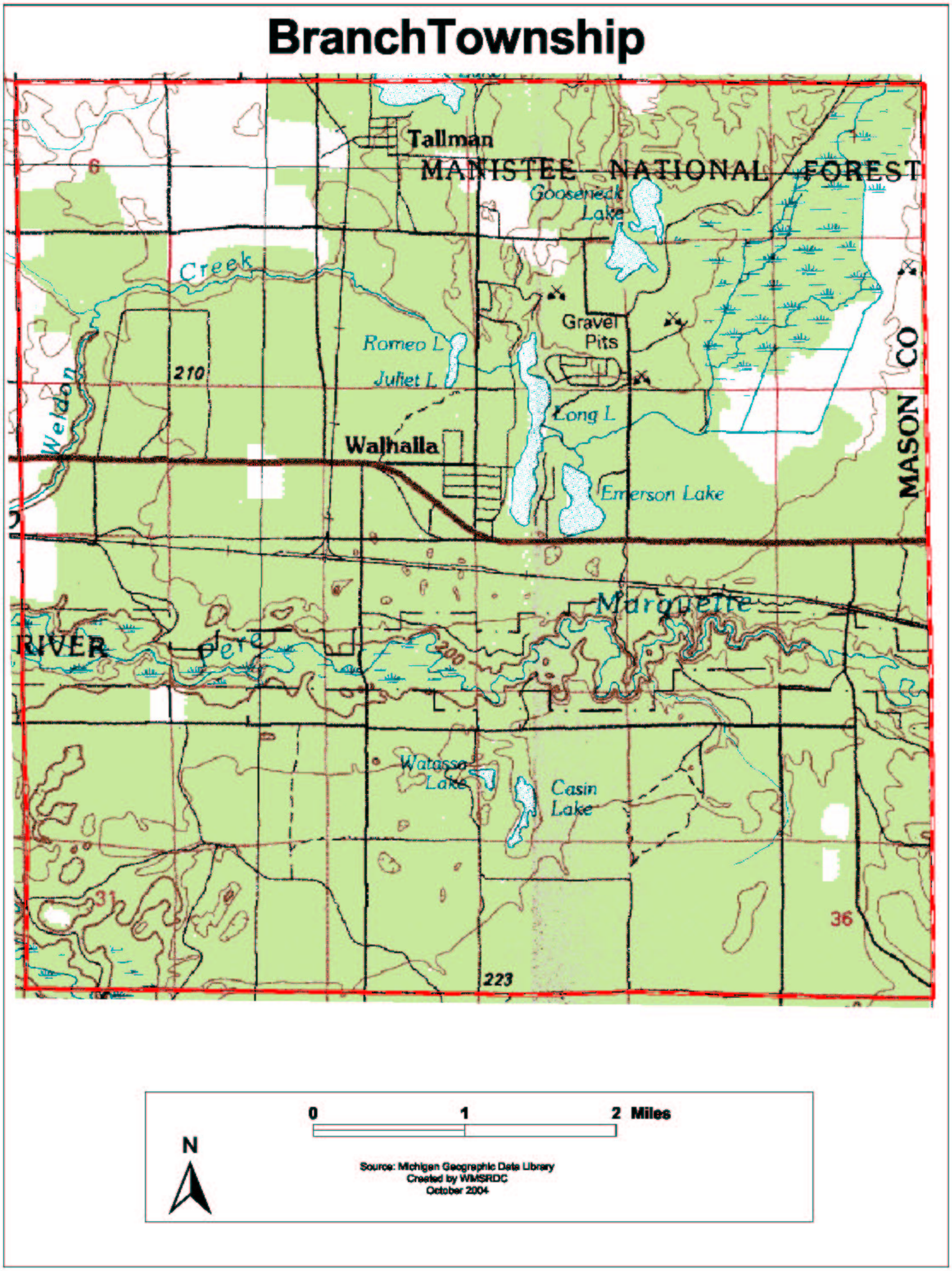
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-10 - Marquette Rail (Switch yard 1 mile South of Walhalla)

		- US-10 bridge over Weldon Creek - Walhalla Rd. bridge over Pere Marquette River North Branch
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,328
b.	**peak population (seasonal):**		2,275
c.	**percent over 65:**		18.4
d.	**percent under 18:**		23.4
e.	**percent that are homeowners:**		86.2
f.	**percent below poverty level:**		19.4
g.	**percent with disability or mobility limitation:**		29.9
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$2,035,400 $2,295,800 $0 $54,799,950 $2,060,400 $61,191,550
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	- - 0 $0
j.	**location of floodplains:**	- Floodplains along Pere Marquette River	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



CUSTER TOWNSHIP

1.	**major geographic features**	- 35.9 persons per square mile - 17.2 housing units per square mile - Moderately forested (portions of Manistee National Forest) - Pere Marquette River - Lincoln River - 3 to 4 small lakes and ponds, 3 to 4 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- Orchard View, 3520 US-10 (capacity 12) - Pinecrest, 1316 Chauvez (capacity 6) - Willowbrook Care Home, 2023 W US 10 (capacity 20)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Simpson’s Timberlane Resort, 3677 US-10 (10 cottages) - Crystal Lake Campground, 1884 W Hansen Rd (160 campsites) - Scottville Riverside Park, 700 S Scottville Rd (62 campsites)
g.	**major employers:**	- None Identified

3.	**Population Shifts** *(numbers include Village of Custer)*	
a.	**daily:**	- 581 commute with an average commuting time of 21.3 minutes - 253 school-aged children
b.	**seasonal:**	- 599 total housing units: 492 occupied/107 vacant - Of the 107 vacant, 37 are for seasonal recreational or occasional use

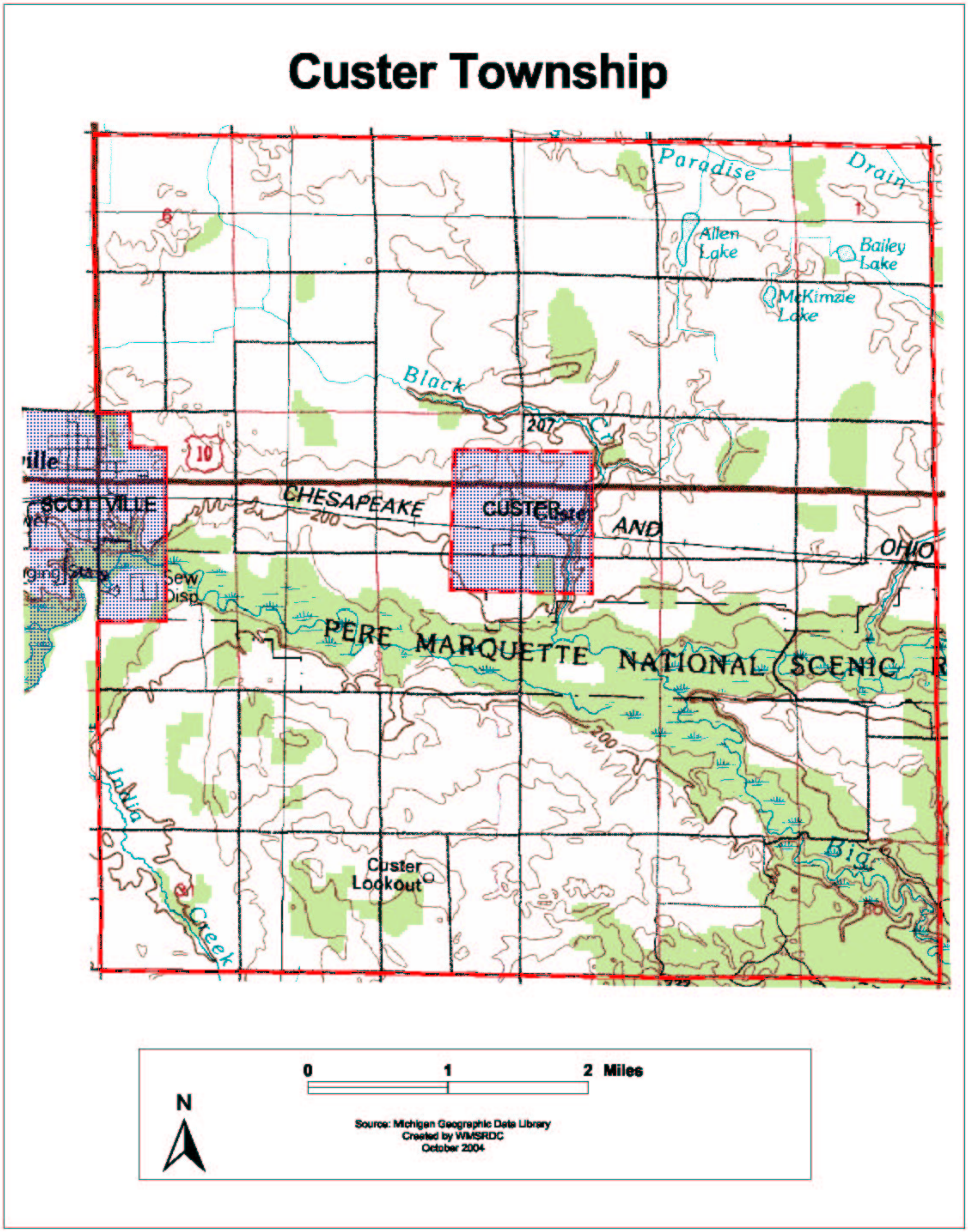
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Crossroads Church, 1463 E. US 10
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Notipekago Commemorative Designation, S Custer Rd, N Conrad Rd, near Pere Marquette River
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Consumers Energy Power Line

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - US-10 - Marquette Railroad - Scottville Rd. bridge over Pere Marquette River - Custer Rd. bridge over Pere Marquette River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Consumers Energy Power Line
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(numbers include Village of Custer)*	1,254
b.	**peak population (seasonal):**	*(numbers include Village of Custer)*	1,348
c.	**percent over 65:**		16.5
d.	**percent under 18:**		21.8
e.	**percent that are homeowners:**		87.6
f.	**percent below poverty level:**		11.4
g.	**percent with disability or mobility limitation:**		21.0
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$10,456,900 $1,245,000 $0 $32,284,300 $1,298,300 $45,284,500
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- Special Flood Hazard Areas (SFHA) identified along Pere Marquette River	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



EDEN TOWNSHIP

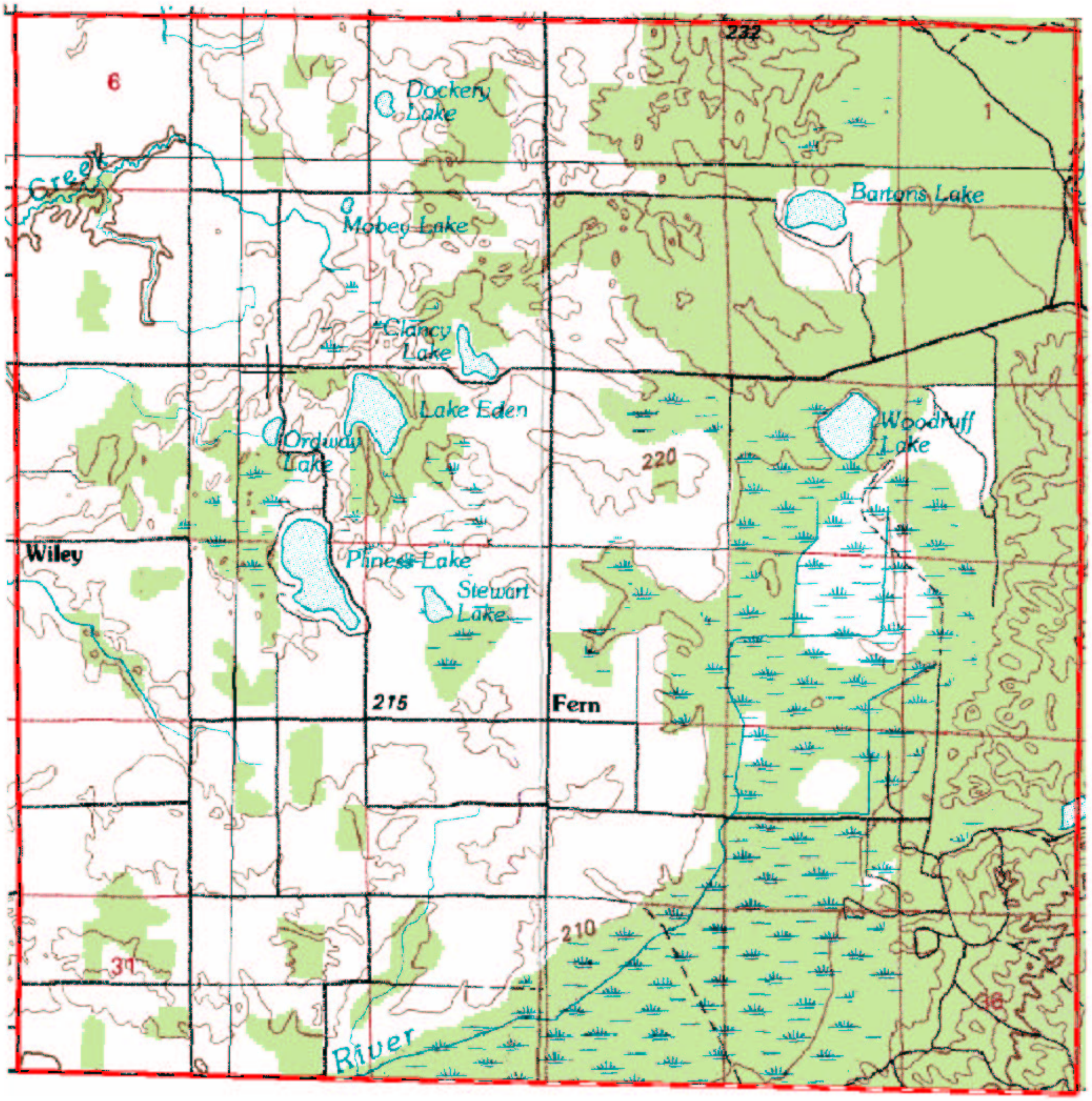
1.	**major geographic features**	- 16.4 persons per square mile - 11 housing units per square mile - Densely forested (Manistee National Forest in eastern half) - Pentwater River - Pleiness Lake - 8 to 10 small lakes and ponds, 3 to 4 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Whiskey Creek Campground, 5080 Sippy Rd. (148 sites) - Whiskey Creek Resort, 5080 Sippy Rd. (97 campsites) - Rakas Camp, 1918 E. Hawley Rd.
g.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 285 commute with an average commuting time of 22.8 minutes - 111 school-aged children
b.	**seasonal:**	- 391 total housing units: 228 occupied/163 vacant - Of the 163 vacant, 147 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Eden Township Hall, 3369 Hawley Rd.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Scottville Rd. bridge over Swan Creek
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Whiskey Creek Dam No. 2 - Consumers Energy Power Line
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

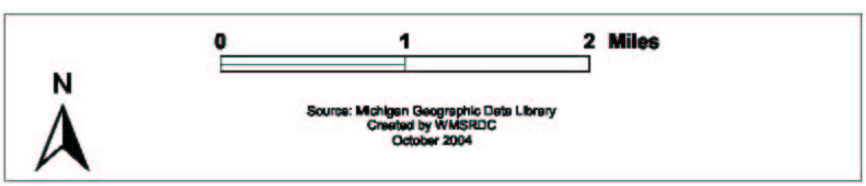
6.	**Socio-Economic Profile of Sector**	
a.	**total population (night):**	582
b.	**peak population (seasonal):**	957
c.	**percent over 65:**	18.7
d.	**percent under 18:**	23.9
e.	**percent that are homeowners:**	88.2
f.	**percent below poverty level:**	13.2
g.	**percent with disability or mobility limitation:**	18.3
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):** Agricultural:	$9,255,500
	Commercial:	$0
	Industrial:	$0
	Residential:	$28,966,200
	Total Personal:	$773,300
	Total:	$38,995,000
i.	**flood insurance coverage:** Total Losses since 01/01/78:	-
	Total Payments since 01/01/78:	-
	Policies In-Force:	0
	Total Insurance In-Force:	$0
j.	**location of floodplains:**	- None mapped by NFIP

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

Eden Township





FREE SOIL TOWNSHIP

1.	**major geographic features**	- 21.2 persons per square mile - 14.6 housing units per square mile - Densely forested (Manistee National Forest in northern half) - Gun Lake - Big Sable River - 2 to 3 small lakes and ponds
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Lazy B Cabins, 10400 N US-31 - Michigan Corrections: Camp Sauble, 4058 E. Freesoil Rd. (156 capacity)
g.	**major employers:**	- None Identified
3.	**Population Shifts** *(numbers include Village of Free Soil)*	
a.	**daily:**	- 395 commute with an average commuting time of 22.1 minutes - 140 school-aged children
b.	**seasonal:**	- 566 total housing units: 345 occupied/221 vacant - Of the 221 vacant, 177 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- None Identified
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - Marquette Railroad - US-31 bridge over Big Sable River - Custer Rd. bridge over Big Sable River

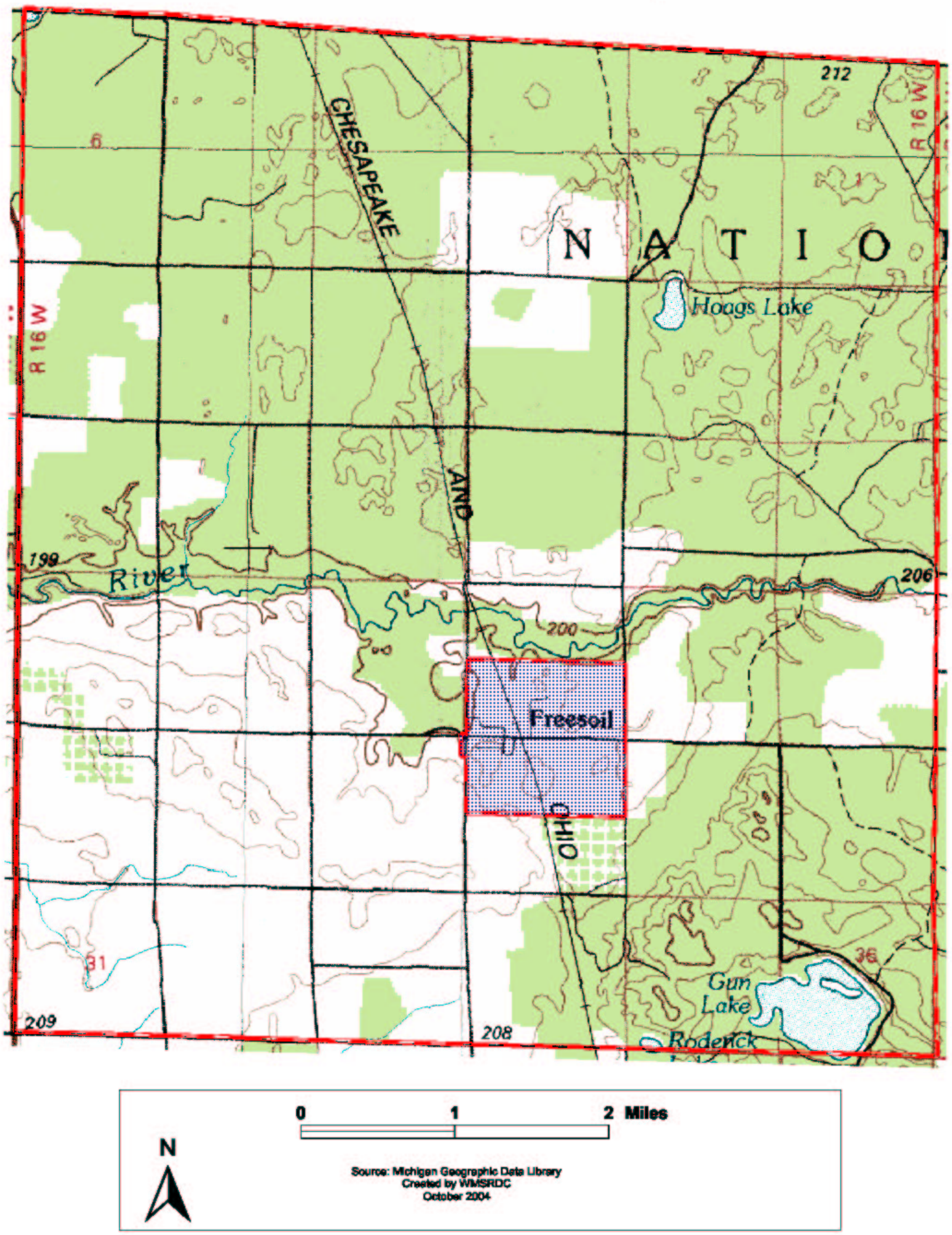
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Gun Lake Dam
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(numbers include Village of Free Soil)*	822
b.	**peak population (seasonal):**	*(numbers include Village of Free Soil)*	1,238
c.	**percent over 65:**		18.4
d.	**percent under 18:**		18.9
e.	**percent that are homeowners:**		89.6
f.	**percent below poverty level:**		6.5
g.	**percent with disability or mobility limitation:**		21.2
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$4,850,200 $459,200 $0 $35,353,500 $932,100 $41,595,000
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

Freesoil Township



GRANT TOWNSHIP

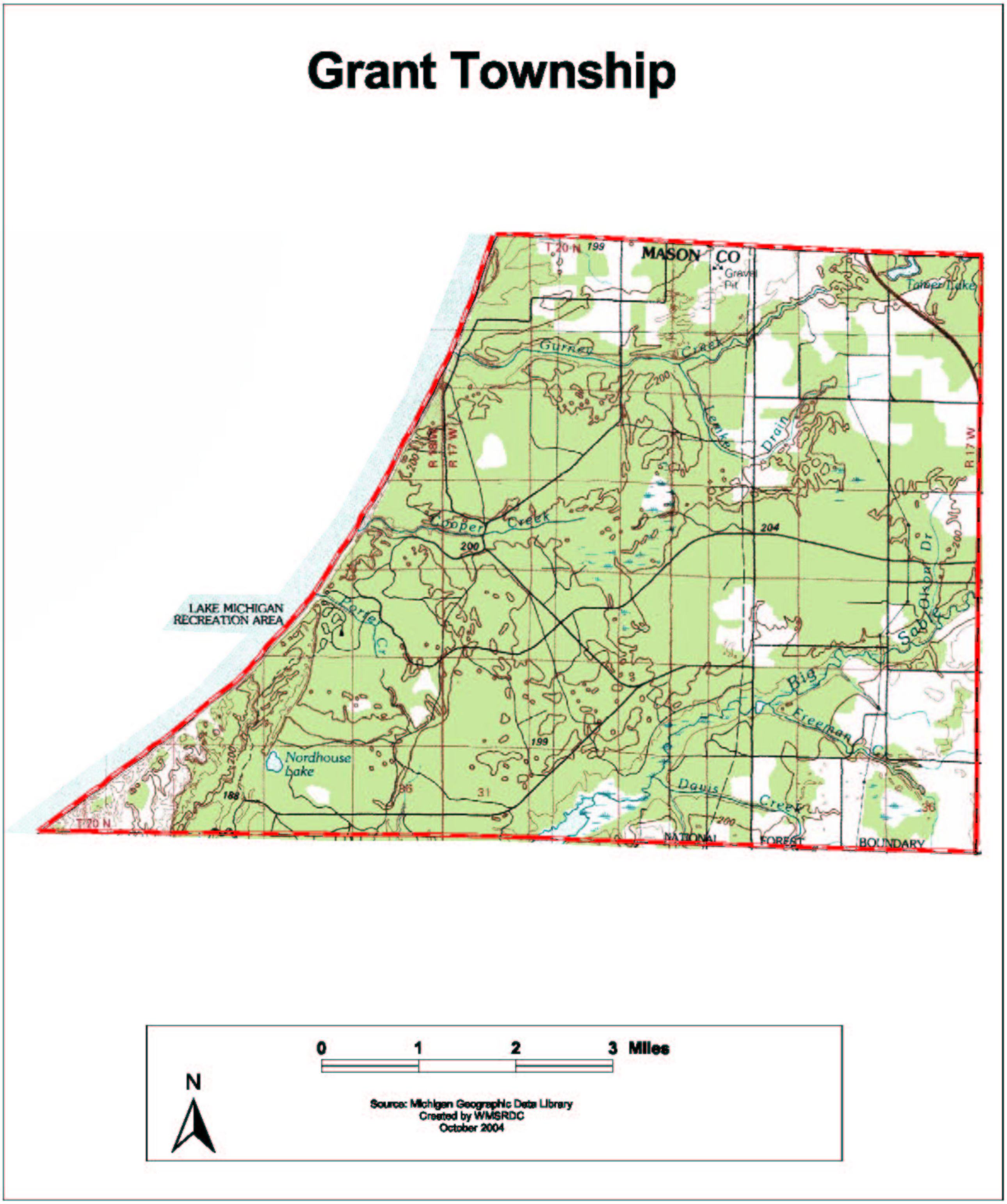
1.	**major geographic features**	- 18.7 persons per square mile - 10.8 housing units per square mile - Densely forested (Manistee National Forest) - Lake Michigan shoreline and beach - Coastal sand dunes - Hamlin Lake - Big Sable River - 1 to 2 small lakes and ponds, 5 to 7 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- Hankins, Linda, 15 W Treml Rd (capacity 12)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Sauble River Inn, 9121 N. US-31
g.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 309 commute with an average commuting time of 23.8 minutes - 149 school-aged children
b.	**seasonal:**	- 524 total housing units: 375 occupied/149 vacant - Of the 149 vacant, 138 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Grant Township Fire & Rescue, 835 W. Hoague Rd.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Driftwood Village Mobile Home Park, 617 County Line Rd - Grant Township Hall, 835 W. Hoague Rd.
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - US-31 bridge over Big Sable River - Quarterline Rd. bridge over Big Sable River

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Consumers Energy Power Line
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- Brine Pipeline - H2S Gas Pipeline - MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		909
b.	**peak population (seasonal):**		1,243
c.	**percent over 65:**		16.4
d.	**percent under 18:**		18.4
e.	**percent that are homeowners:**		90.1
f.	**percent below poverty level:**		4.9
g.	**percent with disability or mobility limitation:**		18
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$2,491,300 $910,200 $1,285,000 $68,168,200 $3,547,700 $76,402,400
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**		- Special Flood Hazard Areas (SFHA) identified along Lake Michigan

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



HAMLIN TOWNSHIP

1.	**major geographic features**	- 123.9 persons per square mile - 85.4 housing units per square mile - Moderately dense housing near Hamlin Lake - Densely forested - Ludington State Park - Hamlin Lake - Lake Michigan shoreline and beach - Coastal sand dunes - Lincoln Lake/River - 8 to 10 small lakes, bayous, and ponds - 3 to 4 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- Hamlin Lake Apartments, 3263 N Lakeshore Dr (10 units)
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- At the Waterfront Cottages, 6062 N Grace Ave. (5 units) - Barnhart's Resort and Marina, 6006 Barnhart Rd (4 units) - Clark's Castle Point Resort, 6239 Barnhart Rd. (1 house, 5 units) - Country Haven Resort/ Motel, 3263 N Lakeshore Dr (6 rooms, 5 units) - Duneview Cottages, 7158 Duneview Drive (4 units) - Epworth Heights Golf Course, 1611 N. Lakeshore Dr. (9 holes) - Ferwerda's Peaceful Acres Resort Inc, 2670 Piney Ridge Rd (16 units) - Hemlock Golf Club, 5105 W. Decker Rd. (18 holes) - K's Edgewater Resort, 4010 N Lakeshore Dr (7 units) - Laman's Landing, 6100 Beaune Rd (129 campsites) - Ludington State Park, SR 116 (344 campsites) - Laman's Landing Resort Mobile Home Community, 6100 Beaune Road R#2 - Lakewood Motel, 1934 N. Lakeshore Dr. (10 rooms) - Lincoln Hills Golf Club, 1527 N. Lakeshore Dr. (18 holes) - North Bayou Resort & Marina, 4849 N. Lakeshore Dr. (69 slips, 3 cottages) - North Bayou Trailer Park Association, 4849 N Lakeshore Dr (30 sites) - Sauble Resort, 3443 N. Stearns Rd (30 units) - Sunny Birch Resort Marina, 3841 N Lakeshore Dr (4 units) - Tamarac Village Mobile Home Park, 2875 N Lakeshore Dr (88 sites) - Waterside Resort & Marina, 3298 N. Lakeshore Dr. (3 units) - Willow-By-The-Lake Resort, 4739 N Lakeshore Dr (4 units)

g.	**major employers:**	- Bruce Mitchell Refrigeration Heating & Air Conditioning Inc, 5634 W Dewey Rd - Hamlin Grocery, 3611 N Sebavy Dr (10 employees) - Hamlin Sport Center, 5760 Dewey Rd (6 employees) - Omimex Energy, 4854 Angling Rd (8 employees) - Parklanes Bowling Center, 1963 N Lakeshore Dr - Vandervest Electric Motor & Fabrication LLC, 5635 W Dewey Rd (5 employees)

3.	**Population Shifts**	
a.	**daily:**	- 1,461 commute with an average commuting time of 18.2 minutes - 588 school-aged children
b.	**seasonal:**	- 2,349 total housing units: 1,440 occupied/909 vacant - Of the 909 vacant, 774 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Hamlin Township Fire Department, 3733 N. Jebavy Dr.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Big Sable Point Light Station, Lake Michigan north of Ludington State Park
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Hamlin Township Hall, 3775 N. Jebavy Dr.

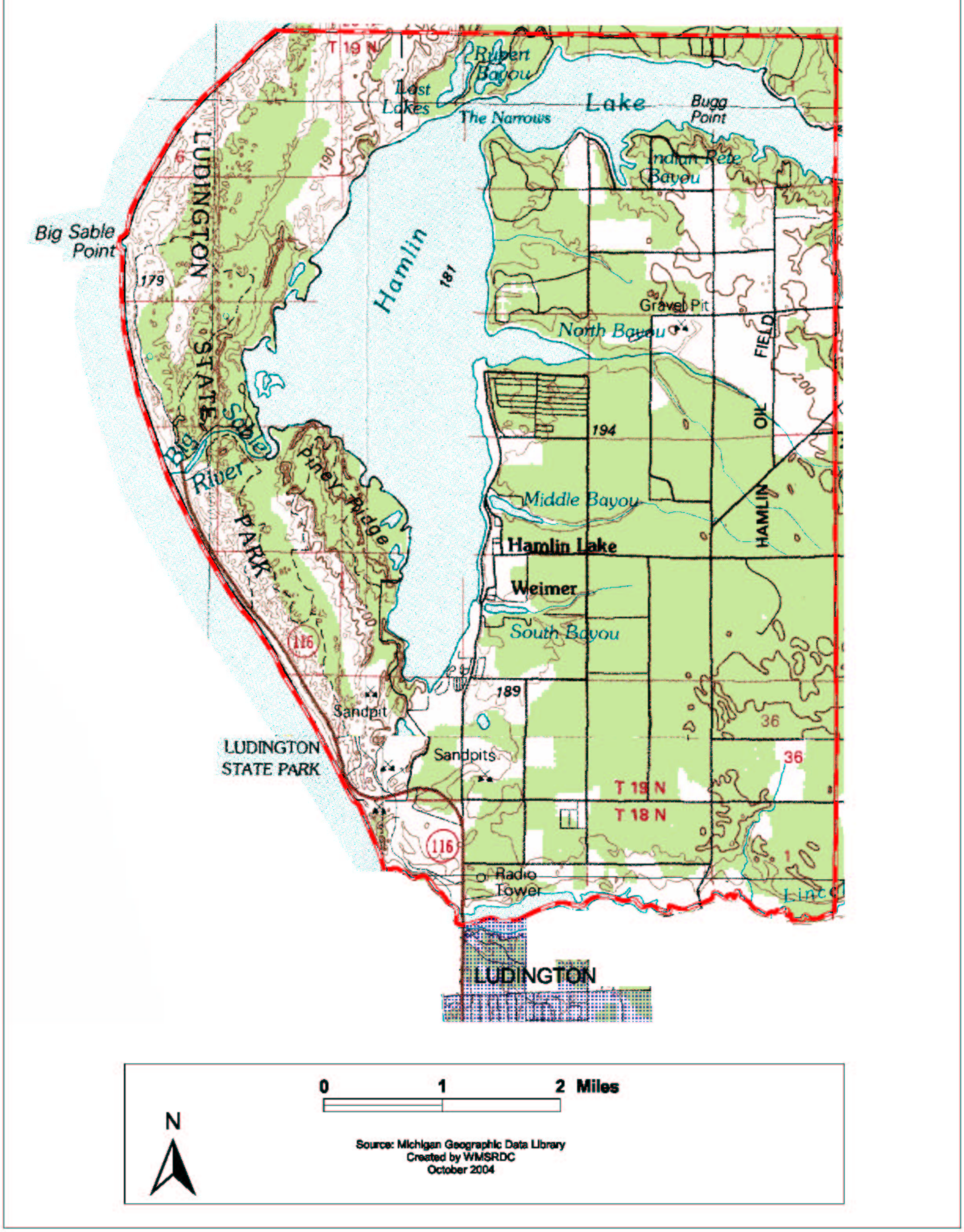
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- M-116 - Lakeshore Dr. (SR-116) bridge over Lincoln Lake - Jebavy Road bridge over Lincoln River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Hamlin Lake Dam
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**	
a.	**total population (night):**	3,408
b.	**peak population (seasonal):**	5,242
c.	**percent over 65:**	21.1
d.	**percent under 18:**	80.3
e.	**percent that are homeowners:**	92.8
f.	**percent below poverty level:**	3.8
g.	**percent with disability or mobility limitation:**	16.5

h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$763,400 $12,877,600 $460,500 $215,738,300 $3,607,100 $233,446,900
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	N/A N/A 26 $6,077,200
j.	**location of floodplains:**	Floodplains along Lake Michigan shoreline, Lincoln Lake shoreline, Hamlin Lake shoreline, Lincoln River, Big Sable River, and North Bayou	
7.	**Emergency Warning System Coverage**		
a.	**siren locations and/or description of warning system:**	- None Identified	
b.	**percent of population covered by warning sirens or system:**	N/A	

Land Use and Natural Features Map (USGS Quad.)

HamlinTownship



LOGAN TOWNSHIP

1.	**major geographic features**	- 8.7 persons per square mile - 11.2 housing units per square mile - Densely forested (Manistee National Forest) - Pere Marquette River - 5 to 6 small lakes and ponds, 3 to 4 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Whiskey Creek Campground, 5080 Sippy Rd.
g.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 78 commute with an average commuting time of 22.7 minutes - 25 school-aged children
b.	**seasonal:**	- 403 total housing units: 151 occupied/252 vacant - Of the 252 vacant, 232 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Carr Community Fire Department, 4930 S. Masten Rd.
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Logan Township Hall, Anthony Rd. and Masten Rd.

5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Walhalla Rd. bridge over Pere Marquette River South Branch - Masten Rd. bridge over Carr Creek
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

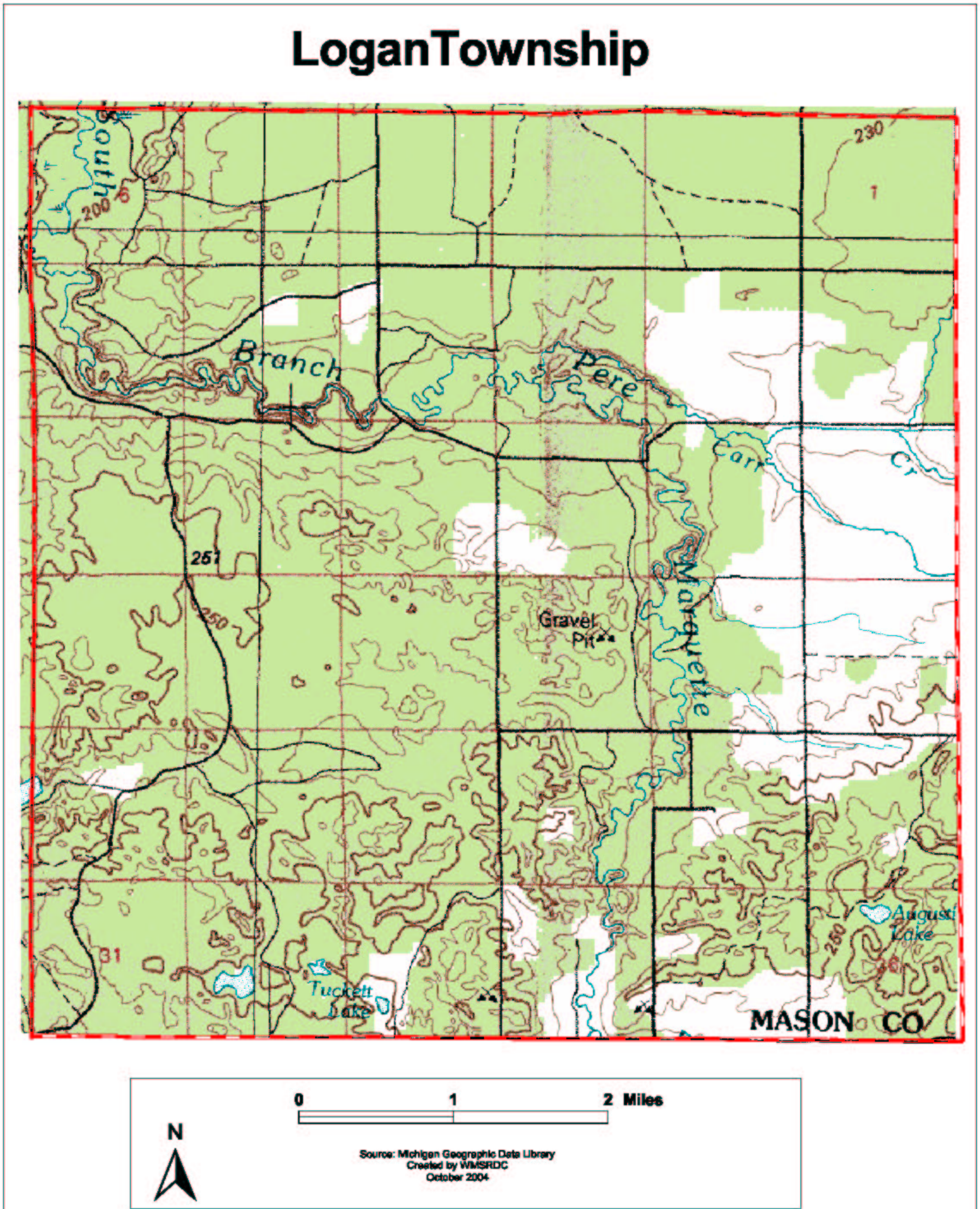
6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		312
b.	**peak population (seasonal):**		792
c.	**percent over 65:**		28.2
d.	**percent under 18:**		9.9
e.	**percent that are homeowners:**		83.4
f.	**percent below poverty level:**		2.3
g.	**percent with disability or mobility limitation:**		25.2
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$2,602,200 $474,300 $0 $30,380,000 $312,800 $33,769,300
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	- - 1 $100,000
j.	**location of floodplains:**	- Floodplains along Pere Marquette River and Carr Creek	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

(Note: Map showing warning siren location and system coverage is contained in Part D.)

Land Use and Natural Features Map (USGS Quad.)

LoganTownship

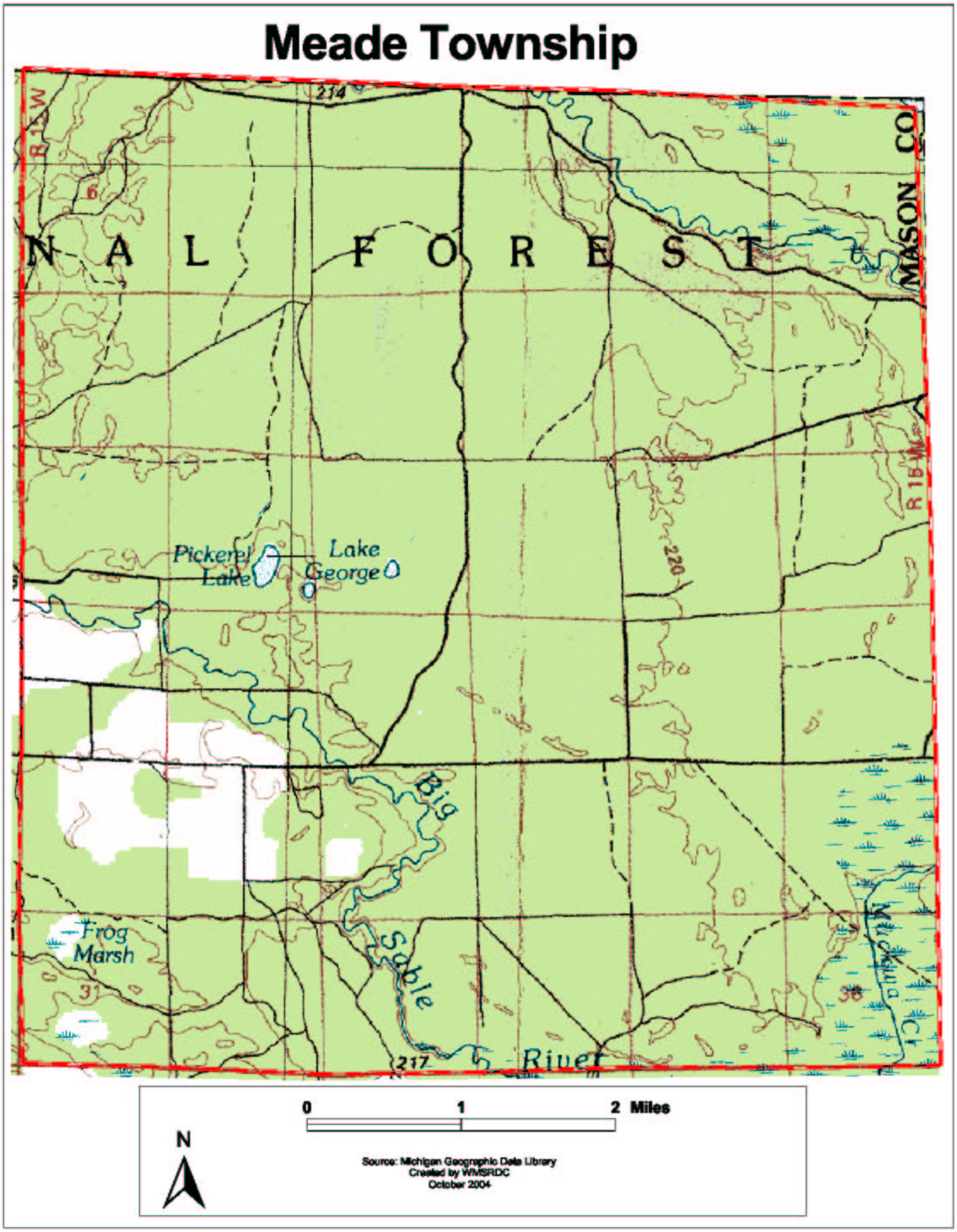


MEADE TOWNSHIP

1.	**major geographic features**	- 7.6 persons per square mile - 6.1 housing units per square mile - Densely forested (Manistee National Forest) - Big Sable River - Little Manistee River - 8 to 10 small lakes and ponds
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- None Identified
g.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 34 commute with an average commuting time of 33.8 minutes - 40 school-aged children
b.	**seasonal:**	- 208 total housing units: 80 occupied/128 vacant - Of the 128 vacant, 116 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Meade Township Hall, Budzynski Rd and Free Soil Rd
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- None Identified
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		181
b.	**peak population (seasonal):**		443
c.	**percent over 65:**		18.2
d.	**percent under 18:**		24.3
e.	**percent that are homeowners:**		87.5
f.	**percent below poverty level:**		29.4
g.	**percent with disability or mobility limitation:**		25.3
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	\$0 \$0 \$0 \$19,099,900 \$168,000 \$19,267,900
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 \$11,735 1 \$13,900
j.	**location of floodplains:**	- None mapped by NFIP	
7.	**Emergency Warning System Coverage**		
a.	**siren locations and/or description of warning system:**	- None Identified	
b.	**percent of population covered by warning sirens or system:**	N/A	

Land Use and Natural Features Map (USGS Quad.)



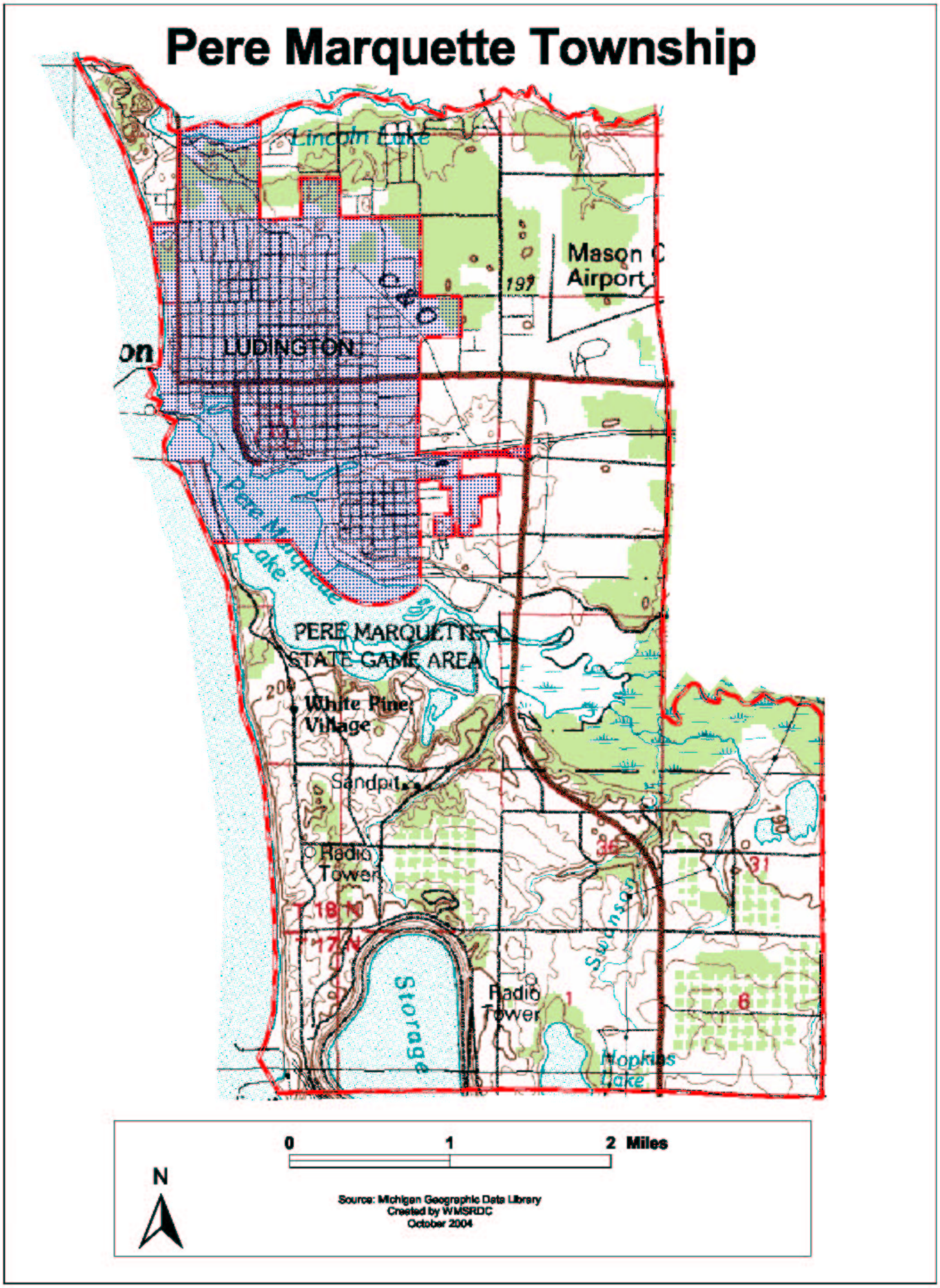
PERE MARQUETTE TOWNSHIP

1.	**major geographic features**	- 167.8 persons per square mile - 93.4 housing units per square mile - Moderately dense residential areas near lakes and Ludington - Pere Marquette Lake/River - Lake Michigan shoreline and beach - Coastal sand dunes - Lincoln Lake - Ludington Pumped Storage Plant (Reservoir) - 3 to 4 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- Dexter Trail, 5963 W 6th St (capacity 6)
b.	**large apartment buildings:**	- The Manor at Sherman Oaks, 700 Sherman Oaks Dr (46 senior units)
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- Bowman, Leta M, 1260 N Jebavy Dr (capacity 12) - Enbody, LeAnne, 6693 W Ann St (capacity 12) - Foote, Karen Ann, 5694 Riverview (capacity 12) - Munchkin Land Day Care, 3850 W First St (capacity 30) - Small Wonders, 5757 W Johnson Rd (capacity 41)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Western Michigan Fairgrounds, 5302 W. US-10, with West Michigan Fair in August) - Historic White Pine Village, 1687 S. Lakeshore Drive - Day's Inn-Ludington, 5095 W. US-10 (43 rooms) - Holiday Inn Express, 5323 W. US-10 (102 rooms) - Nova Motel, 472 S. Pere Marquette Highway (32 rooms) - Super 8 Motel, 5005 W. US-10 (64 rooms) - Mason County Campground, 5906 W. Chauvez Rd. (54 campsites) - Poncho's Pond RV Park, 5335 W. Wallace Rd. (226 campsites) - Vacation Station RV Park, 4895 W. US-10 (150 campsites) - Lakeside Links Golf Course, 5369 W. Chauvez Rd. (27 holes) - Heritage Hills Mobile Village, 3677 South Pere Marquette
g.	**major employers:**	- Cal Chlor North Corporation, 5739 W. 6th St. (40 employees) - Change Parts, Inc., 185 S Jebavy Dr (45 employees) - Cone Drive Ludington- Clyde Blower, 5115 W. Progress Dr. (34 employees) - Consumers Energy Pumped Storage Plant (44 employees) - Consumers Energy Service Center, 5115 W Progress Dr (23 employees) - Harsco Track Technologies, 200 S Jackson Rd (200 employees) - Ludington Components, 5170 W. Progress Dr. (252 employees) - Mason Lake ISD, 2130 W US 10 (154 employees) - Wal-Mart, 4854 W. US-10 (173 employees) - Whitehall Industries, 5175 W 6th St (372 employees)

3.	**Population Shifts**	
a.	**daily:**	- 1,043 commute with an average commuting time of 15.2 minutes - 471 school-aged children
b.	**seasonal:**	- 1,317 total housing units: 915 occupied/402 vacant - Of the 402 vacant, 335 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Pere Marquette Township Fire Department, 1040 S. Pere Marquette Highway
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Calvary Baptist Church, 220 N. Jebavy Drive
f.	**community medical facilities, hospitals:**	- Life EMS of Mason County, 4910 W 1st St.
g.	**historic sites:**	- First Mason County Courthouse, South Lakeshore Drive - Marquette's Death Informational Site, Pere Marquette Park, bottom of Shrine
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Pere Marquette Township Hall, 1699 S. Pere Marquette Highway - Rieth-Reilly, 5621 W. 1st St,
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - US-10 - Marquette Railroad - S. Pere Marquette Highway bridge over Pere Marquette River South Branch - S. Pere Marquette Highway bridge over Pere Marquette River North Branch - Lakeshore Dr. (SR-116) bridge over Lincoln Lake - US-31 bridge over Pere Marquette River - Jebavy Road bridge over Lincoln River
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Consumers Energy Power Line - Ludington Pumped Storage Plant and Dam (Consumers Energy) - Michigan Power, L.P. (natural gas cogeneration facility), 5795 W. 6th St. - Ludington Wastewater Disposal Plant, East 6th - Sanitary Lift Stations: Seven
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- Brine Pipeline - H2S Gas Pipeline - Ludington Mass Transportation Authority, 5545 Carr Street - Mason County Airport, 5300 W. US-10 - County-owned transmission tower, 6280 W. Bradshaw
6.	**Socio-Economic Profile of Sector**	
a.	**total population (night):**	2,366
b.	**peak population (seasonal):**	3,204

c.	**percent over 65:**	20.7
d.	**percent under 18:**	23.8
e.	**percent that are homeowners:**	87
f.	**percent below poverty level:**	3.4
g.	**percent with disability or mobility limitation:**	15.1
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):** Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$3,593,900 $44,896,900 $242,508,300 $138,990,100 $18,638,100 $448,627,300
i.	**flood insurance coverage:** Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	2 $937 15 $3,688,100
j.	**location of floodplains:**	Floodplains along Lake Michigan shoreline, Lincoln Lake shoreline, Pere Marquette Lake shoreline, Lincoln River, and Pere Marquette River
7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



RIVERTON TOWNSHIP

1.	**major geographic features**	- 32.8 persons per square mile - 16 housing units per square mile - Moderately forested - Pere Marquette River - 4 to 6 small lakes and ponds, 8 to 12 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- Christian AFC, 4964 S Stiles Rd (capacity 3) - Country Care AFC, 5065 S Schwass Rd (capacity 6)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- Morton, Sheryl Annette, 2580 S Hogenson Rd (capacity 12) - Saucedo, Mary, 2205 S Scottville Rd (capacity 12)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Driftwood Golf Club, Washington and Brye - Henry's Landing, 600 S. Scottville Rd.
g.	**major employers:**	- Indian Summer Co-op, 3958 W Chauvez Rd (200 employees) - Mason County Fruit Packers Co-op Inc., 3958 W Chauvez Rd (150 employees)

3.	**Population Shifts**	
a.	**daily:**	- 602 commute with an average commuting time of 19.6 minutes - 241 school-aged children
b.	**seasonal:**	- 564 total housing units: 442 occupied/122 vacant - Of the 122 vacant, 59 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- Riverton T. Fire Department, 2104 W Hawley
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Riverton Elementary, 4964 S. Stiles Rd.
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Riverton Township Hall, Hawley Rd and Stiles Rd.

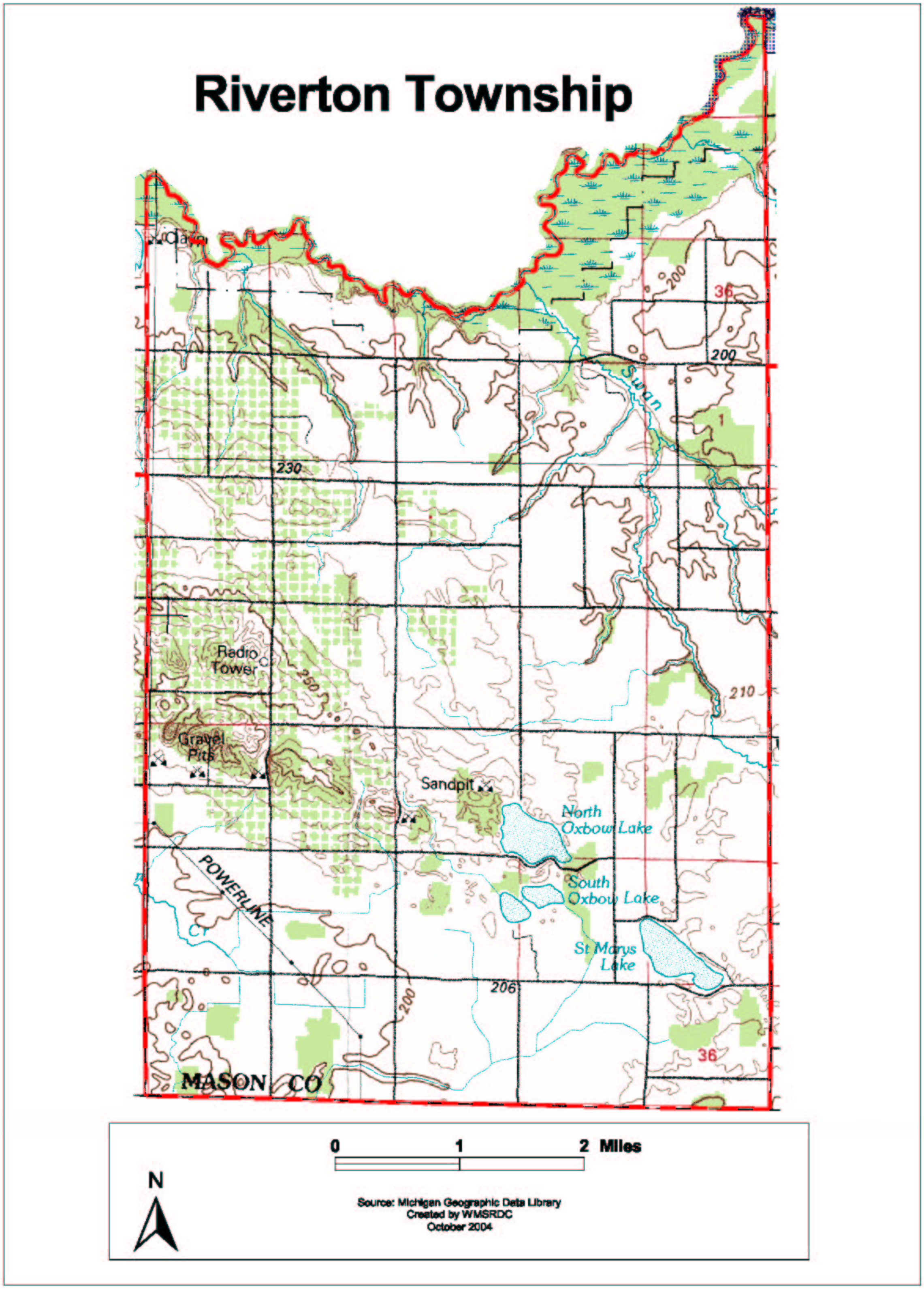
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	-Chauvez Rd. bridge over Swan Creek -Scottville Rd. bridge over Swan Creek

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Consumers Energy Power Line - Lake Winds Energy Park, 56 wind turbines in Riverton and Summit twps (Consumers Energy)
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- H2S Gas Pipeline - MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,153
b.	**peak population (seasonal):**		1,307
c.	**percent over 65:**		13.7
d.	**percent under 18:**		22.6
e.	**percent that are homeowners:**		90
f.	**percent below poverty level:**		6
g.	**percent with disability or mobility limitation:**		16.1
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$23,725,000 $0 $1,557,000 $29,496,800 $3,845,000 $58,623,800
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- Special Flood Hazard Areas (SFHA) identified along Pere Marquette River	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	- N/A
(Note: Map showing warning siren location and system coverage is contained in Part D.)		

Land Use and Natural Features Map (USGS Quad.)



SHERIDAN TOWNSHIP

1.	**major geographic features**	- 31.1 persons per square mile - 30.9 housing units per square mile - Densely forested (Manistee National Forest) - Round Lake - Big Sable River - Lincoln River - 10 to 12 small lakes and ponds, 3 to 5 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- Hill Haven, 3590 N Taylor Rd (capacity 5)
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- B's Cottage, 5196 N. Ford Lake Rd. - Blue Lake Resort, 6199 Larson Rd (15 cottages) - Gulembo Trailer Park, 3588 N Morse Rd. (27 sites) - Lander's Landing, 6503 E. Sugar Grove Rd (6 units) - Southern Shores Resort, 5164 N. Ford Lake Rd. - Timber Surf Camping Resort, 6575 Dewey Rd. (70 campsites) - Whisky Creek Woods & Waters, 2258 N. Schoenherr Rd.
g.	**major employers:**	- None Identified
3.	**Population Shifts**	
a.	**daily:**	- 405 commute with an average commuting time of 30.2 minutes - 168 school-aged children
b.	**seasonal:**	- 1,062 total housing units: 462 occupied/600 vacant - Of the 600 vacant, 552 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- Starr Commonwealth for Boys, 26 Mile Rd
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Sheridan Township Hall, Dewey Rd. and Benston Rd.

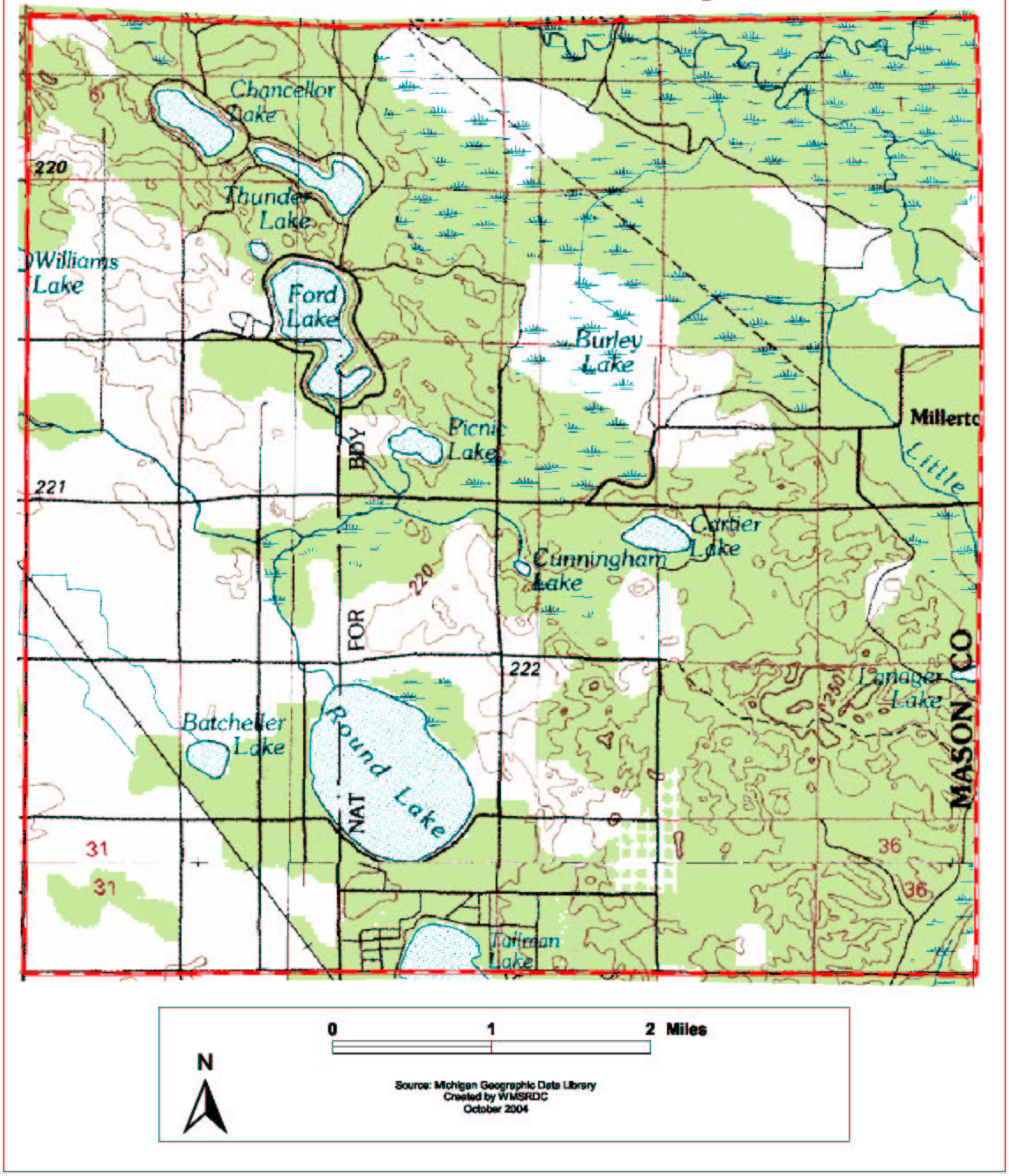
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- Marquette Railroad
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,072
b.	**peak population (seasonal):**		2,347
c.	**percent over 65:**		21.1
d.	**percent under 18:**		18.1
e.	**percent that are homeowners:**		87.4
f.	**percent below poverty level:**		6.1
g.	**percent with disability or mobility limitation:**		24.6
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$3,393,600 $0 $0 $58,679,700 $580,500 $62,653,800
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	- - 0 $0
j.	**location of floodplains:**	- None mapped by NFIP	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

Sheridan Township



SHERMAN TOWNSHIP

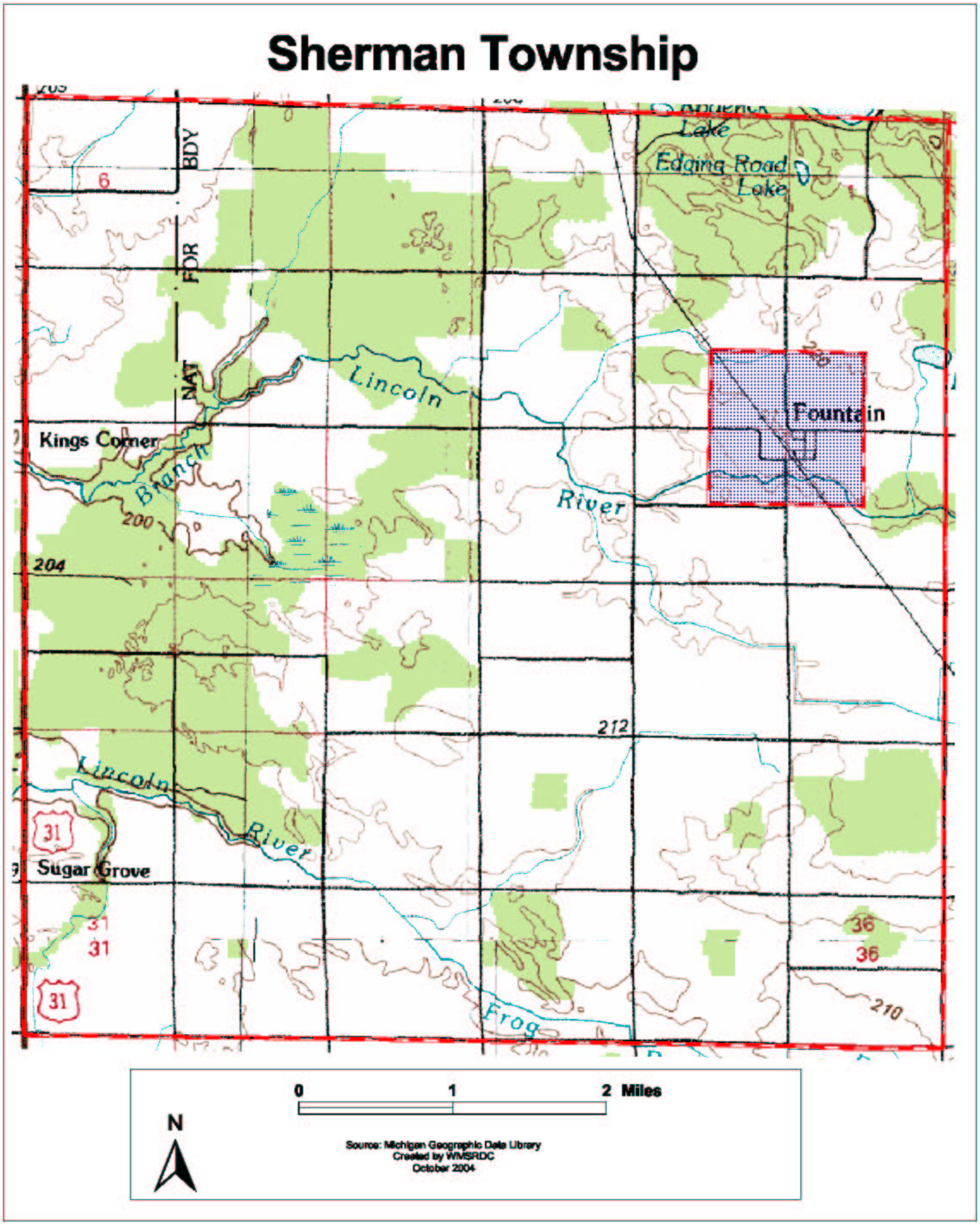
1.	**major geographic features**	- 32.8 persons per square mile - 15.1 housing units per square mile - Densely forested (Manistee National Forest in northern portion) - Lincoln River - 4 to 6 small lakes and ponds, 3 to 5 small creeks
2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Farm View Resort, 6700 N. US-31
g.	**major employers:**	- McCormick Sawmills LLC, 4431 E. Fountain Rd. (30 employees)
3.	**Population Shifts** *(numbers include Village of Fountain)*	
a.	**daily:**	- 460 commute with an average commuting time of 21.4 minutes - 244 school-aged children
b.	**seasonal:**	- 548 total housing units: 457 occupied/91 vacant - Of the 91 vacant, 62 are for seasonal recreational or occasional use
4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Sherman Township Hall, 3854 Main St. (in Fountain)
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - Marquette Rail Railroad - US-31 bridge over Lincoln River South Branch - US-31 bridge over Lincoln River North Branch - Fountain Rd. bridge over Lincoln River North Branch - Custer Rd. bridge over Lincoln River North Branch

b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- None Identified
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**	*(numbers include Village of Fountain)*	1,186
b.	**peak population (seasonal):**	*(numbers include Village of Fountain)*	1,347
c.	**percent over 65:**		14.5
d.	**percent under 18:**		23.5
e.	**percent that are homeowners:**		85.8
f.	**percent below poverty level:**		11.9
g.	**percent with disability or mobility limitation:**		16.6
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$5,869,300 $1,604,100 $311,900 $35,137,900 $1,572,900 $44,496,100
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	- - 1 $45,000
j.	**location of floodplains:**	- None mapped by NFIP	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)



SUMMIT TOWNSHIP

1.	**major geographic features**	- 71.6 persons per square mile - 67.1 housing units per square mile - Moderately dense residential areas near lakes - Moderately forested - Bass Lake - Ludington Pumped Storage Plant (Reservoir) - Lake Michigan shoreline and beach - Coastal sand dunes - 3 to 5 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- None Identified
d.	**childcare facilities:**	- None Identified
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Ferwerda's Bass Lake Resort, 7100 S Lakeshore Dr (13 units) - Kibby Creek Travel Park, 4900 W. Deren Rd. (113 campsites) - Smert's Bass Lake Resort, 6567 S Schlick Rd (7 units) - Summit Child Development Center, 4966 W. Lattin Rd. (63 capacity) - Whispering Surf Camping Resort, 7070 S. Lakeshore Dr. (68 campsites)
g.	**major employers:**	- None Identified

3.	**Population Shifts**	
a.	**daily:**	- 398 commute with an average commuting time of 26.1 minutes - 144 school-aged children
b.	**seasonal:**	- 866 total housing units: 399 occupied/467 vacant - Of the 467 vacant, 419 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- None Identified
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	- Summit Township Hall, 4966 W. Lattin Rd.

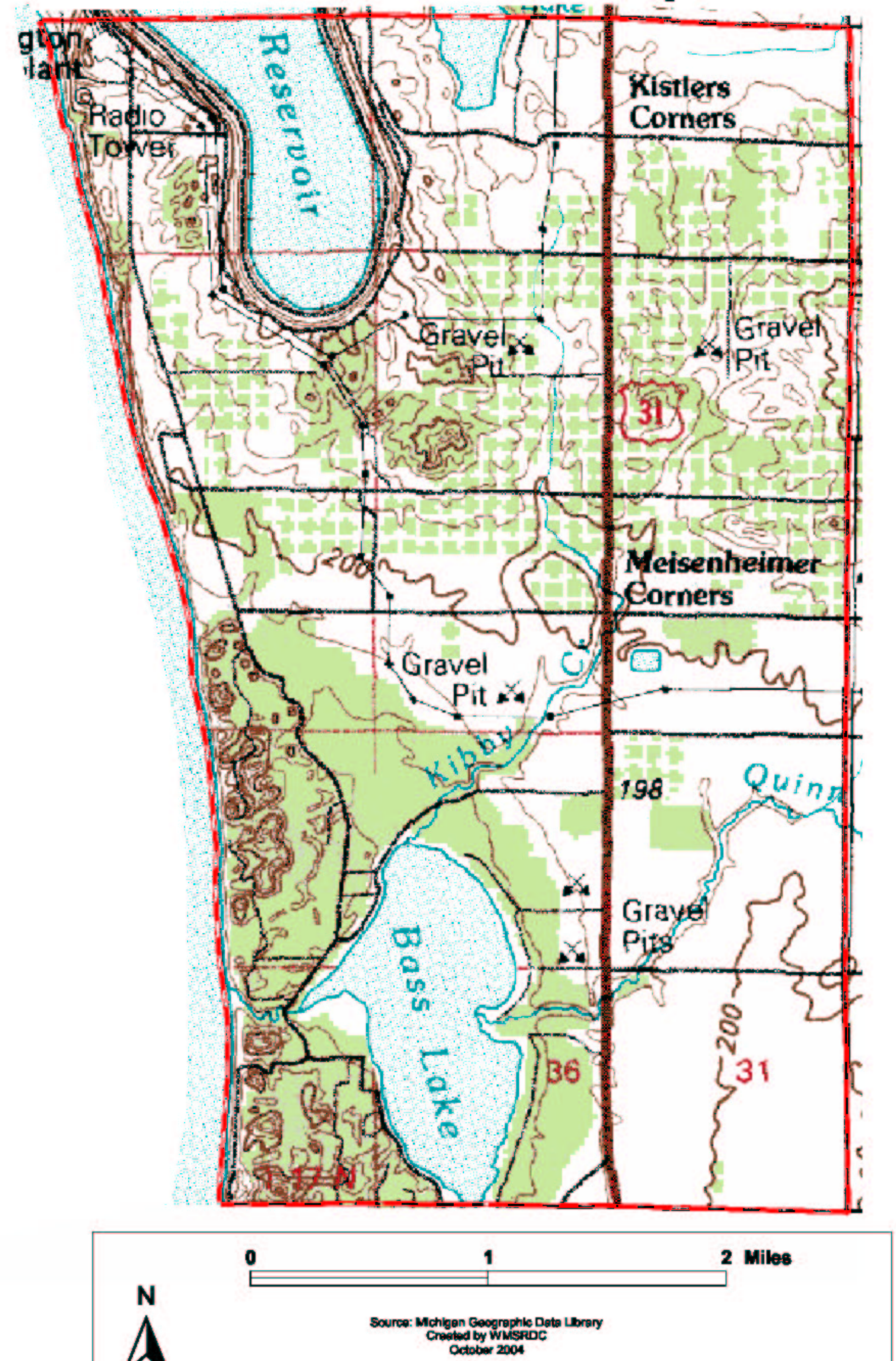
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - Lakeshore Dr. bridge over Bass Lake Channel - S. Pere Marquette Highway bridge over Quinn Creek.
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Bass Lake Dam - Consumers Energy Power Line - Ludington Pumped Storage Plant and Dam (Consumers Energy) - Lake Winds Energy Park, 56 wind turbines in Riverton and Summit twps (Consumers Energy)
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- None Identified

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		924
b.	**peak population (seasonal):**		1,896
c.	**percent over 65:**		25.8
d.	**percent under 18:**		17.6
e.	**percent that are homeowners:**		90.2
f.	**percent below poverty level:**		5.7
g.	**percent with disability or mobility limitation:**		21.6
h.	**estimated property insurance coverage (Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$6,735,000 $2,538,100 $65,556,800 $113,255,900 $9,036,400 $197,122,200
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	3 $16,221 4 $871,400
j.	**location of floodplains:**	Floodplains along L. Michigan shoreline, Bass and Hopkins Lake shorelines, Kibby and Quinn Creeks	

7.	**Emergency Warning System Coverage**	
a.	**siren locations and/or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

Summit Township



VICTORY TOWNSHIP

1.	**major geographic features**	- 38.5 persons per square mile - 17.9 housing units per square mile - Moderately forested (Manistee National Forest in northwest corner) - Hamlin Lake - Lincoln River - 1 to 2 small lakes and ponds, 6 to 8 small creeks

2.	**Population Concentrations**	
a.	**group homes:**	- None Identified
b.	**large apartment buildings:**	- None Identified
c.	**schools:**	- Mason-Lake ISD Career Tech Center, 3000 N Stiles Rd (375 students, 25 staff) - West Shore Community College, 3000 N Stiles Rd (1,512 students, 82 staff)
d.	**childcare facilities:**	- Winey, Melissa Marie, 5411 Victory Park Rd (capacity 12) - Victory Early Elementary Center, 4171 N Stiles (capacity 64)
e.	**large office buildings:**	- See 4.h.
f.	**other:** (such as stadiums, concert halls, amusement parks, fairgrounds, correctional facilities, nursing homes, other special populations or large crowd assembly areas)	- Farmview Resort, 6735 N U.S.-31 (40 campsites) - Lakeview Campsite, 6181 Peterson Rd. (106 sites) - Sunset Bluff Resort, 6075 N Victory Park Rd (13 units) - West Shore Community College Liberal Arts & Sciences Center, 3000 N. Stiles (300 seat auditorium) - West Shore Community College Freedom Festival (July)
g.	**major employers:**	- West Shore Community College, 3000 N. Stiles Rd. (82 employees)

3.	**Population Shifts**	
a.	**daily:**	- 638 commute with an average commuting time of 22.4 minutes - 323 school-aged children
b.	**seasonal:**	- 643 total housing units: 524 occupied/119 vacant - Of the 119 vacant, 73 are for seasonal recreational or occasional use

4.	**Important or Critical Public and Private Facilities**	
a.	**police precincts:**	- None Identified
b.	**fire stations:**	- None Identified
c.	**public works yards:**	- None Identified
d.	**pumping stations:**	- None Identified
e.	**community shelters:**	- Victory Elementary Center, 4171 N. Stiles - W. Shore Community College, 3000 N. Stiles
f.	**community medical facilities, hospitals:**	- None Identified
g.	**historic sites:**	- None Identified
h.	**other:** (i.e., government buildings, record center, major construction companies, warehouses, demolition companies, heavy equipment rental, emergency equipment and vehicle storage)	-Victory Township Hall, Victory Dr. & Stiles Rd.

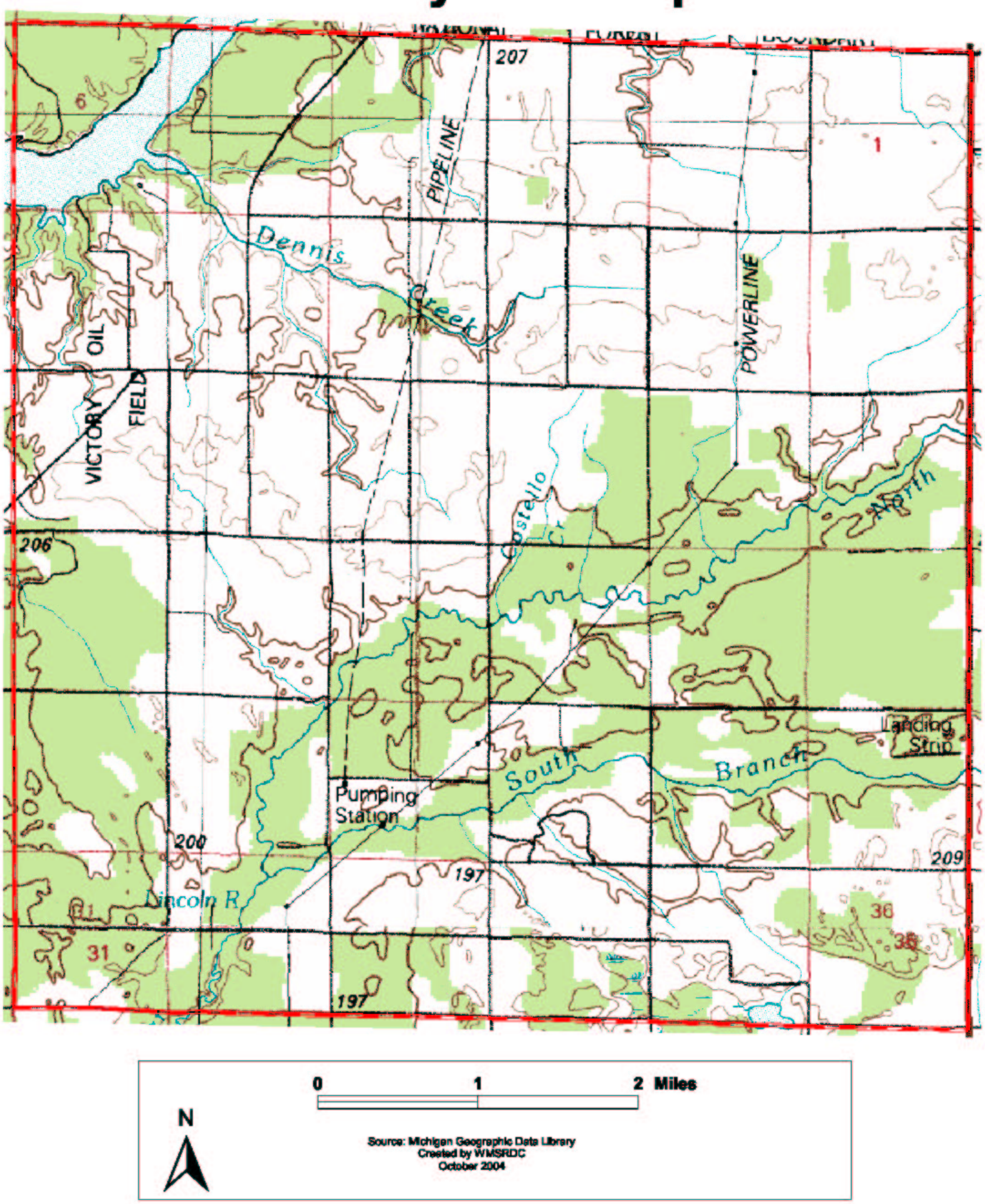
5.	**Vital or Critical Infrastructure**	
a.	**roads, railroads, and bridges:**	- US-31 - US-31 bridge over Lincoln River South Br - US-31 bridge over Lincoln River North Br - Stiles Rd. bridge over Lincoln River South Br
b.	**dams, power stations, water treatment plants, sanitary lift stations, etc.**	- Consumers Energy Power Line - Sanitary Lift Stations: One - West Shore Community College Dam
c.	**other** (i.e. airports, pipelines, bus terminals, train stations, military bases, marine passenger ferry services)	- Brine Pipeline - H2S Gas Pipeline - MichCon Gas Pipeline

6.	**Socio-Economic Profile of Sector**		
a.	**total population (night):**		1,383
b.	**peak population (seasonal):**		1,576
c.	**percent over 65:**		14.9
d.	**percent under 18:**		26.1
e.	**percent that are homeowners:**		86.1
f.	**percent below poverty level:**		18.2
g.	**percent with disability or mobility limitation:**		14.2
h.	**estimated property insurance coverage** **(Real and Personal Equalized Valuations):**	Agricultural: Commercial: Industrial: Residential: Total Personal: Total:	$10,142,800 $1,439,000 $0 $46,250,200 $3,797,500 $50,047,700
i.	**flood insurance coverage:**	Total Losses since 01/01/78: Total Payments since 01/01/78: Policies In-Force: Total Insurance In-Force:	*Not participating in the NFIP*
j.	**location of floodplains:**	- None Identified	

7.	**Emergency Warning System Coverage**	
a.	**siren locations or description of warning system:**	- None Identified
b.	**percent of population covered by warning sirens or system:**	N/A

Land Use and Natural Features Map (USGS Quad.)

Victory Township



Appendix B:
HAZARD PROFILES AND EVALUATIONS

Hazard Identification Profile
Mason County

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out. Local declaration of emergency for Riverton, Summit, Pere Marquette, and Amber townships.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7
- July 13, 2000: 1" hail. $20k property damage, $10k crop damage, Scottville.
- May 17, 2001: .88" hail. $10k property damage, $10k crop damage, Riverton Township.
- October 3, 2006: .75" hail. $15k property damage. $15k crop damage. Hamlin Township.
- May 3, 2012: 1.75" hail. $25k property damage, Scottville.

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning:
- August 13, 1995: Lightning. $30k property damage, Ludington.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- September 16, 1997: Severe thunderstorm winds. $25k property damage, Ludington; $10k, Fountain.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Ludington.
- September 11, 2000: Severe thunderstorm winds. $25k property damage, Scottville.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- July 24, 2005: Severe thunderstorm winds. $40k property damage, Freesoil; $20k, Scottville.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.
- August 2, 2012: Severe thunderstorm winds. $100k property damage, Hamlin Township.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:

- April 12, 1972: Tornado (F2). 8 injuries, $2.5m property damage, Eden Township.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).
- March 20, 2012: 40-acre wildfire sparked by bonfire remnants, Custer Township.

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63
- June 11, 1881: Conflagration destroyed 67 buildings in Ludington.
- February 28, 1993: Structural fire in Ludington. 9 fatalities.

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26
- April 5, 1970: Accidental spill of cyanide acid into the Ludington sewer system.

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- September 11, 2000: Power outage. 305 customers in Ludington and 190 customers in Scottville.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- September 13, 2005: Many trees and power lines blown down (thunderstorms), Scottville.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- June 12, 2008: Several trees and power lines downed (thunderstorms), Ludington and Hamlin Township.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- July 25, 2012: Several trees and power lines blown down (thunderstorms), Ludington.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- 45 wells are known to have detectable levels of hydrogen sulfide in the following Mason County townships: Amber (1), Eden (5), Grant (3), Hamlin (13), and Riverton (3), and Victory (18).
- May 13, 1994: Blown gasket at a compression station allowed hydrogen sulfide emissions causing a number of self-evacuations and at least 11 emergency hospitalizations, Victory Township.
- January 5, 1996: Stuck valve caused 18 emergency calls, Victory Township.

2.10 Pipeline Accidents:

- February 1995: Pipeline rupture. 1 evacuation, Victory Township.
- April 1995: Pipeline rupture. 30 evacuations, Victory Township.
- July 1996: Pipeline rupture. Self-evacuations, Victory Township.
- August 1996: Pipeline rupture. Self-evacuations, Victory Township.
- September 1996: Accident involving pipeline replacement. 1 injury, Victory Township.

2.11 Transportation Accidents: - None Identified.

3. <u>HUMAN -RELATED HAZARDS</u>

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances:

- Summer 1970 and 1971: Protest demonstrations in Ludington City Park. Over 100 arrests.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

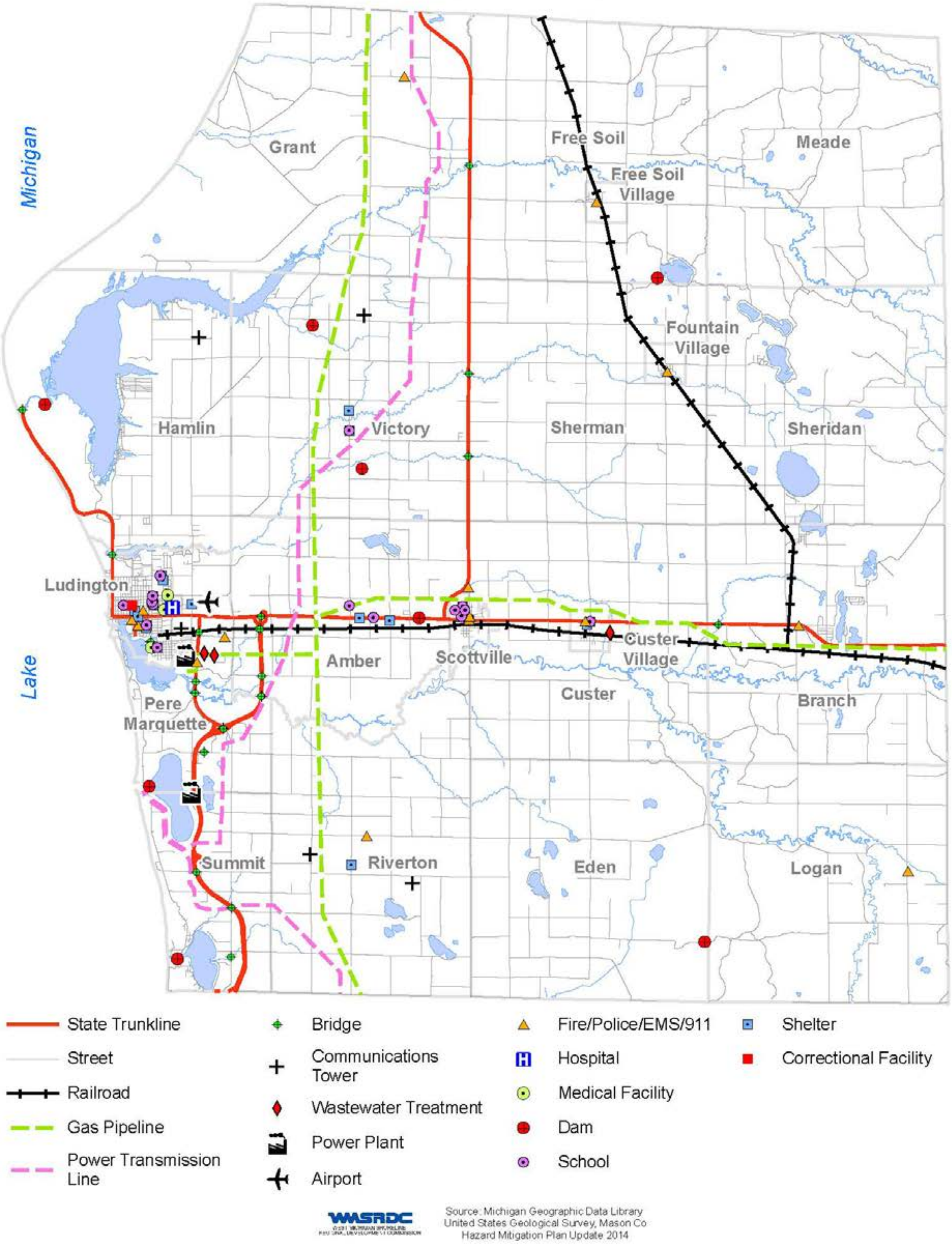
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Mason County Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	3	1	1	1	6	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	2	1	2	2	9	18
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	2	3	10	20
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	2	1	1	2	7	14
2.11	Transportation Accidents	2	1	1	2	7	14
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

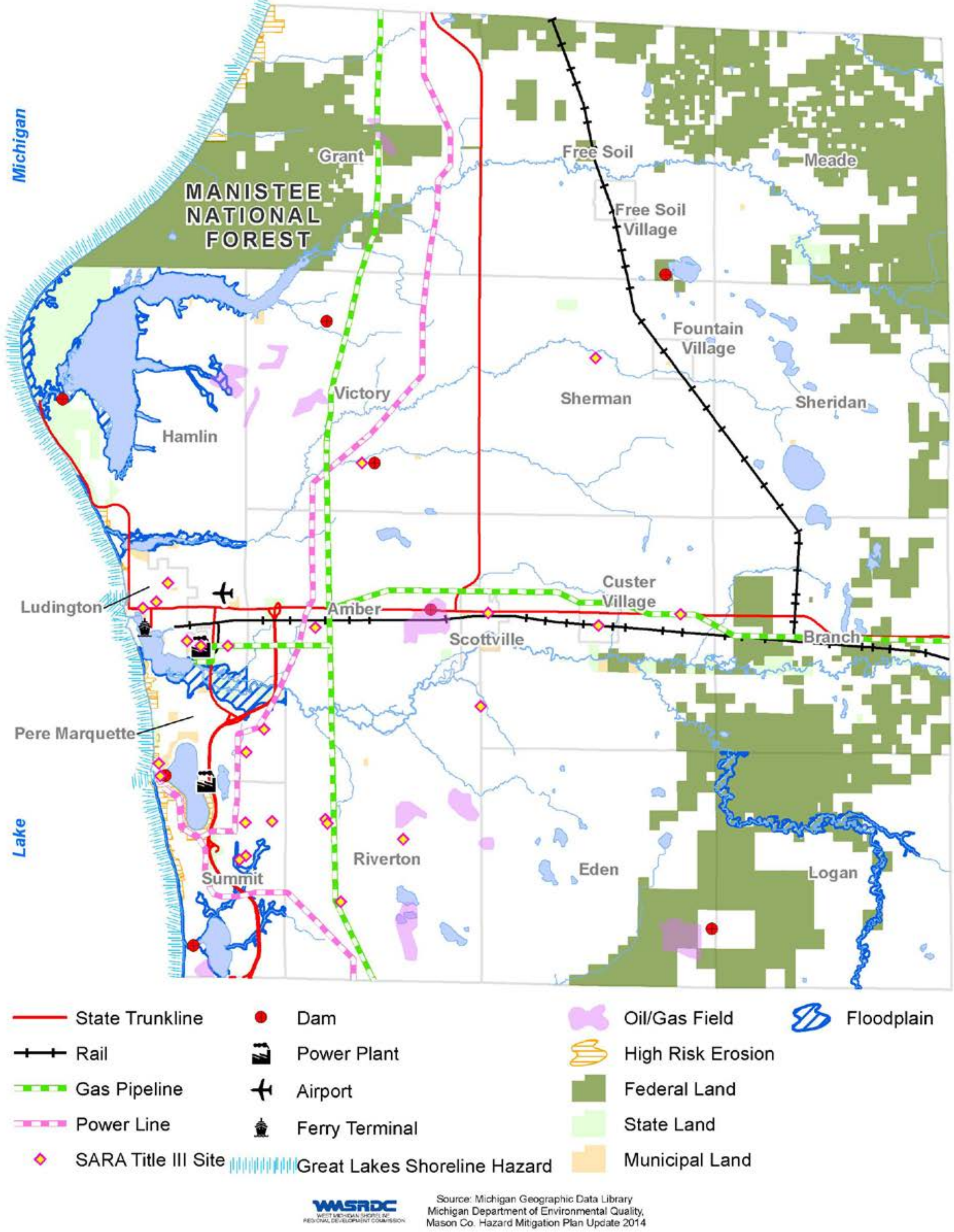
Mason County Hazard Ranking

Rank	Hazard	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		10		30
6	Fire – Structural	3		9		27
7	Drought	2		13		26
8	Flooding: Riverine/Urban	3		8		24
8	Great Lakes Shoreline	3		8		24
8	Lightning	3		8		24
11	Dam failure	2		10		20
12	Catastrophic Incidents	1		18		18
12	Hail	3		6		18
12	Public Health Emergencies	2		9		18
12	Tornadoes	2		9		18
16	Energy Emergencies	2		8		16
17	HAZMAT – Fixed Site	2		7		14
17	HAZMAT – Transportation	2		7		14
17	Invasive Species	2		7		14
17	Pipeline Accidents	2		7		14
17	Transportation Accidents	2		7		14
22	Fog	3		4		12
22	Oil/Natural Gas Well Accidents	2		6		12
24	Celestial Impacts	1		8		8
25	Civil Disturbances	1		6		6
25	Fire – Scrap Tires	1		6		6
25	Subsidence	1		6		6
25	Terrorism & Similar Criminal Acts	1		6		6
	Earthquake	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-

MASON COUNTY
Critical Facilities



MASON COUNTY
Potential Hazards



Hazard Identification Profile
City of Ludington

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $5m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out across Mason County.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning:
- August 13, 1995: Lightning. $30k property damage, Ludington.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- ***September 16, 1997: Severe thunderstorm winds. $25k property damage, Ludington; $10k, Fountain.***
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- ***June 1, 2000: Severe thunderstorm winds. $25k property damage, Ludington.***
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.

- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63
- ***June 11, 1881: Conflagration destroyed 67 buildings in Ludington.***
- ***February 28, 1993: Structural fire in Ludington. 9 fatalities.***

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26
- ***April 5, 1970: Accidental spill of cyanide acid into the Ludington sewer system.***

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- ***September 11, 2000: Power outage. 305 customers in Ludington, 190 in Scottville.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- ***June 12, 2008: Several trees and power lines downed (thunderstorms), Ludington and Hamlin Township.***
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- ***July 25, 2012: Several trees and power lines blown down (thunderstorms), Ludington.***
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances:

- ***Summer 1970 and 1971: Protest demonstrations in Ludington City Park. Over 100 arrests.***

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

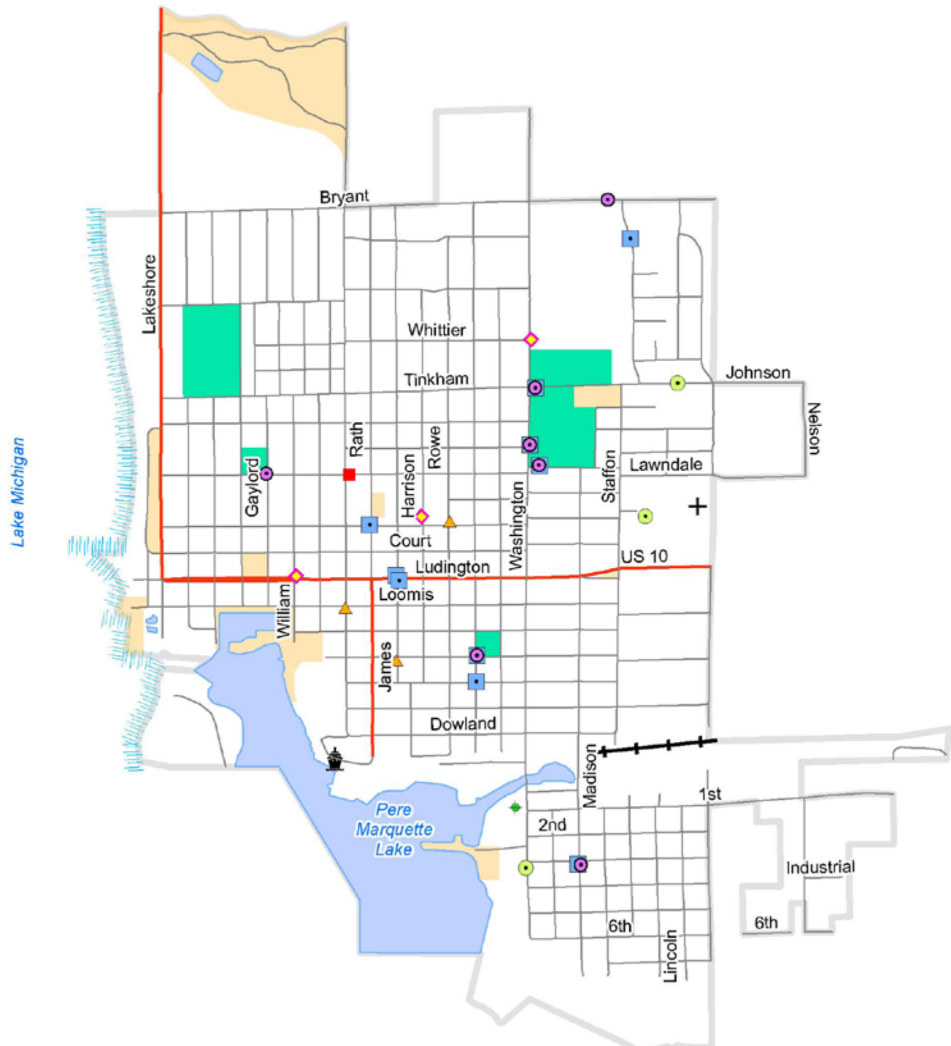
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	City of Ludington Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	1	1	1	3	8	8
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	0	-	-	-	-	-
2.04	Fire – Structural	3	1	2	3	10	30
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	2	7	14
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	2	1	2	1	8	16
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

City of Ludington Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Fire – Structural	3	10	30
3	Infrastructure Failures	3	10	30
6	Flooding: Riverine/Urban	3	8	24
6	Great Lakes Shoreline	3	8	24
6	Lightning	3	8	24
6	Wildfire	2	12	24
10	Drought	2	11	22
11	Catastrophic Incidents	1	18	18
11	Hail	2	9	18
11	Public Health Emergencies	2	9	18
14	Civil Disturbances	2	8	16
14	Energy Emergencies	2	8	16
16	Tornadoes	1	15	15
17	HAZMAT – Fixed Site	2	7	14
17	HAZMAT – Transportation	2	7	14
17	Transportation Accidents	2	7	14
20	Fog	3	4	12
20	Invasive Species	2	6	12
22	Celestial Impacts	1	8	8
22	Dam failure	1	8	8
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Fire – Scrap Tires	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-
	Pipeline Accidents	0	-	-

CITY OF LUDINGTON
Critical Facilities and Infrastructure



- State Trunkline
- Street
- Railroad
- Great Lakes Shoreline Hazard
- SARA Title III Site
- Bridge
- Communications Tower
- Ferry Terminal
- Fire/Police/911/EMS
- Medical Facility
- School
- Shelter
- Correctional Facility
- School Property
- Municipal Land

0 0.375 0.75 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
City of Scottville

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out across Mason County.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7
- ***July 13, 2000: 1" hail. $20k property damage, $10k crop damage, Scottville.***
- ***May 3, 2012: 1.75" hail. $25k property damage, Scottville.***

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- ***September 11, 2000: Severe thunderstorm winds. $25k property damage, Scottville.***
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- ***July 24, 2005: Severe thunderstorm winds. $40k property damage, Freesoil; $20k, Scottville.***
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. <u>TECHNOLOGICAL HAZARDS</u>

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- ***September 11, 2000: Power outage. 305 customers in Ludington and 190 customers in Scottville.***
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- ***September 13, 2005: Many trees and power lines blown down (thunderstorms), Scottville.***
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. <u>HUMAN -RELATED HAZARDS</u>

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

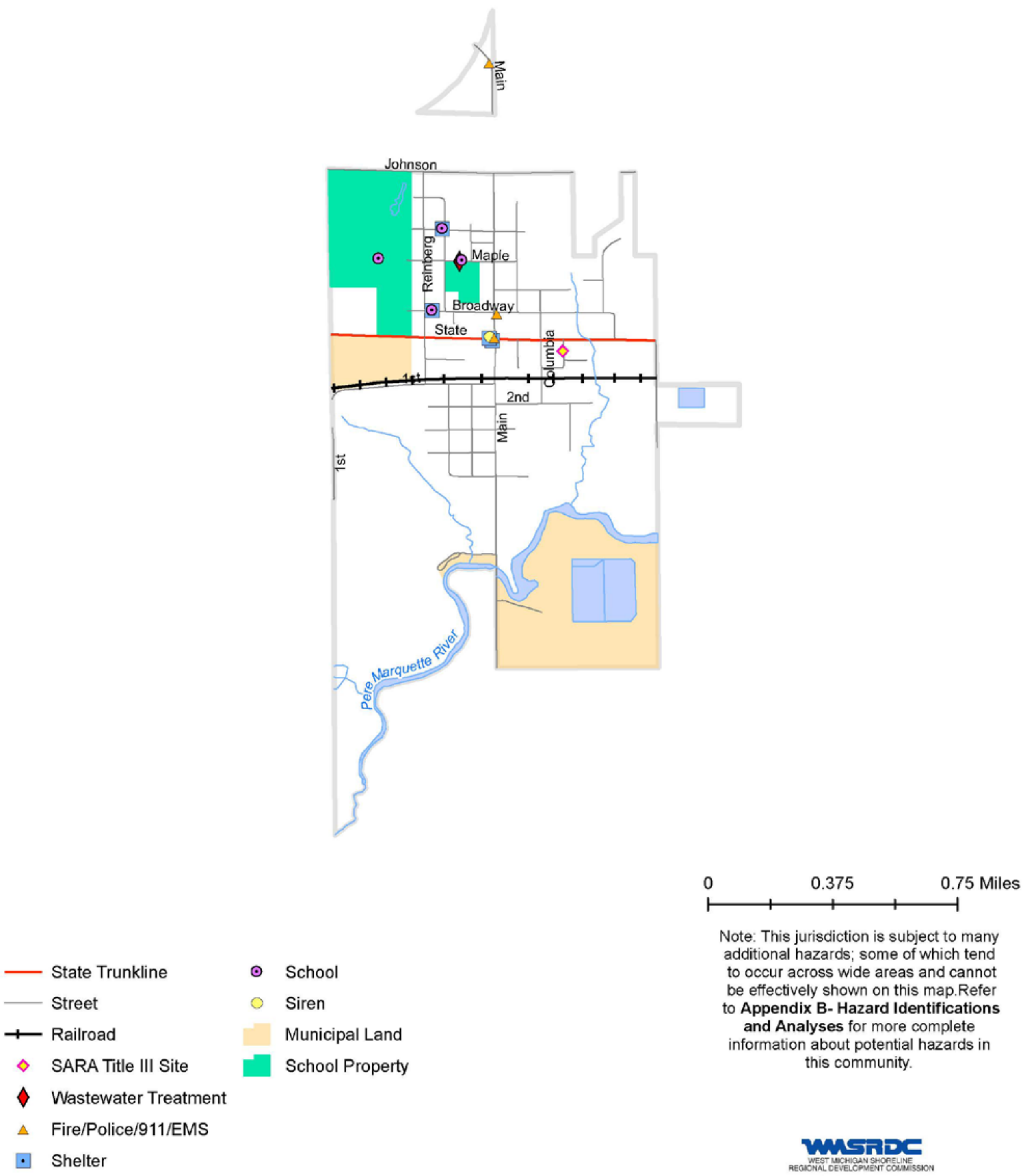
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	City of Scottville Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	3	10	30
2.05	HAZMAT – Fixed Site	2	1	1	1	6	12
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

City of Scottville
Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Fire – Structural	3	10	30
3	Infrastructure Failures	3	10	30
6	Lightning	3	8	24
6	Wildfire	2	12	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Transportation	2	7	14
16	HAZMAT – Fixed Site	2	6	12
16	Invasive Species	2	6	12
16	Oil/Natural Gas Well Accidents	2	6	12
16	Transportation Accidents	2	6	12
20	Pipeline Accidents	1	9	9
21	Celestial Impacts	1	8	8
21	Fog	2	4	8
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

CITY OF SCOTTVILLE
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of Custer

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

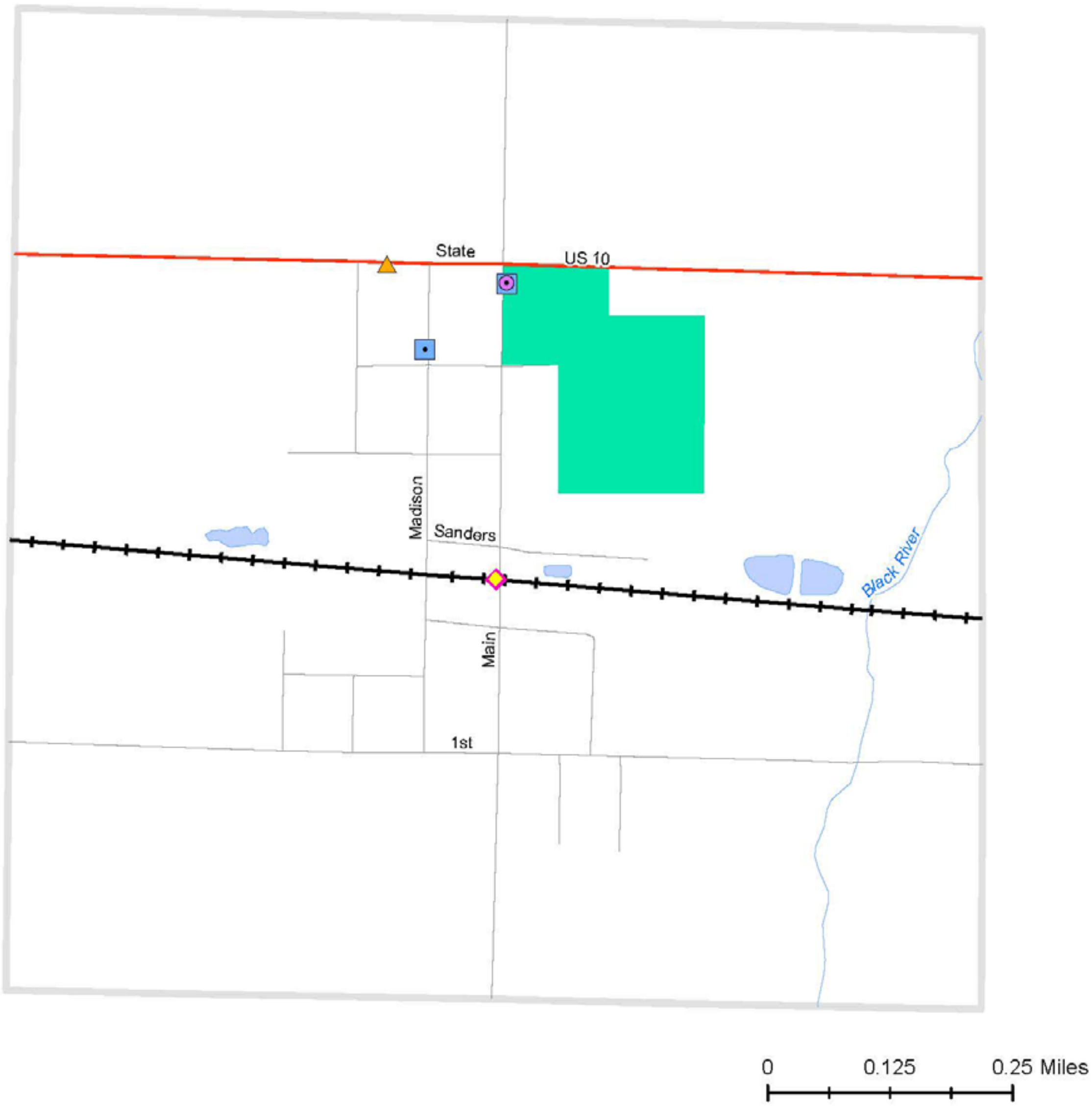
3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Village of Custer Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	0	-	-	-	-	-
2.04	Fire – Structural	3	1	2	3	10	30
2.05	HAZMAT – Fixed Site	2	1	1	1	6	12
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	1	2	7	7
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

	Village of Custer Hazard Ranking	Probability of Occurrence X	Impacts Total =	Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Fire – Structural	3	10	30
3	Infrastructure Failures	3	10	30
6	Lightning	3	8	24
6	Wildfire	2	12	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
13	Tornadoes	1	15	15
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
16	Flooding: Riverine/Urban	2	6	12
16	HAZMAT – Fixed Site	2	6	12
16	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Pipeline Accidents	1	7	7
22	Civil Disturbances	1	6	6
22	Subsidence	1	6	6
22	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Fire – Scrap Tires	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

CUSTER VILLAGE
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Railroad
- SARA Title III Site
- Fire/Police/911/EMS
- Shelter
- School
- School Property

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of Fountain

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- ***September 16, 1997: Severe thunderstorm winds. $25k property damage, Ludington; $10k, Fountain.***
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- ***September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.***
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

Village of Fountain Hazard Rating		Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	3	10	30
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	1	6	12
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Village of Fountain Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Fire – Structural	3	10	30
3	Infrastructure Failures	3	10	30
6	Lightning	3	8	24
6	Wildfire	2	12	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
13	Tornadoes	1	15	15
14	Flooding: Riverine/Urban	2	6	12
14	HAZMAT – Transportation	2	6	12
14	Invasive Species	2	6	12
14	Transportation Accidents	2	6	12
18	Celestial Impacts	1	8	8
18	Fog	2	4	8
20	Civil Disturbances	1	6	6
20	Fire – Scrap Tires	1	6	6
20	Subsidence	1	6	6
20	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-
	Pipeline Accidents	0	-	-

FOUNTAIN VILLAGE
Critical Facilities and Potential Hazards

0 0.125 0.25 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- Street
- Railroad
- Fire/Police/911/EMS
- Municipal Land

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Village of Free Soil

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- ***July 24, 2005: Severe thunderstorm winds. $40k property damage, Free Soil; $20k, Scottville.***
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

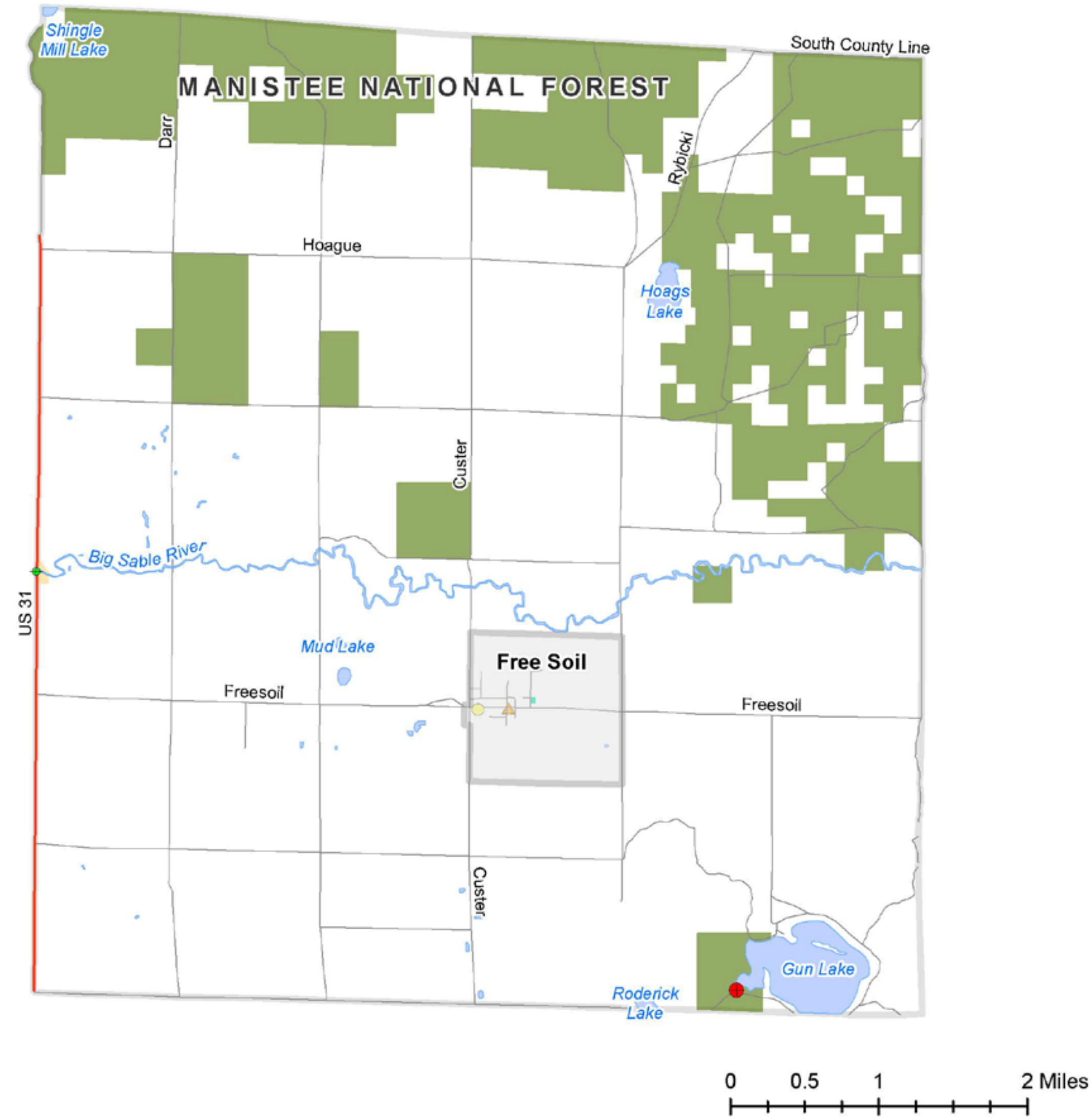
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Village of Free Soil Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	2	2	2	2	12	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	3	10	30
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Village of Free Soil Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Fire – Structural	3	10	30
3	Infrastructure Failures	3	10	30
6	Lightning	3	8	24
6	Wildfire	2	12	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
13	Tornadoes	1	15	15
14	HAZMAT – Transportation	2	7	14
15	Flooding: Riverine/Urban	2	6	12
15	Invasive Species	2	6	12
15	Transportation Accidents	2	6	12
18	Celestial Impacts	1	8	8
18	Fog	2	4	8
20	Civil Disturbances	1	6	6
20	Fire – Scrap Tires	1	6	6
20	Subsidence	1	6	6
20	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-
	Pipeline Accidents	0	-	-

FREE SOIL TOWNSHIP
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Amber Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- ***June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out. Local declaration of emergency for Riverton, Summit, Pere Marquette, and Amber townships.***
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:

- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. **TECHNOLOGICAL HAZARDS**

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- ***1 well is known to have detectable levels of hydrogen sulfide Amber Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. **HUMAN -RELATED HAZARDS**

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

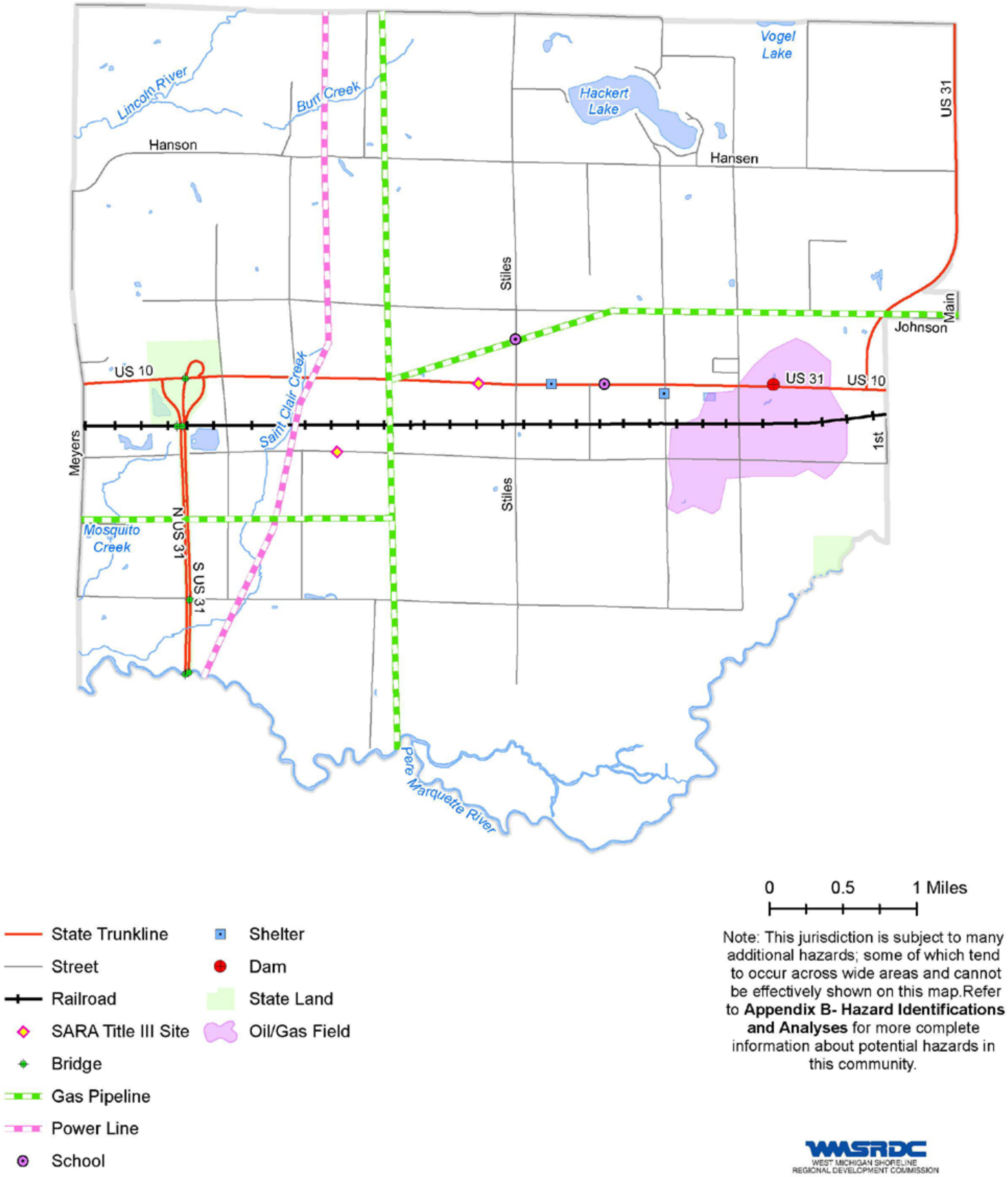
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Amber Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	1	2	2	9	27
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	1	2	7	14
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	2	7	14
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Amber Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Infrastructure Failures	3	10	30
5	Fire – Structural	3	9	27
5	Wildfire	3	9	27
7	Lightning	3	8	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	Dam failure	2	7	14
15	HAZMAT – Fixed Site	2	7	14
15	HAZMAT – Transportation	2	7	14
15	Transportation Accidents	2	7	14
19	Invasive Species	2	6	12
19	Oil/Natural Gas Well Accidents	2	6	12
21	Pipeline Accidents	1	9	9
22	Celestial Impacts	1	8	8
22	Fog	2	4	8
24	Civil Disturbances	1	6	6
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

AMBER TOWNSHIP
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Branch Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. **TECHNOLOGICAL HAZARDS**

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. **HUMAN -RELATED HAZARDS**

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

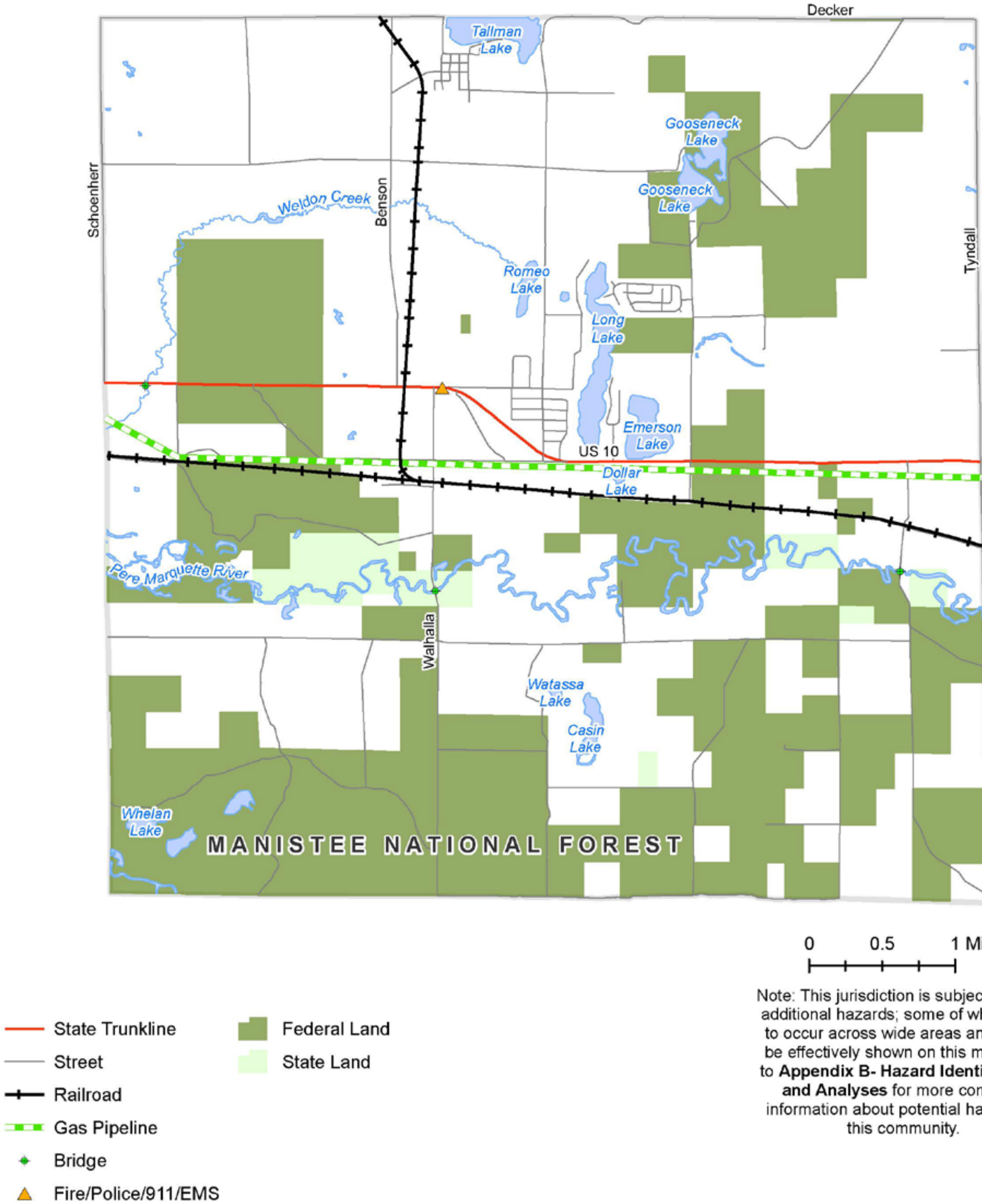
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Branch Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	0	-	-	-	-	-
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Branch Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Lightning	3	8	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Transportation	2	7	14
16	Invasive Species	2	6	12
16	Transportation Accidents	2	6	12
18	Pipeline Accidents	1	9	9
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Civil Disturbances	1	6	6
21	Fire – Scrap Tires	1	6	6
21	Subsidence	1	6	6
21	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Oil/Natural Gas Well Accidents	0	-	-

BRANCH TOWNSHIP
Critical Facilites and Potential Hazards



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WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Custer Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).
- ***March 20, 2012: 40-acre wildfire sparked by bonfire remnants, Custer Township.***

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. **TECHNOLOGICAL HAZARDS**

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. **HUMAN -RELATED HAZARDS**

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

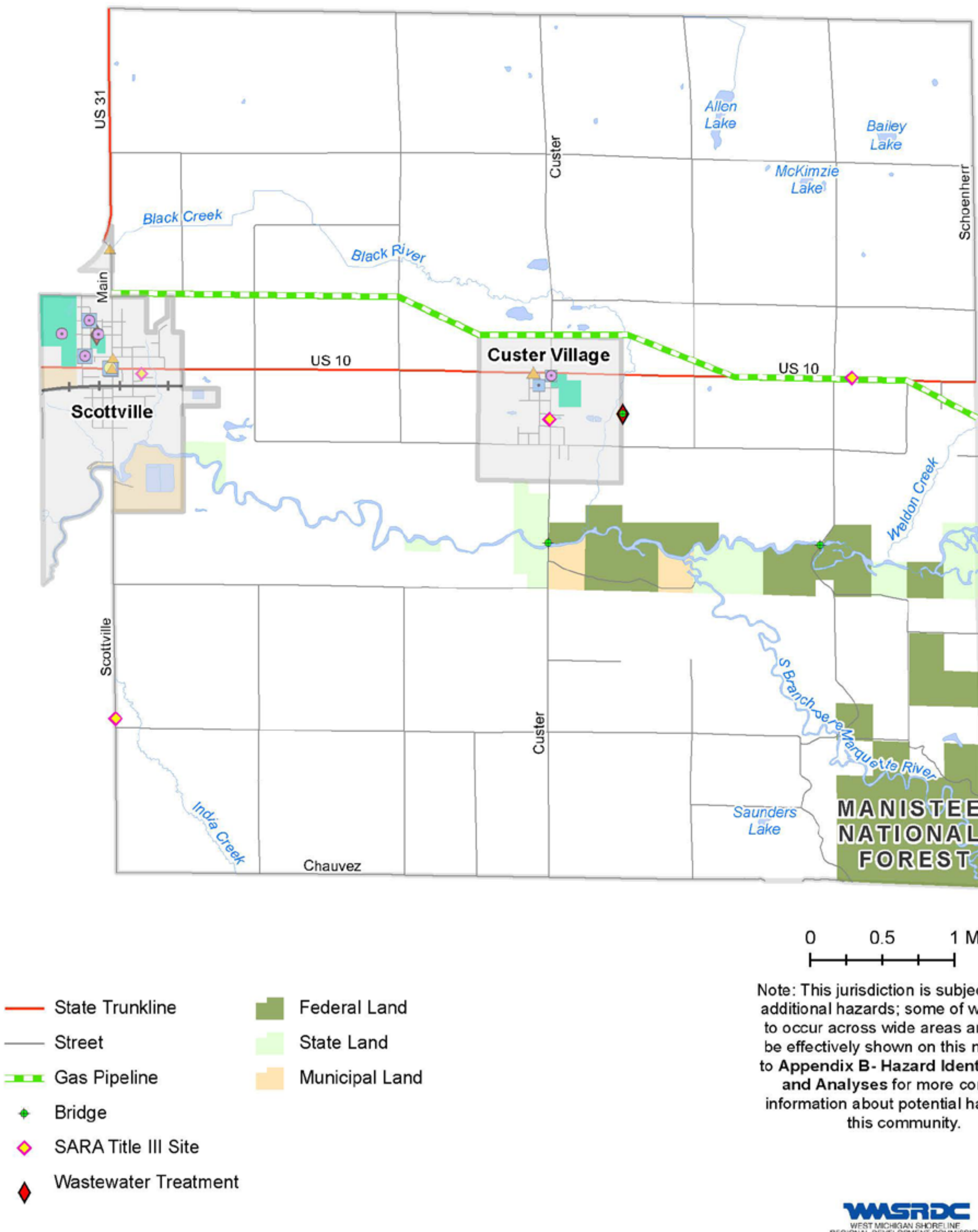
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Custer Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	1	6	12
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	2	1	1	9	9
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Custer Township Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
5	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Lightning	3	8	24
8	Catastrophic Incidents	1	18	18
8	Flooding: Riverine/Urban	3	6	18
11	Hail	2	9	18
12	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
12	Tornadoes	1	15	15
12	HAZMAT – Transportation	2	7	14
16	Invasive Species	2	7	14
17	HAZMAT – Fixed Site	2	6	12
17	Transportation Accidents	2	6	12
17	Oil/Natural Gas Well Accidents	1	9	9
17	Celestial Impacts	1	8	8
17	Fog	2	4	8
22	Civil Disturbances	1	6	6
22	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
25	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

CUSTER TOWNSHIP
Critical Facilites and Potential Hazards



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WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Eden Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes:
- ***April 12, 1972: Tornado (F2). 8 injuries, $2.5m property damage, Eden Township.***

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.
- ***5 wells are known to have detectable levels of hydrogen sulfide in Eden Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

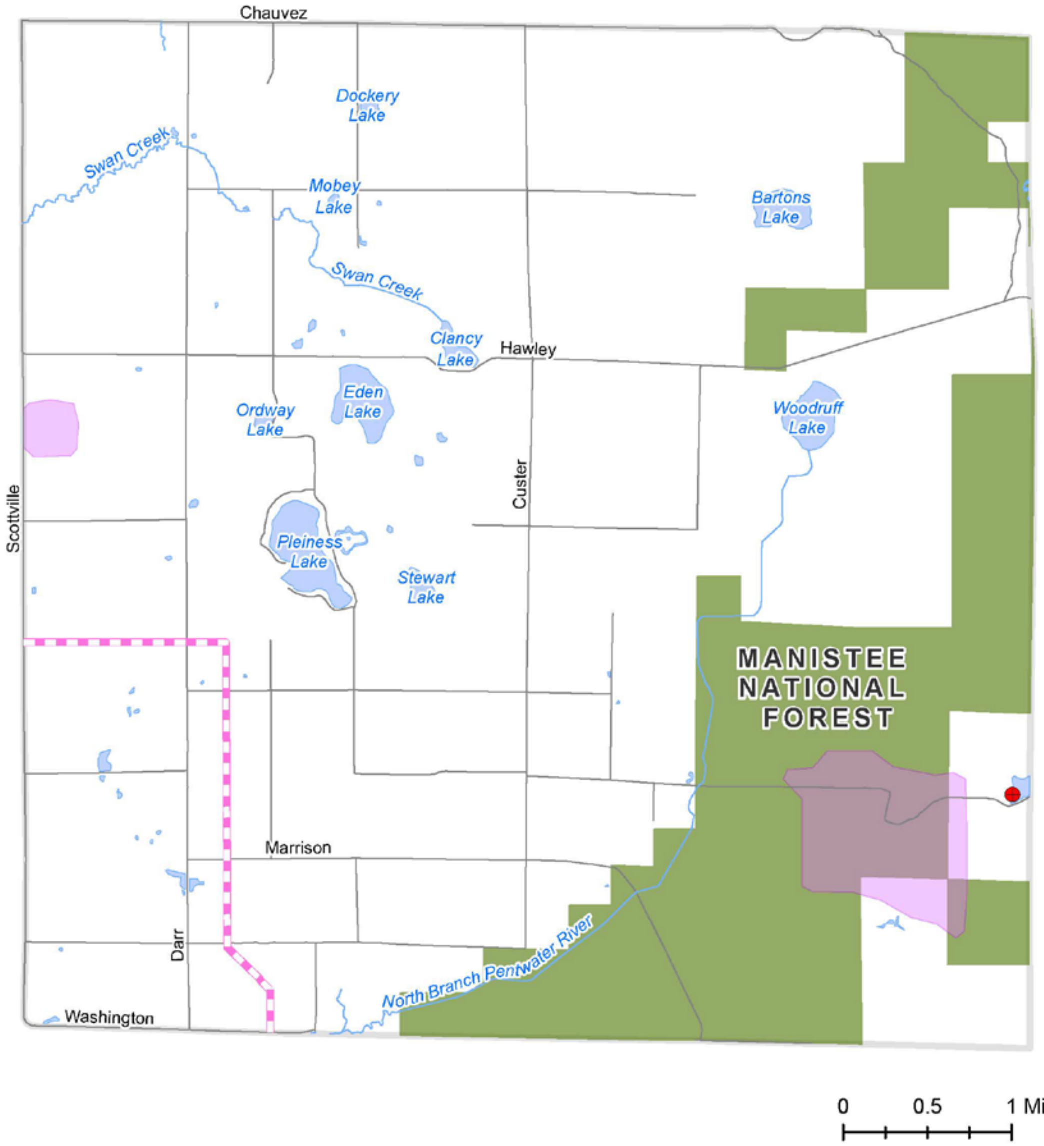
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Eden Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	2	1	11	22
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	1	1	6	12
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Eden Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		10		30
6	Fire – Structural	3		9		27
7	Drought	2		13		26
8	Lightning	3		8		24
9	Hail	2		11		22
10	Catastrophic Incidents	1		18		18
10	Public Health Emergencies	2		9		18
12	Energy Emergencies	2		8		16
13	Tornadoes	1		15		15
14	HAZMAT – Fixed Site	2		7		14
14	HAZMAT – Transportation	2		7		14
14	Invasive Species	2		7		14
17	Dam failure	2		6		12
17	Flooding: Riverine/Urban	2		6		12
17	Oil/Natural Gas Well Accidents	2		6		12
20	Celestial Impacts	1		8		8
20	Fog	2		4		8
22	Civil Disturbances	1		6		6
22	Fire – Scrap Tires	1		6		6
22	Subsidence	1		6		6
22	Terrorism & Similar Criminal Acts	1		6		6
22	Transportation Accidents	1		6		6
	Earthquake	0		-		-
	Great Lakes Shoreline	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-
	Pipeline Accidents	0		-		-

EDEN TOWNSHIP
Critical Facilities and Potential Hazards



- Street
- Power Line
- Dam
- Federal Land
- Oil/Gas Field

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Free Soil Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- ***July 24, 2005: Severe thunderstorm winds. $40k property damage, Free Soil; $20k, Scottville.***
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Free Soil Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	1	1	1	1	6	6
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Free Soil Township Hazard Ranking

		Probability of Occurrence X	Impacts Total =	Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Lightning	3	8	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
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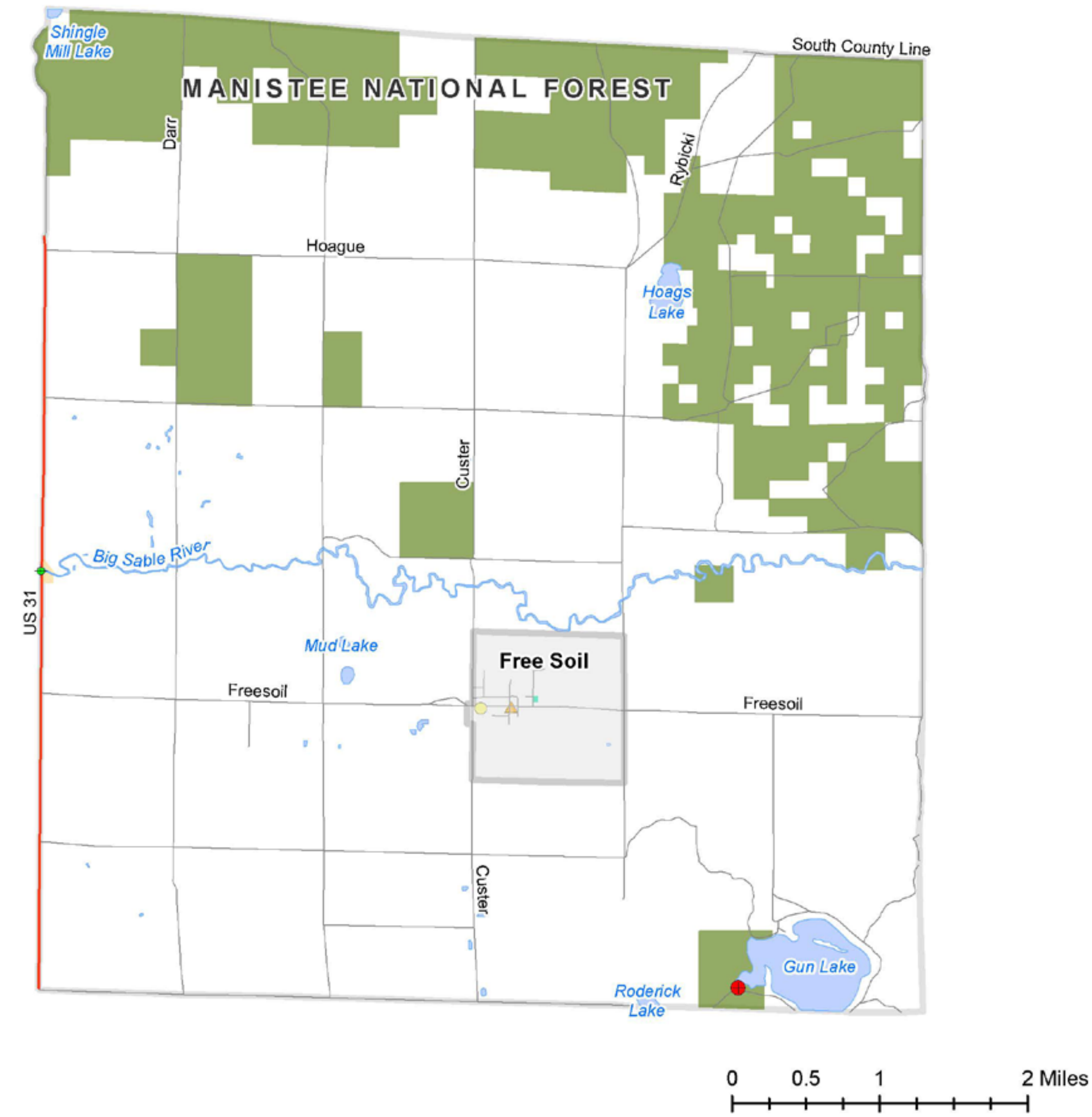
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Transportation	2	7	14
15	Invasive Species	2	7	14
17	Transportation Accidents	2	6	12
18	Celestial Impacts	1	8	8
18	Fog	2	4	8
20	Civil Disturbances	1	6	6
20	Dam failure	1	6	6
20	Fire – Scrap Tires	1	6	6
20	Oil/Natural Gas Well Accidents	1	6	6
20	Subsidence	1	6	6
20	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

FREE SOIL TOWNSHIP
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- State Trunkline
- Street
- Bridge
- Dam
- Federal Land
- Municipal Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Grant Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

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- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:

- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:

- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
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1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

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- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
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- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
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- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

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- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- ***3 wells are known to have detectable levels of hydrogen sulfide in Grant Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Grant Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
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1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
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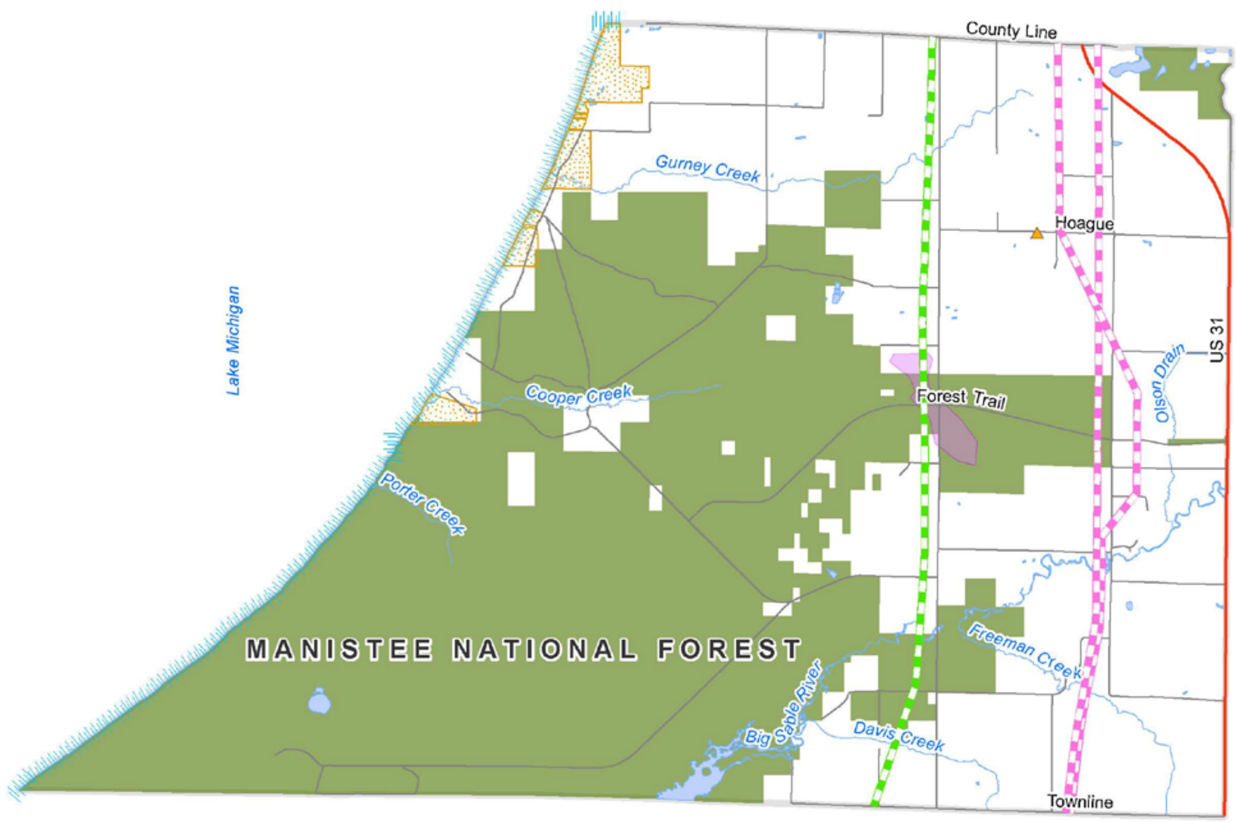
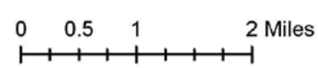
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Grant Township Hazard Ranking		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Great Lakes Shoreline	3	8	24
7	Lightning	3	8	24
9	Drought	2	11	22
10	Catastrophic Incidents	1	18	18
10	Flooding: Riverine/Urban	3	6	18
10	Hail	2	9	18
10	Public Health Emergencies	2	9	18
14	Energy Emergencies	2	8	16
15	Tornadoes	1	15	15
16	HAZMAT – Fixed Site	2	7	14
16	HAZMAT – Transportation	2	7	14
18	Fog	3	4	12
18	Invasive Species	2	6	12
18	Oil/Natural Gas Well Accidents	2	6	12
18	Transportation Accidents	2	6	12
22	Pipeline Accidents	1	9	9
23	Celestial Impacts	1	8	8
24	Civil Disturbances	1	6	6
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

GRANT TOWNSHIP
Critical Facilities and Potential Hazards





- State Trunkline
- Street
- Gas Pipeline
- Power Line
- Great Lakes Shoreline Hazard
- Fire/Police/911/EMS
- Federal Land
- High-Risk Erosion Area

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Hamlin Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:

- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Mason County since 1991: 7
- ***October 3, 2006: .75" hail. $15k property damage. $15k crop damage. Hamlin Township.***

1.09 Invasive Species:

- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.
- ***August 2, 2012: Severe thunderstorm winds. $100k property damage, Hamlin Township.***

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- ***June 12, 2008: Several trees and power lines downed (thunderstorms), Ludington and Hamlin Township.***
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- ***13 wells are known to have detectable levels of hydrogen sulfide in Hamlin Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

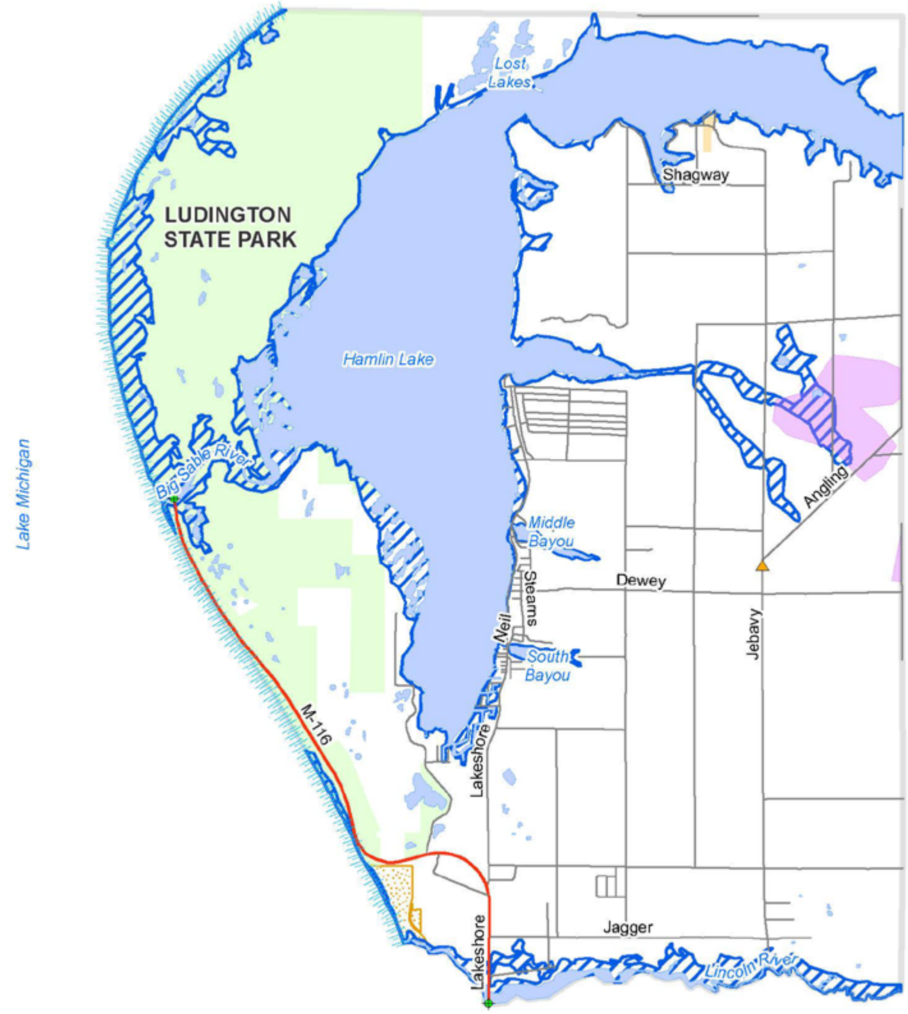
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Hamlin Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	2	3	10	20
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	1	1	1	1	6	6
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Hamlin Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X	Impacts Total	=	Hazard Score
1	Winter Storms	3		15		45
2	Severe Winds	3		12		36
3	Wildfire	3		11		33
4	Extreme Temperatures	3		10		30
4	Infrastructure Failures	3		10		30
6	Fire – Structural	3		9		27
7	Flooding: Riverine/Urban	3		8		24
7	Great Lakes Shoreline	3		8		24
7	Lightning	3		8		24
10	Drought	2		11		22
11	Dam failure	2		10		20
12	Catastrophic Incidents	1		18		18
12	Hail	2		9		18
12	Public Health Emergencies	2		9		18
15	Energy Emergencies	2		8		16
16	Tornadoes	1		15		15
17	Fog	3		4		12
17	Invasive Species	2		6		12
17	Oil/Natural Gas Well Accidents	2		6		12
20	Pipeline Accidents	1		9		9
21	Celestial Impacts	1		8		8
22	Civil Disturbances	1		6		6
22	Fire – Scrap Tires	1		6		6
22	HAZMAT – Transportation	1		6		6
22	Subsidence	1		6		6
22	Terrorism & Similar Criminal Acts	1		6		6
22	Transportation Accidents	1		6		6
	Earthquake	0		-		-
	HAZMAT – Fixed Site	0		-		-
	Nuclear Attack	0		-		-
	Nuclear Power Emergencies	0		-		-

HAMLIN TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 2 Miles

- State Trunkline
- Street
- Bridge
- Great Lakes Shoreline Hazard
- Fire/Police/911/EMS
- State Land
- Municipal Parks
- High-Risk Erosion Area
- Oil/Gas Field
- Floodplain

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Maso Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Logan Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:

- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

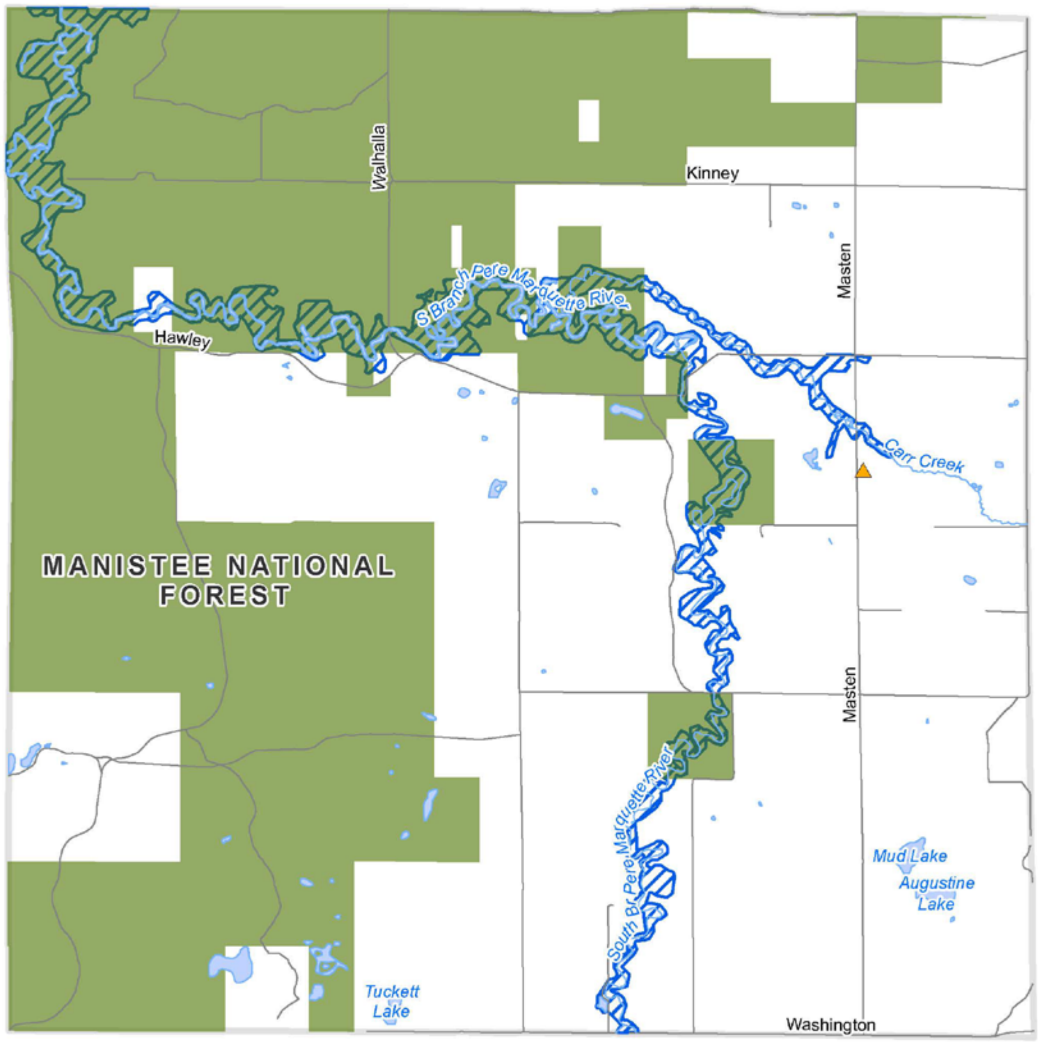
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Logan Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	1	1	1	1	6	6
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Logan Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Lightning	3	8	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	Invasive Species	2	6	12
15	Oil/Natural Gas Well Accidents	2	6	12
17	Celestial Impacts	1	8	8
17	Fog	2	4	8
19	Civil Disturbances	1	6	6
19	Fire – Scrap Tires	1	6	6
19	HAZMAT – Transportation	1	6	6
19	Subsidence	1	6	6
19	Terrorism & Similar Criminal Acts	1	6	6
19	Transportation Accidents	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

LOGAN TOWNSHIP
Critical Facilities and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

- Street
- Fire/Police/911/EMS
- Federal Land
- Floodplain

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Meade Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

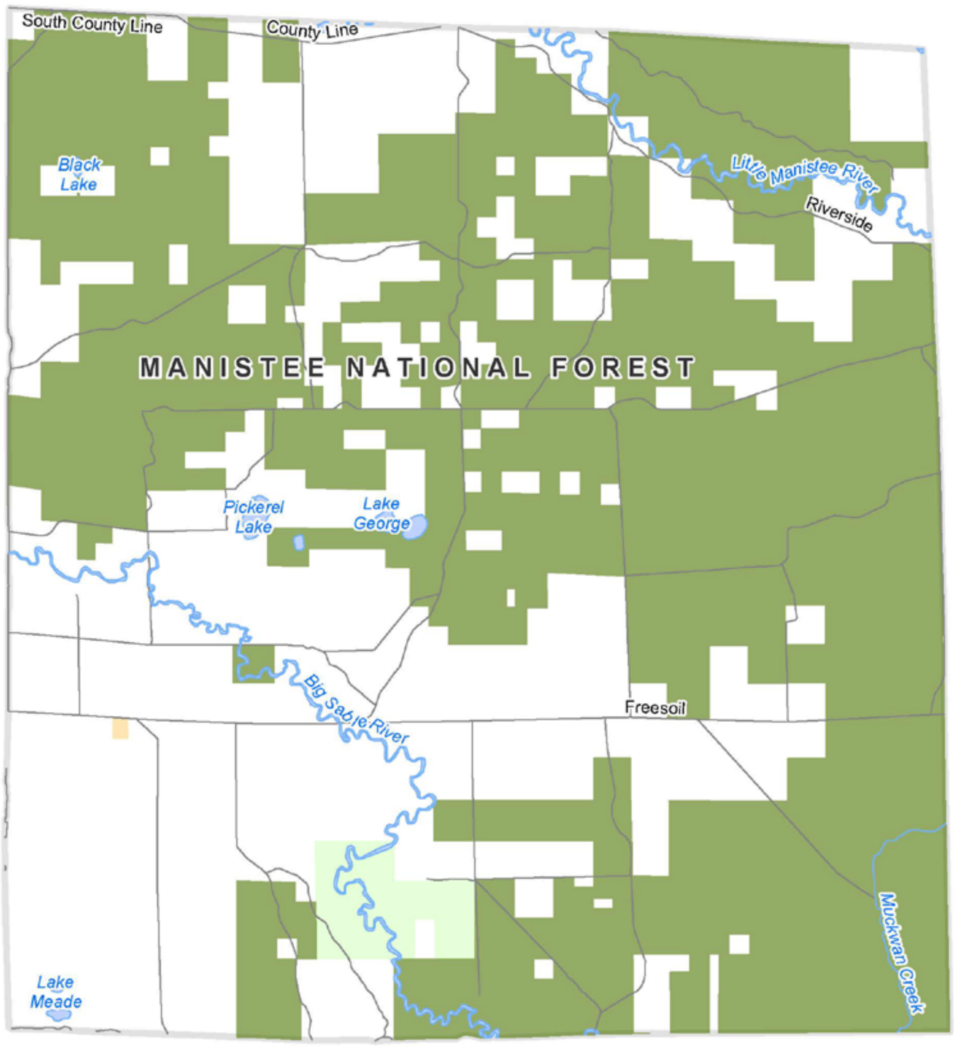
Meade Township Hazard Rating

		Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	2	10	20
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	1	1	1	1	6	6
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Meade Township
Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Flooding: Riverine/Urban	3	8	24
7	Lightning	3	8	24
9	Drought	2	10	20
10	Catastrophic Incidents	1	18	18
10	Hail	2	9	18
10	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Fixed Site	2	7	14
16	Invasive Species	2	6	12
17	Celestial Impacts	1	8	8
17	Fog	2	4	8
19	Civil Disturbances	1	6	6
19	Fire – Scrap Tires	1	6	6
19	HAZMAT – Transportation	1	6	6
19	Oil/Natural Gas Well Accidents	1	6	6
19	Subsidence	1	6	6
19	Terrorism & Similar Criminal Acts	1	6	6
19	Transportation Accidents	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

MEADE TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 2 Miles

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

Street
Federal Land
State Land
Municipal Land

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Pere Marquette Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- ***June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out. Local declaration of emergency for Riverton, Summit, Pere Marquette, and Amber townships.***
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

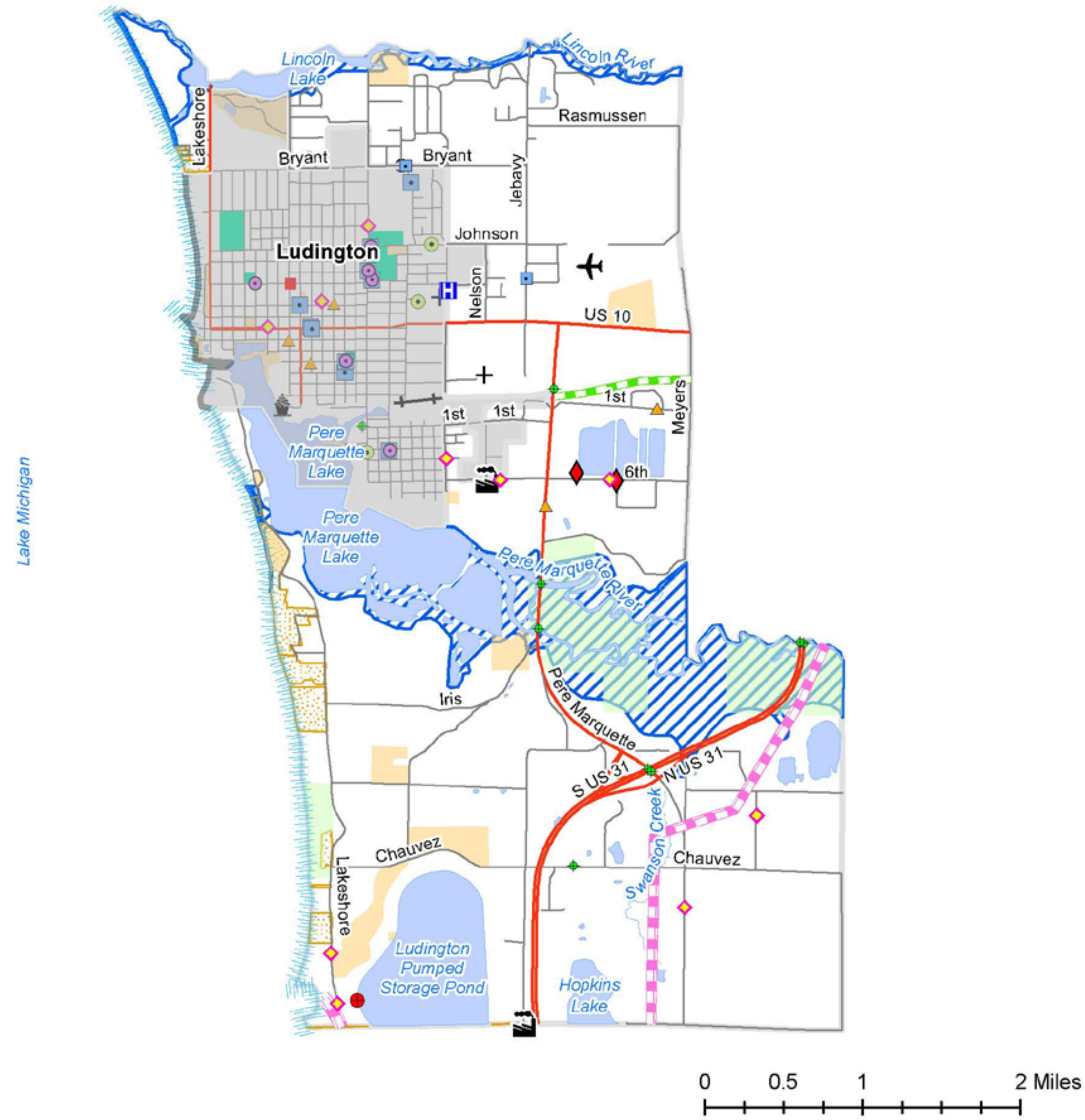
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Pere Marquette Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	1	2	1	8	24
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	2	2	3	13	26
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Pere Marquette Township Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Extreme Temperatures	3	10	30
3	Infrastructure Failures	3	10	30
5	Fire – Structural	3	9	27
6	Dam failure	2	13	26
7	Flooding: Riverine/Urban	3	8	24
7	Great Lakes Shoreline	3	8	24
7	Lightning	3	8	24
7	Wildfire	3	8	24
11	Drought	2	11	22
12	Catastrophic Incidents	1	18	18
12	Hail	2	9	18
12	Public Health Emergencies	2	9	18
15	Energy Emergencies	2	8	16
16	Tornadoes	1	15	15
17	HAZMAT – Fixed Site	2	7	14
17	HAZMAT – Transportation	2	7	14
19	Fog	3	4	12
19	Invasive Species	2	6	12
19	Oil/Natural Gas Well Accidents	2	6	12
29	Transportation Accidents	2	6	12
23	Pipeline Accidents	1	9	9
24	Celestial Impacts	1	8	8
25	Civil Disturbances	1	6	6
25	Fire – Scrap Tires	1	6	6
25	Subsidence	1	6	6
25	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

PERE MARQUETTE TOWNSHIP
Critical Facilities and Potential Hazards



- State Trunkline
- Street
- Gas Pipeline
- Power Line
- Great Lakes Shoreline Hazard
- SARA Title III Site
- Bridge
- Wastewater Treatment
- Communications Tower
- Airport
- Power Plant
- Dam
- Hospital
- Fire/Police/911/EMS
- Shelter
- State Land
- Municipal Land
- High-Risk Erosion Area
- Floodplain

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Riverton Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- ***June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out. Local declaration of emergency for Riverton, Summit, Pere Marquette, and Amber townships.***
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7
- ***May 17, 2001: .88" hail. $10k property damage, $10k crop damage, Riverton Township.***

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
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- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- ***3 wells are known to have detectable levels of hydrogen sulfide in Riverton Township.***

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

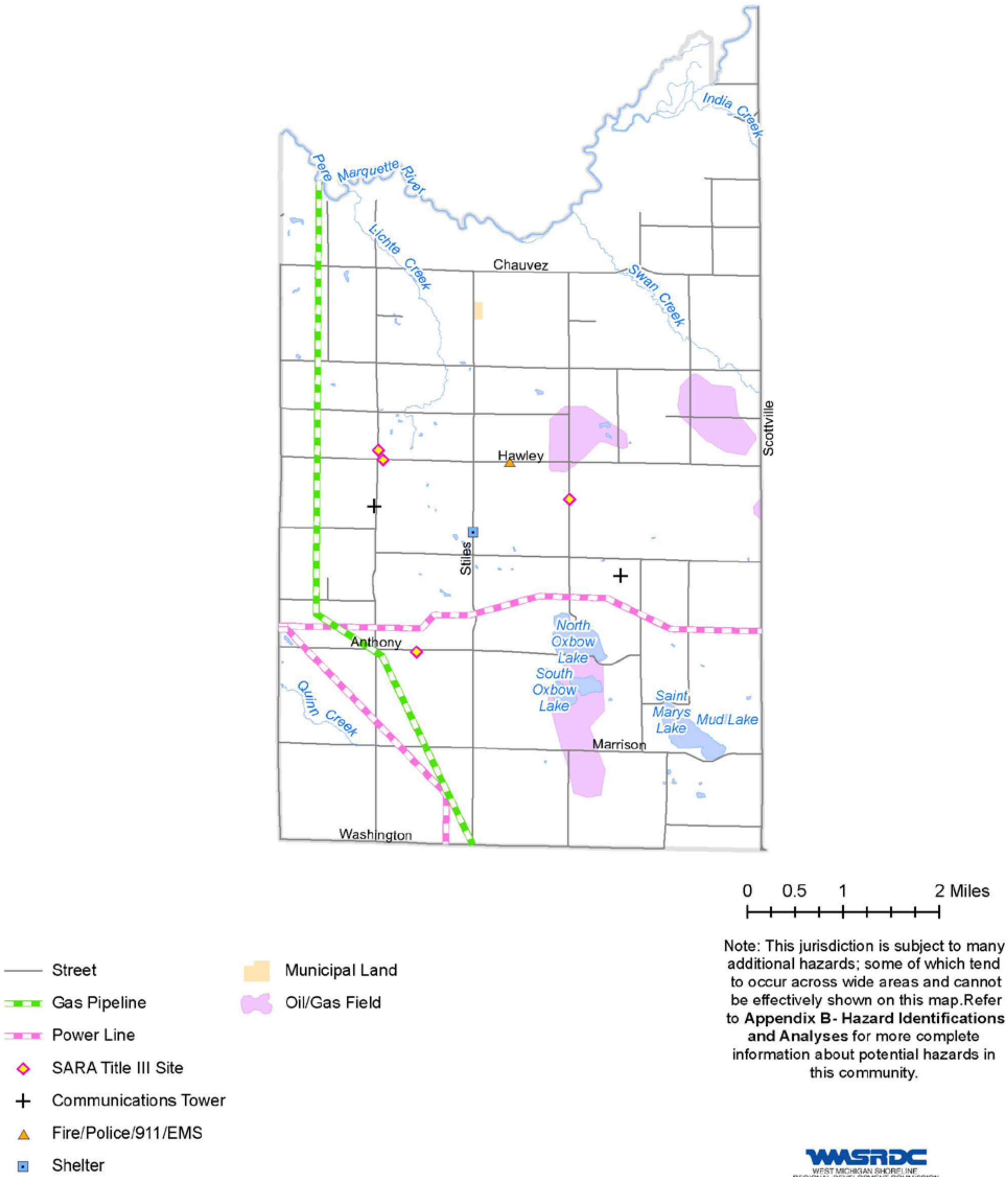
Riverton Township Hazard Rating

		Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	1	1	1	3	8	8
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	1	6	12
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Riverton Township Hazard Ranking

		Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Lightning	3	8	24
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Fixed Site	2	7	14
15	Invasive Species	2	7	14
17	HAZMAT – Transportation	2	6	12
17	Oil/Natural Gas Well Accidents	2	6	12
19	Pipeline Accidents	1	9	9
20	Celestial Impacts	1	8	8
20	Dam failure	1	8	8
20	Fog	2	4	8
23	Civil Disturbances	1	6	6
23	Fire – Scrap Tires	1	6	6
23	Subsidence	1	6	6
23	Terrorism & Similar Criminal Acts	1	6	6
23	Transportation Accidents	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

RIVERTON TOWNSHIP
Critical Facilites and Potential Hazards



Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Sheridan Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:

- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:

- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:

- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:

- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:

- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:

- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:

- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

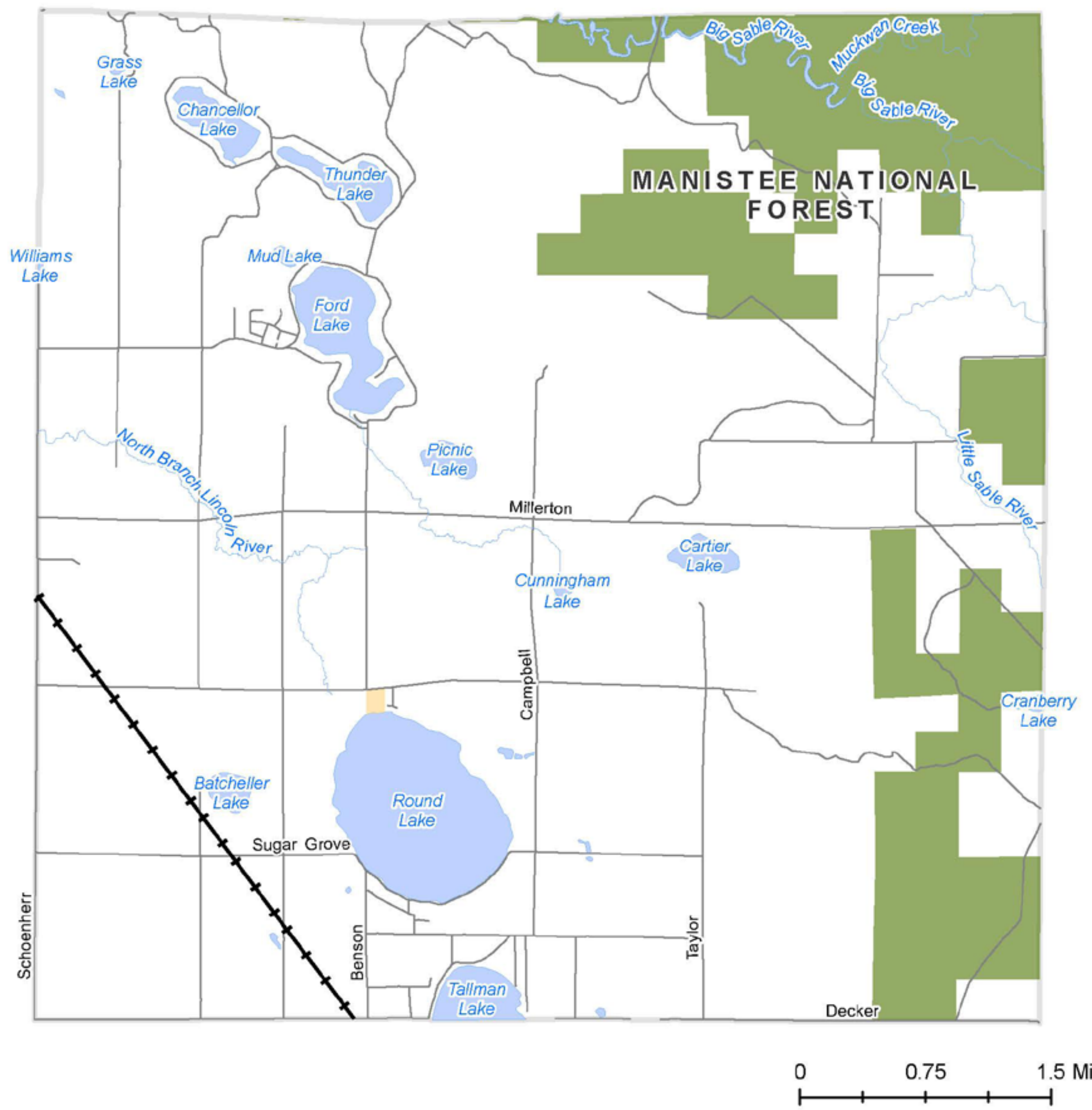
3.05 Terrorism and Similar Criminal Activities: - None Identified.

Sheridan Township Hazard Rating		Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	1	3	11	22
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	1	1	6	18
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	1	6	12
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	0	-	-	-	-	-
2.06	HAZMAT – Transportation	2	1	1	1	6	12
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	1	1	1	1	6	6
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Sheridan Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Lightning	3	8	24
8	Drought	2	11	22
9	Catastrophic Incidents	1	18	18
9	Flooding: Riverine/Urban	3	6	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
13	Energy Emergencies	2	8	16
14	Tornadoes	1	15	15
15	HAZMAT – Transportation	2	6	12
15	Invasive Species	2	6	12
17	Celestial Impacts	1	8	8
17	Fog	2	4	8
19	Civil Disturbances	1	6	6
19	Fire – Scrap Tires	1	6	6
19	Oil/Natural Gas Well Accidents	1	6	6
19	Subsidence	1	6	6
19	Terrorism & Similar Criminal Acts	1	6	6
19	Transportation Accidents	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	HAZMAT – Fixed Site	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

SHERIDAN TOWNSHIP
Critical Facilities and Potential Hazards



- Street
- Railroad
- Federal Land
- Municipal Land

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile

Sherman Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- ***September 16, 1997: Severe thunderstorm winds. $25k property damage, Ludington; $10k, Fountain.***
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:
- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:
- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):
- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:
- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:
- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

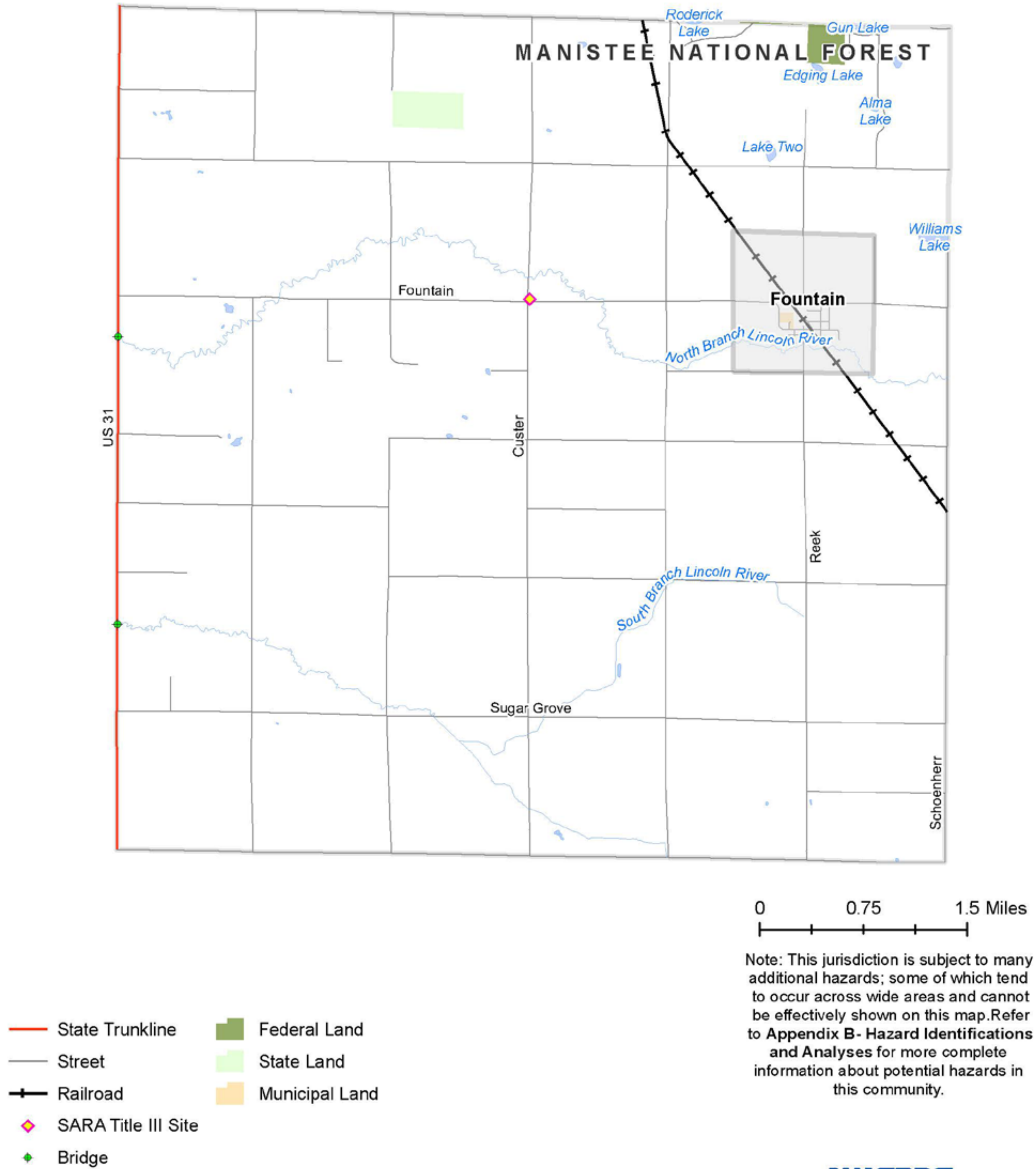
3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Sherman Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	0	-	-	-	-	-
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	1	6	12
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	1	1	1	1	6	6
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Sherman Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Drought	2	13	26
8	Lightning	3	8	24
9	Catastrophic Incidents	1	18	18
9	Hail	2	9	18
9	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
13	Tornadoes	1	15	15
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
16	Flooding: Riverine/Urban	2	6	12
16	HAZMAT – Fixed Site	2	6	12
16	Transportation Accidents	2	6	12
19	Celestial Impacts	1	8	8
19	Fog	2	4	8
21	Civil Disturbances	1	6	6
21	Fire – Scrap Tires	1	6	6
21	Oil/Natural Gas Well Accidents	1	6	6
21	Subsidence	1	6	6
21	Terrorism & Similar Criminal Acts	1	6	6
	Dam failure	0	-	-
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

SHERMAN TOWNSHIP
Critical Facilities and Potential Hazards



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WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Summit Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- ***June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out. Local declaration of emergency for Riverton, Summit, Pere Marquette, and Amber townships.***
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards:
- Extreme high water levels in the Great Lakes: 1929, 1952, 1973, 1986, and 1997.
- Extreme low water levels in the Great Lakes: 1926, 1934, 1964, 2003, and 2013.
- Rip current incidents on Lake Michigan, 2002-2012: 77 fatalities, 230 rescues.
- June 1986: Record high water level on Lake Michigan.
- July 13, 1938: Seiche/storm surge on Lake Michigan. 3 drowned in Holland, 1 in Muskegon, and 1 near Pentwater.
- 2013: Record low water level on Lake Michigan.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:

- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
- January 12, 1993: Heavy snow. $50k property damage, northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
- September 16, 1997: Power lines downed in Fountain and across county. 500 customers affected.
- May 31, 1998: Power outage (thunderstorms). 681,000 outages in Lower Michigan. Countywide for up to a week.
- November 10, 1998: Power outage (high wind). 167,000 customers without power, statewide.
- April 3, 2003: Hundreds of thousands lose power (ice storm), Lower Michigan.
- October 10, 2004: 100,000 without power (high wind), statewide.
- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.

2.10 Pipeline Accidents: - None Identified.

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

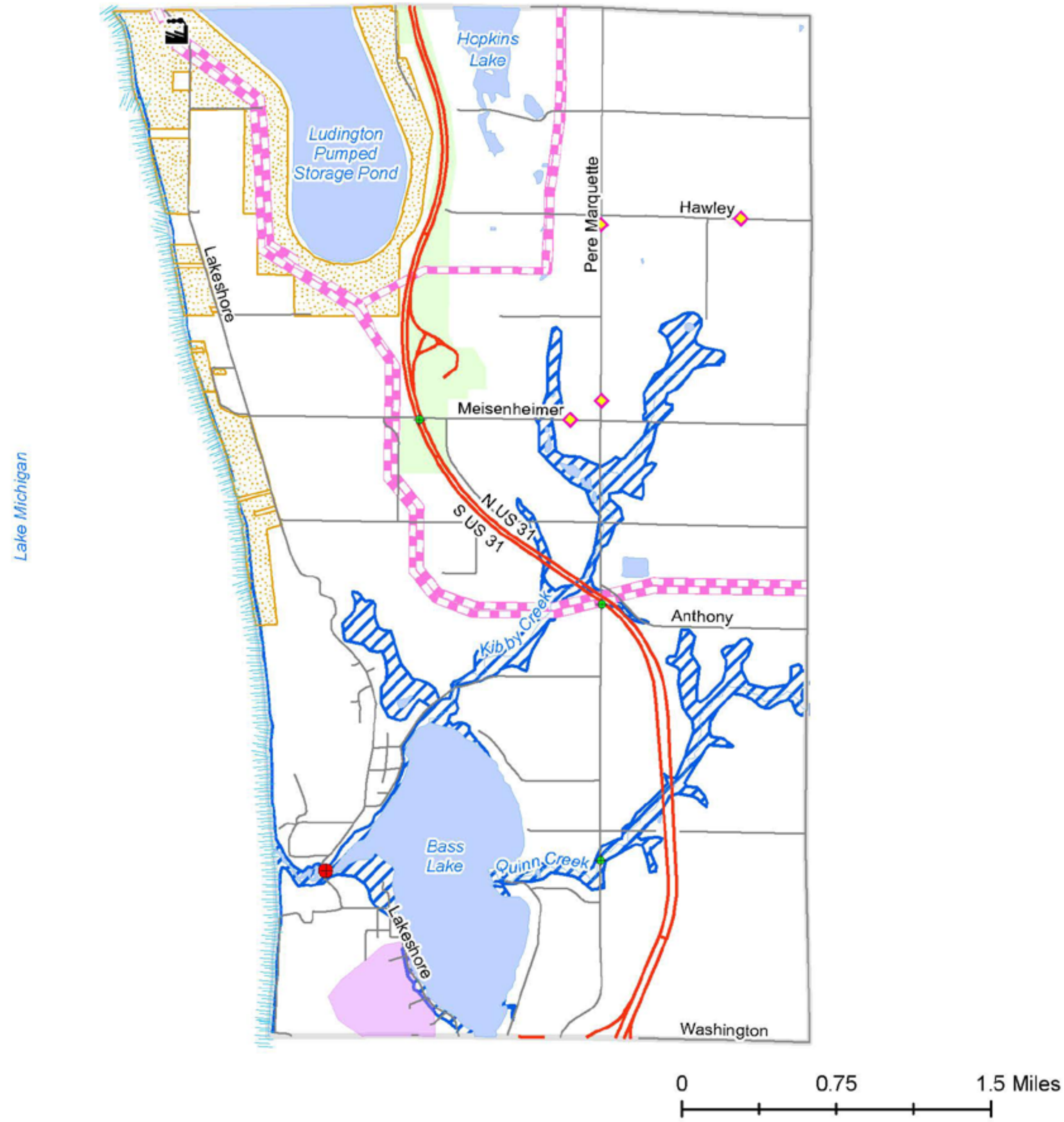
3.05 Terrorism and Similar Criminal Activities: - None Identified.

Summit Township Hazard Rating		Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	3	1	2	1	8	24
1.06	Fog	3	1	0	1	4	12
1.07	Great Lakes Shoreline	3	1	2	1	8	24
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	2	2	3	13	26
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	0	-	-	-	-	-
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Summit Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
1	Winter Storms	3	15	45
2	Severe Winds	3	12	36
3	Wildfire	3	11	33
4	Extreme Temperatures	3	10	30
4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
7	Dam failure	2	13	26
7	Drought	2	13	26
9	Flooding: Riverine/Urban	3	8	24
9	Great Lakes Shoreline	3	8	24
9	Lightning	3	8	24
12	Catastrophic Incidents	1	18	18
12	Hail	2	9	18
12	Public Health Emergencies	2	9	18
15	Energy Emergencies	2	8	16
16	Tornadoes	1	15	15
17	HAZMAT – Fixed Site	2	7	14
17	HAZMAT – Transportation	2	7	14
17	Invasive Species	2	7	14
20	Fog	3	4	12
20	Oil/Natural Gas Well Accidents	2	6	12
20	Transportation Accidents	2	6	12
23	Celestial Impacts	1	8	8
24	Civil Disturbances	1	6	6
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-
	Pipeline Accidents	0	-	-

SUMMIT TOWNSHIP
Critical Facilities and Potential Hazards



- State Trunkline
- State
- Power Line
- Great Lakes Shoreline Hazard
- SARA Title III Site
- Bridge
- Power Plant
- Dam
- State Land
- Floodplain
- Oil/Gas Field
- High-Risk Erosion Area

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Hazard Identification Profile
Victory Township

1. NATURAL HAZARDS

1.01 Celestial Impacts: - None Identified.

1.02 Drought:
- Summer 1871: Prolonged drought over much of the Great Lakes region.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- 12 recorded drought events in the area (including Lake, Mason, Muskegon, Newaygo, and Oceana counties) lasting eight months or greater: 1895-1896 (15 months), 1899-1900 (11 months), 1901-1902 (10 months), 1909-1911 (24 months), 1925-1926 (11 months), 1930-1931 (18 months), 1956-1957 (8 months), 1962-1963 (9 months), 1971-1972 (12 months), 1976-1977 (13 months), and 2002-2003 (12 months).

1.03 Earthquake: - None Identified; no significant threat.

1.04 Extreme Temperatures:
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer 1988: 39 days with temperatures over 90 degrees, statewide.
- January 20, 1994: Record cold. $50m property damage across Michigan.
- March 2012: Anomalous temperatures. $209.8m crop damage across Michigan.

1.05 Flooding - Riverine/ Urban:
- September 10-19, 1986: Flooding. Presidential disaster declaration.
- February 9-10, 2001: Flash flood. $100k property damage, Mason County.
- May 15-16, 2001: Flash flood. $150k property damage, $150k crop damage across Mason County.
- Late May-Early June, 2004: Flooding. $1m property damage, 200k crop damage, Mason County
- June 9, 2004: Flooding. Over 8" rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out.
- June 13, 2008: Flash flood. Presidential disaster declaration. Up to 11" rain in 6-8 hours, $3m property damage, $500k crop damage, Mason County.
- May 3, 2012: Flash flood. $75k property damage, Mason County.
- April 2014: Flood. (details yet to come), Mason County.

1.06 Fog:
- January 11-13, 1995: Dense Fog. 4 traffic accident fatalities, school closures, and flight delays across Michigan.

1.07 Great Lakes Shoreline Hazards: - None Identified.

1.08 Hail:
- Severe hail events (1" or greater) recorded in Mason County since 1991: 7

1.09 Invasive Species:
- Invasive species exist in Mason County, however no significant events have been identified.

1.10 Lightning: - None Identified.

1.11 Severe Winds:
- April 6, 1997: High wind. $5m property damage across southwest Lower Michigan.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 18, 2001: High wind. $100k property damage across central Lower Michigan.
- March 9, 2002: High wind. $485k property damage across southwest Lower Michigan.
- October 30, 2004: High wind. $1.15m property damage across southwest Lower Michigan.
- October 4, 2006: Severe thunderstorm winds. $80k property damage, $20k crop damage, Mason County.

1.12 Subsidence: - None Identified.

1.13 Tornadoes: - None Identified.

1.14 Wildfire:
- October 1871: Wildfires. 1.2m acres burned, 200 fatalities, Lower Peninsula.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.
- 1981-2010: Approximately 1 wildfire and 5 acres burned per year on county lands under MDNR jurisdiction (32 total wildfires, 154.6 total acres burned).

1.15 Winter Storms:
- January 26, 1978: Blizzard, snowstorm. Declaration of statewide emergency by President, disaster by Governor.
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- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003: Ice storm. $4.9m property damage throughout West Michigan.

2. TECHNOLOGICAL HAZARDS

2.01 Dam Failure:

- Two documented in Mason County but locations not identified.

2.02 Energy Emergencies: - None Identified.

2.03 Fire - Scrap Tire: - None Identified.

2.04 Fire - Structural:

- County fire rate per 1,000 population in 1998: 4.63

2.05 Hazard Material Incidents - Fixed Site (including industrial accidents):

- SARA Title III sites within Mason County: 26

2.06 Hazard Material Incidents - Transportation: - None Identified.

2.07 Infrastructure Failure:

- Number of NCDC events showing downed power lines or power outages in Mason County, 1997-2014: 27
- January 20, 1994: Frozen sewer/water lines.
- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day (high wind event), statewide.
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- October 4, 2006: Several trees and power lines downed (thunderstorms), Mason County.
- December 28, 2008: Several trees and power lines downed (high wind), Mason County.
- February 1-2, 2013: Scattered power outages (lake effect snow), Mason County.

2.08 Nuclear Power Plant Emergencies: - None Identified.

2.09 Oil and Natural Gas Well Accidents:

- 710 oil and gas wells within Mason County.
- ***18 wells are known to have detectable levels of hydrogen sulfide in Victory Township.***
- ***May 13, 1994: Blown gasket at a compression station allowed hydrogen sulfide emissions causing a number of self-evacuations and at least 11 emergency hospitalizations, Victory Township.***
- ***January 5, 1996: Stuck valve caused 18 emergency calls, Victory Township.***

2.10 Pipeline Accidents:

- ***February 1995: Pipeline rupture. 1 evacuation, Victory Township.***
- ***April 1995: Pipeline rupture. 30 evacuations, Victory Township.***
- ***July 1996: Pipeline rupture. Self-evacuations, Victory Township.***
- ***August 1996: Pipeline rupture. Self-evacuations, Victory Township.***
- ***September 1996: Accident involving pipeline replacement. 1 injury, Victory Township.***

2.11 Transportation Accidents: - None Identified.

3. HUMAN -RELATED HAZARDS

3.01 Catastrophic Incidents (National Emergencies): - None Identified.

3.02 Civil Disturbances: - None Identified.

3.03 Nuclear Attack: - None Identified.

3.04 Public Health Emergencies: - None Identified.

3.05 Terrorism and Similar Criminal Activities: - None Identified.

	Victory Township Hazard Rating	Probability of Occurrence	Impact on People	Impact on Property	Impact on Economy	Impacts Total	Hazard Score
1.01	Celestial Impacts	1	2	0	2	8	8
1.02	Drought	2	2	2	3	13	26
1.03	Earthquake	0	-	-	-	-	-
1.04	Extreme Temperatures	3	2	1	2	10	30
1.05	Flooding: Riverine/Urban	2	1	1	1	6	12
1.06	Fog	2	1	0	1	4	8
1.07	Great Lakes Shoreline	0	-	-	-	-	-
1.08	Hail	2	2	1	1	9	18
1.09	Invasive Species	2	1	1	2	7	14
1.10	Lightning	3	1	2	1	8	24
1.11	Severe Winds	3	2	2	2	12	36
1.12	Subsidence	1	1	1	1	6	6
1.13	Tornadoes	1	3	2	2	15	15
1.14	Wildfire	3	2	2	1	11	33
1.15	Winter Storms	3	3	2	2	15	45
2.01	Dam failure	2	1	1	1	6	12
2.02	Energy Emergencies	2	2	0	2	8	16
2.03	Fire – Scrap Tires	1	1	1	1	6	6
2.04	Fire – Structural	3	1	2	2	9	27
2.05	HAZMAT – Fixed Site	2	1	1	2	7	14
2.06	HAZMAT – Transportation	2	1	1	2	7	14
2.07	Infrastructure Failures	3	2	1	2	10	30
2.08	Nuclear Power Emergencies	0	-	-	-	-	-
2.09	Oil/Natural Gas Well Accidents	2	1	1	1	6	12
2.10	Pipeline Accidents	1	1	2	2	9	9
2.11	Transportation Accidents	2	1	1	1	6	12
3.01	Catastrophic Incidents	1	3	3	3	18	18
3.02	Civil Disturbances	1	1	1	1	6	6
3.03	Nuclear Attack	0	-	-	-	-	-
3.04	Public Health Emergencies	2	2	0	3	9	18
3.05	Terrorism & Similar Criminal Acts	1	1	1	1	6	6

Victory Township Hazard Ranking

Rank	Hazard	Probability of Occurrence	X Impacts Total	= Hazard Score
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4	Infrastructure Failures	3	10	30
6	Fire – Structural	3	9	27
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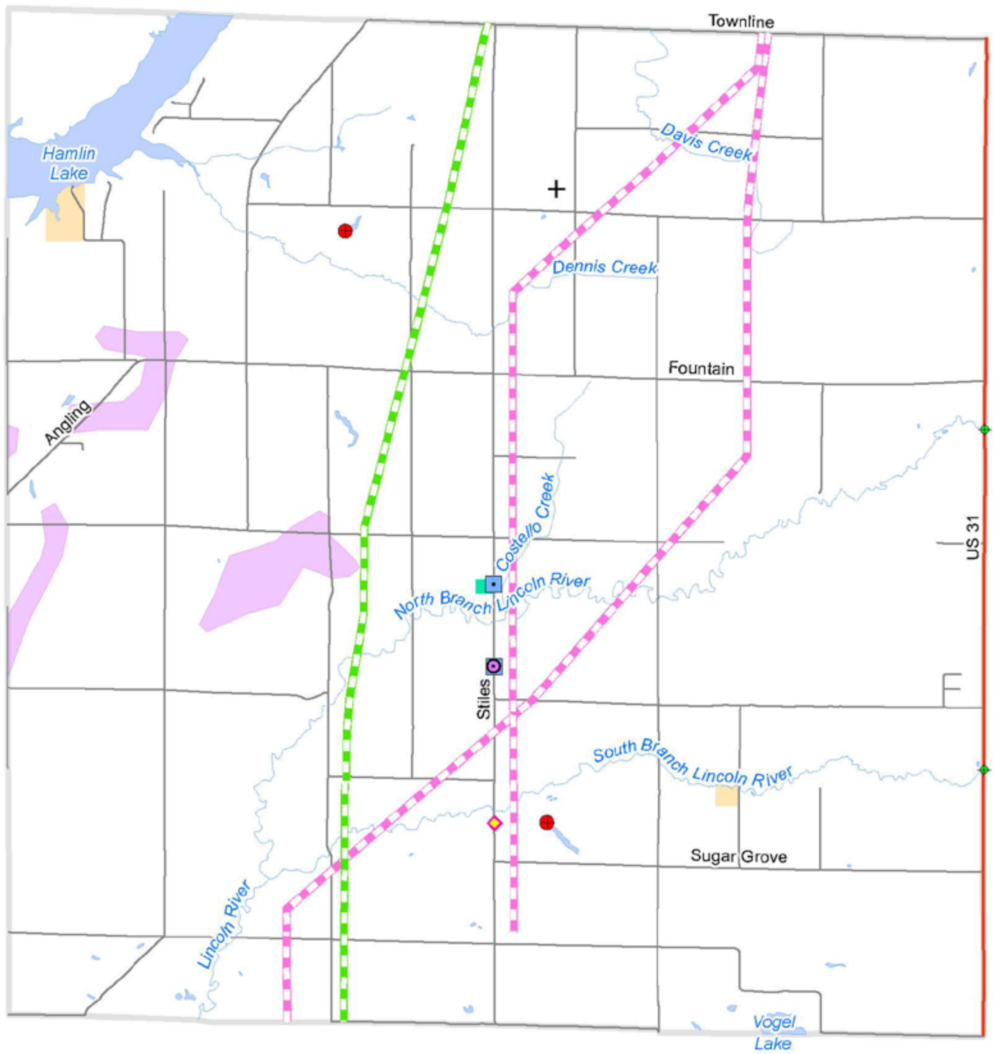
9	Public Health Emergencies	2	9	18
12	Energy Emergencies	2	8	16
13	Tornadoes	1	15	15
14	HAZMAT – Fixed Site	2	7	14
14	HAZMAT – Transportation	2	7	14
14	Invasive Species	2	7	14
17	Dam failure	2	6	12
17	Flooding: Riverine/Urban	2	6	12
17	Oil/Natural Gas Well Accidents	2	6	12
17	Transportation Accidents	2	6	12
21	Pipeline Accidents	1	9	9
22	Celestial Impacts	1	8	8
22	Fog	2	4	8
24	Civil Disturbances	1	6	6
24	Fire – Scrap Tires	1	6	6
24	Subsidence	1	6	6
24	Terrorism & Similar Criminal Acts	1	6	6
	Earthquake	0	-	-
	Great Lakes Shoreline	0	-	-
	Nuclear Attack	0	-	-
	Nuclear Power Emergencies	0	-	-

VICTORY TOWNSHIP
Critical Facilities and Potential Hazards



0 0.5 1 2 Miles

- State Trunkline
- Street
- Gas Pipeline
- Power Line
- SARA Title III Site
- Bridge
- Communications Tower
- Dam
- School
- Shelter
- School Property
- Municipal Land
- Oil/Gas Field

Note: This jurisdiction is subject to many additional hazards; some of which tend to occur across wide areas and cannot be effectively shown on this map.Refer to **Appendix B- Hazard Identifications and Analyses** for more complete information about potential hazards in this community.

WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION

Source: Michigan Geographic Data Library V 12b, Mason Co. Hazard Mitigation Plan Update 2014

Appendix C:
HAZARD IDENTIFICATION DATA AND MAPS

National Climatic Data Center: Storm Events
(140 events were reported in Mason County, Michigan between 01/01/1950 and 03/31/2005)

COUNTY	DATE	TIME	TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE ($)	
							property	crop
1 MASON	4/24/1960	1631	Hail	0.75 in.	0	0	0	0
2 MASON	8/15/1966	1500	Tornado	F0	0	0	0K	0
3 MASON	4/12/1972	930	Tornado	F1	0	0	0K	0
4 MASON	4/12/1972	930	Tornado	F2	0	8	2.5M	0
5 MASON	4/12/1972	2130	Tornado	F1	0	0	0K	0
6 MASON	7/10/1975	110	Hail	0.75 in.	0	0	0	0
7 MASON	8/31/1976	1900	Tstm Wind	0 kts.	0	0	0	0
8 MASON	9/5/1983	1820	Tstm Wind	0 kts.	0	0	0	0
9 MASON	8/29/1984	2200	Tstm Wind	0 kts.	0	0	0	0
10 MASON	6/8/1985	2225	Tstm Wind	0 kts.	0	0	0	0
11 MASON	6/8/1985	2250	Tstm Wind	0 kts.	0	0	0	0
12 MASON	8/17/1988	1700	Tstm Wind	0 kts.	0	0	0	0
13 MASON	8/4/1989	2200	Tstm Wind	0 kts.	0	0	0	0
14 MASON	7/3/1991	1630	Hail	1.00 in.	0	0	0	0
15 MASON	7/7/1991	1620	Hail	1.00 in.	0	0	0	0
16 MASON	6/17/1992	1417	Tstm Wind	0 kts.	0	0	0	0
17 MASON	6/17/1992	1421	Tstm Wind	0 kts.	0	0	0	0
18 MASON	6/17/1992	1435	Tstm Wind	0 kts.	0	0	0	0
19 MASON	6/17/1992	1440	Tstm Wind	0 kts.	0	0	0	0
20 MASON	9/18/1992	500	Tstm Wind	56 kts.	0	0	0	0
21 S. Lower MI	1/3/1993	2300	Flooding	N/A	0	0	5K	0
22 MIZ004	1/12/1993	2300	Heavy Snow	N/A	0	0	50K	0
23 MIZ001	1/21/1993	0	Ice Storm	N/A	0	0	0	0
24 MIZ004	3/23/1993	300	Freezing Rain	N/A	0	0	0	0
25 MIZ011	4/1/1993	0	Heavy Snow	N/A	0	0	50K	0
26 Upper and W MI	12/20/1993	1000	Heavy Snow	N/A	0	0	0	0
27 MIZ001	12/23/1993	1400	Heavy Snow	N/A	0	0	0	0
28 Upper and W MI	12/25/1993	700	Heavy Snow	N/A	0	0	0	0
29 Upper and W MI	12/29/1993	0	Heavy Snow	N/A	0	0	0	0
30 Upper MI	1/12/1994	0	Heavy Lake Snow	N/A	0	0	500K	0
31 Miz000	1/13/1994	0	Record Cold	N/A	0	0	50.0M	0
32 Lower MI/ part UP	1/27/1994	0	Heavy Snow/freezing Rain	N/A	0	0	5.0M	0
33 W Lower MI	2/2/1994	0	Heavy Snow	N/A	0	0	0	0
34 C Upper, N MI	2/22/1994	1900	Heavy Snow	N/A	0	0	0	0
35 Scottville	7/5/1994	1851	Thunderstorm Winds	N/A	0	0	0	0
36 Statewide	11/18/1994	0	High Winds	up to 62 kts	0	0	1M	0
37 N Lower	12/16/1994	1900	Heavy Snow	N/A	0	0	0	0
38 Lower MI	1/1/1995	0	Heavy Lake Snow	N/A	0	0	0	0
39 Lower Michigan	1/11/1995	1800	Dense Fog	N/A	0	0	0	0
40 MIZ001	2/3/1995	1800	Heavy Lake Snow	N/A	0	0	0	0
41 MIZ001	2/11/1995	0	Heavy Lake Snow	N/A	0	0	0	0
42 Southern Lower	2/27/1995	100	Ice Storm	N/A	0	0	0	0
43 MIZ001	3/6/1995	0	Heavy Snow	N/A	0	0	0	0
44 Ludington	5/13/1995	2102	Thunderstorm Winds	N/A	0	0	0	0
45 Freesoil	5/13/1995	2125	Thunderstorm Winds	N/A	0	0	0	0
46 Ludington	8/13/1995	1800	Lightning	N/A	0	0	30K	0
47 W Cent Lower	11/27/1995	700	Heavy Snow	N/A	0	0	0	0
48 MIZ037	1/29/1996	7:00 AM	Winter Storm	N/A	0	0	0	0
49 Mason Co Arprt	5/19/1996	2:15 AM	Hail	0.75 in.	0	0	0	0
50 MIZ037	11/10/1996	1:00 AM	Heavy Snow	N/A	0	0	0	0
51 MIZ037	12/25/1996	7:00 PM	Heavy Snow	N/A	0	0	0	0
52 MIZ037	2/21/1997	6:00 AM	Flood	N/A	0	0	0	0
53 Scottville	2/21/1997	10:15 AM	Flash Flood	N/A	0	0	0	0
54 Scottville	4/5/1997	9:20 PM	Tstm Wind	52 kts.	0	0	0	0
55 MIZ037	4/6/1997	4:00 PM	High Wind	0 kts.	0	0	5.0M	0
56 Ludington	9/16/1997	11:15 PM	Tstm Wind	50 kts.	0	0	25K	0
57 Fountain	9/16/1997	11:45 PM	Tstm Wind	0 kts.	0	0	10K	0

58 MIZ037	11/11/1997	9:00 PM	Lake Effect Snow	N/A	0	0	0	0
59 MIZ037	12/4/1997	7:00 PM	Lake Effect Snow	N/A	0	0	0	0
60 MIZ037	12/30/1997	7:00 AM	Lake Effect Snow	N/A	0	0	0	0
61 MIZ037	1/4/1998	12:00 AM	Freezing Rain	N/A	0	0	0	0
62 MIZ037	1/7/1998	5:00 PM	Winter Storm	N/A	0	0	0	0
63 MIZ037	1/22/1998	7:00 PM	Winter Storm	N/A	0	0	0	0
64 MIZ037	3/9/1998	7:00 AM	Blizzard	N/A	0	0	0	0
65 MIZ037	3/10/1998	0	Lake Effect Snow	N/A	0	0	0	0
66 MIZ037	3/13/1998	3:00 PM	Heavy Snow	N/A	0	0	0	0
67 Ludington	5/29/1998	12:00 AM	Tstm Wind	0 kts.	0	0	25K	0
68 Ludington Arpt	5/29/1998	12:06 AM	Tstm Wind	50 kts.	0	0	0	0
69 Ludington	5/31/1998	3:45 AM	Tstm Wind	0 kts.	0	5	1.0M	0
70 Ludington	5/31/1998	3:50 AM	Tstm Wind	68 kts.	0	0	0	0
71 Scottville	5/31/1998	3:55 AM	Tstm Wind	57 kts.	0	0	0	0
72 Hamlin Lake	6/25/1998	8:59 PM	Tstm Wind	63 kts.	0	0	0	0
73 Scottville	6/25/1998	8:59 PM	Tstm Wind	61 kts.	0	0	0	0
74 Walhalla	8/6/1998	5:00 PM	Flash Flood	N/A	0	0	10K	0
75 Ludington	9/26/1998	3:15 AM	Hail	1.00 in.	0	0	0	0
76 MIZ037	11/10/1998	10:00 AM	High Wind	87 kts.	1	0	0	0
77 MIZ037	12/21/1998	1:00 PM	Lake Effect Snow	N/A	0	0	0	0
78 MIZ037	12/29/1998	7:00 PM	Lake Effect Snow	N/A	0	0	0	0
79 MIZ037	1/2/1999	7:00 AM	Blizzard	N/A	0	0	0	0
80 MIZ037	1/3/1999	0	Heavy Snow	N/A	0	0	0	0
81 MIZ037	1/4/1999	0	Snow	N/A	0	0	0	0
82 MIZ037	1/5/1999	9:00 PM	Lake Effect Snow	N/A	0	0	0	0
83 MIZ037	1/8/1999	8:00 AM	Lake Effect Snow	N/A	0	0	0	0
84 MIZ037	1/10/1999	4:00 AM	Winter Storm	N/A	0	0	0	0
85 MIZ037	1/11/1999	0	Snow	N/A	0	0	0	0
86 MIZ037	2/5/1999	7:00 PM	Freezing Rain	N/A	0	0	0	0
87 Ludington	2/11/1999	5:37 PM	Tstm Wind	0 kts.	0	0	10K	0
88 MIZ037	1/3/2000	3:00 PM	Winter Storm	N/A	0	0	0	0
89 MIZ037	1/12/2000	12:00 PM	Winter Storm	N/A	0	0	0	0
90 MIZ037	1/19/2000	4:00 PM	Winter Storm	N/A	0	0	0	0
91 MIZ037	1/25/2000	10:00 AM	Winter Storm	N/A	0	0	0	0
92 Scottville	3/8/2000	8:45 PM	Hail	0.75 in.	0	0	10K	0
93 MIZ037	4/7/2000	12:00 PM	Winter Storm	N/A	0	0	0	0
94 Ludington	6/1/2000	8:24 PM	Tstm Wind	53 kts.	0	0	25K	0
95 Scottville	7/13/2000	8:40 PM	Hail	1.00 in.	0	0	20K	10K
96 Scottville	9/11/2000	10:36 PM	Tstm Wind	53 kts.	0	0	25K	0
97 MIZ037	11/19/2000	6:00 PM	Winter Storm	N/A	0	0	0	0
98 MIZ037	12/5/2000	7:00 PM	Heavy Snow	N/A	0	0	0	0
99 MIZ037	12/11/2000	6:00 AM	Winter Storm	N/A	0	0	0	0
100 MIZ037	12/19/2000	0	Heavy Snow	N/A	0	0	0	0
101 MIZ037	12/20/2000	7:00 PM	Heavy Snow	N/A	0	0	0	0
102 MIZ037	12/23/2000	7:00 AM	Heavy Snow	N/A	0	0	0	0
103 MIZ037	2/7/2001	10:00 PM	Winter Storm	N/A	0	0	0	0
104 Countywide	2/9/2001	9:00 AM	Flood	N/A	0	0	100K	0
105 Countywide	5/15/2001	8:00 AM	Flood	N/A	0	0	25K	25K
106 Countywide	5/15/2001	12:00 AM	Flash Flood	N/A	0	0	50K	50K
107 Countywide	5/16/2001	1:00 AM	Flash Flood	N/A	0	0	50K	50K
108 Countywide	5/16/2001	3:00 AM	Flood	N/A	0	0	25K	25K
109 Scottville	5/17/2001	8:18 PM	Hail	0.88 in.	0	0	10K	10K
110 Walhalla	8/9/2001	4:17 PM	Tstm Wind	53 kts.	0	0	10K	0
111 MIZ037	12/23/2001	3:00 PM	Winter Storm	N/A	0	0	0	0
112 MIZ037	1/16/2002	10:00 AM	Winter Storm	N/A	0	0	0	0
113 MIZ037	2/25/2002	7:00 PM	Winter Storm	N/A	0	0	0	0
114 MIZ037	3/2/2002	1:00 AM	Winter Storm	N/A	0	0	0	0
115 MIZ037	3/9/2002	12:54 PM	High Wind	62 kts.	0	0	485K	0
116 Fountain	4/18/2002	6:55 PM	Tstm Wind	53 kts.	0	0	10K	0
117 Ludington	4/18/2002	10:45 PM	Hail	1.00 in.	0	0	5K	5K
118 Scottville	7/30/2002	10:50 PM	Tstm Wind	53 kts.	0	0	10K	0
119 MIZ037	12/1/2002	10:00 AM	Heavy Snow	N/A	0	0	0	0

120 MIZ037	1/18/2003	10:00 AM	Heavy Snow	N/A	0	0	0	0
121 MIZ037	2/10/2003	4:00 AM	Heavy Snow	N/A	0	0	0	0
122 MIZ037	2/11/2003	10:00 AM	Heavy Snow	N/A	0	0	0	0
123 MIZ037	3/4/2003	6:00 PM	Heavy Snow	N/A	0	0	0	0
124 MIZ037	4/3/2003	10:00 AM	Ice Storm	N/A	0	0	4.9M	0
125 Scottville	7/20/2003	10:15 AM	Tstm Wind	53 kts.	0	0	25K	10K
126 MIZ037	1/14/2004	4:00 AM	Heavy Snow	N/A	0	0	0	0
127 MIZ037	1/18/2004	7:00 AM	Heavy Snow	N/A	0	0	0	0
128 MIZ037	1/27/2004	7:00 AM	Winter Storm	N/A	0	0	0	0
129 MIZ037	5/21/2004	11:32 PM	Flood	N/A	0	0	25.0M	4.6M
130 Freesoil	6/9/2004	02:45 AM	Tstm Wind	53 kts.	0	0	5K	0
131 MIZ037	6/9/2004	05:00 AM	Flood	N/A	0	0	20K	0
132 Ludington	8/27/2004	03:09 AM	Tstm Wind	53 kts.	0	0	10K	0
133 MIZ037	10/30/2004	11:00 AM	High Wind	59 kts.	0	0	1.2M	0
134 MIZ037	12/12/2004	07:00 PM	Heavy Snow	N/A	0	0	0	0
135 MIZ037	12/18/2004	12:00 PM	Heavy Snow	N/A	0	0	0	0
136 MIZ037	12/20/2004	07:00 AM	Heavy Snow	N/A	0	0	0	0
137 MIZ037	1/4/2005	07:00 PM	Heavy Snow	N/A	0	0	0	0
138 MIZ037	1/18/2005	11:00 AM	Heavy Snow	N/A	0	0	0	0
139 MIZ037	2/27/2005	07:00 PM	Heavy Snow	N/A	0	0	0	0
140 Ludington	3/30/2005	08:05 PM	Hail	0.75 in.	0	0	10K	0
TOTALS:					1	13	96.195M	4.785M

***The Storm Events Database contains data from the following sources:**

- **All Weather Events from 1993 - 1995, as entered into Storm Data. (Except 6/93 - 7/93, which is missing) (NO Latitude/Longitude)**
- **All Weather Events from 1996 - Current, as entered into Storm Data. (Including Latitude/Longitude)**
- **Additional data from the Storm Prediction Center including: Tornadoes 1950-1992, Thunderstorm Winds 1955-1992, and Hail 1955-1992**

National Climatic Data Center: Storm Events

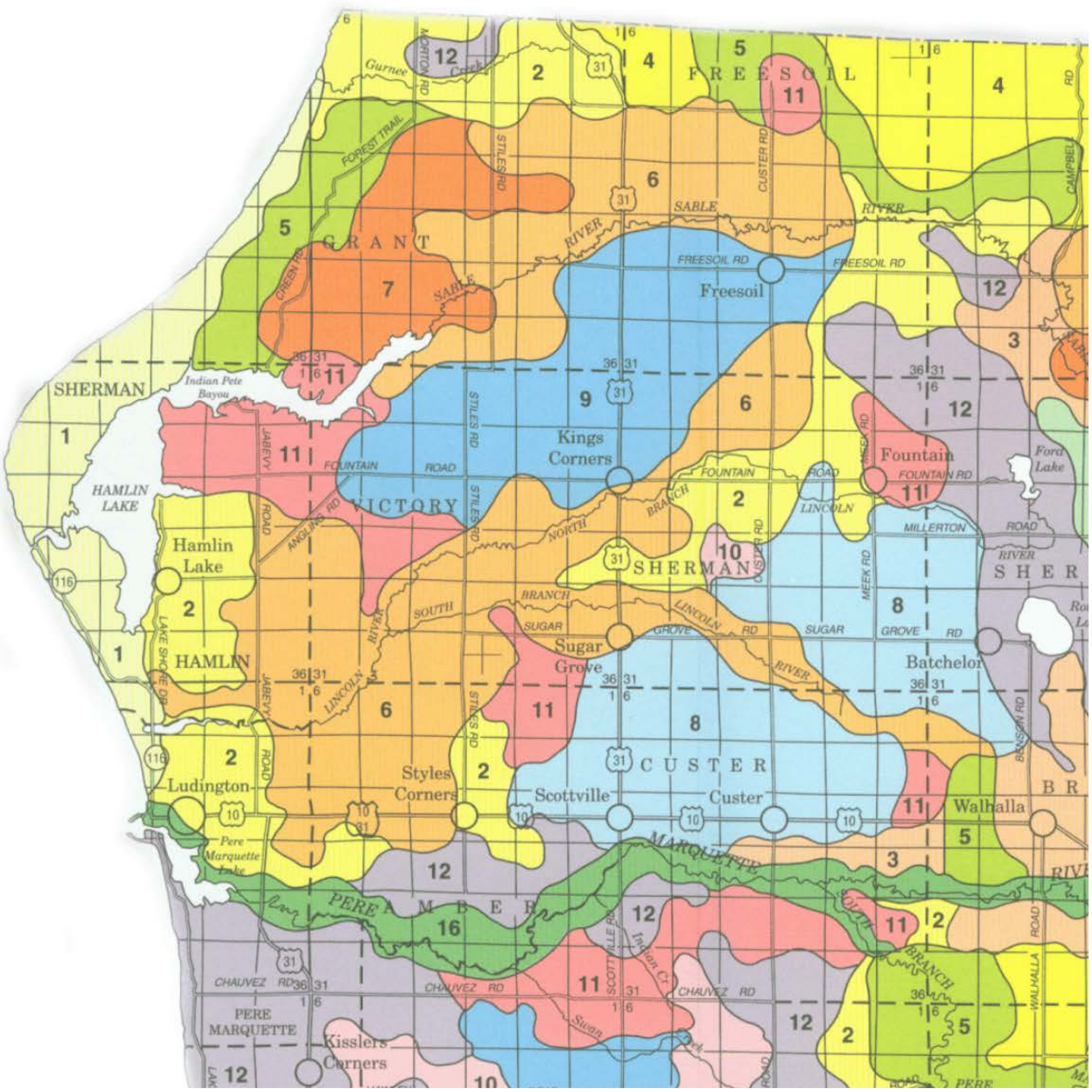
04/01/2005 through 02/28/2014 ⬩ 85 events reported for Mason County

Location or Zone (zone indicates multiple counties)	Date	Duration	Type	Magnitude	Death	Injury	Damage ($)		Notes
							property	crop	
Freesoil	7/24/05	<1 day	Thunderstorm Wind	61 mph	0	0	40k	0	Trees, limbs, and power lines downed. A few trees downed onto houses.
Scottville	7/24/05	<1 day	Thunderstorm Wind	61 mph	0	0	20k	0	Trees, limbs, and power lines downed. A few trees downed onto houses.
Wiley	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	25k	0	Trees, limbs, and power lines downed across the area.
Scottville	7/26/05	<1 day	Thunderstorm Wind	61 mph	0	0	20k	0	Trees, limbs, and power lines downed across the area.
Ludington	8/4/05	<1 day	Thunderstorm Wind	61 mph	0	0	5k	0	Trees downed 6 mi SE of Ludington
Scottville	9/13/05	<1 day	Thunderstorm Wind	61 mph	0	0	20k	0	Trees and power lines downed
Mason County (zone)	1/20/06	1 day	Heavy Snow	6-10” snow	0	0	0	0	
Mason County (zone)	2/16/06	1 day	Heavy Snow	6-8” snow	0	0	0	0	
Walhalla	7/9/06	<1 day	Thunderstorm Wind	60 mph	0	0	10k	0	Trees down on wires near intersection of US 10 and Schoenherr Rd
Ludington	7/17/06	<1 day	Thunderstorm Wind	60 mph	0	0	25k	5k	Numerous trees down along Lake MI shoreline
Mason County	8/2/06	<1 day	Thunderstorm Wind	60 mph	0	0	20k	0	Several trees down across southern Mason Co
Hamlin Township	10/3/06	<1 day	Hail	.75”	0	0	15k	15k	Reported at Ludington State Park
Northern Mason Co.	10/4/06	<1 day	Thunderstorm Wind	61 mph	0	0	50k	10k	Widespread wind damage (downed trees) across northern Mason County
Mason County	10/4/06	<1 day	Thunderstorm Wind	60 mph	0	0	30k	10k	Several trees and power lines downed across Mason County
Mason County (zone)	12/1/06	1 day	Heavy Snow	9-12” snow	0	0	0	0	
Mason County (zone)	12/4/06	1 day	Lake Effect Snow	6-8” snow	0	0	0	0	
Mason County (zone)	12/6/06	1 day	Lake Effect Snow	8-12” snow	0	0	0	0	
Mason County (zone)	2/2/07	2 days	Blizzard	up to 6” snow	0	0	0	0	Blizzard conditions caused numerous road closures, power outages, and car accidents
Mason County	6/7/07	<1 day	Thunderstorm Wind	58 mph	0	0	2k	0	Two trees downed in western Mason County
Mason County	6/8/07	<1 day	Thunderstorm Wind	58 mph	0	0	10k	0	Several trees downed across Mason County
Fountain	6/18/07	<1 day	Thunderstorm Wind	58 mph	0	0	10k	0	Several trees downed in Fountain
Mason County (zone)	12/23/07	1 day	Winter Storm	6-8” snow	0	0	0	0	
Mason County (zone)	12/28/07	1 day	Heavy Snow	6-8” snow	0	0	0	0	
Mason County (zone)	1/10/08	1 day	Winter Storm	6-7” snow	0	0	0	0	
Mason County (zone)	1/23/08	1 day	Winter Storm	6-10” snow	0	0	0	0	
Mason County (zone)	1/29/08	1 day	Winter Storm	4-7” snow	0	0	0	0	Blizzard to near blizzard conditions
Mason County (zone)	2/6/08	1 day	Winter Storm	12” snow	0	0	0	0	Near blizzard conditions
Mason County (zone)	2/14/08	1 day	Winter Storm	up to 12” snow	0	0	0	0	
Mason County (zone)	2/18/08	2 days	Lake Effect Snow	10-15” snow	0	0	0	0	
Mason County	4/25/08	<1 day	Thunderstorm Wind	60 mph	0	0	20k	0	Several trees blown down across county, mainly north of US 10. Gust measured at Mason Co Arpt
Grant Township	6/12/08	<1 day	Tornado	EF1	0	0	0	0	Tornado struck the Nordhouse Dunes region of the Manistee National Forest
Freesoil	6/12/08	<1 day	Thunderstorm Wind	70 mph	0	0	0	0	Part of the roof of a convenience store blown off and several trees were uprooted
Mason County	6/12/08	<1 day	Thunderstorm Wind	70 mph	0	0	0	0	Several trees and power lines downed in the Ludington and Hamlin Lake areas
Mason County	6/13/08	1 day	Flash Flood	~11” rain in 8hr	0	0	3m	500k	Presidential Disaster Declaration for flooding; extensive damage to public infrastructure
Hamlin Township	6/14/08	<1 day	Hail	1.00”	0	0	0	0	Measured near Twin Bridges near Hamlin Lake
Custer	6/14/08	<1 day	Hail	1.00”	0	0	0	0	

Hamlin Township	6/28/08	<1 day	Thunderstorm Wind	59 mph	0	0	0	0	Gust measured at Big Sable GLERL observation site
Mason County (zone)	11/20/08	1 day	Lake Effect Snow	8" snow	0	0	0	0	
Mason County (zone)	11/30/08	1 day	Winter Storm	4-9" snow	0	0	0	0	
Mason County (zone)	12/6/08	1 day	Winter Storm	6-10" snow	0	0	0	0	
Mason County (zone)	12/8/08	1 day	Winter Storm	10-16" snow	0	0	0	0	
Mason County (zone)	12/19/08	1 day	Winter Storm	6-9" snow	0	0	0	0	
Mason County (zone)	12/20/08	1 day	Winter Storm	6-10" snow	0	0	0	0	Wind gusts up to 45 mph
Mason County (zone)	12/23/08	2 days	Winter Storm	6-10" snow	0	0	0	0	
Mason County (zone)	12/28/08	1 day	High Wind	60 mph	0	0	0	0	Several trees and power lines blown down
Mason County (zone)	1/17/09	1 day	Winter Storm	up to 15" snow	0	0	0	0	
Mason County (zone)	2/21/09	1 day	Winter Storm	8" snow	0	0	0	0	
Mason County (zone)	12/8/09	1 day	Winter Storm	10-12" snow	0	0	0	0	Snow accompanied by 40 mph wind gusts
Mason County (zone)	12/24/09	1 day	Winter Weather	.1-.25" ice	0	0	0	0	
Mason County (zone)	1/1/10	2 days	Lake Effect Snow	12-16" snow	0	0	0	0	
Mason County (zone)	2/23/10	1 day	Lake Effect Snow	12" snow	0	0	0	0	
Riverton Township	9/21/10	<1 day	Hail	1.00"	0	0	0	0	Reported 2 mi NE of Summit Township
Mason County	10/27/10	<1 day	High Wind	71 mph	0	0	0	0	Gust measured at Big Sable GLERL observation site; 60 mph gusts measured inland
Mason County (zone)	12/5/10	3 days	Lake Effect Snow	18-24" snow	0	0	0	0	
Mason County (zone)	1/3/11	1 day	Winter Weather	4.8" snow	0	0	0	0	
Mason County (zone)	1/7/11	1 day	Lake Effect Snow	6-12" snow	0	0	0	0	
Mason County (zone)	1/22/11	1 day	Winter Weather	3-6" snow	0	0	0	0	
Mason County (zone)	2/1/11	1 day	Winter Storm	6-12" snow	0	0	0	0	Snow accompanied by 50 mph wind gusts
Mason County (zone)	2/20/11	1 day	Winter Storm	6-8" snow	0	0	0	0	
Mason County (zone)	3/22/11	1 day	Winter Storm	2-4" snow, 1" sleet	0	0	0	0	
Wiley	9/29/11	<1 day	Hail	.75	0	0	0	0	5 mi S of Scottville
Freesoil	10/25/11	<1 day	Hail	.75	0	0	0	0	5 mi NW of Freesoil
Mason County (zone)	1/1/12	2 days	Lake Effect Snow	6" snow	0	0	0	0	
Mason County (zone)	1/12/12	2 days	Winter Storm	8-12" snow	0	0	0	0	
Mason County (zone)	3/2/12	1 day	Heavy Snow	6.8" snow	0	0	0	0	
Mason County	5/3/12	1 day	Flash Flood	5-7" rain	0	0	75k	0	Barnett Rd washed out in Branch Township
Scottville	5/3/12	<1 day	Hail	1.75"	0	0	25k	0	
Branch Township	5/3/12	<1 day	Hail	1.00"	0	0	0	0	
Ludington	5/3/12	<1 day	Hail	.75"	0	0	0	0	
Ludington	7/25/12	<1 day	Thunderstorm Wind	66 mph	0	0	25k	0	Many trees and power lines blown down
Hamlin Township	8/2/12	<1 day	Thunderstorm Wind	60-70 mph	0	0	100k	0	Downed trees at Ludington State Park caused damage to camper trailers, vehicles, and buildings
Ludington	9/17/12	<1 day	Thunderstorm Wind	60 mph	0	0	0	0	Trees downed in Pere Marquette and Riverton townships
Mason County (zone)	10/30/12	<1 day	High Wind	60 mph	0	0	0	0	Healthy trees blown down
Mason County (zone)	12/20/12	2 days	Winter Storm	6-10" snow, 60 mph	0	0	0	0	Scattered power outages
Mason County (zone)	1/21/13	2 days	Lake Effect Snow	12" snow, 57 mph	0	0	0	0	
Mason County (zone)	2/1/13	2 days	Lake Effect Snow	>12" snow	0	0	0	0	Moderate travel impacts and scattered power outages
Mason County (zone)	2/15/13	2 days	Lake Effect Snow	10-16" snow	0	0	0	0	
Mason County (zone)	2/19/13	2 days	Winter Weather	6-8" snow	0	0	0	0	

Mason County (zone)	4/17/13	6 days	Flood		0	0	3m	0	Significant flooding due to rain from early to mid-April
Hamlin Lake	8/7/13	<1 day	Thunderstorm Wind	61 mph	0	0	50k	0	
Riverton Twp	8/27/13	<1 day	Thunderstorm Wind	64 mph	0	0	25k	0	Multiple large trees down near Wiley
Mason County (zone)	11/17/13	<1 day	High Wind	70 mph	0	0	75k	0	60-70 mph wind gusts caused numerous power outages
Mason County (zone)	1/22/14	1 day	Heavy Snow	6” snow	0	0	0	0	
Mason County (zone)	1/24/14	1 day	Heavy Snow	9” snow	0	0	0	0	
Mason County (zone)	2/17/14	<1 day	Heavy Snow	7” snow	0	0	0	0	

GENERAL SOILS MAP
Mason County



	AREAS OF NEARLY LEVEL TO VERY STEEP, EXCESSIVELY DRAINED TO MODERATELY WELL DRAINED, SANDY SOILS AND AREAS OF DUNE LAND
1	Dune land-Nordhouse-Quartzipsamments association
2	Grattan-Epworth association
3	Plainfield-Coloma association
4	Typic Udipsamments association
5	Entic Haplorthods, sandy association
	NEARLY LEVEL AND UNDULATING, POORLY DRAINED TO EXCESSIVELY DRAINED, SANDY SOILS ON OUTWASH PLAINS AND LAKE PLAINS
6	Covert-Pipestone-Saugatuck association
7	Entic Haplorthods, sandy-Aeric Haplaquods, sandy Aquic-Udipsamments association
	NEARLY LEVEL AND UNDULATING, SOMEWHAT POORLY DRAINED, SANDY AND LOAMY SOILS
8	Ithaca-Arkona association
9	Capac-Wixom association
	NEARLY LEVEL TO VERY STEEP, EXCESSIVELY DRAINED, WELL DRAINED, AND SOMEWHAT POORLY DRAINED SOILS
10	Perrinton-Ithaca association
11	Fern-Marlette association
12	Coloma-Spinks-Fern association
13	Alfic Haplorthods, sandy-Entic Haplorthods, sandy-Haplic Glossudalfs, fine-loamy association
	NEARLY LEVEL, VERY POORLY DRAINED AND POORLY DRAINED SOILS
14	Medisaprists-Mollic Psammaquents association
15	Kingsville-Adrian association
16	Kerston-Carlisle-Glendora association

Source: USDA/Mich.Dept.Agr.(issued September, 1995)

MASON COUNTY DAMS

The National Inventory of Dams (NID) identifies 6 dams within Mason County. The NID consists of dams meeting at least one of the following criteria:

1) High hazard classification - loss of one human life is likely if the dam fails;
2) Significant hazard classification - possible loss of human life and likely significant property or environmental destruction;
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage;
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

Dam hazard potential classes are defined as:

LOW HAZARD POTENTIAL

Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL

Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

HIGH HAZARD POTENTIAL

Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

NAME	LOCATION	HAZARD POTENTIAL
Brookside Cemetery Dam	Amber Township	LOW
Whiskey Creek Dam No. 2	Eden Township	
Gallie Dam	Victory Township	
West Shore Community College	Victory Township	
None	N/A	SIGNIFICANT
Hamlin Lake Dam	Hamlin Township	HIGH
Ludington Pumped Storage Plant	Pere Marquette Township	

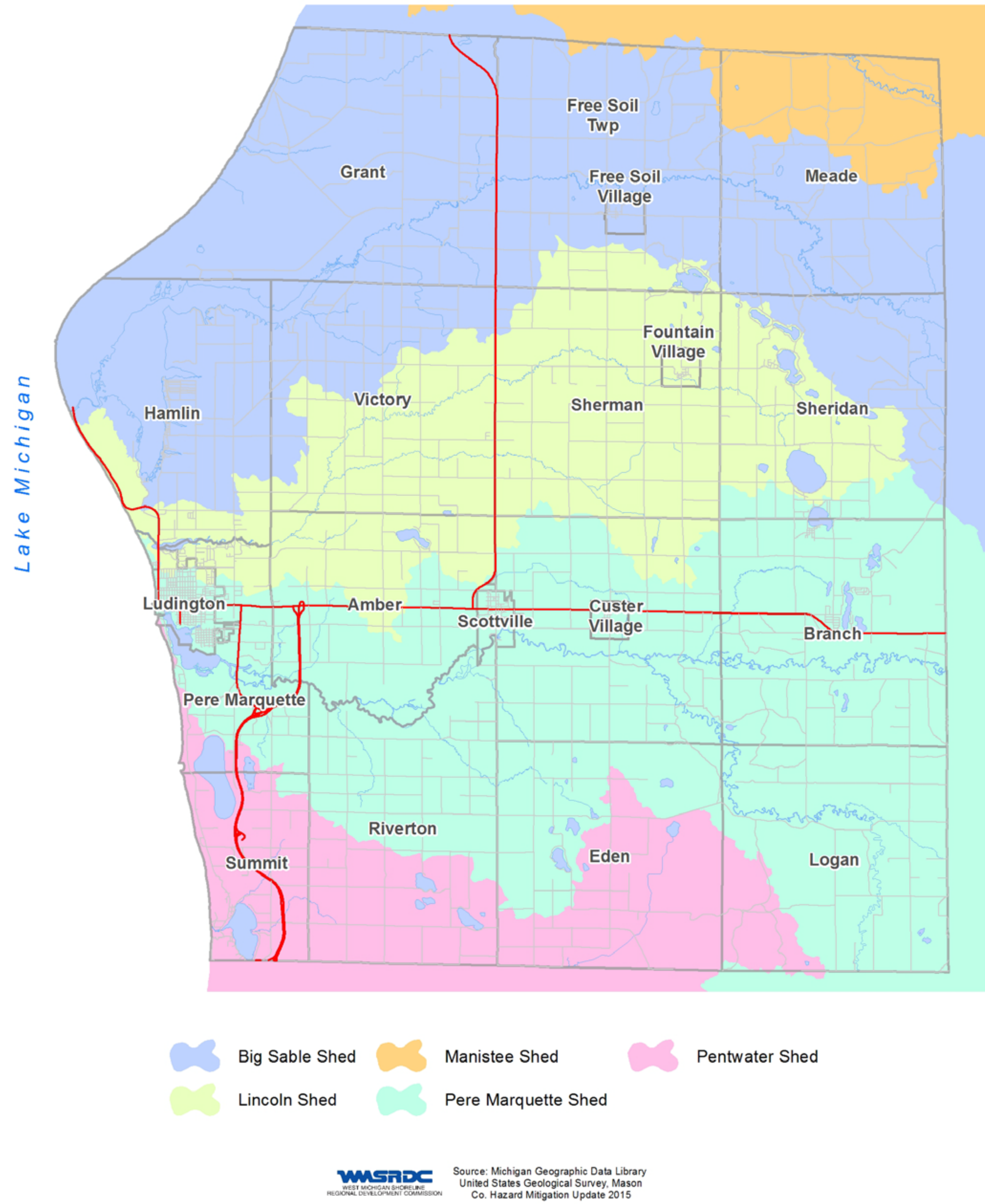
Source: National Inventory of Dams, US Army Corps of Engineers July 19, 2013.

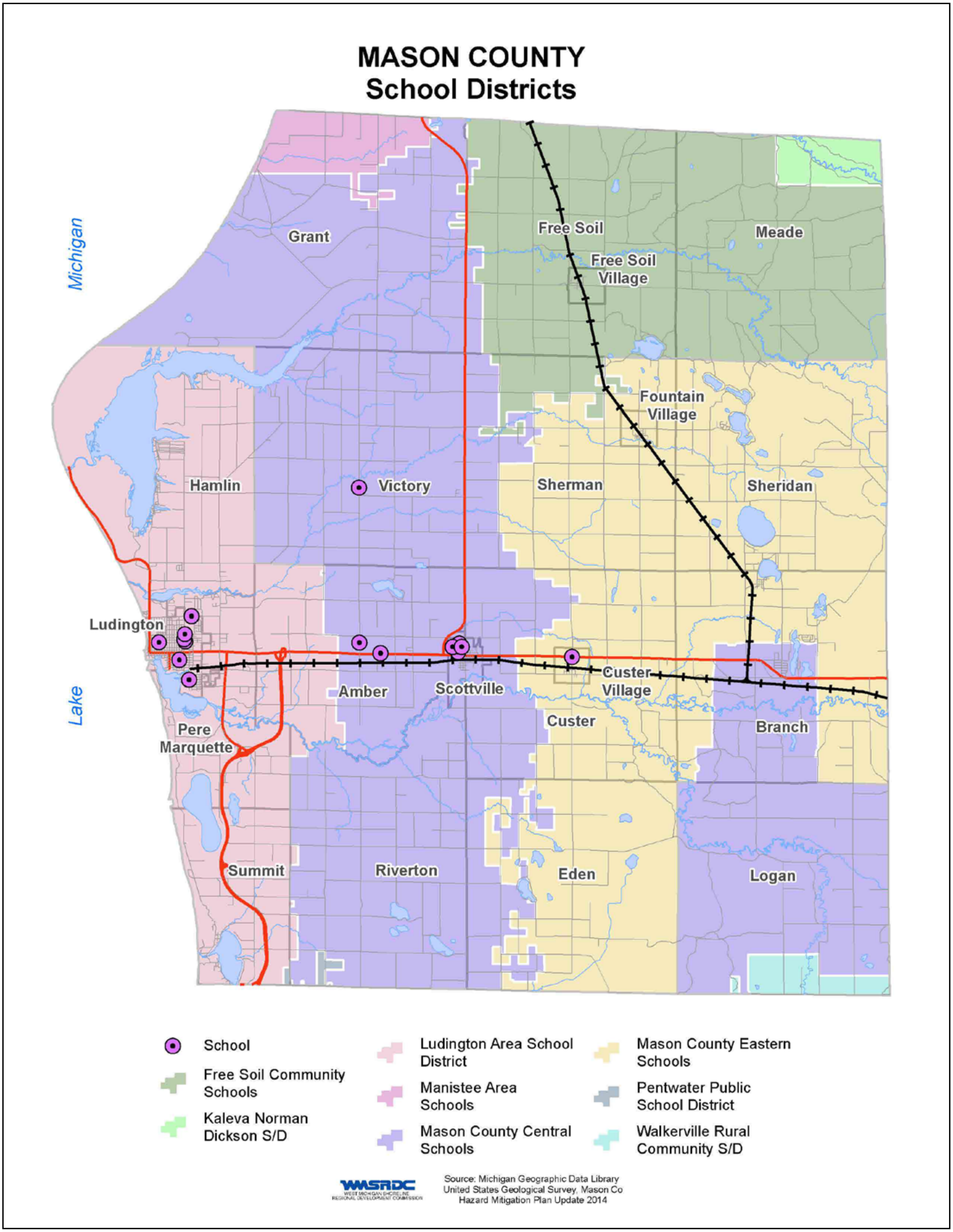
In addition to the dams listed above, the county has two dams that are not rated, yet are worthy of mention.

LOCATION	HAZARD POTENTIAL
Gun Lake, Free Soil Township	NOT RATED
Bass Lake, Summit Township	NOT RATED

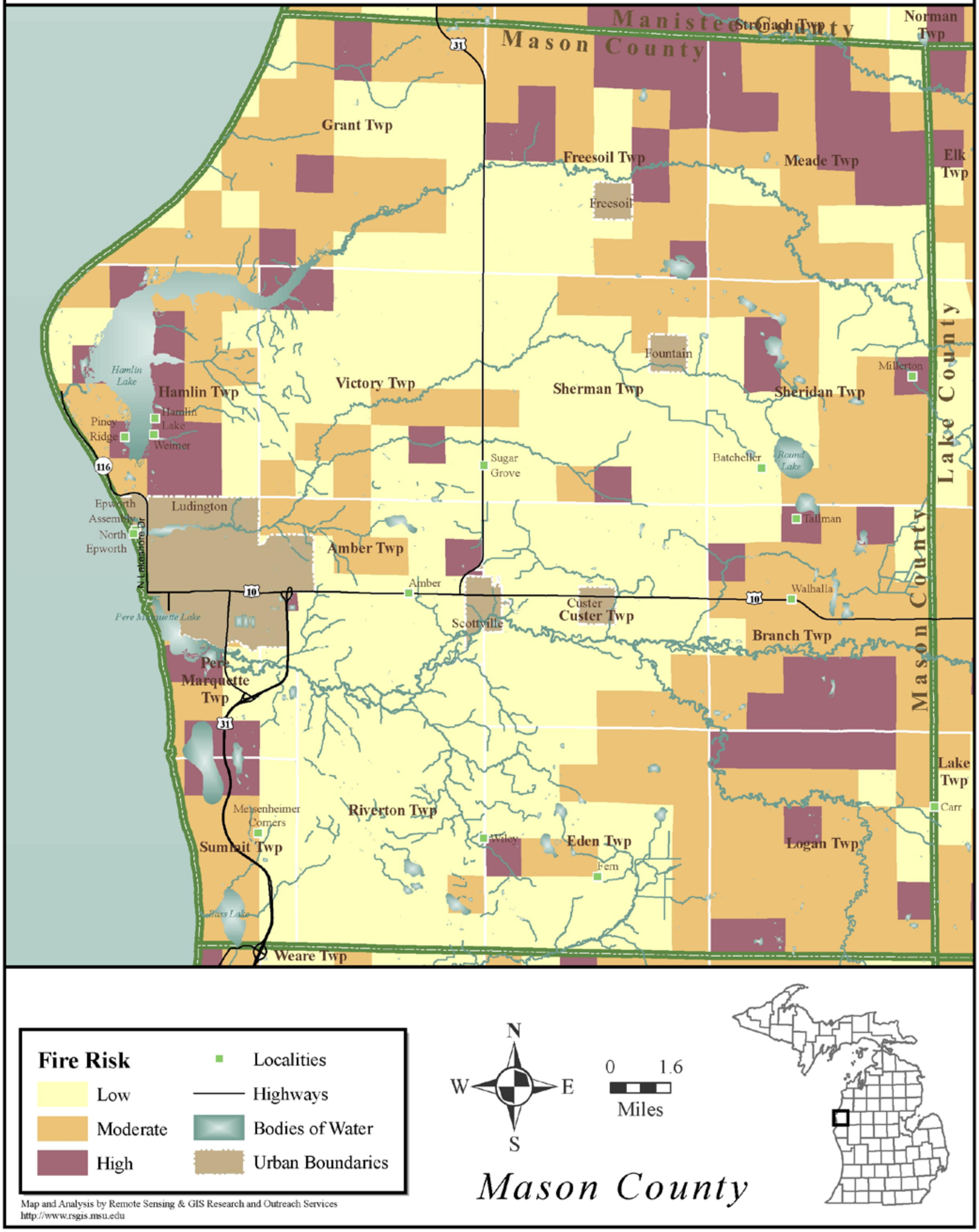
Source: Mason County Emergency Management

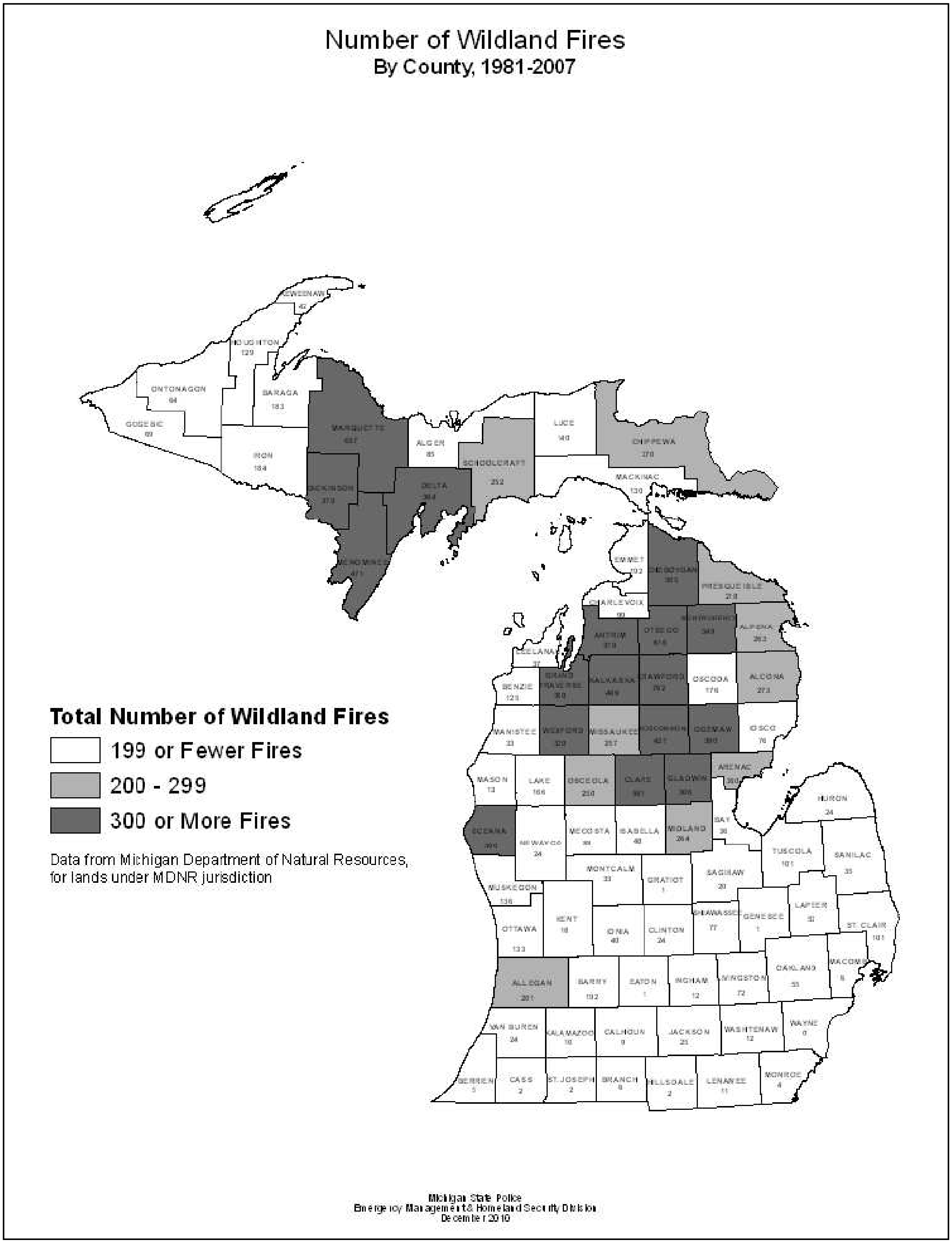
MASON COUNTY
Watersheds




MASON COUNTY
School Districts
Michigan
Lake
Grant
Free Soil
Meade
Free Soil Village
Fountain Village
Hamlin
Victory
Sherman
Sheridan
Ludington
Amber
Scottville
Custer Village
Custer
Branch
Pere Marquette
Summit
Riverton
Eden
Logan
School
Free Soil Community Schools
Kaleva Norman Dickson S/D
Ludington Area School District
Manistee Area Schools
Mason County Central Schools
Mason County Eastern Schools
Pentwater Public School District
Walkerville Rural Community S/D
WMSRDC
Source: Michigan Geographic Data Library
United States Geological Survey, Mason Co
Hazard Mitigation Plan Update 2014

Fire Management - Communities at Risk




Number of Wildland Fires
By County, 1981-2007
Total Number of Wildland Fires
199 or Fewer Fires
200 - 299
300 or More Fires
Data from Michigan Department of Natural Resources, for lands under MDNR jurisdiction
Michigan State Police
Emergency Management & Homeland Security Division
December 2010

Number of Wildfires and Acres Burned, by County: 1981-2010 (MDNR jurisdiction only)

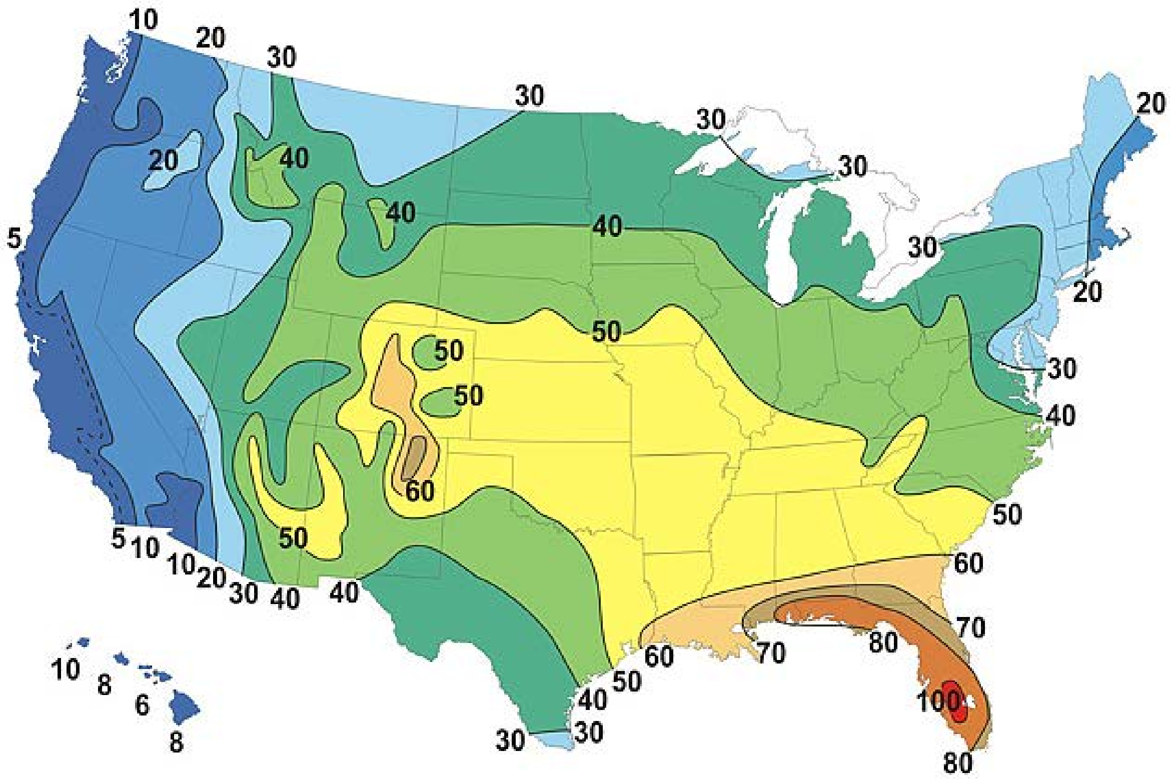
County	Number of Wildfires	Number of Wildfires/Year* (over 30 year period)	Number of Acres Burned	Number of Acres Burned/Year* (over 30 year period)
Alcona	119	4	843.8	28
Alger	41	1	123.0	4
Allegan	72	2	312.0	10
Alpena	156	5	267.2	9
Antrim	194	6	194.1	6
Arenac	127	4	418.8	14
Baraga	57	2	1897.6	63
Barry	99	3	447.3	15
Bay	16	1	142.2	5
Benzie	169	6	279.3	9
Berrien	8	0	24.4	1
Branch	6	0	19.3	1
Calhoun	9	0	41.2	1
Cass	3	0	27.0	1
Charlevoix	151	5	492.3	16
Cheboygan	737	25	1424.0	47
Chippewa	391	13	5108.2	170
Clare	822	27	2385.6	80
Clinton	27	1	138.9	5
Crawford	1142	38	25861.5	862
Delta	551	18	3213.8	107
Dickinson	506	17	2411.0	80
Eaton	3	0	0.3	0
Emmet	317	11	543.5	18
Genesee	1	0	0.1	0
Gladwin	484	16	1938.9	65
Gogebic	116	4	245.4	8
Grand Traverse	386	13	1296.9	43
Gratiot	2	0	40.0	1
Hillsdale	2	0	23.0	1
Houghton	181	6	1200.1	40
Huron	29	1	725.5	24
Ingham	14	0	474.7	16
Ionia	33	1	728.4	24
Iosco	112	4	1630.3	54
Iron	279	9	1953.9	65
Isabella	101	3	931.8	31
Jackson	35	1	520.5	17
Kalamazoo	14	0	74.3	2
Kalkaska	559	19	2953.4	98
Kent	20	1	125.9	4
Keweenaw	59	2	375.6	13
Lake	315	11	1283.5	43
Lapeer	60	2	533.8	18
Leelanau	56	2	212.0	7
Lenawee	16	1	224.2	7
Livingston	79	3	651.4	22
Luce	207	7	18679.9	623
Mackinac	197	7	1610.6	54
Macomb	7	0	15.4	1
Manistee	49	2	1041.6	35
Marquette	835	28	16087.6	536
Mason	32	1	154.6	5
Mecosta	169	6	844.9	28
Menominee	646	22	2353.4	78
Midland	412	14	1414.9	47
Missaukee	344	11	1772.0	59
Monroe	5	0	233.3	8
Montcalm	33	1	567.6	19
Montmorency	555	19	1271.5	42
Muskegon	251	8	2675.7	89
Newaygo	47	2	404.2	13
Oakland	54	2	368.5	12
Oceana	346	12	1766.0	59
Ogemaw	563	19	8296.1	277
Ontonagon	94	3	1438.1	48
Osceola	405	14	1085.2	36
Oscoda	268	9	8765.3	292
Otsego	970	32	1924.9	64
Ottawa	145	5	469.9	16
Presque Isle	330	11	838.4	28
Roscommon	613	20	4551.9	152
Saginaw	20	1	474.7	16
Sanilac	44	1	427.3	14
Schoolcraft	344	11	3210.5	107
Shiawassee	80	3	576.7	19
St. Clair	110	4	1642.8	55
St. Joseph	3	0	7.7	0
Tuscola	121	4	930.9	31
Van Buren	27	1	249.2	8
Washtenaw	17	1	217.5	7
Wayne	2	0	42.2	1
Wexford	428	14	1057.4	35
Total DNR fire events	17449	582	152228.3	5074

*rounded to nearest whole number

Source: Michigan Department of Natural Resources—Forest Management Division

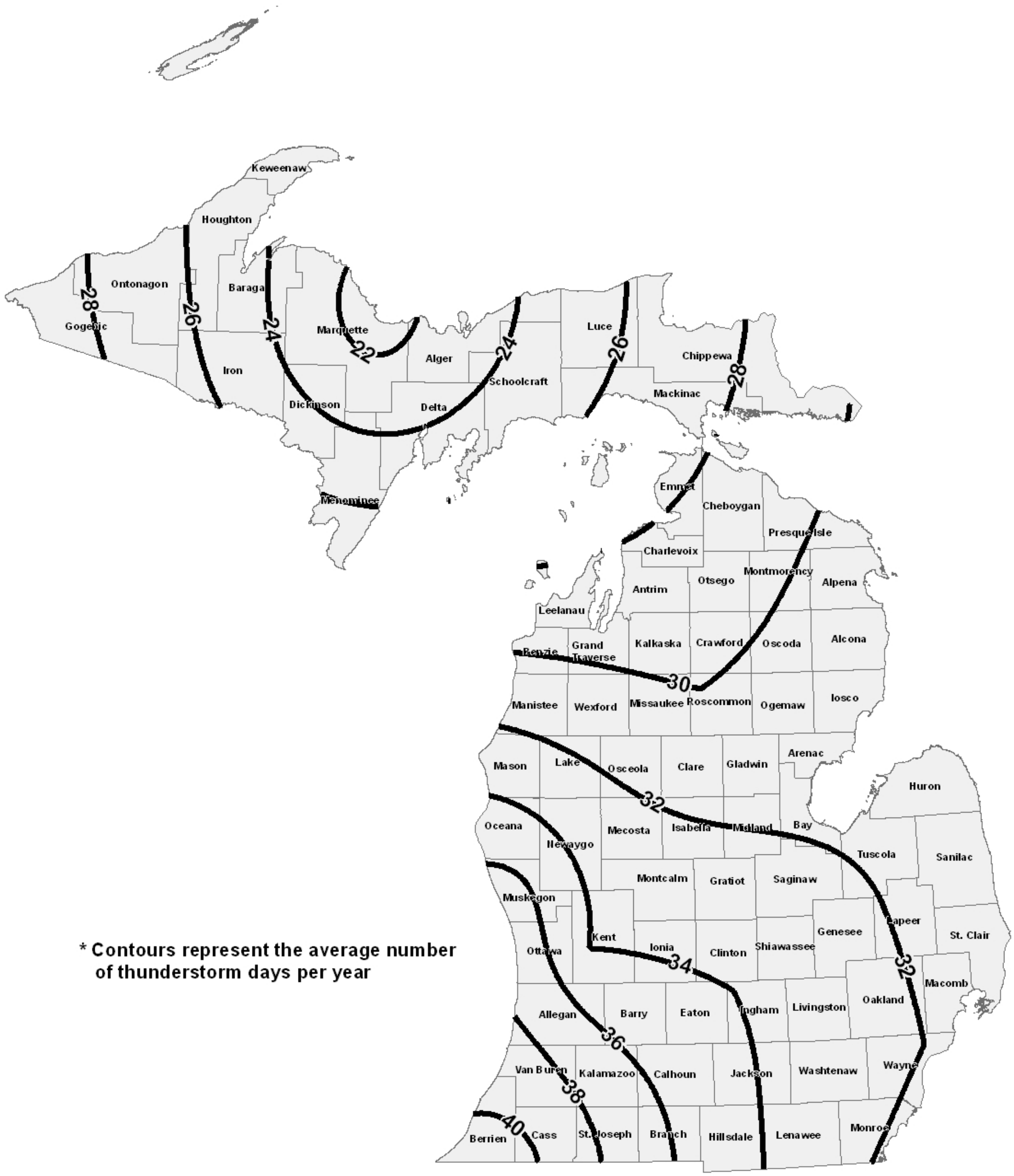
Source: Michigan Hazard Mitigation Plan, 2011

Average Annual Thunderstorm Days



Source: NOAA National Weather Service

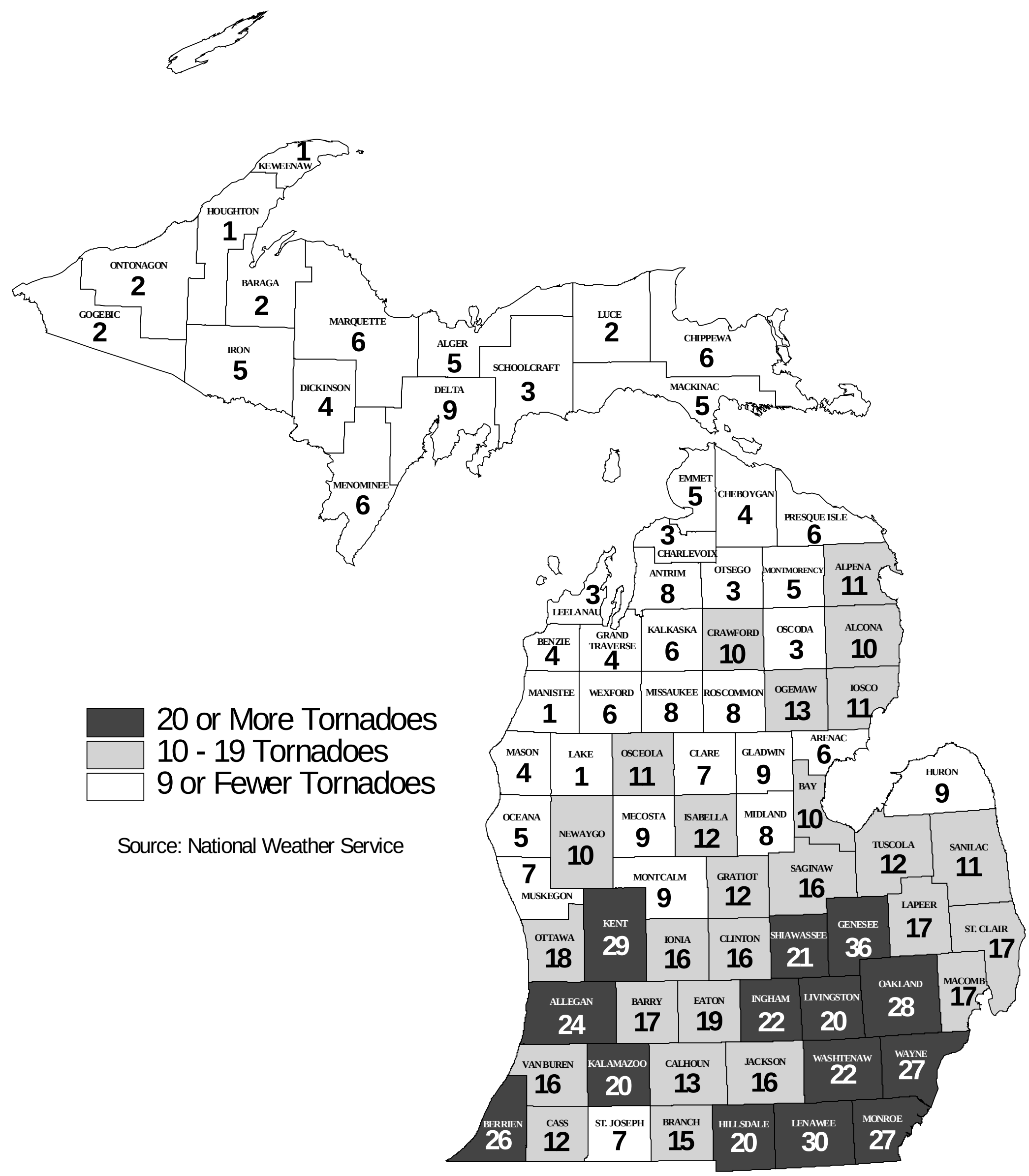
Thunderstorm Hazards



*** Contours represent the average number of thunderstorm days per year**

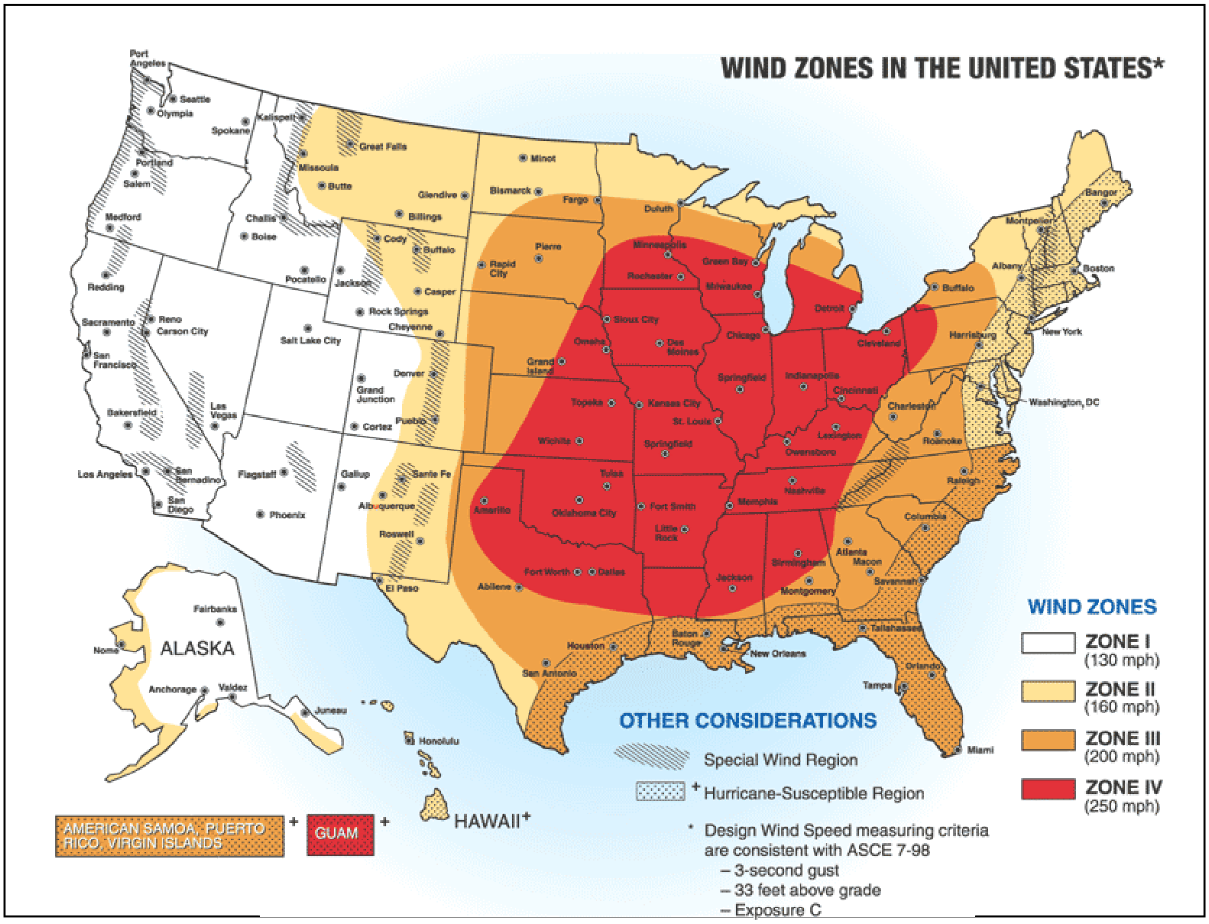
Produced by:
Michigan State Police
Emergency Management and Homeland Security Division
January 2011

Number of Tornadoes in Michigan
by County, 1950-2001

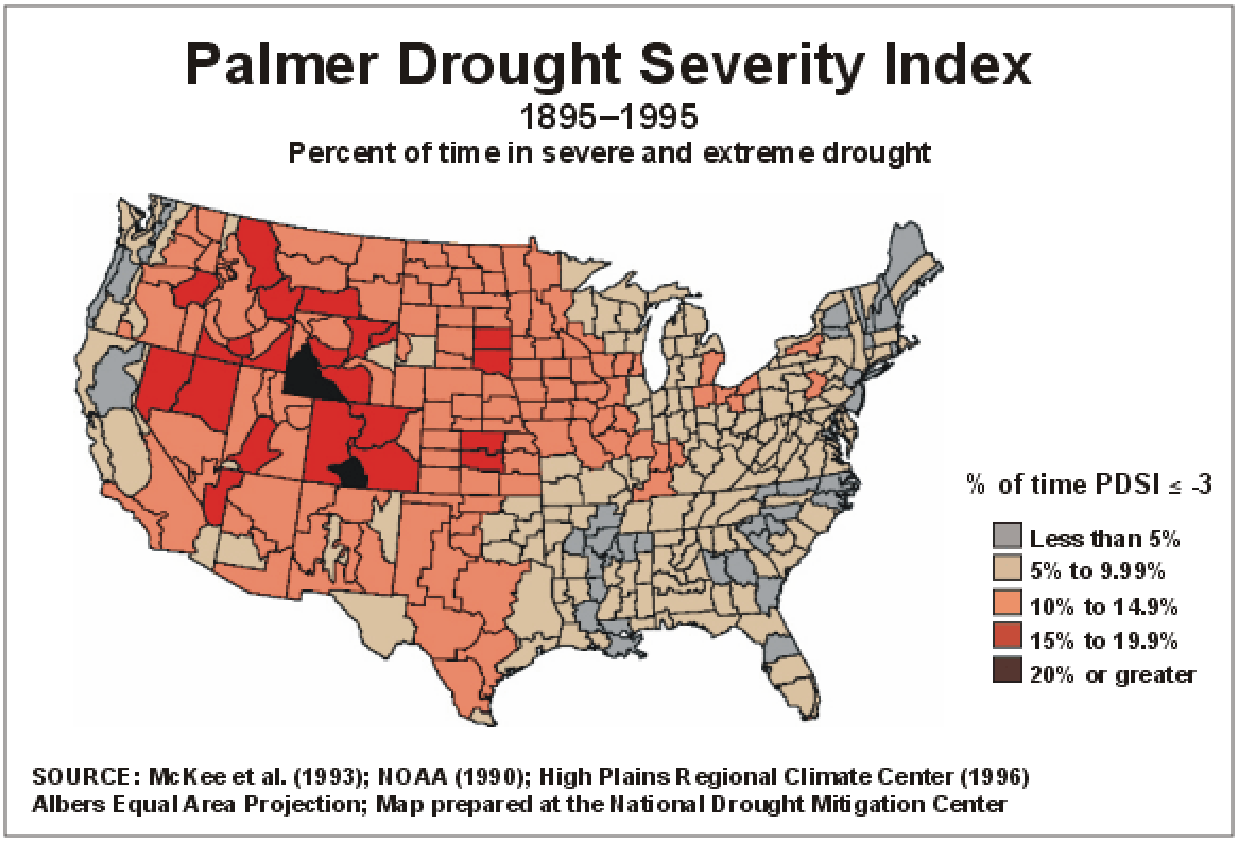


Source: National Weather Service

Produced by:
Michigan State Police
Emergency Management Division
12 December 2001



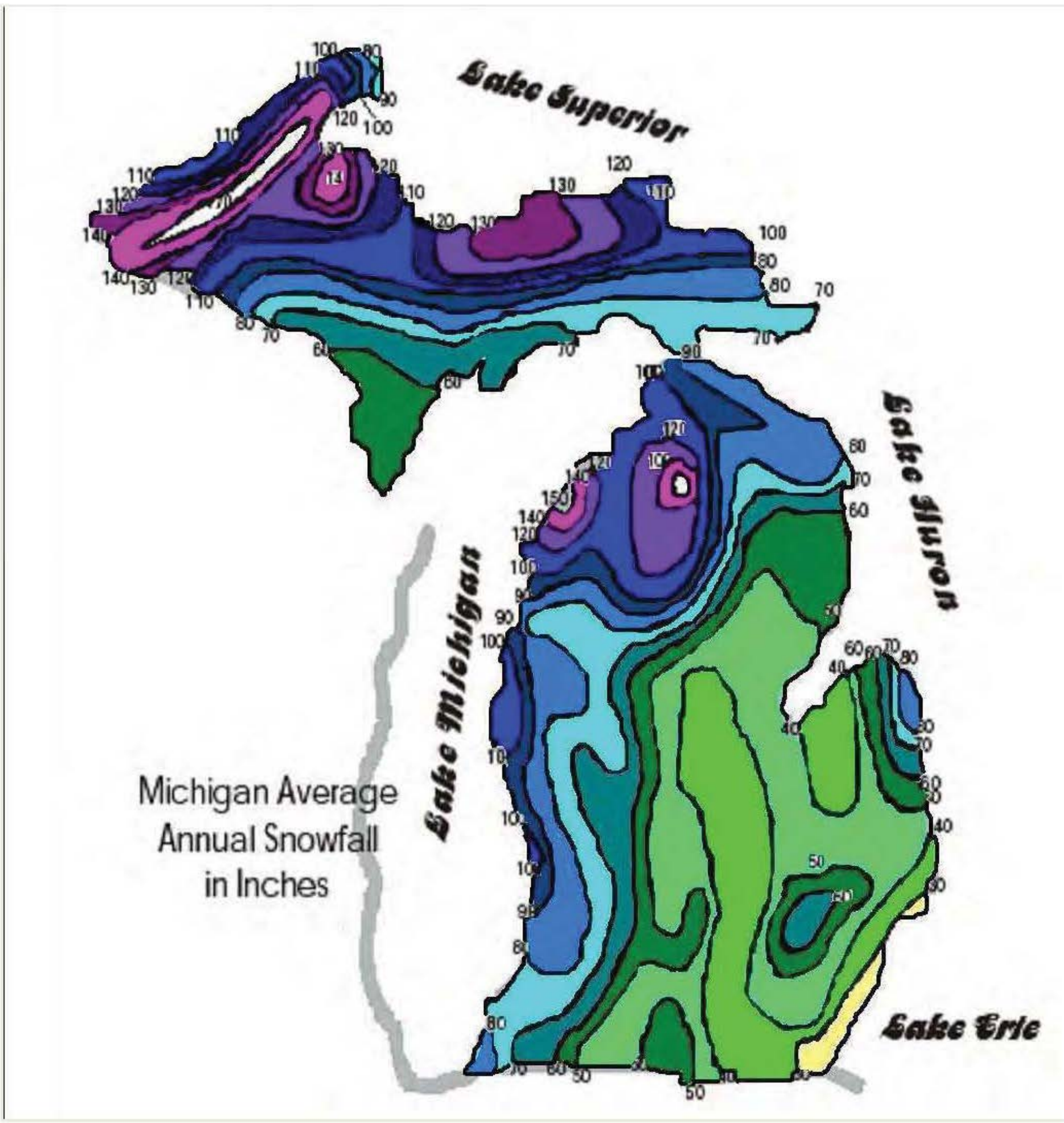
Source: Federal Emergency Management Agency

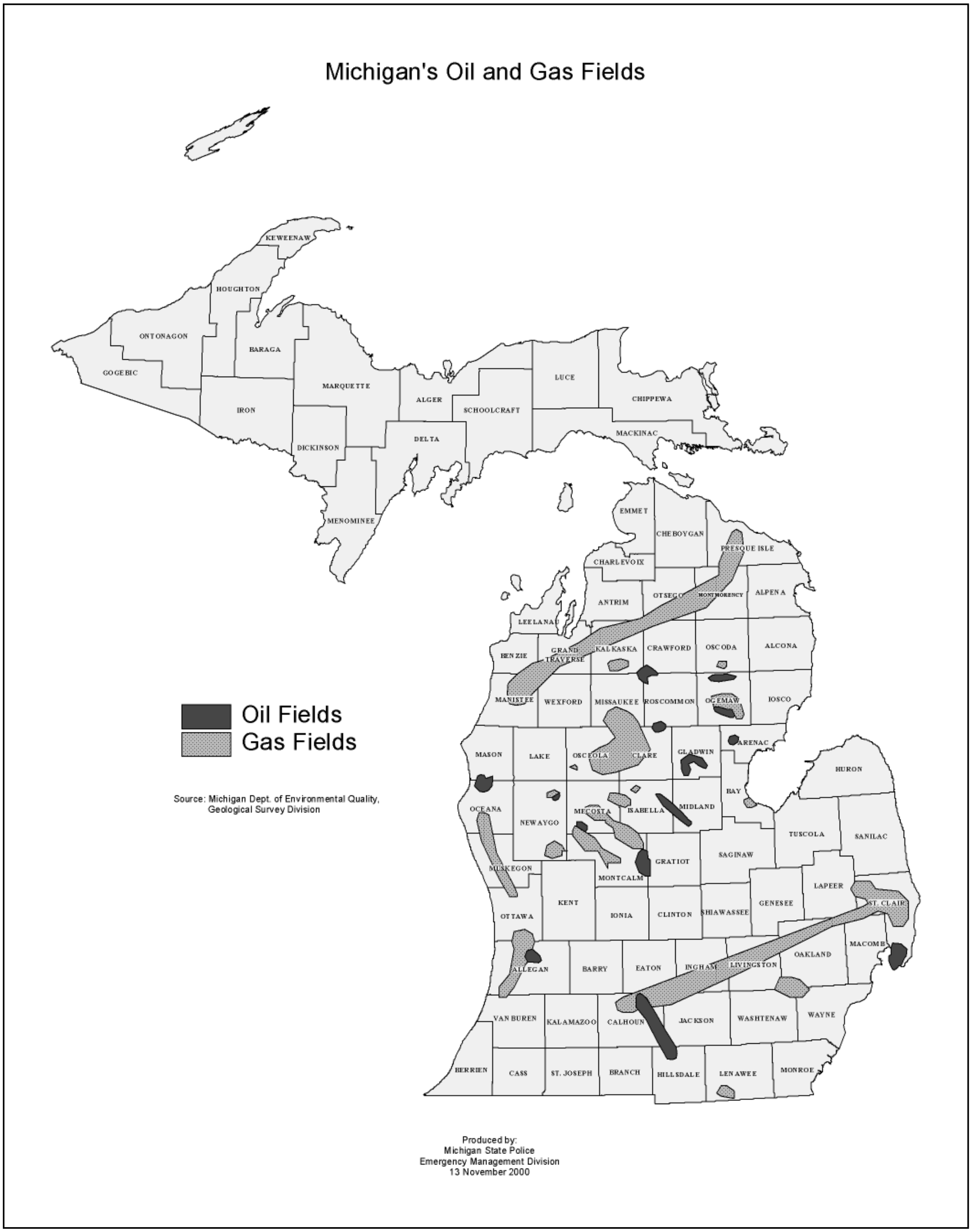


Palmer Drought Severity Index
1895–1995
Percent of time in severe and extreme drought
% of time PDSI ≤ -3
Less than 5%
5% to 9.99%
10% to 14.9%
15% to 19.9%
20% or greater
SOURCE: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

Michigan Average Annual Snowfall

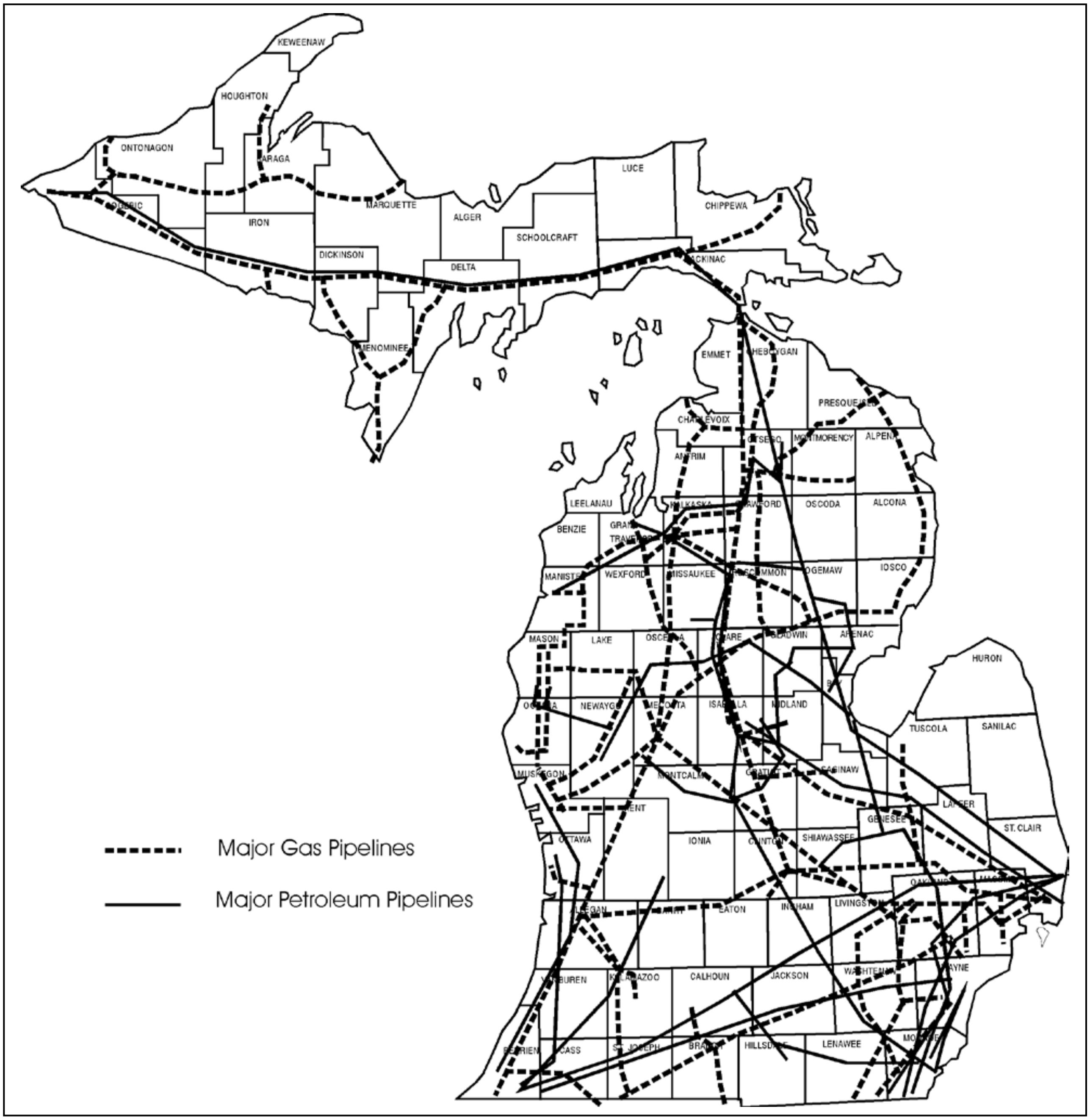
Source: Michigan Committee for Severe Weather Awareness



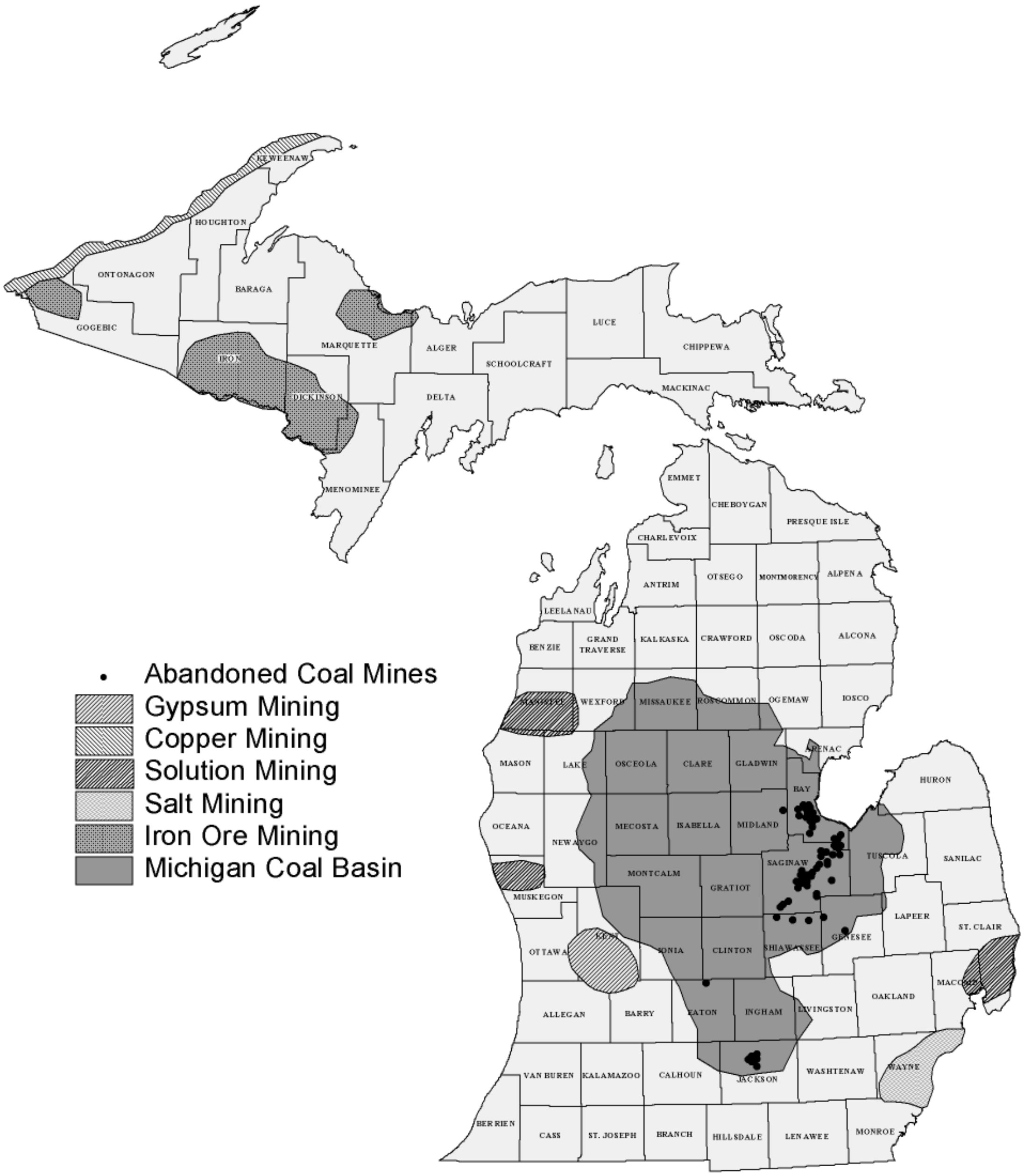

Michigan's Oil and Gas Fields
Oil Fields
Gas Fields
Source: Michigan Dept. of Environmental Quality, Geological Survey Division
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
IRON
ALGER
SCHOOLCRAFT
LUCE
CHIPPEWA
DICKINSON
DELTA
MACKINAC
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ARENAC
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
GRATIOT
SAGINAW
MUSKEGON
MONTCALM
LAPEER
KENT
GENESEE
ST. CLAIR
OTTAWA
IONIA
CLINTON
SHIAWASSEE
MACOMB
OAKLAND
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
Produced by:
Michigan State Police
Emergency Management Division
13 November 2000

Major Petroleum and Natural Gas Pipelines in Michigan

Source: Michigan Public Service Commission; pipeline company maps



Potential Subsidence Hazards



Produced by:
Michigan State Police
Emergency Management Division
20 November 2000

Appendix D:
HAZARD MITIGATION PLAN UPDATE SURVEY

March 2, 2012

Dear Interested Person,

The West Michigan Shoreline Regional Development Commission (WMSRDC) is seeking information about various hazards that might eventually affect people, property, or the environment in the area of Mason County.

The WMSRDC is beginning the research that is necessary to help fulfill federal requirements for updating a hazard mitigation plan, and thereby maintain the Mason County Hazard Mitigation Plan. Communities that wish to apply for funding for hazard mitigation projects from the Hazard Mitigation Grant Program are required (by the Federal Emergency Management Agency) to create, or participate in the creation of, an approved local hazard mitigation plan satisfying the requirements of the Disaster Mitigation Act of 2000 and 44 CFR 201.6. If your community intends to adopt the hazard mitigation plan once updated, you are strongly encouraged to participate in this survey.

Please take a moment to consider the enclosed questionnaire, and note any conditions which may bring harm to people or property, or interfere significantly with business or community infrastructure. If you need more room to respond, feel free to use additional sheets of paper. Completed surveys are requested no later than Friday, May 11, 2012.

A public hearing is scheduled for 4:00 on Tuesday, May 15, 2012 to discuss the hazard mitigation project and receive comments and concerns from the public with regards to potential hazards to the community. The hearing will take place during the Mason County LEPC meeting, held at the Mason County Sheriff's Office, 302 N. Delia Street, Ludington, MI 49431.

Additional copies of the survey can be obtained at www.wmsrdc.org in the Special Projects section. If you have any questions about the questionnaire or the hazard mitigation project, please contact Stephen Carlson at (231) 722-7878 extension 11, or at scarlson@wmsrdc.org.

Respectfully,

Stephen Carlson
Associate Planner

MASON COUNTY Hazard Mitigation Plan Update Survey

PART 1 - Hazard Identification

Provided below is documentation of historical hazard events in Mason County, according to the Hazard Mitigation Plan for Mason County prepared in 2005.

Please take a moment to review the following events and provide additions, changes, and updates to this information.

Thunderstorm Hazards (severe winds, tornadoes, hail, lightning, heavy rain):

- April 12, 1972: Tornado (F2). 8 injuries, $2.5m property damage, Eden Township.
- August 13, 1995: Lightning. $30k property damage, Ludington.
- September 16, 1997: Severe thunderstorm winds. $25k property damage, Ludington; $10k, Fountain.
- May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President.
- June 3-5, 1998: Thunderstorms & high winds. Declaration of disaster by Governor.
- June 1, 2000: Severe thunderstorm winds. $25k property damage, Ludington.
- July 13, 2000: 1 inch hail. $20k property damage, $10k crop damage, Scottville.
- September 11, 2000: Severe thunderstorm winds. $25k property damage, Scottville.
- May 17, 2001: .88 inch hail. $10k property damage, $10k crop damage, Riverton Township.

Severe Winter Weather (ice, sleet, snow storms):

- January 26-27, 1978: Blizzard, snowstorm. Statewide declarations of emergency by President and Governor.
- January 12, 1993: Heavy snow. $50k property damage, central and northern Lower Michigan.
- January 12-21, 1994: Heavy lake effect snow. $500k property damage across western Lower Michigan.
- January 27, 1994: Heavy snow and freezing rain. $5m property damage across region.
- March 9, 1998: Winter storm. $100k property damage across region.
- April 3, 2003, Ice storm. $4.9m property damage throughout West Michigan.

Floods (shoreline, riverine, urban):

- September 10-19, 1986: Flooding. Declaration of major disaster by President.
- October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
- August 6, 1998: Flash flood. $10k property damage, Walhalla.
- May 15-16, 2001: Flash flood & flooding. $75k property damage. $75k crop damage each day.
- June 9, 2004: Flooding. Declaration of emergency by County for Riverton, Summit, Pere Marquette, and Amber Townships. Over 8" of rain in 3 hours, $20k property damage, 31 roads closed, 1 washed out in Riverton.

Extreme Temperatures:

- July, 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
- Summer, 1988: 39 days with temperatures over 90 degrees.
- January 20, 1994: Record cold. $50m property damage across Michigan.

Drought:

- Summer 1871: Prolonged drought over much of the Great Lakes regions.
- May-September, 1891: Drought devastated Michigan's lumber industry.
- Statewide: 1930-1937, 1960-1967, 1976-1980, and 1986-1989.
- Lower Peninsula: 1939-1942: crop damage.
- 1964: Record "low" water levels.

Wildfires:

- October 1871: Flames swept across much of the lower peninsula, killing 200 and burning 1.2 million acres.
- May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.

Structural and Scrap Tire Fires (including explosions, industrial accidents):

- County Fire Rate per 1,000 population in 1998: 4.63.
- December 9th, 2001: Mobile home fire. 5 fatalities, Mason County.

Dam Failures:

- Two documented failures in Mason County, locations not identified.

Infrastructure Failure (storm/sanitary sewers, water, electrical, and communications systems):

- January 20, 1994: Frozen sewer/water lines.
- September 16, 1997: 500 customers affected. Power lines downed in Fountain and across county.
- May 31, 1998: 681,000 homes and businesses in lower peninsula. County-wide for up to a week. Power outage.
- September 11, 2000: 305 customers in Ludington and 190 customers in Scottville. Power outage.
- April 3, 2003: Hundreds of thousands of customers in southern lower Michigan. Power outage.

Oil and Gas Well/Pipeline Accidents: - No events identified

- Oil and gas wells in the county: 629

Civil Disturbances (riots, prison uprisings, etc.):

- Summer 1970 and 1971: Protest demonstrations in Ludington City Park. Over 100 arrests.

Hazardous Materials Incidents (fixed site and transportation related, nuclear material):

- SARA Title III sites within Mason County: 18

Other Hazard Events:

- Earthquake / Land Subsidence
- Transportation Accidents
- Public Health Emergencies
- Nuclear Attack/Civil Defense Emergency
- Weapons of Mass Destruction/Terrorism/Sabotage

Comments:

PART 2 – Hazard Ranking

Provided below is a prioritized list of hazards in Mason County, according to the Hazard Mitigation Plan for Mason County. Priorities were determined through a ranking system that scored the impact of each hazard in the following areas: Likelihood of Occurrence; Percent of Population Affected; Potential for Causing Casualties; Potential for Negative Effects; Corollary Effects; and Public Awareness of Hazard.

Please take a moment to consider these hazards and prioritize them, with #1 being the most important.

Priority	Hazard	Score (out of 10 possible points)	Your Priority
1st	Snow/Ice/Sleet Storms	7.65	
2nd	Extreme Temperatures	6.60	
3rd	Severe Winds	6.35	
4th	Infrastructure Failures	6.20	
5th	Fire Hazards: Structural	5.65	
6th	Fire Hazards: Wildfire	5.25	
7th	Dam Failures	5.20	
8th	Drought	4.85	
9th	Tornadoes	4.65	
10th	Flooding: Riverine/Urban	4.25	
11th	HAZMAT: Fixed Site	4.15	
12th	Lightning/Heavy Rain	3.80	
13th	Public Health Emergencies	3.70	
14th	Transportation Accidents	3.60	
15th	Hail	3.55	
16th	Flooding: Shoreline	3.50	
17th	Pipeline Accidents	3.40	
18th	HAZMAT: Transportation	3.25	
19th	Oil/Gas Well Accidents	1.60	
20th	Civil Disturbances	1.45	
21st	Land Subsidence	1.25	

PART 3 – Contact Information

Name | Date |

Organization | Title |

Email |

Please remit survey to:	WMSRDC attention: Stephen Carlson PO Box 387 Muskegon, MI 49443-0387	OR	email: scarlson@wmsrdc.org fax: 231-722-9362

3

Summary of Survey Results

Part 1 – Hazard Identification

- June 12-13, 2008: Flooding & heavy rain. Declaration of disaster by Governor.
- June 12-13, 2008: City of Ludington, Sewer system

Part 2 – Hazard Ranking

Survey Responses

Hazard Mitigation Plan	Hazard	Ludington	Pere Marquette Twp	Free Soil Village	Sherman Twp	Mason Co. Airport	County Admin.	County Commissio / Local Busines	County Planning Commission	Life EMS	Scottville Fire Dept	Dist. 10 Health Dept	County Em. Mgmt	Branch Township	SUBTTOAL	AVERAGE	Average - Ranked	Hazard Mitigation Plan
1	Snow/Ice/Sleet Storms	1	1	2	1	1	1	1	13	1	1	1	3	1	28	2.2	1	1
2	Extreme Temperatures	8	5	3	3	3	6	4	18	3	6	2	9	2	72	5.5	3	2
3	Severe Winds	2	2	1	4	4	2	2	12	4	2	3	1	3	42	3.2	2	3
4	Infrastructure Failure	5	3	6	12	6	3	14	4	7	11	4	7	4	86	6.6	5	4
5	Fire Hazards: Structural	6	9	5	10	8	4	5	8	8	4	5	8	5	85	6.5	4	5
6	Fire Hazards: Wildfire	7	4	4	11	9	5	15	9	9	5	6	5	6	95	7.3	8	6
7	Dam Failures	18	13	11	13	15	7	16	15	13	13	7	10	7	158	12.2	14	7
8	Drought	16	12	7	7	14	11	7	16	19	14	8	12	8	151	11.6	11	8
9	Tornadoes	17	7	8	9	10	14	3	17	10	12	9	6	9	131	10.1	9	9
10	Flooding: Riverine/Urban	3	6	9	6	5	10	13	10	2	7	10	4	10	95	7.3	6	10
11	HAZMAT: Fixed Site	9	17	12	14	7	17	6	3	11	15	11	11	11	144	11.1	10	11
12	Lightning/Heavy Rain	4	8	10	2	2	8	8	19	5	8	12	2	12	100	7.7	7	12
13	Public Health Emergencies	10	11	15	16	11	13	9	11	6	16	13	17	13	161	12.4	12	13
14	Transportation Accident	11	10	16	15	12	12	10	14	12	3	14	18	14	161	12.4	12	14
15	Hail	12	14	17	8	13	15	17	20	18	17	15	13	15	194	14.9	18	15
16	Flooding: Shoreline	13	18	18	5	19	16	18	7	15	19	16	19	16	199	15.3	17	16
17	Pipeline Accident	15	16	19	17	18	9	12	1	16	9	17	15	17	181	13.9	15	17
18	HAZMAT: Transportation	14	15	13	18	16	18	19	6	14	10	18	14	18	193	14.8	16	18
19	Oil/Gas Well Accident	19	19	14	19	17	19	11	2	17	18	19	16	19	209	16.1	19	19
20	Civil Disturbances	20	20	20	20	20	20	21	21	20	20	20	20	20	262	20.2	21	20
21	Land Subsidence	21	21	21	21	21	21	20	5	21	21	21	21	21	256	19.7	20	21

Observations

1. Decent range of survey respondents.
2. 11.7% response rate (13 out of 111).
2. Snow/Ice/Sleet Storms and Severe Winds are the highest priorities overall.
3. Riverine/Urban flooding and Lightning are a higher priority than previously ranked.
4. Extreme Temperatures, Drought, and Dam Failures are not as much of a priority as the previous ranking reflected.

Appendix E:
ACKNOWLEDGMENTS & DOCUMENTATION

County LEPC
2013 MEMBERSHIP ROSTER

Mason County LEPC
2013 Appointees

Name	Agency	Representing Discipline	Date Appointed
Fabian Knizacky	Adminsitration	PIO	8/10/1994
John Henderson	City of Ludington Mayor	Local Government	3/12/1997
Murray Stall	Soil Conservation District	Agriculture	2/11/1999
Ruth Sommerfeldt	Memorial Medical	Hospital	12/9/1999
Michael Woroniak		Private Industry	8/9/2000
Gary Berk		RACES	12/1/2000
Robert Biers	Amptech	Chemical Industry	8/14/2002
Bret Haner	DHD #10	Public Health	12/11/2002
Dave Hasenbank	Drain Commission	Public Works	4/13/2004
Karen Ripke	DHD #10	Public Health	4/13/2004
Lynne Russell	United Way	Community Group	11/9/2005
Patty Klevorn	Ludington Daily News	Broadcast & Print Media	11/9/2005
Kevin Leavitt	MSP	Law Enforcement	2/14/2006
Elizabeth Reimink	Mason Co EMC	Emergency Management	3/13/2007
Jerry Funk	Ludington FD	Fire Services	4/14/2009
Shannon Stickney	Rural Fire Authority	Fire Services	5/12/2009
Mike Harrie	Ludington Police Dept	Law Enforcement	3/9/2010
Jeff Stockhill	Life EMS	EMS	3/9/2010
Suzanne Pate	Consumer's Energy	Private Industry	4/10/2012
Kit Hinz	American Red Cross	Red Cross	4/10/2012
Alice Meldrum	American Red Cross	Red Cross	4/10/2012
Shaun Cross	US Coast Guard	USCG	4/10/2012
Tom Routhier	Equalization	Damage Assessment	3/12/2013
Jordan DeVries	Soil Conservation District	Agriculture	3/12/2013
Kim Cole	Sheriff Dept	Law Enforcement	3/12/2013
Jody Hartley	Sheriff Dept	Law Enforcement	3/12/2013
Mary Nichols	Commissioner	Government	3/12/2013
	Dept of Human Services	Human Services	
Gary Dittmer	Road Commission	Public Works	
Ray Hasil	911	Communications	6/13/2013
Todd Myers	911	Communications	6/13/2013
		Environmental	
		Transportation	
		Education	

Mason County Hazard Mitigation Plan Update
2012 ADVISORY COMMITTEE

Liz Reimink
Emergency Management
lreimink@masoncounty.net

Bret Haner
Dist. #10 Health Dept.
bhaner@dhd10.org

Jeff Fiers
Mason Co. Sherrif
jfiers@masoncounty.net

Gary Dittmer
Mason County Road Commission
masoncrc@sbcglobal.net

Jim Herrema
EMS
jherrema@lifeems.com

Lewis Squires
County Board of Commissioners
drsquires@SBCGlobal.net

Murray Stall
Conservation District
murray.stall@mi.nacdnet.net

Ruth Sommerfeldt
Memorial Medical Center
ruths@mmcwm.com

Rita Copenhaver
Emergency Management
rcopenhaver@masoncounty.net

Karen Ripke
Dist. #10 Health Dept.
kripke@dhd10.org

Patti Klevorn
Media
patti@ludingtondailynews.com

Fabian Knizacky
County Administrator
fknizacky@masoncounty.net

Joe Cooper
Riverton Fire Department
chiefj2601@hotmail.com

Mike Harrie
Law Enforcement
harrie219@ci.ludington.mi.us

Shannon Stickney
Rural Fire Authority
shanjo93@yahoo.com

MEETINGS

Public meetings attended by WMSRDC staff for the purpose of updating the Mason County Hazard Mitigation Plan, including attendance lists and synopses of pertinent comments and discussion that took place during the meeting.

February 21, 2012: Mason County LEPC Meeting

Mason County Local Emergency Planning Committee
February 21, 2012

Name	Representing
Liz Reimink	Mason County EM
Rita Copenhaver	Administration
Dave Hasenbank	MC DPW
Mo Poellither	MCRFA
SUZANNE PATE	CONSUMERS ENERGY
Jim Herrema	Life EMS
JOHN Allison	MCRFA
Stephen Carlson	WMSRDC
Karen Ripke	Health Dept
Cozette Thomas	Red Cross
Alice Meldrum	American Red Cross
LEW SQUIRES	M. Cty Commissioner

Synopsis:

Introduction of Hazard Mitigation planning and a presentation of the anticipated planning process. Also discussed establishment of the Hazard Mitigation Advisory Team.

May 15, 2012: Mason County LEPC Meeting and Hazard Mitigation Public Hearing

Mason County Local Emergency Planning Committee
May 15, 2012

Name	Representing
Liz Reimink	Mason County EM
[illegible]	Mason County Rural Fire
Stephen Carlson	WMSRDC
SHAUN CROSS	US COAST GUARD
David Hasenbank	Mason Co DPW
Shannon Stickney	Rural Fire Auth.
Kevin Cavitt	MSP
Mike Shoup	BRANCH Township
Rita Copenhaver	Emg. Mgt.
Ruth Sommerfeldt	MLCWM
[illegible]	United Way
[illegible]	Fire

Synopsis:

Public meeting to discuss hazard mitigation at the beginning of the planning process. It was noticed in the Ludington Daily News, discussed in the WMSRDC electronic newsletter, and announced in the March 2012 survey mailing. The meeting featured a presentation about the hazard mitigation planning process, and the public was invited to comment on and discuss the survey that was distributed to 110 community individuals, and made available on the WMSRDC website.

August 20, 2013: Mason County LEPC Meeting

Mason County Local Emergency Planning Committee
August 20, 2013

Name	Representing
Liz Reimink	Mason County EM
Karen Ripke	DHD #10
Kathleen Rodell	Oakview Medical Care facility
Kevin Leavitt	MSP
Fabian Knizacky	Mason County
Jody Hartley	MCSO
Dave Hasenbank	Mason DPW
Jerry Funk	Fire
Joe Cooper	Rural Fire
Ray Hasil	Mason-Oceana 911
[illegible]	United Way
Patti Klevorn	Ludington Daily News
Janet Vyse-Stacyck	Department of Human Services
Shannon Stickney	
Jordan DeVries	
Tom Routhier	
Stephen Carlson	WMSRDC

Synopsis:

Reviewed the draft critical facilities map and the revised Mason County hazard ratings and rankings. Verified that dams exist at Bass and Gun lakes, however their hazard potential is minimal. Regarding gas lines on critical facilities maps…natural gas and sour gas pipelines run parallel in the north/south direction. We will consider adding propane retailers to the map. Individuals at the meeting will work with Emergency Management to identify those locations. Only comment received regarding the ratings/rankings was a complement on simplifying the system.

October 23, 2013: Water, Woods & Wetlands Regional Forum

ALISA	GONZALES-PENNINGTON	DEQ CZM	OFFICE OF GREAT LAKES-CZM
GARY	WILSON	Great Lks environmental	CHICAGO COMMENTATOR, GREAT LAKES ECHO
MATTHEW	CHILD	International JC	IJC - GREAT LAKES REGIONAL OFFICE
ANNA	KORNOELJE	Kzoo environmental	KALAMAZOO NATURE CENTER
STEPHANIE	SWART	MDEQ	MDEQ OFFICE OF THE GREAT LAKES
ROBERT	SWEET	MDEQ	MDEQ NON POINT SOURCE PROGRAM
JON	ALLAN	MDEQ	DIRECTOR, MICHIGAN OFFICE OF THE GREAT LAKES
SUZANNE	DIXON	MDNR	LEAGUE OF WOMEN VOTERS-DIRECTOR-DNR
SHAUN	HOWARD	MI environmental	NATURE CONSERVANCY IN MICHIGAN
JEAN	WEIRICH	MI environmental	WILDFLOWER ASSOCIATION OF MICHIGAN
STEPHANIE	BARRETT	Mkg Co. elected	MUSKEGON COUNTY INTERIM DRAIN COMMISSION
SUSIE	HUGHES	Mkg Co. elected	MUSKEGON COUNTY COMMISSIONER
LUPE	ALVIAR	Mkg Co. Veterans	MUSKEGON COUNTY VETERANS BOARD
KIM	ARTER	Mkg local elected	LAKETON TOWNSHIP SUPERVISOR
LEA	MARKOWSKI	Mkg local official	CITY OF MUSKEGON COMMISSIONER
DAVID	SHEEHY	Mkg local official	LAKETON TOWNSHIP ZONING ADMINISTRATOR
RON	BROWN	Mkg Non-Profit	MUSKEGON ENVIRONMENTAL RESEARCH & EDUCATION SOCIETY
DARLENE	DEHUDY	Mkg resident	MUSKEGON COUNTY RESIDENT
TOM	MATYCH	Mkg resident	MUSKEGON COUNTY RESIDENT
BILLIE	HOLMES	MLWP	JACKSON HILL NEIGHBORHOOD ASSOC. & MLWP
CATHERINE	SWIATEK	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP
THERESA	BERNHARDT	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP
WAYNE	GROESBECK	MLWP	MUSKEGON LAKE WATERSHED PARTNERSHIP & MRWA
NANCY	BURMEISTER	MRWA	MUSKEGON RIVER WATERSHED ASSEMBLY
GARY	NOBLE	MRWA	MUSKEGON RIVER WATERSHED ASSEMBLY
DENNIS	DONAHUE	NOAA	NOAA GLERL LAKE MICHIGAN FIELD STATION
TERRY	HEATLIE	NOAA	NOAA FISHERIES
JOEL	DARLING	Non-Profit	DARLING CETACEANS
LISA	DUTCHER	Oceana Co. RC	RSX CONSULTANT - OCEANA COUNTY ROAD COMMISSION
TOM	BOOM	Private Business	BARR ENGINEERING
ERIC	JOHNSON	Private Business	WEST SHORE CONSULTANTS
BOB	KRENN	Private Business	TIMBER BRIDGES
KELLY	RICE	Private Business	CARDNO JF NEW
CHRIS	WARREN	Private Business	BARR ENGINEERING COMPANY
ELAINE	ISELY	Regional environmental	WEST MICHIGAN ENVIRONMENTAL ACTION COUNCIL
JENNIFER	MCKAY	Regional environmental	TIP OF THE MITT WATERSHED COUNCIL
CAROLYN	ULSTAD	Regional environmental	MACATAWA AREA COORDINATING COUNCIL
RICK	WESTERHOF	USFWS	US FISH & WILDLIFE SERVICE
CHARLES	BYERS	USGS	US GEOLOGICAL SURVEY
JOE	DURIS	USGS	USGS - MICHIGAN WATER SCIENCE CENTER
RYAN	OSTER	USGS	USGS MICHIGAN WATER SCIENCE CENTER
DENNIS	MARVIN	utilities	CMS ENERGY
TANYA	CABALA	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
GREG	MUND	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
THOMAS	TISUE	Wh. Lk. PAC	WHITE LAKE PUBLIC ADVISORY COUNCIL
TOM	HAMILTON	Wh. R. WP	WHITE RIVER WATERSHED PARTNERSHIP
STEPHEN	CARLSON	WMSRDC	WMSRDC SENIOR PLANNER
JOSHUA	CROFF	WMSRDC	WMSRDC PLANNER
SANDEEP	DEY	WMSRDC	WMSRDC EXECUTIVE DIRECTOR
KATHY	EVANS	WMSRDC	WMSRDC ENVIRONMENTAL PROGRAM MANAGER
JOEL	FITZPATRICK	WMSRDC	WMSRDC TRANSPORTATION PLANNER
AMY	HAACK	WMSRDC	WMSRDC
ERIN	KUHN	WMSRDC	WMSRDC ECONOMIC DEVELOPMENT PROGRAM MGR
BRIAN	MULNIX	WMSRDC	WMSRDC TRANSPORTATION PROGRAM MGR
MARY	SEEGER	WMSRDC	WMSRDC
RUTH	OLSEN		
VIRGINIA	O'TOOLE		

Synopsis:

WMSRDC staff discussed hazard mitigation at the "Water, Woods, & Wetlands" regional forum on October 23, 2013 in Muskegon, Michigan. The hazard mitigation session addressed the potential for coordination between hazard mitigation and a variety of environmental initiatives. Examples of successful mitigation projects in Michigan highlighted many common interests, such as culvert improvements, flood control, and stream bank stabilization.

December 17, 2013: Mason County LEPC Meeting

LEPC Meeting
Dec 17, 2013

Name	Representing
Liz Reimink	EM
Rita Copenhaver	Admin
Jim Herrema	Life Ems
Joe Cooper	Rural Fire
Kevin Leavitt	MSP HMT
[illegible]	Fire
Jody Hartley	MCSO
Dave Hasenbank	Masonco DPW
Shannon Stickney	MCRFA
Kathleen [illegible]	Oakview
Pamela Montgomery	Oakview
Tom Routhier	Equalization
Stephen Carlson	WMSRDC
Pam Montgomery	Oakview MCF
Patti Klevorn	LDN
Karen Ripke	DHD #10
Ray Hosil	Mason-Oceana 911

Synopsis:

Reviewed amd discussed Hazard Mitigation Goals & Objectives. The Action Agenda worksheet was also discussed. A few comments were received regarding progress towards hazard mitigation.

- Riverton Township acquired a generator
- The Mason County Sheriff Department acquired an armored vehicle
- Life EMS acquired a new ambulance
- Oakview (nursing home) completed a Preparedness Plan

February 18, 2014: Mason County LEPC Meeting

Mason County Local Emergency Planning Committee
February 18, 2014

Name	Representing
Liz Reimink	Mason County EM
David Hasenbank	Mason Co DPW
Jody Hartley	MCSO
Mark Russo	MSP & MHSP
Ray Hasil	Mason-Oceana 911
Todd Myers	Mason · Oceana 911
Fabian Knizacky	Mason County Administrator
Stephen Carlson	WMSRDC
[illegible]	Ludington Daily News
Shannon Stickney	Rural Fire
Janet Vyse-Staszak	DHS
Mary Nichols	County Brd
Jordan Devries	

Synopsis:

Discussed results of the Action Agenda Questionnaire (progress made towards hazard mitigation). LEPC was offered an opportunity to review draft sections of the Hazard Mitigation Plan that had been completed to-date.

December 16, 2014: Mason County LEPC Meeting and Hazard Mitigation Public Hearing

Mason County Local Emergency Planning Committee
December ~~20~~ 16, 2014

Name	Representing
Liz Reimink	Mason County EM
Rita Copenlaver	Mason Co E.M.
Karen Ripke	DHD #10
Jim Heffema	Life Ems
JERRY FUNK	Fire
Mark Barnett	LPD
LARRY GAYLORD	PMFD
FABIAN KNIZACKY	MASON COUNTY
Dave Hasenbank	MC DPW
WAYNE SCHOONOVER	MASON CO. RD. COMM.
Stephen Carlson	WMSRDC
Tom Hooper	Mason Co. P.D.
Ruth Sommerfeldt	OHCH
Bill Carpenter	MC COMMISSIONER
Meredith Filter	Mason Co EM
Patti Klevorn	Ludington Daily News
Mary Reilly	Planning/Building Mason County
Janet Vyse-Staszak	Mason-Oceana DHS
Shannon Stickney	Rural Fire Auth.
Michael Harrie	Ludington P.D.

Synopsis:

This meeting was noticed in the Ludington Daily News, announced in the WMSRDCelectrontic newsletter, and invitations were mailed and emailed to all local elected officials in Mason County. These communications invited recipients to review the Hazard Analysis and Goals & Objectives sections, which were posted on the WMSRDC website prior to the public meeting. Recipients were offered an opportunity to comment on the drafted sections by attending the public meeting or by submitting written comments to WMSRDC staff prior to the meeting. No comments were received regarding the draft material. The meeting also featured a work session, whereas a proposed set of hazard mitigation action items were reviewed, discussed, and prioritized utilizing interactive polling technology.

RESOURCES

Many resources, documents, and websites were researched and referenced during the development of this plan. The following were most helpful during this process:

2013 Mason County Master Plan Update (2013)

Mason County Hazard Analysis (3/01)

Mason County Zoning Ordinance

Mason County Stormwater Runoff, Soil Erosion and Sedimentation Control Guidelines and Ordinance (10/99)

Michigan Hazard Analysis (July 2012)

Michigan Hazard Mitigation Plan (updated March 2011)

Michigan Department of Agriculture Food and Agricultural Systems Profiles (2009)

Hazard Mitigation Plan for Kent and Ottawa Counties (revised 2012)

United States 2010 Census

Flood Insurance Rate Maps from the National Flood Insurance Program

USGS topographic maps

Plat maps

USDA Mason County Soil Survey (September 1995)

Web sites:

- National Climatic Data Center: http://www.ncdc.noaa.gov/
- FEMA www.fema.gov
- Michigan Geographic Data Library: www.mcgi.state.mi.us/mgdl/
- Local media
  - MLIVE: www.mlive.com
  - Shoreline Media: www.shorelinemedia.net

ARTICLES & PUBLIC NOTICES

Articles and public notices published during the Mason County Hazard Mitigation Plan Update planning process.

June / July 2011 – WMSRDC print newsletter

Expected Hazard Mitigation Plan Updates

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards. Mitigation Plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage.

Five years ago, WMSRDC authored Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. All five plans attained Federal Emergency Management Agency (FEMA) approval, helping the counties become eligible for certain types of non-emergency disaster assistance, including funding for mitigation projects.

These plans are now in need of a formal update to maintain this condition for mitigation funding eligibility. The Commission recently partnered with Oceana County to apply for a FEMA Hazard Mitigation Planning Grant to update existing Hazard Mitigation plans for the five counties.

This two-year project is expected to commence in August 2011. WMSRDC will coordinate with each county's Emergency Manager to assemble an advisory committee, identify local hazards, and educate local communities and citizens about local hazards and how to mitigate their effects. This planning process is as important as the plan itself, because it creates a framework for risk-based decision-making to reduce damages to lives, property, and the economy from future disasters.

For more information, check out the Hazard Mitigation Planning section at wmsrdc.org under "Special Projects." You may also contact Stephen Carlson, Associate Planner, at (231) 722-7878 extension 11 or scarlson@wmsrdc.org.

Novemer 8, 2011 – WMSRDC e-newsletter

WMSRDC Initiates Updates of Hazard Mitigation Plans

Five years ago, WMSRDC authored Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. All five plans attained Federal Emergency Management Agency (FEMA) approval, helping the counties become eligible for certain types of non-emergency disaster assistance, including funding for mitigation projects. WMSRDC is now in the process of updating the plans to maintain this condition for mitigation funding eligibility. As a part of the planning process, WMSRDC will coordinate with each county's emergency manager to identify local hazards and educate local communities and citizens about local hazards and how to mitigate their effects. This two-year project is expected conclude in October 2013.

December 2011 / January/February 2012 – WMSRDC print newsletter

Spotlight on… Hazard Mitigation Planning

In October of 2011, Oceana County with assistance from the WMSRDC secured a Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Planning Grant for the update of Hazard Mitigation Plans for the five counties of Lake, Mason, Muskegon, Newaygo and Oceana. WMSRDC will be responsible for performing these FEMA-required five-year updates over a two-year period.

The primary objective of hazard mitigation is to reduce or eliminate long-term risk to people and property. These plans are helpful in identifying a community's risks, prioritizing those risks, and identifying actions to mitigate those risks. The plans, once approved by FEMA, also help communities qualify for certain types of non-emergency disaster assistance, including funding for mitigation projects.

Community and stakeholder involvement in the preparation of a hazard mitigation plan is essential to the planning process and has a direct influence on a plan's effectiveness. Therefore, Advisory Teams have been established in each county to help guide the update of the plans. Each team is lead by their county's Emergency Manager, and includes representatives from an array of sectors involved with emergency planning.

The first major task in the update planning process is to invite participation from the public. In the month of February WMSRDC will distribute a hazard mitigation survey questionnaire to a wide range of organizations such as local officials and agencies, public utilities, and emergency responders via mail and e-mail. This survey will also be available to the public on the WMSRDC website under Special Projects. In March and April, WMSRDC will organize a public meeting in each county to discuss the hazard mitigation project, and to receive public comments and concerns associated with hazard mitigation.

For more information regarding the Hazard Mitigation project or to receive a survey, visit www.wmsrc.org, or contact Stephen Carlson, Associate Planner at (231) 722-7878 extension 11 or at scarlson@wmsrdc.org.

May 1, 2012 – Ludington Daily News

NOTICE OF PUBLIC HEARING REGARDING HAZARD MITIGATION

The West Michigan Shoreline Regional Development Commission (WMSRDC), in cooperation with Mason County, has begun the process of updating the Mason County Hazard Mitigation Plan. Public input is requested regarding natural and man-made hazards that pose a threat to people and property in Mason County. A public hearing to discuss Hazard Mitigation and receive input from the community will take place at 4:00 PM on May 15, 2012 at the Mason County Sheriff's Office located at 302 N. Delia Street, Ludington, MI, 49431. Additional information about the Mason County Hazard Mitigation Plan Update is available at www.wmsrdc.org. Please direct any questions to Mr. Stephen Carlson, Associate Planner, at (231) 722-7878, extension 11 or at scarlson@wmsrdc.org.

March 2012 – WMSRDC e-newsletter

Participate in Hazard Mitigation Planning in Your Community Through Surveys and Public Hearings

WMSRDC recently distributed over 700 hazard mitigation questionnaires to community leaders and stakeholders via mail and e-mail. This survey is an important component of the process to update the Hazard Mitigation plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. It is intended to encourage respondents to provide valuable input from a local perspective, as well as increase awareness of the hazard mitigation update process which is underway. The surveys are open to the public, and can be viewed and downloaded here..

This spring, WMSRDC and partners will hold hazard mitigation public hearings in each of the five counties. Hazard mitigation will be discussed and opportunities will be provided for attendees to comment on natural and man-made threats to their community. Dates, times, and locations of the public hearings are listed below. For more information, please contact Stephen Carlson, associate planner at (231) 722-7878 ext. 11 or scarlson@wmsrdc.org.

Public Hearings

- Lake County, March 8, 11:00 AM, Lake County Courthouse
- Mason County, May 15, 4:00 PM, Mason County Sheriff's Office
- Muskegon County, April 10, 10:30 AM, Norton Shores City Hall
- Newaygo County, March 20, 2:00 PM, Newaygo County Emergency Operations Center
- Oceana County, March 27. 12:00, Oceana County Courthouse

March / April 2012 – WMSRDC print newsletter

Hazard Mitigation Update

Efforts are in full-swing to update the Hazard Mitigation Plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. In February and March, surveys were mailed or emailed to over 700 individuals throughout the five counties in order to gather information, as well as increase awareness of hazard mitigation planning.

In addition, research is underway to identify natural and manmade hazards. Once the research is complete, hazards will be ranked prioritized for each county and strategies will be identified to prevent or lessen future damages to people, structures, and property from disasters. The public is invited to participate throughout the project, which on schedule to conclude in the fall of 2013.

For more information or to partake in the Hazard Mitigation Survey, visit the Hazard Mitigation Planning page at www.WMSRDC.org, or contact Stephen Carlson, Associate Planner, at (231) 722-7878 extension 11 or at scarlson@wmsrdc.org.

December 2012 Annual Report – WMSRDC print newsletter

Spotlight on Hazard Mitigation

In 2011, Oceana County with the assistance of WMSRDC received a $225,000 Pre-Disaster Mitigation (PDM) grant from the Federal Emergency Management Agency (FEMA) to update the hazard mitigation plans for Lake, Mason, Muskegon, Newaygo and Oceana counties. Each county, as well as WMSRDC, combined to contribute local match for the grant. In 2012, WMSRDC made great progress towards accomplishing the updates, a process which is expected to span two years.

Hazard mitigation aims to reduce or eliminate long-term risk to people and property from hazards. Mitigation plans (like the ones prepared by WMSRDC) form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. In addition, the plans help communities qualify for certain Hazard Mitigation Assistance (HMA) funding for pre-disaster and post-disaster mitigation. The relocation or demolition of a structure located within a floodplain is example of a mitigation project.

Community and stakeholder involvement in the preparation of a hazard mitigation plan is essential to the planning process and has a direct influence on a plan's effectiveness. Once a plan is completed, it must be approved by FEMA and then adopted locally. The goals, objectives, and action items should then be incorporated into the community's planning for such things as capital improvements, transportation, and future land use.

Hazards addressed in WMSRDC's hazard mitigation plans are organized into three areas and include, but are not limited to, the following hazards:

- Natural Hazards such as thunderstorms, flooding, winter weather, wildfires, etc;
- Technological Hazards such as structural fires, infrastructure failures, and transportation accidents; and
- Human-Related Hazards such as public health emergencies, civil disturbances, and terrorism.

June 2013 – WMSRDC e-newsletter

Hazard Mitigation Planning Update

WMSRDC is continuing the process of updating Hazard Mitigation Plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. The first phase of the project is nearly complete for all five plans. This has included extensive research of demographics, critical facilities, infrastructure, and so forth; as well as the identification of potential hazards and documentation of historical hazardous events. A survey was also mailed and/or emailed to over seven hundred individuals and agencies within the five-county region. The survey is still available and open to the public at www.wmsrdc.org on the Hazard Mitigation page. The next step for the Hazard Mitigation Plan updates will be to prioritize the identified hazards with a ranking system that takes into account each hazard's frequency and propensity to impact people, property, and the economy.

August / September 2013 – WMSRDC print newsletter

Hazard Mitigation Update

WMSRDC continues working to update the Hazard Mitigation plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. Each plan includes analysis of 31 natural, technological, and human-related hazards. The latest milestone of this effort was the revision of the method used to rate and rank these hazards. The new system assesses four metrics for each hazard. These metrics include:
- Probability of Occurrence;
- Impact on the Population;
- Impact on Property; and
- Impact on the Economy.

A weighting system is then applied to help rank the hazards in order of importance. "Probability of Occurrence" and "Impact on the Population" are the two most important factors in this ranking system.

The resulting list of hazards will be used in the next phase of the planning process to help identify hazard mitigation priorities and to select feasible mitigation projects for each county.

For more information about Hazard Mitigation, please contact Stephen Carlson, Senior Planner, at (231) 722-7878 ext. 11 or at scarlson@wmsrdc.org.

February / March 2014 – WMSRDC print newsletter

Hazard Mitigation Update

Hazard mitigation is a relatively unknown concept. Yet upon closer inspection, one realizes that hazard mitigation is virtually everywhere. It encompasses any action taken to eliminate or reduce damages and losses to property and life. Seemingly endless policies and practices are already in place with that goal in mind.

Having a Federal Emergency Management Agency (FEMA)-approved hazard mitigation plan helps a community qualify for certain types of hazard mitigation assistance. Projects in Michigan that have received such assistance include acquisition of flood-prone properties, stream bank stabilization, and culvert replacements.

WMSRDC continues working to update the Hazard Mitigation plans for the counties of Lake, Mason, Muskegon, Newaygo, and Oceana. Once the updates are complete, financial and/or technical help might be available to further hazard mitigation in those areas. The plan updates are on track to be complete in second half of 2014.

For more information about Hazard Mitigation, please contact Stephen Carlson, Senior Planner, at (231) 722-7878 ext. 11 or at scarlson@wmsrdc.org.

April / May 2014 – WMSRDC print newsletter

Hazard Mitigation

WMSRDC continues to make progress toward updating the Hazard Mitigation plans for Lake, Mason, Muskegon, Newaygo, and Oceana counties. The project is funded through a grant awarded to Oceana County by the Michigan State Police – Emergency Management and Homeland Security Division. Oceana County is the fiduciary for the grant, while WMSRDC is responsible for fulfilling the grant obligations.

The project is scheduled to end July 31, 2014, however a one-year extension has been requested to accommodate the potentially lengthy approval and adoption process. Each county's hazard mitigation plan must be reviewed by MSP, approved by FEMA, and locally adopted. The plans are "multi-jurisdictional," meaning that each municipality in addition to the county may adopt the plan to become eligible for certain types of hazard mitigation funds.

December 2, 2014 – Ludington Daily News

HAZARD MITIGATION PUBLIC MEETING

Public input is requested for the Mason County Hazard Mitigation Plan, which is being developed by Mason County Emergency Management with assistance from the West Michigan Shoreline Regional Development Commission (WMSRDC). The "Hazard Analysis" and "Goals & Objectives" of the plan are currently available for public review at http://wmsrdc.org/hazardmitigation. The public is invited to comment on these sections at 4:00 PM on December 16, 2014 at the Mason County Sheriff's Office located at 302 N. Delia Street, Ludington, MI, 49431. Written comments may also be emailed to scarlson@wmsrdc.org prior to the meeting. Please direct any questions to Mr. Stephen Carlson, Senior Planner, at (231) 722-7878.

December 4, 2014 – WMSRDC e-newsletter

Hazard Mitigation Public Review Opportunity

ATTENTION MASON COUNTY! The public is invited to review the Hazard Analysis and Goals & Objectives sections of the Mason County Hazard Mitigation Plan. These sections are freely accessible at http://wmsrdc.org/hazardmitigation.html.

A public meeting will be held on December 16, 2014 to receive comments regarding these sections at the following time and location: 4:00 AM at the Mason County Sheriff's Office, 302 North Delia Street, Ludington. If you are unable to attend, comments and inquiries may be emailed to Stephen Carlson, scarlson@wmrdc.org, prior to the meeting.

Appendix F:
POTENTIAL HAZARD MITIGATION FUNDING SOURCES

Source: Michigan Hazard Mitigation Plan (Updated March 2011)

STATE AGENCY MITIGATION FUNDING PROGRAMS

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Extreme Temperatures	Wildfire	Dam Failure	Riverine Flooding	Great Lakes Shoreline Flooding	Subsidence	Hail	Lightning	Severe Wind	Tornadoes	Ice and Sleet Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
MICHIGAN DEPARTMENT OF AGRICULTURE																
Conservation Reserve Enhancement Program						X					X				X	X
Intercounty Drain Program (available to drain commissioners only)					X	X										X
MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY																
Coastal Management Program							X								X	X
Michigan Great Lakes Protection Fund							X								X	
State Revolving Fund (Loan)						X									X	
Wetland Program Development (also see 66.461 in CFDA)						X	X								X	
MICHIGAN DEPT. OF NATURAL RESOURCES																
Land & Water Conservation Fund						X	X								X	
Michigan Habitat Improvement Fund Project Grants						X									X	
Michigan Natural Resources Trust Fund				X		X									X	
Michigan Volunteer Fire Assistance				X											X	
Recreational Trails Program Grants						X	X								X	
Community Forestry Program											X	X	X		X	X
MICHIGAN DEPARTMENT OF STATE POLICE																
Emergency Management Performance Grants (also see 97.042 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Flood Mitigation Assistance (also see 97.029 in CFDA)						X	X								X	
Hazard Mitigation Grant Program (also see 97.039 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Federal Disaster Assistance to Individuals and Households in Presidential Declared Disaster Areas (also see 97.048 in CFDA)		X		X		X	X	X			X	X			X	
Presidential Declared Disaster Assistance - Disaster Housing Operations For Individuals And Households (also see 97.049 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Presidential Declared Disaster Assistance To Individuals And Households - Other Needs (also see 97.050 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Disaster Grants-Public Assistance (Presidentially Declared Disasters) (also see 97.036 in CFDA)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pre-Disaster Mitigation (also see 97.047 in CFDA)			X	X		X	X				X	X			X	
Severe Loss Repetitive Program (also see 97.110 in CFDA)						X	X								X	
Repetitive Flood Claims (also see 97.092 in CFDA)						X	X								X	
MICHIGAN DEPARTMENT OF TRANSPORTATION																
Transportation Economic Development Fund						X	X								X	
MICHIGAN ECONOMIC DEVELOPMENT CORP																
Community Development Block Grant Program (also see 14.218,14.219, 14.228 in CFDA)						X	X								X	
Urban Land Assembly						X	X								X	
MICHIGAN STATE HOUSING DEVELOPMENT AUTHORITY																
CDBG Housing Resource Fund (Inc HOME) (also see 14.239 in CFDA)						X	X		X		X	X			X	
Home/Property Improvement Loans						X	X		X		X	X			X	
MICHIGAN DEPARTMENT OF TREASURY																
Michigan Finance Authority-Local Gov't Loan Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Michigan Finance Authority-State Aid Note	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornados Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
10.054 Emergency Conservation Program	X					X					X	X			X	
10.069 Conservation Reserve Program						X					X	X			X	X
10.072 Wetlands Reserve Program						X	X								X	X
10.202 Cooperative Forestry Research				X							X	X			X	
10.410 Very Low to Moderate Income Housing Loans			X	X		X	X	X	X	X	X	X			X	
10.411 Rural Housing Site Loans and Self Help Housing and Development Loans						X	X								X	
10.417 Very Low Income Housing Repair Loans/Grants			X	X		X	X	X	X	X	X	X			X	
10.445 Direct Housing Natural Disaster (Very Low/Low Income Loans)				X		X	X		X	X	X	X			X	
10.652 Forestry Research						X	X				X	X			X	
10.664 Cooperative Forestry Assistance				X											X	
10.760 Water & Waste Disposal Sys. for Rural Comm.						X	X								X	
10.763 Emergency Community Water Assistance Grants	X					X	X								X	
10.766 Community Facilities Loans & Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
10.768 Business and Industry Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
10.770 Water/Waste Disposal Loans/Grants						X	X								X	
10.773 Rural Business Opportunity Grants						X	X								X	
10.850 Rural Electrification Loans and Loan Guarntees										X	X	X	X	X	X	
10.901 Resource Conservation and Development	X	X	X	X		X	X									X
10.902 Soil and Water Conservation	X	X	X	X		X	X									X
10.904 Watershed Protection and Flood Prevention					X	X	X								X	X
10.913 Farm and Ranch Land Protection Program						X	X								X	
10.914 Wildlife Habitat Incentive Program						X	X								X	
11.300 Investments for Public Works and Economic Development Facilities					X	X	X								X	
11.303 Economic Development Technical Assistance						X	X								X	X
11.307 Economic Adjustment Assistance					X	X	X				X	X			X	
11.419 Coastal Zone Mgmt. Administration Awards							X									X
11.462 Hydrologic Research	X				X	X	X								X	
11.463 Habitat Conservation							X								X	
11.477 Fisheries Disaster Relief	X			X	X	X	X								X	
11.478 Center for Coastal Ocean Research_Coastal Ocean Program							X								X	
11.550 Public Telecommunication Facilities-Planning & Construction												X			X	
12.101 Beach Erosion Control Projects							X								X	
12.102 Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works					X	X	X								X	
12.103 Emergency Operations Flood Response & Post-Flood Response					X	X	X								X	
12.104 Flood Plain Management Services					X	X	X									X
12.105 Protection of Essential Highways, Highway Bridge Approaches, and Public Works					X	X	X								X	
12.106 Flood Control Projects					X	X	X								X	
12.108 Snagging and Clearing for Flood Control					X	X	X								X	
12.109 Protection, Clearing and Straightening Channels						X	X								X	
12.111 Emergency Advance Measures for Flood Protection					X	X	X								X	
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

FEDERAL HAZARD MITIGATION FUNDING SOURCES (CONT.)

Funding Sources for Hazard-Specific Measures	Drought	Earthquake	Temperatures	Wildfire	Dam Failure	Riverine Flooding	Shoreline Flooding and Erosion	Subsidence	Hail	Lightning	Severe Wind	Tornadoes Ice and Sleet	Storms	Snowstorms	FINANCIAL ASSISTANCE	TECHNICAL ASSISTANCE
14.218 Community Development Block Grants/Entitlement Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.219 Community Development Block Grants -Small Cities Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.228 Community Development Block Grants-State's Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.239 HOME Investment Partnerships Program						X	X		X	X	X	X			X	
14.246 Community Development Block Grant/Brownfileds Economic Development Initiative						X	X				X	X			X	
14.250 Rural Housing and Economic Development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14.511 Community Outreach Partnership Center Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15.623 North American Wetlands Conservation Fund						X	X								X	
15.904 Historic Preservation Fund Grants-In-Aid						X	X	X	X	X	X	X	X	X		X
15.916 Outdoor Recreation-Acquisition, Development and Planning (Land and Water Conservation Fund Grants)						X	X								X	
15.918 Disposal of Federal Surplus Real Property for Parks, Recreation, and Historic Monuments						X	X									
15.921 Rivers, Trails, and Conservation Assistance						X	X									X
47.041 Engineering Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
59.008 Disaster Assistance Loans		X		X		X	X	X	X	X	X	X	X	X	X	
66.461 Regional Wetlands Program Development Grants						X	X								X	
66.469 Great Lakes Program							X								X	
81.042 Weatherization Assistance for Low-Income Persons			X												X	
97.018 National Fire Academy Training Assistance				X												X
97.022 Flood Insurance						X	X									X
97.023 Community Assistance Program - State Support Services Element (NFIP)						X	X									X
97.024 Emergency Food and Shelter National Board Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.026 Emergency Management Institute-Training Assistance	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.028 Emergency Management Institute-Resident Education Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
97.029 Flood Mitigation Assistance						X	X								X	
97.030 Community Disaster Loans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.031 Cora Brown Fund	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.036 Disaster Grants - Public Assistance (Presidentially Declared Disasters)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.037 Disaster Housing Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.039 Hazard Mitigation Grant Program	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.041 National Dam Safety Program					X											X
97.042 Emergency Management Performance Grants	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.044 Assistance to Firefighters Grant				X											X	
97.045 Cooperating Techincal Partners						X	X								X	
97.046 Fire Management Assistance Grant				X											X	
97.047 Pre-Disaster Mitigation		X		X		X	X	X			X	X			X	
97.048 Disaster Housing Assistance to Individuals and Households in Presidential Declared Disaster Areas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.049 Presidential Declared Disaster Assistance - Disaster Housing Operations for Individuals and Housholds	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.050 Presidential Declared Disaster Assistance to Individual and Households - Other Needs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
97.092 Repetitive Flood Claims						X	X								X	
97.110 Severe Repetitive Loss Program						X	X								X	